ANNUAL REPORT

OF THE

MINISTER OF MINES

OR THE

YEAR ENDING 31ST DECEMBER

1917

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.
1918.

To His Honour Sir FRANK STILLMAN BARNARD, K.C.M.G.,

Lieutenant-Governor of the Province of British Columbia.

MAY IT PLEASE YOUR HONOUR:

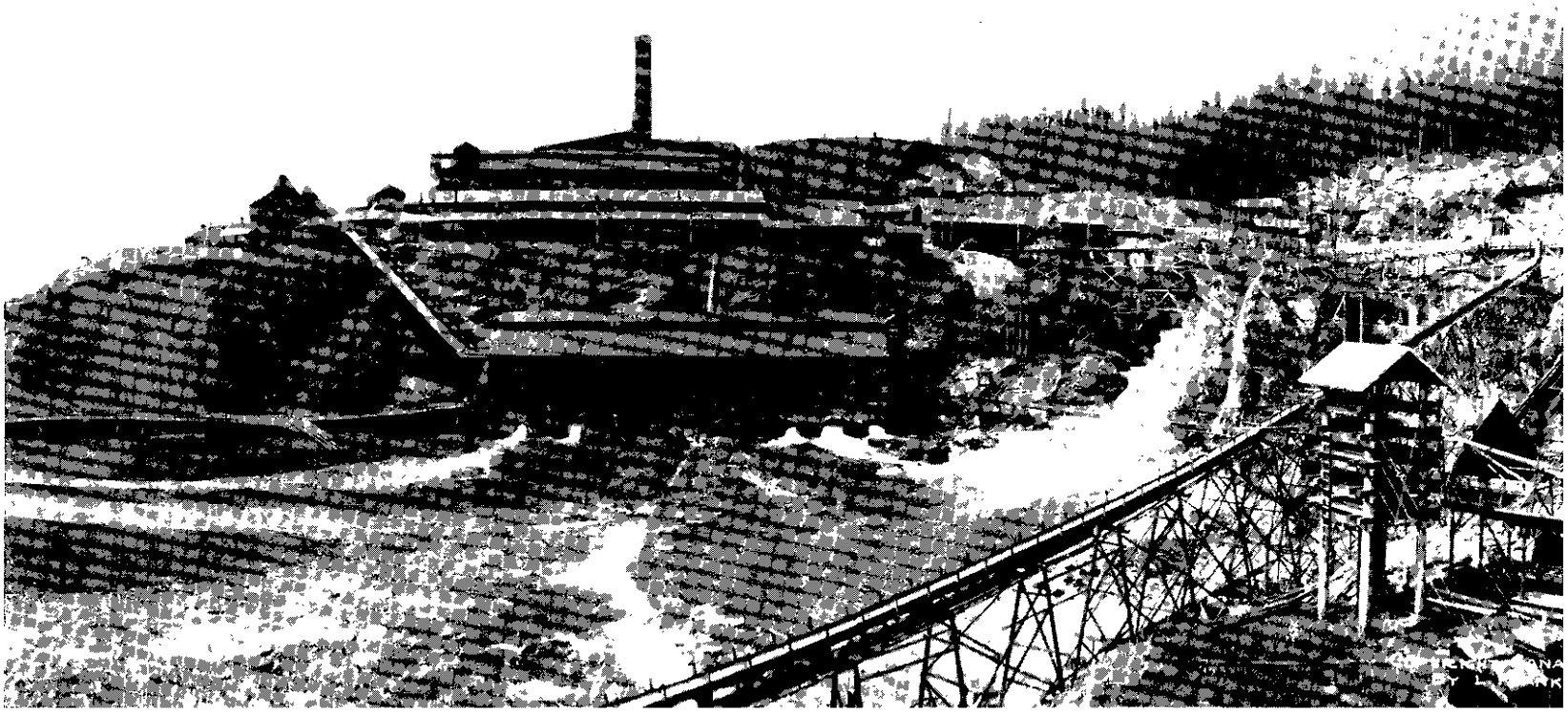
The Annual Report of the Provincial Mineralogist upon the Mining Industry of the Province for the year 1917 is herewith respectfully submitted.

WILLIAM SLOAN,

Minister of Mines.

Minister of Mines' Office,

February 27th, 1918.



General View, Granby Smelter, Anyox, B.C.

To the Honourable William Sloan,

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, 1917.

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.,

February 27th, 1918.

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 1917.

Gold, placer	$ 75,116,103
Gold, lode	93,717,974
Silver	43,623,761
Lead	39,366,144
Copper	130,597,620
Zinc	10,379,018
Coal and coke	174,313,658
Building-stone, bricks, etc.	27,902,381
Miscellaneous minerals, etc	554,448
Total	$595,571,107

TABLE II.—PRODUCTION FOR EACH YEAR FROM 1852 TO 1917 (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
1916	42,290,462
1917	37,010,392
Total	$595,571,107

Table III. gives a statement in detail of the quantities and value of the different mineral products for the years 1915, 1916, and 1917. It has been impossible as yet to collect complete statistics regarding building-stone, lime, bricks, tiles, and other miscellaneous products, but such figures as it has been possible to secure are given in some detail in Table V.

TABLE III.

QUANTITIES AND VALUE OF MINERAL PRODUCTS FOR 1915, 1916, AND 1917.

	Customary Measure.	1915.		1916.		1917.	
		Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold, placer	Ounces.	38,500	$ 770,000	29,025	$ 580,500	24,800	$ 496,000
" lode	"	250,021	5,167,934	221,932	4,587,334	114,523	2,367,190
Silver	"	3,366,506	1,588,991	3,301,923	2,059,739	2,929,216	2,265,749
Lead	Pounds	46,503,590	1,939,200	48,727,516	3,007,462	37,307,465	2,951,020
Copper	"	56,918,405	9,835,500	65,379,364	17,784,494	59,007,565	16,038,256
Zinc	"	12,982,440	1,460,524	37,168,980	4,043,985	41,848,513	3,166,259
Coal	Tons, 2,240 lb.	1,611,129	5,638,952	2,084,093	7,294,325	2,149,975	7,524,913
Coke	" "	245,871	1,475,226	267,725	1,606,350	159,905	959,430
Miscellaneous products			1,571,181		1,326,273		1,241,575
			$29,447,508		$42,290,462		$37,010,392

TABLE IV.

OUTPUT OF MINERAL PRODUCTS BY DISTRICTS AND DIVISIONS.

NAMES.	DIVISIONS.			DISTRICTS.		
	1915.	1916.	1917.	1915.	1916.	1917.
CARIBOO DISTRICT				$ 885,502	$ 778,157	$ 529,897
Cariboo Mining Division	$ 217,500	$ 162,000	$ 137,756			
Quesnel "	86,000	20,000	15,000			
Omineca "	582,002	596,157	377,141			
CASSIAR DISTRICT				4,420,988	7,210,949	8,485,438
EAST KOOTENAY DISTRICT				4,653,836	6,810,926	5,056,782
WEST KOOTENAY DISTRICT				7,308,793	9,101,905	5,972,545
Ainsworth Division	360,846	754,902	750,514			
Slocan and Slocan City "	2,455,462	3,761,091	3,554,055			
Nelson "	608,277	619,376	403,436			
Trail Creek "	3,865,284	3,935,836	1,197,283			
Other parts	18,924	30,700	67,257			
BOUNDARY-YALE DISTRICT				5,470,689	7,243,560	5,055,403
Osoyoos, Grand Forks & Greenwood Divisions	5,023,635	6,592,991	4,253,965			
Similkameen, Nicola, Vernon	371,733	450,780	571,300			
Yale, Ashcroft, Kamloops	75,321	199,789	230,138			
LILLOOET DISTRICT				25,643	65,457	73,175
COAST DISTRICT (Nanaimo, Alberni, Clayoquot, Quatsino, Victoria, Vancouver)				6,682,057	11,079,508	11,837,152
				$29,447,508	$42,290,462	$ 37,010,392

TABLE V.

MISCELLANEOUS PRODUCTS AND TOTALS OF PRODUCTION, 1917.

DISTRICT AND DIVISION.	Cement.	Lime and Limestone.	Building-stone.	Riprap.	Crushed Rock, Flux.	Sand and Gravel.	Pottery and Clay.	Fire, Face, and Red Brick.	Total Building Materials.	Miscellaneous Minerals.	Total Miscellaneous Products.	Total Output of Collieries.	Total of Metalliferous Minerals.	Totals for Divisions.	Totals for Districts.
	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$
CARIBOO															529,897
Cariboo		1,000			1,000	500			2,500	256	2,756		135,000	137,756	
Quesnel													15,000	15,000	
Omineca		1,000				500			1,500		1,500		375,641	377,141	
CASSIAR															8,485,438
Atlin													325,670	325,670	
Skeena, Stikine-Liard, Portland C.-Queen Charlotte		1,000			77,742	1,000			79,742		79,742		8,080,026	8,159,768	
EAST KOOTENAY															5,056,782
Fort Steele		500			1,000	500			2,000		2,000	2,027,544	2,818,429	4,847,973	
Windermere-Golden		500			1,000	500			2,000		2,000		206,809	208,809	
WEST KOOTENAY															5,972,545
Ainsworth		500			500	500			1,500		1,500		749,014	750,514	
Slocan & Slocan City					500	500			1,000		1,000		3,553,055	3,554,055	
Nelson		1,000	1,000	1,000	1,000	1,320		4,500	9,820	10,472	20,292		383,144	403,436	
Trail Creek		500			1,000	1,000			2,500		2,500		1,194,783	1,197,283	
Other Divisions		500			1,000	500			2,000		2,000		65,257	67,257	
BOUNDARY-YALE															5,055,403
Grand Forks, Greenwood, Osoyoos, Similkameen, Nicola, Vernon		2,000		1,000	29,904	1,000		2,850	36,754	25,251	62,005		4,191,960	4,253,965	
Yale, Ashcroft, Kamloops		1,000		1,000	1,000	1,000		390	4,390		4,390	529,351	37,559	571,300	
LILLOOET					1,000	1,000			2,000	1,050	3,050		70,125	73,175	73,175
COAST DISTRICT	487,829	91,723	112,275	24,170	21,184	50,822	81,728	183,109	1,052,840		1,052,840	5,927,448	4,856,864	11,837,152	11,837,152
	487,829	102,223	113,275	28,170	138,830	61,642	81,728	190,849	1,204,546	37,029	1,241,575	8,484,343	27,284,474	37,010,392	37,010,392

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 mine, 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 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	1916	580,500
1872	1,610,972	1887	693,709	1902	1,073,140	1917	496,000
						Total	$75,116,103

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	582,255	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	874,781	.....	.....	6,529,420
1899	138,315	2,857,573	2,939,413	1,663,708	21,862,436	878,870	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	232,831	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	4,578,037	.....	.....	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	1,703,825	47,738,703	2,291 458	40,832,720	8,166,544	.....	.....	16,216,847
1908	255,582	5,282,880	2,631,389	1,321,483	43,195,733	1,632,799	47,274,614	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	968,293	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
1916	221,932	4,587,334	3,301,923	2,059,739	48,727,516	3,007,462	65,379,364	17,784,494	37,168,980	4,043,985	31,483,014
1917	114,523	2,367,190	2,929,216	2,265,749	37,307,465	2,951,020	59,007,565	16,038,256	41,848,513	3,166,259	26,788,474
Total	4,544,749	93,717,974	76,338,540	43,623,761	924,186,967	39,366,144	776,513,240	130,597,620	127,302,184	10,379,018	317,684,517

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
1916	2,084,093	7,294,325
1917	2,149,975	7,524,913
Total	47,044,584	$152,965,253

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
1916	267,725	1,606,350
1917	159,905	959,430
Total	3,775,370	$21,348,405

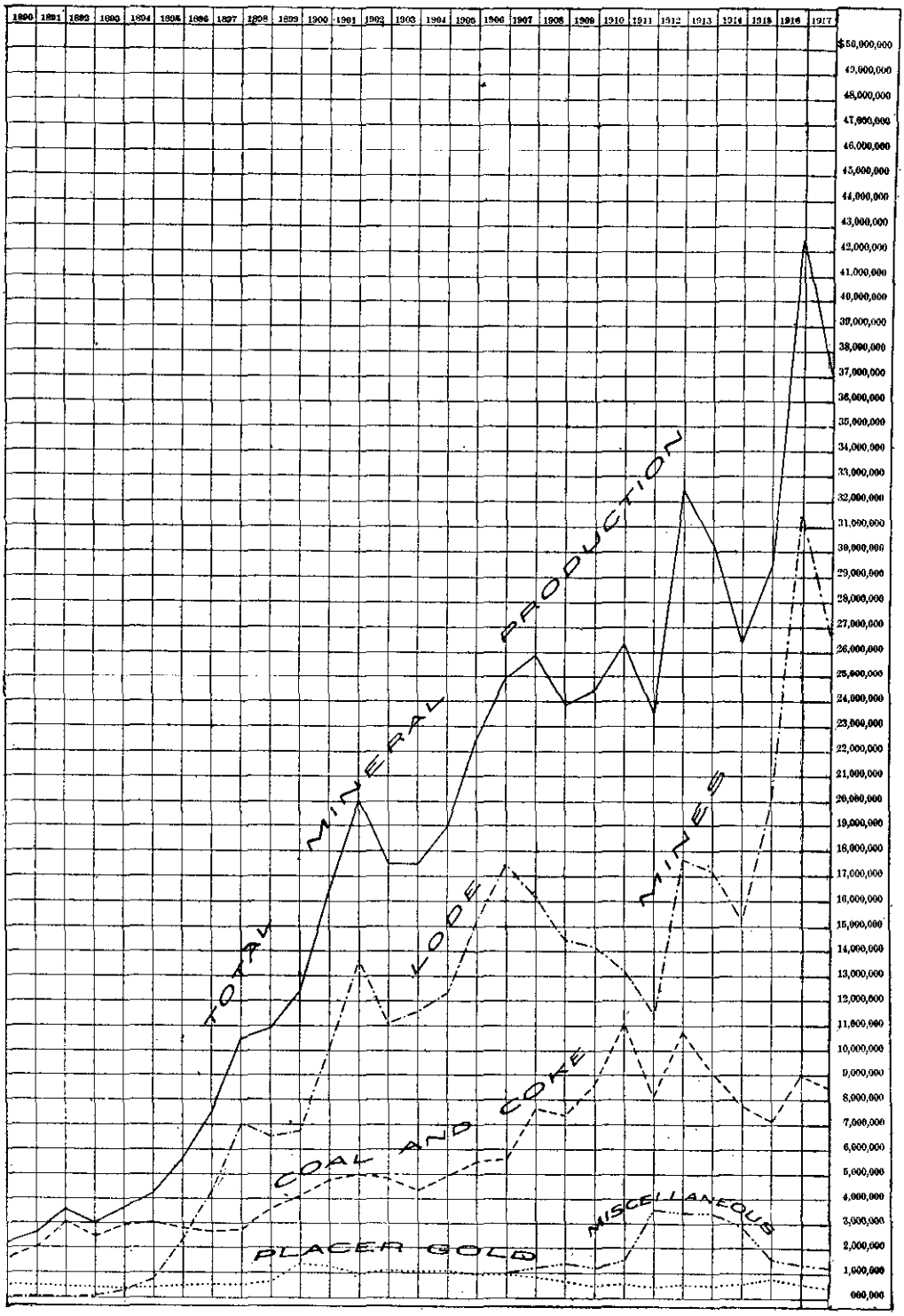
TABLE IX.—PRODUCTION IN DETAIL OF THE

DISTRICT.	YEAR	TONS.	GOLD—PLACER.		GOLD—LODE.		SILVER.	
			Ounces.	Value.	Ounces.	Value.	Ounces.	Value.
				$		$		$
Cariboo								
Cariboo Division	1914		8,250	165,000				
	1915		10,750	215,000				
	1916		7,900	158,000				
	1917		**6,750**	**135,000**				
Quesnel "	1914		1,750	35,000				
	1915		4,250	85,000				
	1916		1,000	20,000				
	1917		**750**	**15,000**				
Omineca "	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
	1916	17,752	850	17,000	1,303	26,933	112,635	70,262
	1917	**4,159**	**600**	**12,000**	**931**	**19,244**	**82,311**	**63,668**
Cassiar								
Atlin Division	1914	270	16,100	322,000	1,000	20,670		
	1915	320	18,850	377,000	875	18,086		
	1916	262	16,925	338,500	736	15,213	3,054	1,905
	1917	**33**	**15,250**	**305,000**	**1,000**	**20,670**		
Liard, Stikine, Skeena, Queen Charlotte, Portland Canal Divisions.	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	175,179	82,684
	1916	*732,889*	*1,100*	*22,000*	*3,806*	*78,670*	*256,802*	*160,198*
	1917	**821,819**	**350**	**7,000**	**9,805**	**202,669**	**343,805**	**265,933**
East Kootenay								
Fort Steele Division	1914	36,384	50	1,000			492,080	256,374
	1915	44,372	750	15,000			481,258	227,154
	1916	98,846	200	4,000			509,693	317,946
	1917	**114,391**	**100**	**2,000**			**180,168**	**139,300**
Windermere-Golden	1914							
	1915	5,556					1,188	561
	1916	2,183					29,178	18,201
	1917	**2,354**					**79,685**	**61,636**
West Kootenay								
Ainsworth Division	1914	66,441			100	2,067	329,586	171,714
	1915	42,630			121	2,501	289,565	136,675
	1916	77,841			45	930	321,202	200,366
	1917	**82,481**			**1**	**20**	**224,461**	**173,621**
Slocan and Slocan City	1914	104,510			13	269	1,775,975	925,283
	1915	114,292			26	537	1,812,550	855,524
	1916	123,886			64	1,323	1,480,571	923,580
	1917	**149,895**			**18**	**372**	**1,547,576**	**1,197,050**
Nelson Division	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
	1916	20,695	50	1,000	4,107	84,891	32,547	20,303
	1917	**10,738**	**50**	**1,000**	**2,521**	**52,109**	**46,229**	**35,758**
Trail Creek Division	1914	297,260			138,568	2,864,201	136,185	70,952
	1915	338,568			142,595	2,947,439	159,584	75,324
	1916	308,924			129,790	2,682,759	132,080	82,391
	1917	**100,171**			**33,290**	**688,104**	**47,112**	**36,441**
Revelstoke, Trout Lake and Lardeau	1914	149	100	2,000	8	165	11,295	5,885
	1915	155	100	2,000	15	310	16,740	7,901
	1916	521	50	1,000	22	455	22,419	13,985
	1917	**534**	**50**	**1,000**	**62**	**1,282**	**37,733**	**29,187**
Boundary-Yale								
(Grand Forks, Greenwood and Osoyoos Divisions.)	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
	1916	1,343,853	50	1,000	75,628	1,563,231	280,578	175,025
	1917	**779,345**	**50**	**1,000**	**56,544**	**1,210,104**	**220,213**	**170,335**
Similkameen, Nicola, and Vernon Divisions	1914	150	150	3,000	35	724	15	8
	1915	225	600	12,000	101	2,088	347	164
	1916	1,416	450	9,000	32	661	830	518
	1917	**1,384**	**400**	**8,000**	**111**	**2,294**	**3,470**	**2,684**
Yale, Ashcroft and Kamloops Divisions	1914	279	150	3,000	14	289	57	30
	1915	2,134	500	10,000	106	2,191	1,702	803
	1916	7,414	150	3,000	570	11,782	4,215	2,629
	1917	**8,254**	**100**	**2,000**	**1,355**	**28,008**	**3,525**	**2,727**
Lillooet								
Lillooet and Clinton Divisions	1914	120	150	3,000	231	4,775	390	203
	1915	50	400	8,000	31	641	5	2
	1916	2,400	250	5,000	2,625	54,259		
	1917	**4,700**	**300**	**6,000**	**3,092**	**63,912**	**276**	**213**
Coast								
(Nanaimo, Alberni, Clayoquot, Quatsino, New Westminster, Vancouver, and Victoria Divisions.)	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
	1916	449,992	50	1,000	3,204	66,227	116,119	72,435
	1917	**681,321**	**50**	**1,000**	**3,793**	**78,402**	**112,652**	**87,136**
TOTALS	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
	1916	3,188,865	29,025	580,500	221,932	4,587,334	3,301,923	2,059,739
	1917	**2,761,579**	**24,800**	**496,000**	**114,523**	**2,367,150**	**2,929,216**	**2,255,749**

METALLIFEROUS MINES, ETC., FOR 1914, 1915, 1916, AND 1917.

LEAD.		COPPER.		ZINC.		TOTALS FOR DIVISIONS.				TOTALS FOR DISTRICTS.
Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	1914.	1915.	1916.	1917.	1917.
	$		$		$	$	$	$	$	$
										525,641
						165,000				
							215,000			
								158,000		
									135,000	
						35,000				
							85,000			
								20,000		
									15,000	
323,482	11,322	6,000	816			92,807				
249,279	10,395	2,831,279	489,245				580,502			
224,451	13,853	1,646,072	447,764	168,616	18,345			594,157		
271,886	21,506	852,373	231,675	364,097	27,548				375,641	
										8,405,696
						342,670				
							395,086			
7,260	448							356,066		
									325,670	
		11,123,376	1,512,779			1,663,907				
30,462	1,270	21,915,481	3,786,995				4,004,002			
1,077	66	24,065,995	6,546,432					6,807,361		
		27,978,015	7,604,424						8,080,026	
										3,025,238
24,863,105	870,209					1,127,583				
26,582,050	1,108,472			180,000	20,250		1,370,876			
24,156,143	1,490,917	5,654	1,538	14,840,000	1,614,592			3,428,993		
13,996,640	1,107,134	9,679	2,631	20,715,050	1,567,304				2,818,429	
216,327	9,021			311,719	35,068		44,650			
571,244	35,257	3,400	925	210,000	22,848			77,231		
1,774,649	140,375	12,640	3,436	18,000	1,362				206,809	
										5,945,253
8,069,525	282,433			280,000	12,320	468,534				
3,436,184	143,289			678,940	76,381		358,846			
7,841,869	484,000			625,971	68,106			753,402		
6,395,350	505,872			918,601	69,501				749,014	
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			
14,415,645	889,734			17,854,357	1,942,554			3,757,191		
11,808,019	934,014			18,789,573	1,421,619				3,553,055	
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			
1,240,784	76,582	176,383	47,980	3,470,036	377,540			608,296		
2,605,666	206,108	50,946	13,847	982,309	74,322				383,144	
		3,779,830	514,057			3,449,210				
		4,651,681	803,811				3,826,574			
		4,200,745	1,142,686					3,907,836		
		1,730,088	470,238						1,184,783	
128,912	4,512					12,562				
89,041	3,713						13,924			
206,741	12,760							28,200		
395,321	31,270			33,279	2,518				65,257	
										4,455,657
1,678	59	16,428,959	2,234,339			4,171,744				
7,127	297	17,402,662	3,007,180				4,954,981			
14,922	921	17,626,623	4,794,794					6,534,971		
36,548	2,891	10,329,765	2,807,630						4,191,960	
						3,732				
		21,701	3,750				18,002			
		182,633	49,680					59,859		
10,697	846	87,326	23,735						37,559	
		14,525	1,975			5,294				
		295,164	51,004				63,998			
47,380	2,924	636,594	173,166					193,501		
12,690	1,004	700,199	190,314	27,564	2,085				223,138	
										70,125
						7,978				
							8,643			
								59,259		
									70,126	
										4,856,864
		13,070,245	1,777,553			1,907,041				
		9,770,197	1,688,290				1,772,926			
		16,835,265	4,579,529					4,719,191		
		17,256,534	4,690,326						4,853,864	
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			
48,727,516	3,007,462	65,379,364	17,784,494	37,168,980	4,048,985			32,063,514		
37,307,455	2,951,020	59,007,585	16,038,256	41,848,513	3,166,259				27,284,474	27,284,474

TABLE X.—SHOWING MINERAL PRODUCTION OF BRITISH COLUMBIA.



PROGRESS OF MINING.

The gross value of the mineral production for 1917 was $37,010,392, a decrease from that of the year 1916 of $5,280,070, or 12.5 per cent., but an increase over that of the previous record year 1912 of $4,569,592, or 14 per cent. The gross value of the metallic minerals recovered in 1917 was $27,284,474, which represents a decrease from last year of $4,779,040, a percentage decrease of about 15 per cent.

The decrease in total value of the 1917 mineral production as compared with that of the previous year would appear at first sight to show a very serious decline in the mining industry; this condition, however, was not due to any decline in mining itself, but to the cumulative effect of several adverse influences acting on the mining industry as a whole. It must be remembered that the year 1916 was a record one of high metal prices and of demand for metals, which therefore made that year a banner one for mining, not only for British Columbia, but for the whole American continent. In comparing the 1917 production with any previous year excepting 1916, it is seen that the 1917 output easily exceeds any other; for instance, it is nearly $5,000,000 greater than the former record year of 1912.

The adverse influences which retarded mineral production in 1917 may be summarized as industrial troubles, reduced metal prices in the last quarter of the year, a very much lessened demand for lead and zinc for munition purposes, and the economic conditions which severely handicapped the mining of gold.

Industrial troubles in 1917 were more frequent and extensive than usual; in the early months of the year a protracted strike in the Crowsnest district not only cut down the output of coal and coke, but forced the copper and lead smelters to close for lack of fuel, and, as a direct cause, stopped mining in the most productive parts of the Province. These troubles were followed by the closing of the mines at Rossland for several months, with the consequent curtailment of gold production. Apparently in this case, although there was some disagreement between the miners and operating company, and a strike seemed imminent, the properties were closed down before such actually took place.

The great decrease in gold production this year is mainly due to the heavy falling-off in the Rossland output, which camp usually makes over one-half the total yearly output of the Province. Early in November labour troubles again occurred at the Trail smelter, which closed the whole plant until practically the end of the year; this in turn stopped productive mining during that time throughout East and West Kootenay.

Metal prices during the year 1917 were favourable to the stimulation of productive mining, as, while there were many fluctuations in price, the general averages were as a rule quite as good as in 1916. The average price of zinc for 1917 was considerably below that of the previous year, but to offset this both silver and lead were considerably higher, while copper was practically the same. During the last quarter of the year the market price of lead declined materially, as the high prices prevailing in the earlier months of the year had so stimulated production as to cause a surplus of lead in the market, with consequent lowering of price. Due to the curtailment of orders for lead by the Imperial Munitions Board, the Trail smelter was forced to decrease its output of lead as no Canadian market was available; a considerably larger production of lead could have therefore been made but for the inability to market it.

Details of the market prices of metals will be found under the discussion of each metal, but it may be noted here that the rise in silver from an average of 50 cents an ounce in 1915 to nearly 86 cents at the close of the year 1917 has proved very beneficial to the silver-lead mines of the Slocan.

The higher cost of labour and supplies—especially powder—has made the cost of new development very high, but in spite of this much work has been done.

Gold-mining also suffered from the increased costs of labour and supplies, with no corresponding increase in the value of the metal produced, thereby causing a smaller margin of profit, and, in many cases, making it unprofitable to mine gold.

But for these untoward circumstances the hope anticipated at the commencement of the year, that the mineral-output of the Province for 1917 would reach the $50,000,000 mark, would probably have been realized. Taken in the aggregate, our mineral production and development in the year 1917 and the future prospects of the industry are conditions for congratulation at this time.

The value of coal produced in 1917 shows an increase of $230,588 as compared with the previous year, but the coke production shows the large decrease of $646,920. The coal production in the Coast District was considerably greater than in 1916, but labour troubles materially decreased the output in the Crowsnest of both coal and coke; it is in this latter district that most of the coke production of the Province is made.

Had it not been that the Crowsnest Collieries, through a series of mishaps—accompanied by a serious shortage of labour due to the war, followed by a labour strike—were unable to make as large an output as expected and intended, the coal and coke production would have been much greater; but as it was, there resulted such a shortage of coke as to partially close the copper-smelters, and these in turn compelled the copper-mines to very much curtail their outputs.

The outputs from metal-mining and coal-mining are intimately related to one another, as any increase in production from the former causes an increased production from the latter for fuel for smelting, power, and transportation purposes. On the other hand, a stoppage of production of coal and coke immediately curtails the metalliferous production.

The following table shows the number of mines which shipped ore during the year 1917, 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.

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 DISTRIBUTION OF SHIPPING MINES IN 1917.

	Tons of Ore shipped.	No. of Mines shipping.	No. of Mines shipping over 100 Tons in 1917.	Men employed in these Mines.		
				Below.	Above.	Total.
CASSIAR DISTRICT:						
Atlin, Stikine, Queen Charlotte, and Portland Canal	4,455	7	3	32	19	51
Skeena	817,397	5	3	359	353	712
CARIBOO DISTRICT:						
Omineca	4,159	13	4	69	62	131
EAST KOOTENAY DISTRICT:						
Fort Steele	114,391	7	3	212	135	347
Windermere-Golden	2,354	9	4	31	13	44
WEST KOOTENAY DISTRICT:						
Ainsworth	82,481	17	8	183	148	331
Slocan and Slocan City	149,895	34	17	598	245	843
Nelson	10,738	15	8	112	93	205
Trail Creek	100,171	6	5	313	109	422
Revelstoke, Lardeau, and Trout Lake	534	13	1	52	20	72
BOUNDARY-YALE DISTRICT:						
Greenwood, Grand Forks, and Osoyoos	779,345	26	12	409	156	565
Similkameen, Nicola, and Vernon	1,384	4	2	38	18	56
Yale, Ashcroft, and Kamloops	8,254	9	2	64	49	113
LILLOOET DISTRICT	4,700	2	2	13	12	25
SOUTHERN COAST DISTRICT	681,321	26	13	697	662	1,359
Total	2,761,579	193	87	3,182	2,094	5,276

In the following table of the non-shipping mines the returns are necessarily incomplete, as they include only the mines reporting to the Department, and not the prospects and properties under preliminary development, which in the aggregate give employment to a large number of men.

TABLE SHOWING NON-SHIPPING MINES AND MEN EMPLOYED.

DISTRICT.	NUMBER OF MINES.			MEN EMPLOYED.		
	Working.	Idle.	Total.	Below.	Above.	Total.
COAST AND CASSIAR	8	20	28	24	23	47
EAST KOOTENAY	2	3	5	3	10	13
AINSWORTH	8	10	18	21	16	37
SLOCAN	9	23	32	29	15	44
NELSON	13	7	20	22	13	35
TRAIL CREEK	....	7	7	....	....	.....
REVELSTOKE-LARDEAU	1	4	5	.....	9	9
BOUNDARY-YALE	4	28	32	6	16	22
LILLOOET	3	2	5	3	2	5
Total	48	104	152	108	104	212

SUMMARY OF 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 1917, aggregating $595,571,107. From this table it will be seen that coal-mining has produced more than any other separate class of mining, a total of $174,313,658; followed next in importance by copper at $130,597,620, and next in order is lode gold at $93,717,974, with placer gold in fourth place at $75,116,103.

TABLE II. shows the value of the total production of the mines of the Province for each year from 1893 to 1917 (inclusive), during which period the output increased tenfold, and reached a gross production for the year 1917 of $37,010,392.

The value of the total mineral production of the Province up to the end of 1917 was $595,571,107.

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 a decrease in the production of placer gold of $84,500, and a decrease in the output of lode gold of $2,220,144, making a total decrease of $2,304,644 in the total production of the metal.

The amount of silver produced this year was 2,929,216 oz., having a gross value of $2,265,749, a decrease in the number of ounces of 372,707. There was a large decrease in the output of Ainsworth Division and small increases from Slocan and Skeena Divisions; all other districts made smaller productions than in 1917. The value of the silver production in 1917 was, however, $206,010 greater than in 1916, due to the prevailing high market price of silver in 1917.

The table shows an output of lead in 1917 amounting to 37,307,465 lb., valued at $2,951,020, which is a decrease from the production of the preceding year of 11,420,051 lb. of lead, but only a decrease in value of $56,442, due to the advance in price of the metal.

The production of copper this year was 59,007,565 lb., valued at $16,038,256, a decrease in amount of 6,371,799 lb., or about 9.8 per cent. The value of the product was less than that of the preceding year by $1,746,238—a decrease of nearly 10 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 Southern Coast District has again the honour of first place on the list, followed, in order of importance, by the Cassiar, West Kootenay, East Kootenay, 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 $1,052,840, as shown in Table V.

TABLE V. is a new table introduced six 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 $1,241,575. 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. shows the statistical record of the placer mines of the Province from 1858 to 1917, and shows a total production of $75,116,103. The output for 1917 was $496,000, a decrease, as compared with the previous year, of 14.5 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 $317,684,517; 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 1917 was 47,044,584 tons (of 2,240 lb.), worth $152,965,253. Of this, there was produced in 1917 2,149,975 tons valued at $7,524,913, an increase of 65,882 tons in quantity and of $230,588 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 1917 was 248,740 tons, from which was made 159,905 tons of coke, having a value of $959,430, a decrease in amount from the preceding year of 107,820 tons, or about 40 per cent., with a decrease in value of $646,920. The total value of the output of the collieries of the Province in 1916 was $8,484,343.

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 1914, 1915, 1916, and 1917, 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 1917 was 2,761,579 tons, having a gross value of $26,788,474, and, with the placer gold, a total value of $27,284,474.

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

Cassiar and Omineca District	29.9
Boundary-Yale District	28.6
Southern Coast District	24.6
Slocan Mining Division	5.4
East Kootenay District	4.2
Trail Creek Mining Division	3.7
Ainsworth Mining Division	3.0
Nelson Mining Division	0.4
Other Mining Divisions	0.2
	100.0

In reports previous to 1910 there has been included in Table IX. 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, in 1912 it reached the $32,000,000 line, in 1916 the $42,000,000 line, while this year it is just above the $37,000,000 line.

GOLD.

Placer Gold.

The production of placer gold during the past year was worth about $496,000 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 a decrease, as compared with 1916, of $84,500.

The production of placer gold is nearly all from the Atlin and Cariboo Districts, about 95 per cent. of the total coming from these two sections.

In hydraulic placer-mining, from which about 90 per cent. of the placer gold obtained in British Columbia is derived, 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.

In the Atlin Division water conditions were normal, so far as is known, but the shortage of labour handicapped operations. So many men have left the district for active service in the war that not only were the larger companies short of labour, but also the number of individuals mining in a small way was materially less than in former years.

In the Cariboo District water conditions were good in the early part of the season owing to the heavy snowfall of the previous winter, which melted off gradually. This was followed by a dry summer, with some compensation by reason of heavy fall rains. The output for the Cariboo and Quesnel Divisions was a little less than in 1916.

Gold-mining in all forms has suffered by the war, due to the fact that the cost of labour and supplies has materially increased, while the price of the product remains standard; hence operating costs are higher and profits lower.

Due to the greatly enhanced market price of the base metals, such mines operating on a sliding scale of wages, regulated by the prices of metals, have been paying abnormally high wages, which has drawn miners away from gold-mining, both placer and lode.

In addition to the increased cost of all supplies, etc., the war conditions have also rendered it almost impossible to obtain new equipment at any price. There has therefore been less inducement for capital to enter into new placer-mining enterprises, either hydraulic or dredging. The development of new placer enterprises in the Cariboo and Atlin fields and elsewhere in the Province can therefore hardly be expected until the world war is over.

Complete news has not 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 Liard-Stikine District the Boulder Creek Hydraulic Mining Company did not have a successful season on Thibert creek, as in the fall a slide carried away the flume, thus preventing the fall clean-up. 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.

Considerable work in connection with placer-mining was done in the Similkameen District, although the actual production was small. About $1,700 worth of crude platinum was recovered and has been included in the placer output.

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

Yale Mining Division made an unusually small output, considering the very low water in the rivers exposed the bars.

The Fort Steele Mining Division made a smaller output than last year.

Gold from Lode-mining.

The value of the gold produced from lode-mining in the Province during the year 1917 was $2,367,190, a decrease, as compared with the previous year, of $2,220,144, or about 48.4 per cent. This smaller production of lode gold is due to decreased tonnages of ore mined in the Rossland and Boundary Districts and to slightly lower values in the gold contents of the Boundary ore.

The decreased tonnages in both these camps, which together produced last year about 93 per cent. of the total lode-gold output of the Province, was partly due to a shortage of coke for smelting owing to labour troubles at the coal-mines.

In the Rossland camp labour troubles at the smelter and the shutting-down of the mines for nearly half the year, reduced the output of this camp from nearly 130,000 oz. in 1916 to 33,290 oz. in 1917, or about 25 per cent. of the camp's normal output.

Nelson Division also made a much smaller output than in the previous year owing to no production having been made from the Sheep Creek camp.

A considerable increase from the Skeena District is recorded, which is accounted for by the initial production from the Surf Inlet mine of the Belmont Canadian Mines, Limited, and the increased tonnage of ore carrying low gold values treated at the Anyox smelter of the Granby Consolidated Company. The first production from the Surf Inlet mine since its acquisition by the present owning company is interesting and important, an output of about 3,000 oz. of gold being made, the result of four months' operation. The property is equipped with a 250-ton mill which commenced milling in August. A considerable gold production in the future from this property seems assured.

It is encouraging to note an increased output from Lillooet District, which produced 3,092 oz., as compared with 31 oz. in 1915 and 2,625 oz. in 1916.

The only large stamp-mill in operation in the Province is the *Nickel Plate* mine at Hedley, in the Osoyoos Mining Division, which this past year milled 71,207 tons of ore having a value of over $740,000. There are smaller stamp-mills operating at the *Queen*, *Perrier*, *Granite*, and other mines in the Nelson Division; and, in addition, there are stamp-mills at the *Jewel* mine, Greenwood; *Coronation*, *Pioneer*, and *Lorne* mines, Lillooet; and the *Engineer* mine, Atlin, which operated during the year.

The following are the values of the gold product of the three most important camps: Rossland, $688,104; Boundary, $1,210,104; and Skeena, $202,669. This year about 65 per cent. of the gold production of the Province was obtained from the smelting of copper-bearing ores, the remainder mainly from stamp-milling.

The Boundary-Yale District shows a decrease of 16,220 oz. as compared with 1916. The Granby Company's mines show a decrease of about 14,500 oz. and the British Columbia Copper Company a decrease of about 2,200 oz. as compared with 1916. The *Union* also shows a decrease. The *Carmi* did not operate and little was done by the *Dividend-Lakeview*.

There was a reduction of about 1,586 oz. in the Nelson District, due mainly to the *Queen*, on Sheep creek, not having been operated during the year. This mine is at present closed and the future plans of the company are not known.

The *Granite* mine made a decreased production. The *Yankee Girl* mine, near Ymir, recommenced shipments to the Greenwood smelter after not shipping for a period of nearly three years, during which time low-level development was carried on.

The Coast production shows a small increase, due to increased production from the *Britannia* and *Marble Bay* mines.

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

The gold production of the various districts was as follows:—

	Oz.
Boundary-Yale	60,010
Rossland	33,290
Skeena	9,805
Coast (Southern)	3,793
Lillooet	3,092
Nelson	2,521
Atlin	1,000
Omineca	931
All others	81
Total	114,523

SILVER.

The total amount of silver produced in the Province during the year 1917 was 2,929,216 oz., valued at $2,265,749, a decrease in amount, as compared with the previous year, of 372,707 oz.; but, owing to the increase in the market value of this metal, the value of the silver-output in 1917 was $206,010 greater than in 1916.

Unlike the other metals, silver declined in price at first owing to the effect of the war on the market. The decline in the price of silver, followed by a sudden rise in value, is best seen by comparing the average yearly prices for the last five years, which were:—

1913	59.8 cents an oz.
1914	54.8 „
1915	49.7 „
1916	65.7 „
1917	81.4 „

The increase in the market price of silver which commenced in the last months of 1915 continued throughout 1916, and on into 1917, steadily rising until in September the high monthly average of 100.74 cents an ounce was reached. Since then the price has dropped somewhat, the average for December being 85.96 cents.

The Slocan District—including the Ainsworth, Slocan, Slocan City, and Trout Lake Mining Divisions—produced about 60 per cent. of the total Provincial output of silver this year, and the Fort Steele Mining Division about 6 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	1,547,576 oz.	silver=	52.8 per cent. of total.
Skeena M.D. produced	343,805 „	11.7	„
Boundary-Yale District produced	227,208 „	7.8	„
Ainsworth M.D. produced	224,461 „	7.7	„
Fort Steele M.D. produced	180,168 „	6.1	„
Coast District produced	112,652 „	3.8	„
Omineca M.D. produced	82,311 „	2.8	„
Windermere-Golden M.D. produced	79,685 „	2.7	„
Trail Creek M.D. produced	47,112 „	1.6	„
Nelson M.D. produced	46,229 „	1.6	„
All others produced	38,009 „	1.4	„
	2,929,216	100.0	

The Slocan Mining Division (with which is included Slocan City Division) is again far in the lead of all other districts in silver producton, nearly 53 per cent. of the total being credited

to the Slocan. The figures for this year show an increased production for the Slocan, as compared with last year, of 67,005 oz., which shows the beneficial influence of the high price of silver. The Slocan output would have been still larger but for the curtailment of ore shipments at different times throughout the year, caused by the inability of the Trail smelter to handle the ore.

The largest producer in the Slocan was again the *Standard*, with an output of about 500,000 oz., followed by *Surprise* and *Queen Bess*, each about 200,000 oz. The total number of shipping mines in the district was about thirty-three.

Ainsworth and Fort Steele Divisions both show decreases as compared with the previous year.

Nearly 50 per cent. of the silver-output from the Boundary District comes from the Granby Company's mines at Phoenix. Other mines contributing are the *Mother Lode*, *Sally*, and *Union*.

The silver production from Trail Creek comes from the smelting of the gold-copper ores of Rossland camp, which carry about ½ oz. of silver to the ton.

The Skeena production comes almost entirely from the Granby Company's *Hidden Creek* mine, at Anyox. The Omineca production, which comes mainly from the *Silver Standard*, was a little lower than in 1916.

The Coast production of silver comes from the smelting of copper ores carrying low values in the precious metals.

About 75 per cent. of the total Provincial output of silver comes from the treatment of silver-lead-zinc ores and the balance mainly from the smelting of gold-copper ores carrying silver.

LEAD.

The lead production of the Province for the year 1917 was 37,307,465 lb. of lead having a market value of $2,951,020, showing, as compared with the previous year, a decrease in amount of 11,420,051 lb. of lead, or 23.4 per cent.

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 1917 was considerably higher than for the previous year, being 8.787 cents a pound as compared with 6.858 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	13,996,640 lb.	lead=37.5	per cent. of total.
Slocan and Slocan City M.D. produced	11,808,019 „	31.7	„
Ainsworth M.D. produced	6,395,350 „	17.1	„
Nelson-Arrow Lake M.D. produced ..	2,605,666 „	7.0	„
Windermere-Golden M.D. produced..	1,774,649 „	4.7	„
Revelstoke, Trout Lake, and Lardeau M.D. produced	395.321 „	1.1	„
Omineca M.D. produced	271.885 „	0.7	„
All others produced	59.935 „	0.2	„
	37,307,465	100.0	

The Fort Steele production comes almost entirely from the *Sullivan* mine, and during 1917 lead-ore shipments from this mine were greatly curtailed. This lessened output, which amounts to about 42 per cent. decrease as compared with 1916, was partly due to industrial troubles at the Trail smelter, partly to excess of custom lead ore at the smelter, and partly owing to the fact that the efforts at the *Sullivan* were concentrated on getting out zinc ore.

The Slocan production shows a small decrease from the previous year, which is accounted for by the suspension of ore shipments during part of the year through inability to get the ore smelted. The heaviest contributor was again the *Standard*—which, however, did not make quite

half of the previous year's production—followed by the *Surprise*, *Galena Farm*, and *Queen Bess*, all with a production approximating 2,000,000 lb.

The production from Ainsworth shows a decrease of about 1,500,000 lb. as compared with 1916. The *Bluebell* is the heaviest shipper with a production of about 3,500,000 lb., followed by the *Highland* with 1,000,000 lb. and the *Florence* with 900,000 lb. Nearly twenty shipping mines are listed in this Division.

The lead production of Nelson Division was 2,601,685 lb., as compared with 1,240,784 lb. in 1916, the increase being due to a larger production from the *Emerald* mine, which makes practically all the output of this Division.

The Windermere and Golden Divisions together produced about three times as much lead as in 1916, due to a largely increased production from the *Paradise* mine; the output of this mine was approximately 1,200,000 lb. Other shippers were the *Couverapee*, *Lead Queen*, and *Monarch*.

The Omineca lead production for 1917 was a little larger than that of 1916. The *Silver Standard* is the largest producer, with half a dozen small shippers. The lead-output from this Division should be larger in the year 1918.

COPPER.

The amount of copper produced during the year 1917 shows somewhat of a decrease as compared with the previous year, but considering the industrial troubles of 1917 the showing made is very satisfactory. A production of 59,007,565 lb., worth $16,038,256, is recorded, as compared with 65,379,361 lb., worth $17,784,494, in the preceding year. The 1917 output, however, is higher than any other year excepting 1916.

The market price of copper was subject to considerable fluctuations during the year. The New York average price for January was 28.673 cents a pound, and rose in February to 31.750 cents, thereafter gradually declining to 25.073 in September. On September 21st, 1917, the War Industries Board of the United States, with the sanction of the President, officially fixed the market price of copper at 23.5 cents a pound. This price has ruled ever since and apparently is satisfactory, as, according to the leading authorities on the copper market, the supply at present just about equals the demand. The average price of copper for the year 1917 was 27.18 cents, as compared with 27.202 in 1916.

The copper production from the several districts was as follows:—

	Lb.
Skeena Division	27,978,015
Southern Coast District	17,256,534
Boundary-Yale District	11,117,290
Trail Creek Division	1,730,088
Omineca Division	852,373
All other districts	73,265
Total	59,007,565

The *Hidden Creek* mines and the smelter at Anyox of the Granby Consolidated Mining and Smelting Company were operated continuously throughout the year, even although at times some difficulty was experienced from shortage of coke and labour. A larger tonnage was treated than in 1916, amounting to approximately 784,000 tons of ore, and in addition 38,000 tons of quartz flux and 53,000 tons of limestone flux. With the increased tonnage handled there was a corresponding increase in the output of copper, 27,661,301 lb. (recovered copper), being produced, as compared with 23,890,896 lb. in 1916.

In the Boundary District the Granby Company's mines at Phoenix and smelter at Grand Forks were not operated continuously nor to full capacity throughout the year owing to the strike in the Crowsnest coalfield shutting off the supply of coke. Only a little over half the 1916 tonnage was handled, and, as the grade of ore remained practically the same, the copper-output shows a proportionate decrease. An output of 6,858,718 lb. was made, as compared with 13,795,151 lb. in 1916. Similarly, the British Columbia Copper Company (now absorbed by the

Canada Copper Corporation) treated a smaller tonnage during the past year than in 1916, with consequent decrease in copper-output.

The *Britannia* mine had a very successful year, the tonnage of ore mined and milled being 662,000 tons, containing 15,780,830 lb. copper, 86,925 oz. silver, and 980 oz. gold. The ore reserves at this mine are large—claimed to be about 17,000,000 tons—and it is expected the yearly tonnage treated will increase still further, as the ultimate plans of the company are to have milling capacity to handle 4,000 tons a day.

The copper-mines on Texada island made about the same output as in 1916; the most important producer was again the *Marble Bay*.

Several small shipments of copper ore were made from Vancouver island and along the Coast. The high price of copper has stimulated the work of developing copper-showings on the Coast, and while this has not resulted in any great quantity of ore being shipped in 1917, it is likely that a considerable increase of production will take place in 1918.

The encouraging feature as regards copper in the Southern Coast District is the very satisfactory results being obtained from serious development, which as yet has not found expression in actual production, but argues well for substantial output in the near future. Development, to be successful, would seem to be so extensive as to be out of reach of any but strong companies.

The production of copper from Nelson Division during 1917 was very low, amounting to about 50,946 lb., mainly from the *Eureka* mine.

The Omineca Division produced less copper in 1917 than in 1916, due mainly to suspension of shipments from the *Rocher Déboulé* mine during the early months of the year.

During the last three years copper-mining has attained the position of being the most important form of mining in the Province, and from all indications it should maintain this prominent place for years to come, as last year the value of the copper mined exceeded the total value of all other metalliferous minerals mined in the Province, and was also nearly double the combined value of coal and coke production. It formed about 60 per cent. of the total value of the metalliferous mines and 43 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.

The following table shows the production of the various districts for the years 1914, 1915, 1916, and 1917:—

	1914. Lb.	1915. Lb.	1916. Lb.	1917. Lb.
Boundary District	16,428,959	17,402,662	17,626,623	10,329,765
Rossland District	3,779,880	4,651,681	4,200,745	1,730,088
Coast, Omineca, and Cassiar Districts	24,199,621	34,516,957	42,547,332	46,086,922
Yale-Kamloops District	14,525	295,164	819,227	700,199
Nelson and other Districts	586,764	51,941	185,437	160,591
Totals	45,009,699	56,918,405	65,379,364	59,007,565

ZINC.

The total quantity of zinc produced in 1917 was 41,848,513 lb., valued at $3,166,259, 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 1916, of 4,679,533 lb., or 12.6 per cent., in amount, but, owing to the lower average market price, a decrease in value of $877,726, or 21.7 per cent

The average yearly price of spelter in the New York market for the last five years is shown in the following table:—

Year.	Price.
1913	5.65 cents a pound.
1914	5.21 "
1915	13.23 "
1916	12.804 "
1917	8.901 "

The high market price of zinc which prevailed during 1915 and 1916, thereby greatly stimulating production everywhere, did not continue in 1917. The average price for the month of January was 9.619 cents a pound and in March 10.3 cents; thereafter a steady decline in price set in until an average for December of 7.685 cents was reached.

The way in which the increased price of zinc during recents years has stimulated the production of this metal in the Province is shown in the following table:—

	Lb.	Value.
1913	6,758,768	$ 324,421
1914	7,866,467	346,125
1915	12,982,440	1,460,524
1916	37,168,980	4,043,985
1917	41,848,513	3,166,259

The following table shows the districts from which the zinc production of the Province for 1917 is made:—

	Lb.
Fort Steele	20,715,090
Slocan	18,789,573
Nelson	982,309
Ainsworth	918,601
Omineca	364,097
Others	78,843
Total	41,848,513

These figures show, as compared with the year 1916, an increase of nearly 6,000,000 lb. from Fort Steele, an increase from Slocan of about 1,000,000 lb., increases from Ainsworth and Omineca, and a decrease of over 2,000,000 lb. from Nelson.

In the Slocan District the heaviest shipper was the *Standard* mine, which is credited with about 10,700,000 lb. of zinc, followed by the *Lucky Jim* and the *Surprise*, each with about 2,000,000 lb.; then the *Galena Farm*, *Van-Roi*, and *Slocan Star*.

The Fort Steele production comes entirely from the *Sullivan* mine; the ore is shipped to the Trail electrolytic refinery.

The Nelson production is a zinc-carbonate ore shipped to United States smelters for treatment, and comes from the *H.B.* group of mines, near Salmo.

The Ainsworth production comes mainly from the *Bell* and *Whitewater* mines, both credited with a production of about 400,000 lb.

The Omineca production comes from the *Silver Standard* mine and consists of hand-sorted ore shipped to United States smelters, carrying about 60 oz. silver to the ton and 40 per cent. zinc.

OTHER MINERALS.

Since the commencement of the war there has been a steadily growing demand for minerals and metals which are but little known by the general public. This was caused by the curtailing of former sources of supply and the general interruption of the world's markets. Many of these minerals rose to high prices, due to scarcity and to the fact that modern war materials require for their manufacture many different metals and mineral products. The enormous output of munitions occasioned the great demand, and consequent rise in price, of copper, lead, and zinc, but many other less well-known metals are also required in comparatively great quantities.

Some of these minerals are known to exist in British Columbia, and during the last two years attempts in a small way have been made to develop these deposits. Other mineral products, not directly used in war materials, but in demand owing to supplies having formerly come from enemy countries, have been prospected for in the Province.

The following paragraphs give brief details about these minerals:—

Iron Ore. The past year has seen a very great demand for iron and steel on the Pacific Coast, the normal demand having been greatly increased by the need for steel in ship-building and munitions-work, while the usual outside sources have been monopolized by war needs in other parts of the world, and the high freight rates have made the lack of local production more pronounced. Consequently, it has been strongly advocated in many quarters that the conditions are favourable for the establishment of an iron-smelting plant somewhere on the British Columbia Coast. So far nothing definite has materialized, although there is apparently a prospect of such a plant being established. As is well known, there is on the Coast, in the aggregate, an adequate supply of magnetite-iron ore, quite sufficiently free from impurities as to be within the "Bessemer limit," to supply ore for such a plant.

The magnetite-deposits of the Coast have therefore had some attention bestowed on them during the past year; this, however, was mainly confined to examination, with but little development. Bulletin No. 3, 1917, of the British Columbia Mines Department describes the more important magnetite-deposits of the Coast.

Platinum. A small quantity of crude platinum is recovered each year from placer-mining operations in the Similkameen District. The price of platinum has advanced greatly in the last two years owing to heavy demands and a shortage of supply. This has occasioned considerable interest in the possibility of more extensive placer-mining for platinum (and associated gold) in the Similkameen District. The occurrence of small quantities of platinum in-place in the peridotite rocks of the upper Tulameen river has been known of for years; and now that refined platinum has reached a price of over $100 an ounce, prospecting has been resumed to see if any zones in this formation can be found which would pay to work for the platinum content.

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 Provincial output of molybdenite during the year was 152 tons of ore, containing about 12,000 lb. of molybdenite. Nearly all this production was from the *Molly* group, on Lost creek, in the Nelson Mining Division. 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 steady 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. A mill was erected on the property in 1916 and about 383 tons of 2-per-cent. ore was treated. 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 in Canada about $2,000 a ton.

Regulations have now been made by the Dominion Government allowing the export of molybdenite ore to the United States. The price in the States has been about double the Canadian price, so that if this high price continues a further incentive is provided to mining the molybdenite ores of the Province.

At the *Molly*, the *Index*, and at Alice arm there are considerable tonnages of low-grade ore, and if these mines were equipped with small but suitable concentrating-mills a regular production could be maintained.

Manganese. Manganese is used in steel-making and during the last year has been in demand owing to increases in steel production. Near Kaslo a manganese-deposit has been developed during the past year and there is said to be a considerable tonnage ready for shipment. The Dominion Government has recently modified the embargo restrictions on shipping manganese ore to the United States, so that the Kaslo property will probably make a production during 1918.

Tungsten. Tungsten is also used in the making of special steels, and the market price of tungsten ores, although fluctuating, is now at a good figure. So far as is known, no tungsten ore has been produced in shipping quantities from the Province, but tungsten minerals, generally in association with other minerals, have been noted in a few localities. A deposit of scheelite (calcium tungstate) has been known of for many years situated near Barkerville, Cariboo District, and it is probable this will be developed in the near future.

Antimony. Antimony is another metal which at first advanced greatly in price owing to war demands, but a largely increased production from China soon brought the price back to normal again. Its principal use in war material is to harden the lead bullets used in shrapnel. 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. Twenty-seven tons of antimony ore was shipped from the *Alps-Alutras* property, situated on a fork of Carpenter creek, in the Slocan Mining Division, in 1916; this ore carried from 50 to 60 per cent. antimony. Reports have been heard of small test shipments from other claims.

Chromite. At the present time there is a considerable demand for chromite, which is used for various purposes, including steel-making. Small deposits of chromite occur in the Tulameen District, but so far have been considered too small to be developed. A deposit near Cascade, Grand Forks Mining Division, is now being developed and other occurrences are being prospected.

Non-metallic Minerals. The following minerals are at the present time in demand, and search for all of them is being carried on in British Columbia: Bauxite, fluorite, magnesite, graphite, China clay, feldspar, mica, phosphate, strontianite, epsomite, talc, fuller's earth, potash, soda, pyrite for the sulphur in it, etc. Although most of the above minerals may not be needed in large quantities, yet the present high prices of the products is an incentive to intensive prospecting.

One hundred and five tons of talc was shipped from the Lillooet District in 1917 and an increasing production may be expected. Several hundred tons of epsomite (magnesium sulphate), which is used in the drug trade, was shipped from Osoyoos Division.

For the first time in the history of the Province there was a production of arsenic; this was made from the *Nickel Plate* mine of the Hedley Gold Mining Company and amounted to $20,000. The arsenic occurs as arsenical iron pyrites in the concentrates shipped by this company to the Tacoma smelter. These concentrates have been going to the smelter for years, but until the recent installation of an arsenic-burner the arsenic content was not recovered.

The production of miscellaneous minerals produced in British Columbia in 1917 was valued at $37,029.

COAL.

The gross production of coal in 1917 was 2,398,715 long tons, of which 248,740 tons was made into coke, leaving the net production at 2,149,975 tons. These figures show a decrease, as compared with 1916, of 86,865 tons gross, but an increase of 65,882 tons net. The quantity of coke made was 159,905 tons, which is a decrease of 107,820 tons as compared with 1916. For purposes of comparison the following table is shown:—

	1912.	1913.	1914.	1915.	1916.	1917.
Coal, gross.....tons, 2,240 lb..	3,025,709	2,570,760	2,166,428	1,972,580	2,485,580	2,398,715
Less made into coke "	396,905	433,277	355,461	361,451	401,487	248,740
Coal, net..... "	2,628,804	2,137,483	1,810,967	1,611,129	2,084,093	2,149,975
Coke made..... "	264,333	286,045	234,577	245,871	267,725	159,905

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

	1914.	1915.	1916.	1917.
Vancouver Island mines.....tons, 2,240 lb.	1,072,314	1,020,942	1,492,761	1,695,721
Nicola and Similkameen mines ..... "	138,931	99,066	110,549	151,243
Crowsnest mines..... "	955,183	852,572	882,270	551,751
Total quantity of coal mined..... "	2,166,428	1,972,580	2,485,580	2,398,715
Less made into coke..... "	355,461	361,451	401,487	248,740
Net quantity of coal produced ..... "	1,810,967	1,611,129	2,084,093	2,149,975

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

	1914.	1915.	1916.	1917.
Vancouver Island collieries.....tons, 2,240 lb.	*Nil*	5,450	27,604	30.406
Nicola and Similkameen collieries... "	*Nil*	*Nil*	*Nil*	*Nil*
Crowsnest District collieries..... "	234,577	240,421	240,121	129,499
Total coke production.. ... "	234,577	245,871	267,725	159,905

As will be seen from the above figures, the net coal production this year is 65,882 tons more than it was in 1916, and greater than it has been since 1912.

This output would have been considerably greater had not the Crowsnest Collieries met with a series of misfortunes during the year that interfered with production, and in addition to this there was a serious shortage of labour—partly caused by the heavy enlistment of the younger men—and in the early part of the year there were labour troubles. All these contributed to occasion a shortage of both coal and coke, when the demand was most keen.

Coke.—The production of coke in 1917 was 159,905 tons (2,240 lb.), which is 107,820 tons less than the preceding year. Of this gross coke production, 129,499 tons was made by the Crow's Nest Pass Coal Company in East Kootenay, and the remaining 30,406 tons was made by the Canadian Collieries at Comox, V.I.

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, 79.5 per cent. of the gross output, their respective production representing 18.8 per cent., 33.2 per cent., and 27.5 per cent. of such *total*.

Of the other collieries: In the Coast District, on Vancouver island, the Pacific Coast Coal Mines, Limited, produced 150,538 tons, the British Columbia Coal Mining Company 61,586 tons, and the Nanoose Collieries, Limited, 27,822 tons; and in the Nicola Valley section of the district, the Middlesboro Colliery Company mined 83,458 tons, the Inland Coal and Coke Company 7,296 tons, the Princeton Coal and Land Company 46,926 tons, and the Pacific Coast Colliery Company some 206 tons of coal.

In the East Kootenay District, in addition to the Crow's Nest Pass Coal Company, which produced 450,686 tons, the Corbin Coal and Coke Company produced 101,065 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 77 per cent. of the total coal-output.

The gross output of the collieries of the Province for the past year was, as already stated, 2,398,715 tons, and 2,805 tons of coal was taken from stock, making the gross amount of coal distributed 2,401,520 tons.

Of this gross amount, there was sold for consumption in Canada, 935,469 tons; sold for consumption in the United States, 754,568 tons; sold in other countries, 38,211 tons; making the total coal sales for the year 1,728,248 tons of 2,240 lb.

In addition to the coal sold, there was used in the manufacture of coke 248,740 tons, and used under companies' boilers, etc., 198,102 tons; while 226,430 tons was lost in washing and screening.

The coke sales of the Province for the past year amounted to 160,522 tons, of which 734 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.	861,672	73,797	935,469
" export to United States ..... "	528,721	225,847	754,568
" export to other countries ..... "	38,211	.....	38,211
Total coal sales	1,428,604	299,644	1,728,248
COKE.			
Sold for consumption in Canada .....tons, 2,240 lb.	31,559	116,252	147,811
" export to United States ..... "	.....	12,711	12,711
" export to other countries ..... "	.....	.....	.....
Total coke sales	31,559	128,963	160,522

COLLIERIES OF COAST DISTRICT.

The Collieries of the Coast District, which includes those on Vancouver island and in the Nicola-Princeton fields, mined 1,846,964 tons of coal in 1917, while 2,811 tons was taken from stock, making 1,849,775 tons distributed from these collieries in 1917. This amount was distributed thus:—

Sold as coal in Canada	861,672	tons.
Sold as coal in United States	528,721	"
Sold as coal in other countries	38,211	"
Total sold as coal	1,428,604	tons.
Used under companies' boilers, etc.	140,452	"
Used in making coke	54,289	"
Lost in washing, etc.	226,430	"
	1,849,775	"
Minus coal taken from stock	2,811	"
Gross output	1,846,964	"

The total coal sales of the Coast collieries for the year show, as compared with the sales of the previous year, an increase of 188,779 tons, equivalent to over 15 per cent.

The coal sold in British Columbia by the collieries of the Coast District show this year an increase of 78,939 tons, or about 10 per cent. from the preceding year; the amount exported to the United States was 77,795 tons greater, and 38,211 tons of coal was exported to other countries.

Only one company in the Coast District—the Canadian Collieries, Limited—has ever made coke; in 1916 the ovens were again put in operation after several years of inactivity, and in 1917 this company produced 30,406 tons (2,240 lb.) of coke, 117 tons was burned under the company's boilers, and 1,270 tons was taken from stock, making the total sales for the year 31,559 tons.

On Vancouver island five companies produced coal this year — the Canadian Collieries, Limited, the Western Fuel Company, the Pacific Coast Coal Mines, the British Columbia Coal

Mining Company, and the Nanoose Collieries, Limited; the majority of these companies each operate two, or more, collieries. The combined gross output of the Island collieries was 1,695,721 tons.

In the Nicola and Princeton coal-fields of the Coast District, the Middlesboro Colliery Company produced 83,458 tons of coal; the Princeton Colliery, 46,926 tons; the Inland Coal and Coke Syndicate (formerly Coal Hill Syndicate), 7,296 tons; the Pacific Coast Colliery Company, 206 tons; and the Merritt Collieries, Limited, 13,357 tons.

The total output of this portion of the sub-district was 151,243 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 450,686 tons; and the Corbin Coal and Coke Company, which made an output of 101,065 tons; making a gross output for the district for 1917 of 551,751 tons of coal. The Hosmer Mines, Limited, did not operate.

In addition to the coal mined, 6 tons was added to stock, making the amount of coal distributed from the collieries 551,745 tons.

Of this gross tonnage, 194,451 tons was used in the manufacture of coke, of which there was produced 129,499 tons (2,240 lb.).

The coke sold this year amounted to 128,963 tons, and 536 tons was added to stock.

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

Sold as coal in Canada	73,797	tons.
Sold as coal in United States	225,847	„
Total sold as coal	299,644	tons.
Used by the companies in making coke	194,451	„
Used by the companies under boilers, etc.	57,650	„
	551,745	„
Plus coal added to stock	6	„
Gross output	551,751	„

BUILDING MATERIALS.

The production of building materials in 1917 was slightly less than in the preceding year, being $1,204,546 as compared with $1,299,553. The statistical returns are not yet as complete as could be desired, due to the reluctance of a few producers to give returns, but it is believed the figure given above approximates very closely to the actual output. Since 1912, when a production amounting to $3,435,722 was recorded, the output of building materials has steadily declined, due to the cessation of the building trade, brought about by the continued financial depression, and the war. It is probable that the figures have now reached a minimum, and that an output amounting from $1,000,000 to $1,500,000 represents the steady yearly demand for these materials for use in repairs, renewals, and various small demands, without any new construction-work. It may be expected, therefore, that the production will remain at about this figure until a period of active construction-work again commences in the Province. The diminution of production has been general in all kinds of material.

The outputs of sand and gravel, of brick, pottery, and cement are all slightly less than in 1916, but the decrease is not serious. The output of fire and face brick shows an increase, due to a slightly larger production by the Clayburn Company. Approximately 88 per cent. of the total production of building materials comes from the Coast District, and the larger part of this finds its markets in the Coast cities.

In Table V., where the production of building materials is given in detail by districts, the column previously headed "Clay, Gypsum, etc.," was changed last year to "Miscellaneous Minerals," this column being used for listing the production of hydromagnesite from Atlin, molybdenite from Skeena, Lillooet, and Nelson, and Osoyoos and antimony ore from Slocan.

The column formerly headed "Pottery and Tile" now is "Pottery and Clay," and includes the production figures of clay, which are, however, small. No production of gypsum has been recorded as yet. The column previously headed "Crushed Rock" is this year "Crushed Rock and Flux"; in it is recorded, in addition to the crushed rock, the tonnages of limestone and quartz which are quarried for use at the smelters as flux.

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.

The only important producer during the past year was the Sechelt Granite Quarries, and the output from this, amounting to a little over $110,000, all went to the Government piers at Victoria.

Marble. No production of marble was made last year so far as has been ascertained. *Marble-quarries in the Ainsworth Mining District and on Texada* island have been partially developed in previous years, but no serious production has yet been started.

Sample slabs from one of the quarries on Texada island 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 very little further work has since been done.

Red Brick. The production of red brick during the past year was about 2,000 M.; the price varies from $8 to $11 a thousand, according to quality and demand. This small output shows very clearly that but little construction-work has been carried on. It is probable, however, that a considerable quantity of brick is still imported into the Province.

Firebrick. The only company producing firebrick in the Province is the Clayburn Company, Limited, with a plant at Clayburn. The fireclay is found here as a bed occurring in bedded rocks of Eocene age. Shales, sandstones, and conglomerates, all but little consolidated, make up this sedimentary series. The shales are quarried or mined for brick-making and one bed is an excellent fireclay. Associated with these *rocks is a bed of lignite which is sufficiently good to be used for firing the boilers of the plant.* The production of this company was a little greater than in 1916. Firebrick is the principal manufactured article produced by this company, but, in addition, considerable quantities of common brick, paving-brick, tiles, drain-pipe, and prepared fireclay are made. The output for the year is valued at nearly $200,000.

Pottery Drain-pipe and Tile. The British Columbia Pottery Company at Victoria West, which manufactures drain and sewer pipes, chimney-tiles, etc., made about the same production in 1917 as in the previous year. The Port Haney Brick Company, besides manufacturing common brick, also makes drain-pipe, partition-blocks, etc.

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 production of lime and limestone for 1916 is valued at $102,223, as compared with $106,000 in 1915, and in addition nearly $100,000 worth of limestone was quarried for use as smelter flux by the Granby and Consolidated Companies.

Portland Cement.

The production of Portland cement in the Province is made by two companies—the Vancouver Portland Cement Company, with works at Tod inlet, and the Associated Cement Company, with works at Bamberton. The combined production amounted to $487,829, which compares with $436,459 worth produced in 1916.

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.

During the boom years of 1911 and 1912 a number of well-equipped plants were put up near Vancouver and Victoria for supplying 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. Practically all of these plants are now idle, as there is but little demand for sand and gravel.

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; while John D. Galloway, M.Sc., was Assistant Provincial Mineralogist until June, when he was appointed Resident Engineer of the North-eastern Mineral District, with headquarters at Hazelton. Major Nation, who went overseas in 1914, returned in September, 1917, and resumed his position as general office assistant.

During the session of 1917 the Hon. the Minister of Mines brought in the "Mineral Survey and Development Act," which was passed on May 19th, 1917, and under the provisions of which the Province was divided into six Mineral Districts, to each of which there was appointed a Resident Engineer with headquarters at a centrally located point in such district.

In the district to which he was appointed the Resident Engineer is expected to devote his whole time to the performance of the duties of his office, and to carry on continuously a mineral survey of his district, keeping records of the same and of the mining and mineral developments taking place, and at the same time to assist prospectors and others with such advice as may be necessary and may come within the scope of a mining engineer's work.

Aside from special reports which may be called for by the Minister, the Resident Engineers are expected annually to make a comprehensive report covering all matters relating to mining, mine development, and prospecting that have occurred within the year in their respective districts.

These annual reports of the Resident Engineers are given later in this general Report, and form the basis of the information given in respect to the mineral industry and its development within the Province.

As the Resident Engineers did not take office until the season of 1917 was well advanced, and as the work was new to many of them, their reports are not as complete or comprehensive as they probably will be next year.

The following are the six Mineral Districts into which the Province is divided, with the Mining Divisions included in each and the location of the permanent office of the district, with the name of the Resident Engineer appointed to each district:—

(1.) The North-western Mineral Survey District shall consist of that portion of the Province contained within the following Mining Divisions, that is to say: Atlin, Stikine, Liard, Skeena, Portland Canal, Bella Coola, and Queen Charlotte; and shall have its permanent survey station and office at the City of Prince Rupert. Resident Engineer, Geo. A. Clothier.

(2.) The North-eastern Mineral Survey District shall consist of that portion of the Province contained within the following Mining Divisions, that is to say: Omineca, Peace River, Cariboo, and Quesnel; and shall have its permanent survey station and office at Hazelton. Resident Engineer, John D. Galloway, M.Sc.

(3.) The Central Mineral Survey District shall consist of that portion of the Province contained within the following Mining Divisions, that is to say: Clinton, Lillooet, Kamloops, Ashcroft, Nicola, Vernon, and Yale; and shall have its permanent survey station and office at the City of Kamloops. Resident Engineer, R. W. Thomson.

(4.) The Southern Mineral Survey District shall consist of that portion of the Province contained within the following Mining Divisions, that is to say: Similkameen, Greenwood, Grand Forks, and Osoyoos; and shall have its permanent survey station and office at the City of Grand Forks. Resident Engineer, Philip B. Freeland.

(5.) The Eastern Mineral Survey District shall consist of that portion of the Province contained within the following Mining Divisions, that is to say: Golden, Windermere, Fort Steele, Ainsworth, Slocan, Slocan City, Trout Lake, Nelson, Arrow Lake, Revelstoke, Lardeau, and Trail Creek; and shall have its permanent survey station and office at the City of Revelstoke. Resident Engineer, A. G. Langley, B.Sc.

(6.) The Western Mineral Survey District shall consist of that portion of the Province contained within the following Mining Divisions, that is to say: Nanaimo, Alberni, Clayoquot, Quatsino, Victoria, Vancouver, and New Westminster; and shall have its permanent survey station and office at the City of Nanaimo. Resident Engineer, W. M. Brewer.

ASSAY OFFICE.

The following is a summary of the work of the Assay Office of the Bureau of Mines for the year 1916 as reported by the Assistant Provincial Assayer, D. E. Whittaker:—

During the year 1917 there were made by the staff in the Government Assay Office 3,272 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	$ 693 50
Fees for assaying	181 15
Fees for melting and assaying gold-dust and bullion	61 35
Fees for assayers' examinations	195 00
Total cash receipts	$1,131 00

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

Attorney-General's Department	$ 525 00
Agriculture Department	400 00
Board of Health	430 00
Treasury Department	61 90
Other departments	10 00
	$1,426 90
Value of work done outside of Department work	$2,557 90

The value of gold melted during the year 1917 was $6,647 in 29 lots, as against $25,823 in 47 lots in 1916.

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.

EXAMINATIONS 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 1917 of the Board of Examiners for Certificates of Competency and Licence to Practise Assaying in British Columbia, as established under the "Bureau of Mines Act Amendment Act, 1899."

An examination was held at Victoria, in the Government Laboratory, on May 18th and the following days. One candidate came up for examination, and obtained the required number of marks; the Board recommended that a Certificate be granted to him. Two candidates applied for exemption under section 2, subsection (2), of the Act, and the Board recommended that certificates be granted to them.

Another examination was held at the Government Laboratory, Victoria, on December 14th. Three candidates came up for examination, and two obtained the required number of marks, and the Board recommended that Certificates be granted to them. Two candidates applied for exemption under section 2, subsection (2), of the Act, and the Board recommended that Certificates be granted to them.

In accordance with the recommendations of the Board, Certificates have been duly issued by the Honourable the Minister of Mines to these seven 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).

Adams, J. B.	Victoria.
Archer, E. G.	Anyox.
Armstrong, N.	Vancouver.
Ayres, D. A.	
Austin, John W.	Hazelton.
Backus, Geo. S.	Britannia Beach.
Baker, C. S. H.	
Barke, A. C.	
Bernard, Pierre	Monte Christo, Wash.
Bishap, 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.	
Craufurd, A. J. F.	Rossland.
Crerar, George	
Cruickshank, G. (C.E.F.)	
Davidson, J. R.	Vancouver.
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.
Hodgson, A. R.	Anyox.
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. (C.E.F.)	
Levy, Frank	Rossland.
Lindsay, W. W.	Kimberley.
Longworth, F. J.	Boyds, Wash.
Laucks, I. F.	Seattle.
Manning, S. M.	Trail.
Martin, S. J.	Hazelton.
Marsh, Richard	Republic, Wash.
Marshall, H. Jukes	Vancouver.
Marshall, William S.	Ladysmith.
Merrifeld, T. T.	Trail.
Miles, Arthur D.	
Mitchell, Charles T.	Copper Cliff, Ont.
McCormick, Alan F.	Ruth, Nevada.
MacDonald, Alec C.	Vancouver.
Morgan, Richard	Trail.
Nicholls, Frank	Norway.
Parker, Robt. H.	
Parsenow, W. L.	
Perkins, Walter G.	
Pickard, T. D.	Vancouver.
Pirrie, Noble W.	Ottawa.
Powell, J. G.	New Hazelton.
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, Chas. John	Monte Carlo.
Snyder, Blanchard M.	
Steven, Wm. Gordon	
Stimmel, B. A.	Trail.
Sundberg, Gustave	Mexico City.
Tally, Robert E.	Spokane, Wash.

Under section 2, subsection (1)—Concluded.

Thomas, Percival W. ..... Vancouver.
Tretheway, John H. .....
Turner, H. A. ..... Vancouver.
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.
Welsh, 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.
Bissett, D. G. ..... Trail.
Bolton, George E. ..... Silverton.
Brennan, Charles Victor .. Bingham, Utah.
Browne, R. J. ..... Rossland.
Browne, P. J. ..... Nelson.
Bryant, Cecil M. .....
Burwash, N. A. .....
Cavers, Thomas W. .....
Clothier, George A. ..... Prince Rupert.
Cole, Arthur A. ..... Cobalt, Ont.
Cole, G. E. ..... Rossland.
Cole, L. Heber ..... Ottawa, Ont.
Conway, E. J. ..... Vancouver.
Coulthard, R. W. (C.E.F.)
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, Ont.
Harding, Wilson M. .....
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.
Kidd, G. L. ..... Edmonton, Alta.
Kilburn, Geo. H. ..... Rossland.
Lathe, Frank E. ..... Grand Forks.
Lay, Douglas (R.E.F.) .....
Lewis, Francis B. ..... South Africa.
Merrit, Charles P. .....
Murphy, C. J. ..... St. Catherines, Ont.
Musgrave, W. N. (C.E.F.) .. England.
McArthur, Reginald E. ....
McDiarmid, S. S. .....
McGinnis, Wm. C. ..... Queen Charlotte Ids.
McKay, Robt. B. ..... Vancouver.
McLellan, John ..... Queen Charlotte Ids.
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. (C.E.F.) Victoria.
Reid, J. A. ..... Greenwood.
Ritchie, A. B. ..... Nelson.
Roaf, J. R. (C.E.F.) .....
Rose, J. H. ..... Thompson, Nevada.
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.
Stroud, J. E. C. ..... Anyox, B.C.
Sullivan, Michael H. ..... Kellogg, Idaho.
Sutherland, T. Fraser .....
Sutherland, Wm. ..... Glasgow, Scotland.
Swinney, Leslie A. E. .....
Thompson, W. K. ..... Trail, B.C.
Thomson, H. Nellis ..... Anaconda, Montana.
Thomson, Robt. W. .....
Watson, A. A. .....
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. (C.E.F.) .....

Under section 2, subsection (3).

Carmichael, Herbert ..... Victoria.
Galloway, J. D. ..... Victoria.
(Resident Engineer.)
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.)

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Pinder, W. J. .....
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NORTH-WESTERN DISTRICT (No. 1).

REPORT OF GEO. A. CLOTHIER, RESIDENT ENGINEER.

INTRODUCTORY.

District No. 1 includes all the north-western portion of the Province from Seymour inlet on the south to the boundary-line between British Columbia, Alaska, and the Yukon on the north. It is comprised of the seven Mining Divisions, viz.: Bella Coola, Queen Charlotte, Skeena, Portland Canal, Stikine, Atlin, and Liard. Its total length is approximately 700 miles, of which about 400 miles, if Portland canal be included, is open coast; the remaining 300 miles is east of the Alaska strip.

Geographically, the district could not be improved upon from a mining view-point, for in its 400 miles of direct coast-line there are innumerable islands, and thousands of miles of water-ways cutting into the mainland, affording transportation facilities far superior to an equal number of miles of railroad. The same features make it an ideal region for the prospector, providing unlimited miles of rock-exposures along the beach, and necessitating a trip of only a few miles from tide-water, in any direction, should he wish to explore the higher ground. He is also fully insured against the "lack of transportation" lessening the value of his prospect. The establishment in this district of several large mining companies on the Coast in the last few years, notably the Granby Company and the Belmont-Surf Inlet Company, and their constant demand for new properties has created a market for meritorious prospects. The prospector of to-day has no difficulty whatever in having his property examined by prospective buyers and exploratory work done if he advances reasonable terms.

Furthermore, the fact that there are on the Coast three smelters purchasing all classes of ore should be an incentive for the prospectors owning small, high-grade veins to mine and ship their own ores. It is worthy of note that several prospects have shipped small tonnages to the smelters during the past season.

Geologically, the distribution of the rock formations in the district is considered as conducive to the deposition of ore-bodies. Briefly, the central entire length of the district is composed of the granodiorites of the Coast range. This core varies in width from thirty to sixty miles, in which, in many places, are extensive areas of included sedimentary rocks, usually with iron pyrites disseminated, and worthy of attention. Dykes of all kinds intrude the granite, and with fracture-cracks, fissures, shear-zones, etc., give passage-way for the circulation of mineral-bearing solutions and favourable conditions for the deposition of ore.

Bordering the main mass of granodiorite, on either side, is a broad contact-belt of altered sedimentaries through which the granite has intruded. These contact regions are naturally broken up, tilted in all directions, and intruded by offshoots of granite from the main batholith, all of which conditions facilitate the circulation of solutions and the precipitation of their mineral contents.

The eastern boundary of the granodiorites is accessible from the Coast by way of the Grand Trunk Pacific Railroad, the broad valley of the Kitsumgallum river marking about the eastern limit. The heads of Observatory inlet and Portland canal also just penetrate the Coast range. Farther north the Stikine river and its principal tributary, the Iskut river, are each navigable to well within the eastern contact-zone.

The district in 1917 produced 822,819 tons, of which 784,000 tons was mined and smelted by the Granby Company, of Anyox, which tonnage includes the low-grade quartz mined for use as flux. Several prospects have shipped small tonnages to the Granby smelter.

An important shipper has been added to the list in the Belmont-Surf Inlet Mines Company, shipping to the Tacoma smelter 722 tons of table and flotation products.

The only other steady shipper was the Ikeda Mines, on Moresby island, its tonnage amounting to 1,000 tons shipped to the Granby Company.

The Drum Lummon Copper Mines, Limited, developing a property on Douglas channel, made a small smelter test shipment.

The present bondholders of the Bush property, on Salmon river, Portland canal, are rawhiding several hundred tons of gold-silver ore from the mine to Eleven-mile, and will haul from there to the beach on double-enders for shipment to the smelter.

The Dolly Varden Mines Company had planned to ship steadily all winter from its property in the Alice Arm section, but was disappointed in the non-completion of the railroad.

THE SKEENA MINING DIVISION.

This is the largest and, as yet, the most important Division in District No. 1, principally due to the operations of the Granby Consolidated Mining, Smelting, and Power Company, which have had a far-reaching effect on the mining outlook for the Coast.

The chief metal product of the Division is copper, producing about 47 per cent. of the total output of the Province in 1917.

With the advent of the Belmont-Surf Inlet Mines into the shipping class this year and the very probable addition of the Dolly Varden Mines in 1918, the production of gold and silver will be very materially improved.

Belmont-Surf Inlet.

This company's mining property consists of nine mineral claims—*D.L.S.*, *Gulch*, *Bluff*, *Bench*, *Uta Frac.*, *Mountain Frac.*, *Twin Peaks*, and *La Quivre*. They are situated about six miles from the head of Surf inlet, about a mile from Bear lake, and are some of the oldest locations in the Skeena Mining Division. These claims, known as the "*D.L.S.* group," were formerly owned by the Surf Inlet Mines, Limited, who optioned them to the Belmont Canadian Mines, Limited, retaining 20 per cent. The Belmont Canadian Mines, Limited, developed and bought the property and reorganized into the present company.

The placing of the property on a producing basis presented some difficult problems, and credit is due the staff for the thoroughly equipped and up-to-date plant now in operation. Nothing has been spared to bring everything to a high degree of efficiency.

The mine, as stated, is about six miles from the head of Surf inlet; in that distance there were two lakes, Cougar and Bear, about a mile apart, a small creek flowing from the foot of the upper to the head of the lower, there being a difference in elevation of 31 feet. The lower end of the first or Cougar lake is approximately 200 yards from the wharf at tide-water at the head of Surf inlet. Both the transportation and power problems were solved by the construction of a reinforced-concrete dam at the lower end of the lower lake. This dam, of the Ambursen type, is 45 feet high and 450 feet in length, and raises the level of the lower lake sufficiently to make a continuous waterway from the head of the dam to the foot of the mountain, about a mile from the mine. From this point an overhead-trolly electric railroad runs to the camp on an even, easy grade, connecting there with an incline tram of the same gauge which runs to the mouth of the working-tunnel. An incline tram from the ocean dock to the lake, equipped with an electric hoist, completes the transportation. A tug and barges, carrying fifteen 2-ton mine-cars, are operated on the lake. The concentrates, so far, have been sacked for shipping, but later on will be sent out in bulk. Cars will be loaded directly from the storage-bins at the foot of the concentrator and emptied into the storage-bins at the dock.

The lake also provides ample storage of water for power purposes and a very compact and efficient power plant has been installed at the beach. A 6-foot pipe-line from the intake at the dam to the power-house, a distance of 314 feet, gives a head of 62 to 84 feet, depending upon the tide. The power-house is a reinforced-concrete building, 35 x 58 feet, and is equipped with two Pelton-Francis turbines of the single spiral volute, cast-iron case, horizontal single runner, double-discharge type. They are 750 horse-power each, requiring 100 cubic feet of water a second, and are fitted with Pelton oil-pressure governors which respond to speed variations of less than ¼ of 1 per cent. Two Westinghouse generators are direct-connected to the turbines, each 468 k.v.a., 440 volts, which is stepped up through three 300-k.v.a., oil-insulated, self-cooled transformers to 22,800 volts for transmission to the mine sub-station, where it is stepped down to meet the requirements of lighting and power.

The mine has over 30,000 feet of underground development, and the company engineers estimate that there are in sight 390,000 tons of $12.50-a-ton ore for milling purposes.

The ore is a pyritized quartz carrying chiefly gold values, with a little silver and copper, and concentrates about 10 or 11 into 1, making between a $125 and $135 concentrate, the gold values in which will run about $120; silver, 6 oz.; and copper, 2.5 per cent. The quartz lies

in two well-defined shear-zones in gneissoid granite, the main fracture, in which the main tunnel was driven, splitting into the two, about 300 feet south of the quartz-bodies. They occur in lenticular bodies varying in width up to 40 feet, averaging about 10 feet. On the main working-level, the 550-foot, the quartz is practically continuous for 800 feet, in which there are developed, so far, about 400 feet of milling-ore. This is in the west or hanging-wall zone. From this level a winze has been sunk about the centre of the ore-shoot to a depth of 265 feet on the dip of the vein, and 700 feet of drifting done from the bottom both ways. This was full of water at the time of my visit, but I was informed by the general superintendent, Mr. Holler, that they opened up an exceptionally fine shoot of ore, over 500 feet in length and averaging about 16 feet in width. Three stopes are being opened up on the 550-foot level, two on the west and one on the east zone. No. 1 stope is a lens 120 feet long, averaging 8 feet in width, of pyritized quartz enclosing bands of schists. About 30 feet north of the end of this stope is the winze to the lower level, and 45 feet beyond that, No. 2 stope opens up and continues for 150 feet, with an average width of 16 feet. The general dip of the quartz is about 38 degrees west. The ore in No. 2 stope is a clean quartz carrying disseminated pyrites with small veinlets and bands of the same material, the only schist being about 2 feet on the foot-wall, in some places a very good grade of ore. No. 3 stope is on the east fork of the main fracture, and on this level is narrow and of medium grade of ore. A raise has been run from a crosscut and drift in the foot-wall of the 550-foot level, through to the 200-foot level, which opens from the surface. From this raise two intermediate levels have been driven at the 430- and 320-foot levels. No. 4 raise also connects the 430-foot level with the 550-foot level and is used as an ore-chute. Both veins have been picked up on the 430-foot level and a stope is being opened up on the west; it is now timbered for a length of 175 feet and averages about 12 feet in width; the centre of it is 16 feet wide, of clean, good-grade milling-ore, which, however, becomes more or less mixed with schist on the ends. The 320-foot level has not been developed to any extent, and it appeared to me that it was probably in the break of the ground where the ore-shoot jumps from the east vein to the west. On the 200-foot level the ore is practically all on the east side, and three stopes are now being opened, each over 150 feet long and averaging over 9 feet wide. All ore from this level is dropped to the main level, which is equipped with heavy 30-inch gauge track for a 6-ton storage-battery, Westinghouse motor, hauling six 2-ton cars a trip to the crusher-bins at the head of the mill.

Stoping is done with Waugh stopers and the heavier development-work with water Leyners. A well-equipped blacksmith-shop includes a Waugh drill-sharpener and a Denver type oil-forge. Mine-timber is procured down the valley, brought over the electric railroad to the foot of the surface tram, thence to the mouth of the tunnel. This surface tram is operated from the head by a 35-horse-power motor, and is so arranged with sidings as to serve the ore-storage building at the foot of the hill, assay office, crushing plant, etc., and each level of the concentrator.

The mine ore is dumped into two cylindrical bins, each of 600 tons capacity, at the head of the crushing plant. Then fed by 4-foot drums under the lip of the chute, regulated by adjustable stroke, to a 6 K alternating-current gyratory crusher, having a capacity of 300 tons in 8 hours, crushing to 2 inches. Some little difficulty is had in obtaining a uniform product on account of the flat fracture of the quartz. From crusher to bin to 20-inch conveyor-belt, over a Merrick weightometer, to two cylindrical storage-bins, same capacity as above, at the head of the mill, a short conveyor-belt permitting of discharge into either bin. The ore is fed by two Wall type feeders to two 6- x 5-foot alternating-current ball-mills with attached ⅛-inch perforated metal trommels; the undersize going to two duplex, 24-inch, 20-mesh, Callow travelling-belt screens, the oversize from which joins the oversize from the trommels and is returned by two 14-inch belt-and-bucket elevators to the ball-mills. Each ball-mill revolves at 23 or 24 r.p.m., carries a charge of 14,000 lb. of steel balls, and is operated by a 100-horse-power motor. Consumption of steel is about 4 lb. a ton of ore crushed. The undersize from the Callow screens go to a distributer, to six No. 9 double-deck Wilfley tables. Concentrates from the Wilfleys to dewaterer, to conveyor, to bins; tailings to four Dorr, duplex, drag classifiers, the sand from which to four 5- x 16-foot Allis Chalmers tube-mills revolving at 27 r.p.m., operated by 60-horse-power motors, grinding 90 per cent. to 200 mesh, and run in closed circuit with the classifiers. The overflow from the classifiers furnishes the feed for the oil-flotation section of the mill. The oil mixture, consisting of 5 per cent. pine-oil, 35 per cent. creosote, and 60 per cent. coal-tar, is fed to the tube-mills. A small amount of sodium sulphide is also used. The flotation section consists of one Jones-Belmont type primary flotation-machine, taking all the classifier overflow, concentrates

to 30- x 12-foot Dorr thickener, tailings to two series of three secondary or rougher-machines each. The final tailings from the rougher-machines go to pond, the concentrates from each of the roughers going to one cleaner-machine. Concentrates from cleaner to Dorr thickener; tailings returned by a 14-inch belt-and-bucket elevator to the classifiers. Spigot product from Dorr thickener to one 11-foot 6-inch by 8-foot Oliver continuous filter, from which the dried concentrates, containing about 12 per cent. moisture, go to 20-inch belt-conveyor to bin. The overflow from the Dorr thickener is pumped by a 2-inch centrifugal back to the classifiers. All the flotation-machines are of the Jones-Belmont type.

The mill is operated by three shifts of three men on each shift. It is producing from 25 to 30 tons of concentrates from a feed of about 300 tons in twenty-four hours. Approximately 50 per cent. of the pyrite content is recovered on the Wilfley tables and is a very clean product, averaging about 5 per cent. silica. The flotation product averages about 15 per cent. insoluble; the combined shipping product therefore averages 10 per cent. silica. The recovery has been about 92 per cent., the concentrates assaying $125 to $135 a ton in gold, 6 oz. a ton in silver, and 2.5 per cent. copper. The company will have shipped in 1917 about 1,700 tons and expect to have a steady output of between 800 and 900 tons a month.

Distribution of motor-power in the mill is as follows: One 25-horse-power motor drives line-shaft for vacuum-pump for filter-press, centrifugal pump, thickener, and elevator from cleaner-cells to tube-mill circuit; one 30 horse-power for one series of rougher-cells and the cleaner; one 30 horse-power for second series of roughers and primary cell; four 60 horse-power for the four tube-mills; one 25 horse-power for line-shaft driving classifiers, oil-feeders, oil-mixer, table feed-distributer, and six Wilfleys; two 100 horse-power for the two ball-mills; one 25 horse-power for line-shaft driving elevators from trommels and Callow screens to ball-mills, Callow screens, and ore-feeders; one 50 horse-power in crusher plant for crusher, ore-feeders, and belt-conveyor; a total of 625 horse-power.

Additional equipment includes a compressor plant comprising a 1,500 cubic feet a minute Rand-Ingersoll compressor supplying air at 110 lb. a square inch at the machine, and run by a 250-horse-power motor; two 6-foot G.E. induction-motor fans, running at 3,600 r.p.m., supplying air at 3 lb. a square inch for the flotation-machines; an auxiliary steam plant of two 50-horse-power return-tubular boilers and a small auxiliary compressor. The steam plant will be utilized this winter for heating the mill and adjacent buildings.

A machine-shop, 24 x 45 feet, equipped with a 22-inch MacDougall gap lathe, a 30-inch radial drill, a 30-inch shaper, a pipe- and bolt-threading machine up to 6 inches, emeries, and miscellaneous tools. A 15-horse-power motor provides power for all.

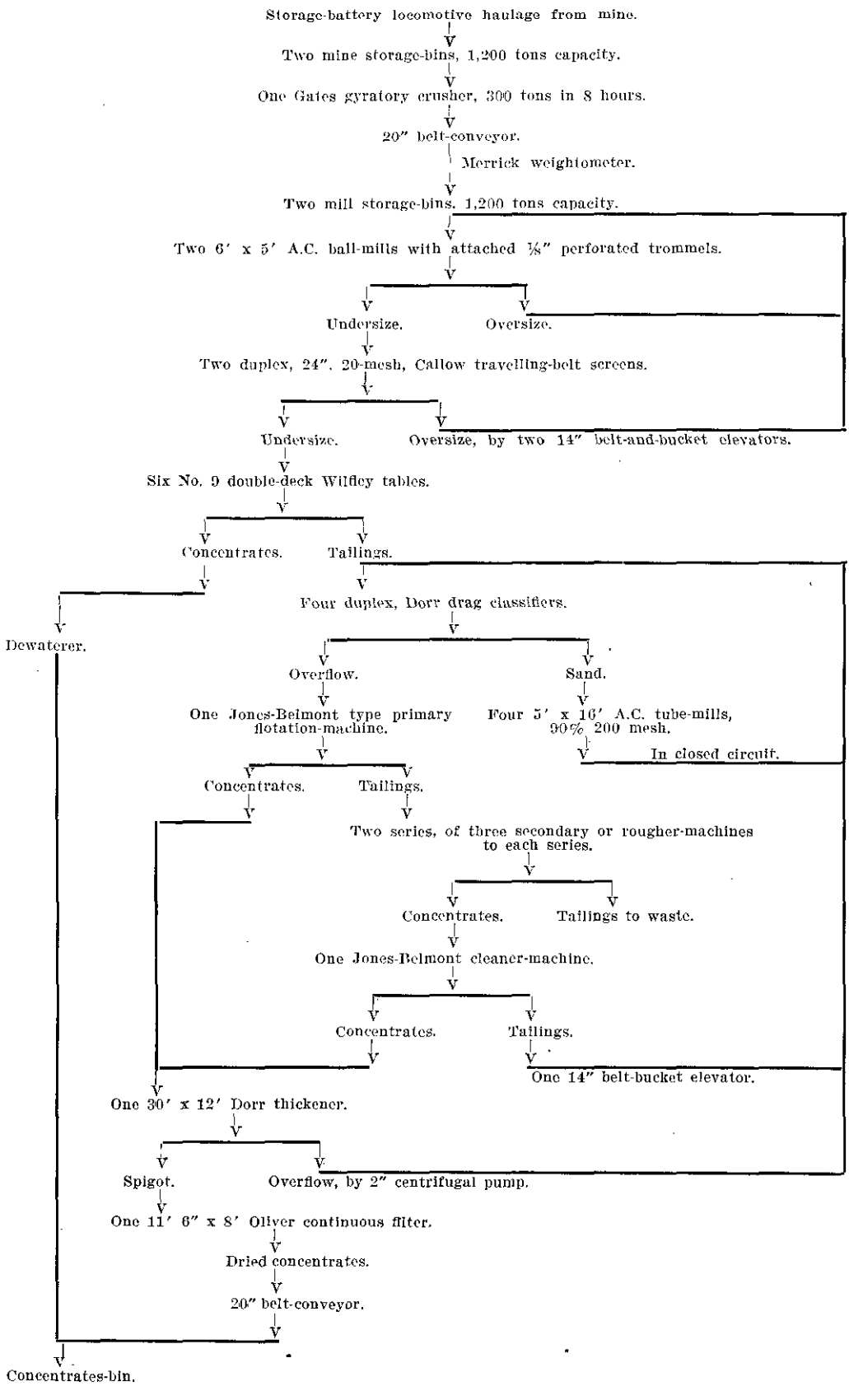
A carpenter-shop, 24 x 60 feet, equipped with a band-saw, a rip-saw, a swing cut-off, and a boring-machine, with a 20-horse-power motor.

A pump-station, 12 x 20 feet, equipped with two Krogh, No. 6, three-stage centrifugal pumps, each direct-connected to a 35-horse-power motor. These furnish two tanks at the head of the mill, from which a similar pump lifts the water to a tank above the working-tunnel for machine-water and also for high-pressure fire-protection system for the whole camp.

A well-furnished, steam-heated, four-roomed assay office is very conveniently located near the concentrator. It is 16 x 36 feet, with a sampling and grinding room furnished with a chipmunk crusher, a Brown pulverizer driven by a 5-horse-power motor, a large, double-muffle, oil-burning furnace, laboratory, and balance-room.

The company has provided its employees with the best of accommodations in every way. There are three two-story bunk-houses, 27 x 72 feet, divided into single rooms furnished with sanitary, double-deck, single iron beds; each floor with lavatory, shower-bath, and wash-room. Each bunk-house is steam-heated from a central plant and accommodates about sixty men. A two-story mess-house, 65 x 80 feet, has been completed, with a seating capacity of 250 men, fine accommodations for the mess-house employees on the upper floor, a large kitchen, a bakery, a root-cellar, and, with the installation of a refrigerating plant, will be thoroughly appointed in every respect. A two-story building, 36 x 84 feet, contains a store and large warehouse in the rear and the general and manager's offices in front, together with engineering and drafting department, and doctor's office pending the completion of the hospital. Numerous cottages have been built and a fine building for the accommodation of the staff is about completed. All the general buildings are steam-heated and electric-lighted.

Flow-sheet, Belmont-Surf Inlet Mines Co. Mill.



The company has under option at the present time three claims across the creek from their own holdings, and known as the Pugsley mine. The formation and conditions are identical, leaving little doubt but that it is the continuation of the *Surf Inlet* vein. Considerable work has been done on them in an upper tunnel in past years, and considerable ore was sorted and shipped from this work. The present work is being done in a lower tunnel supposed to be on a different vein from the upper one. The drift has been for the last 75 feet in a body of quartz averaging about 8 feet wide. I was informed that the average grade of the ore exposed so far is possibly a little better than the *Surf Inlet* ore. It looks very promising.

The staff at the mine is as follows: J. Fred Holler, general superintendent; Fred. H. Penn, mill superintendent; E. W. Hawkins, auditor; Chas. Bigney, mine foreman; A. Terwilliger, assayer; A. J. Smith, master mechanic.

Other Claims. There are several groups of claims in the immediate vicinity of the Belmont-Surf Inlet property on which an appreciable amount of work has been done, and on which, I understand, the showings are very encouraging. At the time of my trip there had been several falls of snow; consequently I was unable to get up in the hills. I believe all the ore-exposures have the same general characteristics.

On Graham reach, between Princess Royal island and the mainland, a number of claims, about thirty altogether, are having the assessment-work kept up on them. The Granby Company did considerable work on a group located on Klekane inlet, but results did not justify taking over the property from the owners. Another group on the same inlet has recently been bonded to Seattle men, who are to start work within a reasonable time. Also on Khutze and Aaltanhash inlets are several locations, as well as a few on Swanson bay.

The Drum Lummon. The Drum Lummon Copper Mines, Limited, is a Vancouver company, with head offices at 510 London Building, 626 Pender Street West, Vancouver, B.C. The holdings consist of fifteen claims, not Crown-granted, situated on Miskatlah bay, on the north shore of Douglas channel, about twenty-five miles east of Hartley Bay, the nearest port of call for the Coast plying boats. From Hartley Bay the property is reached by launch. Supplies are landed by the Coast freighters on a small floating wharf at the camp. In the event of the property developing into a large shipper, good docking facilities could easily be provided.

The workings are about a mile from the beach, to which a good wagon-road was built during the summer by the Provincial Mines Department. This was to have been utilized this winter for sledding ore to the beach, it being the intention of the company to hand-sort and ship the ore taken out in development-work. This looked quite feasible in the spring, but as development proceeded it was found that the nature of the ore changed to such an extent that it became inadvisable to try to sort it.

The ore is a glassy quartz carrying varying amounts of bornite, covellite, chalcocite, and some tetrahedrite and chalcopyrite. When the quartz was first encountered in the underground workings, a considerable amount of the high-grade copper sulphides was found in bunches which warranted sorting and shipping. Further development, however, proved the sulphides more scattered and in veinlets and small bunches, and therefore better adapted for milling. The quartz lies in irregular masses in a solid granite formation, through which are intruded light-coloured, probably acidic dykes, along which the mineralized solutions flowed, dissolving, and replacing the surrounding rock with the deposit of quartz and mineral.

Development-work to date consists of a crosscut tunnel started at the foot of the falls on Copper creek, which are 40 feet high. It cuts diagonally across underneath the creek, and was driven 365 feet before encountering the quartz which evidently forms the outcropping, and was continued a further distance of 60 feet towards the No. 2 vein. A drift was then run west, following the ore all the way for 106 feet, showing the ore to vary in width from 1 to 15 feet and probably averaging about 4 feet. Although there are bunches of barren quartz, the mineralization is fairly regular; the face is 10 feet wide, of good milling-ore which will concentrate about 10 into 1, making a high-grade copper-sulphide concentrate.

I was unable to see the surface on account of the snow, but, from Mr. Galloway's report, "the main surface showing is exposed in Copper creek about 375 feet above the falls for a length of over 200 feet, with an average width of 10 or 12 feet. Stripping and open-cuts along the cropping show bunches of copper sulphides throughout the quartz."

This surface showing and the exposure of its extension underground at a depth of 150 feet or more would lead one to expect the finding of extensive bodies of at least milling-ore. Further development is entirely warranted, and, in my opinion, a raise through to the surface from the east end of the ore-shoot, another raise from the present face, and the continuation of the drift on the ore would be the quickest and cheapest way of proving the property. At least a year's run of ore should be put "in sight" to justify the erection of a concentrator.

The present equipment consists of a Chicago Pneumatic Drill Company 6- x 6-inch compressor run by a 10-horse-power Witte gasolene-engine, furnishing air for a Hardsog stoper used in drifting. A 30-inch Buffalo blower belted to a 6-horse-power Foos Junior gasolene-engine has been set up at the mouth of the tunnel, and an 8-inch air-pipe from the fan to the drift furnishes ventilation. A well-equipped blacksmith-shop is conveniently located in the temporary compressor-house, a car and rails have been put in, and altogether it is a very efficient little plant for the work intended.

A few more thousand dollars spent as judiciously as heretofore might put the property on a producing basis. A test shipment of about 8 tons was sent out this fall.

Stewart Group.

This group consists of five claims—*Minnie*, *Dave*, *Teckla*, *Ventla*, and *Chief*—owned by T. and D. L. Stewart and W. Vickers. They are situated about two miles up from the mouth of a small tributary creek, Pocklington creek, of the Kemano river, which flows into Gardner canal about twenty miles from its head, and are about six miles from tide-water. They are reached by canoe from Gardner canal to the Kemano river, from which a two-mile trail leads to the property.

No work, other than assessments, has been done. There are four veins. The "big vein" is a mineralized dyke lying in the granodiorites of the Coast range. Values in gold, silver, and copper are distributed throughout the dyke, and in places small shoots of ore are found of exceptional grade. Assays as high as $400 a ton have been obtained. The dyke is over 200 feet in width, of which 40 feet will probably assay $8 a ton in all values. The ore is suitable for concentration. The dyke can be traced over the *Minnie* and *Teckla* claims to an elevation of 3,200 feet.

The three other veins vary in width from 1 to 5 feet, and are of quartz carrying bornite and gold and silver values. Good water-power and plenty of timber for all purposes. The claims were not examined by me; however, the above information is entirely reliable.

The *Fortuna* and *Prudentes* claims are located on the north shore of Douglas channel, about fifteen miles from Hartley bay, and are owned by M. McMillan. Some work has been done on the claims on the beach, showing a mineralization of copper pyrites across about 20 feet. Unfortunately this work is under high tide and too meagre to give one much of an idea of the showing.

There are numerous claims located on Douglas channel and Gardner canal and their islands. Also along Grenville channel, on Pitt island, and at Kumeolon inlet are several magnetite-iron showings which, in the light of possible steel production, may warrant thorough investigation.

PORCHER ISLAND.

International Copper Co.

This company has its registered office at Vancouver. A comprehensive report on the property was included in the Minister of Mines' Report of 1916 under the report of the Gold Commissioner for the Skeena Mining Division. Only the necessary assessment-work has been done since that time; consequently there is no information to add to that report. I went over it hurriedly, and found the showings and general conditions warranted the recommendation of the completion of the trail to the beach, about a mile and a half. I understand this work in now under way.

Mammoth Group.

This group consists of eight claims—*Mammoth*, *Mammoth Nos. 2*, *3*, *4*, *5*, *6*, *7*, *8* (inclusive)—lying on the north end of Porcher island, about a mile from Refuge bay and about 200 yards from the wagon-road. The group is owned by Martin O'Reilly, W. J. Carrigan, and associates, of Prince Rupert. The vein is of quartz, with inclusions of bands of schist in places, contained in an argillite formation, and varies in width up to 38 feet. Strike of vein about east and west and dip of 60 degrees east.

Extensive prospecting-work has been done by way of surface stripping and several deep open-cuts across the vein. Unfortunately, the results, so far as values are concerned have been disappointing.

No. 1 open crosscut exposes a 22-foot vein of solid quartz slightly mineralized with iron sulphides. The owners reported no values here, so no samples were taken.

No. 2 open crosscut, 100 feet east of No. 1 cut, shows a width of 20 feet of solid quartz. An open drift was also run along the foot-wall for 30 feet in the quartz. Small amounts of pyrite are scattered here and there through the quartz, and a grab sample was taken from the broken material in the cut, selecting the pyrites with the view of finding out what a concentrate would assay. The sample assayed only a trace in gold.

No. 3 open crosscut, 1,000 feet east of No. 2, is 60 feet long and is 15 feet deep at the face where it cut out of the quartz. It shows the vein to be 38 feet wide at this point, sparingly mineralized with pyrites. A sample was taken across 18 feet of the better-looking material, which gave returns of a trace of gold only. A shaft was sunk 25 feet from the bottom of this cut, giving a total depth of 40 feet on the vein. It was full of water at the time of examination, but I understand was in barren white quartz all the way. The property, in my opinion, does not warrant further exploration.

Jitney Group.

This group includes three claims—*Wolf*, *Laura F.*, and *Jitney*—owned by R. G. Frizzell and associates, of Prince Rupert. They are situated on Jap inlet, Porcher island, about half a mile from the beach. The vein is about a foot in width and is practically solid chalcopyrite, with a little pyrrhotite mixed with it. It lies in a broken-up, faulted formation of argillite, and is therefore very erratic in its occurrence. A tunnel has been driven for 30 feet, from which 4 tons of ore was taken and shipped to the Granby Company last year, giving net returns of $500. The ore is still across the bottom of the crosscut and should be sunk on. The broken-up region might in this way be penetrated and a more stable vein disclosed.

On another vein an incline shaft has been sunk about 15 feet, following the course of the ore. The vein is quartz carrying pyrrhotite and a little chalcopyrite, its tenor being evidently low grade. An open-cut about 25 feet farther along shows only a seam. The ore occurrence is too irregular and too low grade to be of any importance.

Patterson-Gillett Group.

This group of claims, on the north-west end of Porcher island, on Belle range, near Useless bay, consists of three groups—East, South, and West. The East group comprises *Liza Jane*, *Jim Crow*, *Western Hope*, *Sophie B.*, *George R. Frac.*, and *Michael P. Frac.* The South group: *Sophie G.*, *Martha Ellen*, *Merry May*, *Hooligan*, *Little Dick*, and *Sky Pilot*. The West group: *Buck Eye*, *Gypsy*, *Jeannie*, *Eagle*, *Lucie*, *Edward C. Frac.*, and *John R. Frac.*

These groups were under option to the Belmont-Surf Inlet Mines early in the year and extensively prospected by them. They did a lot of surface stripping, disclosing six veins, or rather lenses, on the property. I did not examine the showings, but from first-hand information, maps, assay sheets, etc., I judge that the quartz-deposits occur in a movement or shear-zone in the granodiorite, extending for a width of over 400 feet. In this zone lie lenticular bodies of quartz running in a general east-and-west direction, with a dip to the south of between 70 and 80 degrees. As stated, there are at least six of these lenses disclosed on the surface, from which samples have assayed as high as $120 a ton in gold values, depending on the pyritization of the quartz. The lenses vary in width from 1 to 10 feet. Two short tunnels were driven under two of the most promising-looking outcroppings, but the continuation of the ore-shoot and its values proved unsatisfactory and work was discontinued.

From the extent of the surface showings and the values obtained from surface samples, it would seem that the property would bear further investigation.

There are a number of claims located on the south-western portion of the island, principally on Kitkatla inlet and the North arm, which I was unable to get to this year.

The same applies to prospects on Henry, Kennedy, Banks, and other islands, and around the mouth of the Skeena river.

GIBSON ISLAND.

Standard Group.

There are six claims in the group—*Standard*, *Standard No. 2*, *Standard No. 3*, *Standard No. 4*, *Standard No. 5*, and *Standard No. 6*—covering practically the whole island. They are owned by Frank St. Amour and associates, of Prince Rupert. It is the old *Wild Goose* group reported on by W. E. Brewer in Minister of Mines' Report of 1914. Since that time the Granby Company has had a bond on it and did some development-work, consisting of a shaft 20 feet deep to the tunnel-level and a further depth of

30 feet below the tunnel. The tunnel crosscuts the vein for 65 feet, showing bands of quartz and limestone which will average very low in copper. From the bottom of the shaft crosscuts were run 30 feet each way across the vein, showing, as above, bands of quartz and limestone averaging 1 per cent. copper, 40 per cent. silica, and 20 per cent. lime. This being not up to requirements, work was discontinued. It is the intention of the owners to take the better-grade ore from the surface, hand-sort it, and ship it this winter.

ECSTALL RIVER.

About twenty-five miles up from the mouth of the Ecstall river, a tributary of the Skeena flowing into it at Port Essington, is an immense deposit of iron pyrites which has been held by Victoria interests for the past twenty years. Work was commenced on it at the time of its discovery, and to facilitate the transportation of the ore two surface trams were built, one from the tunnel to a bin at the camp, and another, three-rail, from the camp to the river, about 1,700 feet. I believe that several tons were shipped at that time to the chemical-works for the manufacture of sulphuric acid.

The deposit consists of a mass of pyrite lying in a schist formation enclosed in the granodiorites, the schist-belt being about a mile wide crossing the river. The ore-body conforms to the general strike and dip of the schist, and varies in width from 20 feet in the tunnel to 300 feet on the upper end of the showing. The old work consisted of a crosscut tunnel 100 feet in length and drifts 20 feet each way from it on the ore.

The property was bonded late in 1916 by Mr. Hinman, of New York, who did 750 feet of diamond-drilling in the ore-body early in 1917. The first hole was put down just up the creek from the mouth of the tunnel. It was 86 feet on an incline of 55 degrees, encountering the ore at 50 feet and continuing in it for 15 feet. This proves the ore about 50 feet below the tunnel-level. The second hole is about 200 feet above the falls, at an elevation of 475 feet above sea-level, and is 275 feet deep at an angle of 15 degrees. It struck the ore at 75 feet and was in it for the remainder of the hole. The third hole is about 300 feet farther up the creek from the second, is about 400 feet deep at an angle of 35 or 40 degrees, and is ore all the way. No definite assays are available, but I am informed that the total cores averaged about 1.75 per cent. copper and less than $1 a ton in gold and silver. I understand that the property is under bond to the Granby Company, who will diamond-drill it in the spring.

Another group of claims was staked during the summer across the Ecstall river from the above property. No work has been done on them as yet; the surface shows a strong mineralization of pyrite for a width of 20 feet.

THE GRAND TRUNK PACIFIC RAILROAD.

Along the Grand Trunk Pacific from Prince Rupert to Terrace there are about forty claims located, and in the Kitsumgallum Lake region about fifty more. The only development-work I know of, other than the necessary assessments, in this section of the district was at Amsbury, on the *Autumn* group, under bond to R. O. Jennings, of Prince Rupert. Considerable work was done on this property in the way of stripping and open-cutting, with, I believe, very encouraging results. Some fine specimens of gold-bearing quartz were brought into Terrace during the summer from Thornhill mountain, but I have heard nothing further from subsequent development. Owing to limited time I was unable to get over any of this country.

OBSERVATORY INLET.

Alice Arm. A thorough examination of and report on the mining area tributary to the Kitsault and Illiance rivers was made by Professor J. M. Turnbull, and is contained in the Annual Report of the Minister of Mines for 1916. Assessments and prospecting-work since that report have been highly encouraging, especially on the upper Kitsault, where several prospects are showing up exceptionally well.

With the completion of the railroad for twenty-two miles and the continuation of the main trail from rail end to the head of the river and short side-trails up the main creeks, this section will be in good condition to develop several shippers.

Dolly Varden. This mine, under the management of R. B. McGinnis, is being brought to the producing stage as fast as possible. The principal work this year has been the construction of the railroad, driving the main working-tunnel, and further exploration of the ore-shoots by means of diamond-drilling.

The railroad-construction, under contract to the Taylor Engineering Works, of Vancouver, made good progress, and it was estimated that rails would be laid for fourteen miles before winter would necessitate suspension of work. The grade is finished for about twenty miles, but abnormal weather conditions prevented the finishing of more than about eight miles of track. It was the intention of the company to ship about 100 tons a day, and to that end a sleigh-road was built from the mine to the railroad and contracts practically completed for the hauling of the ore; these plans, of course, had to be abandoned, and the property is closed down for the winter.

The main working-level of the mine has been driven 650 feet, and the ore-shoots, developed on the three levels above, partially defined. The ore-bodies have been proven by diamond-drilling for 150 feet below this main level, giving a total depth of ore of about 500 feet. The big tonnage available in the *Dolly Varden*, together with the ore-bodies explored in the *Wolf* property, also owned by the Dolly Varden Mines Company, are ample justification for the extensive plant to be installed and the railroad now under construction. The plans include an hydro-electric power plant of 700-horse-power capacity, to be developed from Trout creek, a tributary of the Kitsault river flowing into it about three miles above the mine. The company proposes damming the first Trout lake to make a reservoir of 17 acres, also the next three lakes above, which will give an additional storage area of 20 acres. Plans have been drawn for a concentrator with a capacity of 150 tons in 24 hours, suitably located to treat the ores from both the *Dolly Varden* and the *Wolf* mines. The flow-sheet includes a preliminary water-concentration and a final separation by oil-flotation. Tests of the process on the ores have given a recovery of 94 per cent. of the values and a ratio of concentration of 4 or 5 into 1.

There is plenty of shipping-ore in sight, and next year will in all probability see this property an extensive shipper.

The owners of the *La Rose* group of two claims intended mining, hand-sorting, and shipping ore from their property this winter had the railroad been in operation. Additional work has been done in the tunnel since last year's report, its length now being 130 feet. The open-cut and tunnel exposes an ore-shoot about 50 feet long, raking into the hill. There is about 30 tons of good ore on the dump and a few hundred tons might easily be mined. A sample of shipping-grade ore taken from the dump gave 244 oz. silver, 18 per cent. lead, and 12.4 per cent. zinc to the ton.

A 100-foot tunnel is being driven this winter on the *David Copperfield*, starting just below the railroad-track. Described in last year's report and nothing done since.

Nothing has been done on the property of the Molybdenum Mining and Reduction Company, but, from what I can learn from C. P. Riel, the manager, it is their intention to commence operations immediately.

Further investigation of this section was prevented by the early snowfall.

GRANBY BAY.

The Granby Consolidated Mining, Smelting, and Power Company at Anyox, B.C., has had a very satisfactory year in every respect. The tonnage of ore mined and smelted was about 784,000 tons, averaging 2.12 per cent. copper, the gold and silver amounting to approximately $240,000. The tonnage of low-grade quartz ore mined and used as flux was about 37,000 tons, or a total of 812,000 tons. Improvements in all departments and the erection of a 100-ton experimental concentrator puts the company abreast of any on the continent. The company's progressive policy in keeping engineers in the field has stimulated the prospector and put mining confidence in the Coast District.

The Granby Consolidated Mining, Smelting, and Power Company's operations at Anyox are the most important on the Coast of British Columbia, and, as such, merit unusual attention. For this reason I have taken the liberty of quoting *in extenso* a series of three articles descriptive of the company's mine and smelting plant contributed by W. A. Williams, the general superintendent of smelting operations of the Granby Company, published in the *Engineering and Mining Journal* under dates of October 13th, 20th, and 27th, 1917:—

"*The Mine.*

"The head offices for the Western organization of the Granby Consolidated Mining, Smelting, and Power Company are at 813 Birks Building, Vancouver, B.C. The general manager and

managing director, F. M. Sylvester, has his office at Vancouver, as has G. W. Wooster, treasurer of the company, who is also head of all accounting departments. In these offices are also the purchasing departments of the mines, smelting-works, and stores. Directly under the general manager is the superintendent of mines, O. B. Smith, who has charge of all mines and mining-works of the company, and W. A. Williams, superintendent of smelters, who has charge of the two smelting plants and all metallurgical work. In direct charge of the smeltery at Anyox is A. J. Bone, to whom I am indebted for the major part of the metallurgical data in this article. I am also indebted to E. E. Campbell, who is in direct charge of the *Hidden Creek* mine, and who has kindly furnished me with the following interesting data relating to his department.

"The smelting, converting, and mining departments are each in direct charge of a general foreman, under whom are the shiftbosses. All other departments are in charge of a general foreman, assistant, and sub-bosses. There are about 1,000 men employed at the Anyox unit, 450 at the mine and 550 in all other departments. Labour of all nationalities is employed, the majority of men being British subjects.

"The most important events in the history of the mining industry of northern British Columbia to date have been the acquisition and development of the *Hidden Creek* copper-mines, the erection of a smeltery to treat the ores, and the building of a town by the Granby Consolidated Mining, Smelting, and Power Company, Limited. This undertaking has had a stimulating effect both on prospecting activity and mining development along the whole northern coast.

"Granby bay, upon the north-west shore of which lies the town of Anyox, with its mines and smeltery, is a deep-water landlocked bay about four miles and a half long by three-quarters of a mile wide, and is on the western shore of Observatory inlet, thirty-five miles from its entrance. The distance from Prince Rupert is 110 miles and from Vancouver 550 miles. The surrounding mountains are steep and rugged, covered with timber. The mountains have been heavily glaciated and on the crests many glaciers can be seen at all seasons of the year. The Burniston range of mountains lies to the west, rising to an elevation of 5,700 feet and separating Observatory inlet from Portland canal. Four creeks flow into the bay, having their source in this range of mountains—namely, Hidden creek, Falls creek, Bonanza creek, and Glacier creek. The tide has a maximum rise and fall of 23 feet 4 inches. The main dock, which is 800 feet long by 50 feet wide, is double-tracked and has three sets of travelling ore-bunkers and unloaders. A 50-ton derrick is also installed for the handling of heavy machinery. Dock No. 2 is specially constructed with receiving-bins, and belt-conveyors convey the material from the outer or unloading wharf to these bins. A suitable track system upon which switch-engines operate is arranged to handle the tonnage easily and connects all bunkers and wharves with the main line. The tonnage handled over the wharves during 1916 was 316,915 tons, consisting of coke, ore, lime rock, and merchandise. At present there is under construction Dock No. 3, which is a continuation of Dock No. 1, and will be 590 feet long and have two sets of travelling ore-bunkers. In the construction of the docks creosoted piling has been used throughout, spaced 7 x 7 feet, heavily braced, and with 12- x 12-inch caps, 4-inch stringers, and 4-inch decking. The Granby Company is affiliated with the Coastwise Steamship and Barge Company, of Seattle, to facilitate the handling of the large volume of freight and to have a reliable and regular means for transportation of supplies. In this service there are engaged a fleet of three cargo-steamers, two tugs, eight barges, and two scows of 1,200 tons capacity, carrying coke from Tacoma and Vancouver island, general freight from Seattle and Vancouver, ore from outside properties of the Granby Company and custom shippers, lime rock from Swamp point, and quartz from Maple bay, on the Portland canal. In addition, the Granby Company owns a number of smaller tugs and launches for local work. Apart from this service, Anyox is the northern terminal for the three main Coast steamship lines—namely, the Grand Trunk Pacific Steamship Company, the Canadian Pacific Railway, the Pacific Coast Steamship Company, and the Union Steamship Company. The companies operate each a weekly mail and passenger steamship service on a 40- to 50-hour schedule with Vancouver and Victoria, thus furnishing mail service three times a week.

"The town of Anyox is built on the ground lying between the wharves, the smeltery, and the mine. The streets are laid out to conform to the contour of the ground, and at night are well lighted by electricity. The company maintains a modern forty-five-room hotel, with steam heat, hot and cold water, and telephone service in every room.

"A completely equipped hospital with the latest X-ray apparatus is in charge of three physicians and a staff of nurses, so that every provision is made for taking care of sick and injured. Moving-picture theatre, dance-hall, pool and billiard rooms are available for the recreation of the inhabitants. The company has a complete department store, with grocery, dry-goods, men's furnishings, hardware, furniture, drugs, and meat departments, a modern refrigerating plant, and an up-to-date café. The prices charged are reasonable and about on a par with the prevailing prices of commodities in Vancouver. There are two schools in charge of three teachers to provide for the education of the employees' children, while three churches minister to the spiritual welfare of the community. For the accommodation of the single men the company has built two two-story concrete fire-proof rooming-houses. In these rooming-houses there are no hallways, every room having an outside door. The buildings are modern in every respect, having bath-rooms, shower-baths, and lavatories; and each room has hot and cold water, steam heat, and electric light. The boarding-house, which seats 216 men, is a concrete building with all the latest improvements, such as cold storage, bake-shops, and laundry. A high standard of food is maintained, and board is charged for at the rate of $1 per day and rooms $5 per month.

"Since starting active operations in 1912, a new mine town has been built, and no money has been spared to provide the most modern conveniences for the comfort of the employees. This consists essentially of a change-house, mess-house, bunk-house, and fifty cottages. The change-house is a three-story frame building with concrete floors on the first and second stories. The first floor is occupied by a locker-room containing 300 steel sanitary lockers, a wash-room where fifty men can wash at one time, a water-closet and urinal room, twenty-four shower-baths, four porcelain tubs, and a drying-closet for clean clothes. The second floor consists of a pool-room, a library and reading room, a shift-boss's office, an emergency hospital with four beds, and a doctor's office. The third story consists of a dance-hall with the necessary cloak-rooms. This building is heated by an Arco sectional hot-water heater. A hot-water tank holding 1,500 gallons attached to a separate heater provides hot water for the shower-baths.

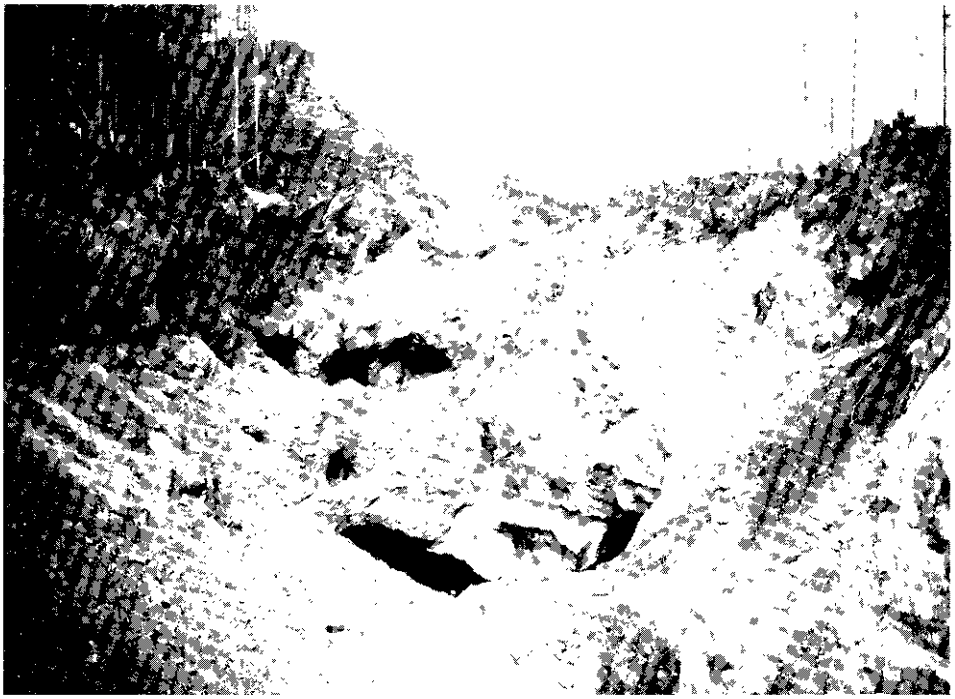
"The mess-house is similar to the one near the smelting-works, except that it is of wooden-frame construction. The bunk-house consists of three wings and is capable of holding 400 men. The heating plant is similar to the one in the change-house. The cottages are all of modern construction, and each is equipped with porcelain bath, wash-basin, and water-closet. They also have hot- and cold-water connections and electric lights. The importance of the sanitary arrangements of the town, including sewer system, incinerators for garbage-disposal, and an adequate water system, is evidenced by the fact that sickness caused by the lack of these things is unknown.

"The *Hidden Creek* mine is a mile from tide-water and at the highest elevation is 900 feet above sea-level. The rocks in which the *Hidden Creek* ore-bodies occur consist of highly altered sedimentaries, including slates, schists, and limestones. These rocks have been steeply tilted and in general lie at angles varying from 45 to 90 degrees from the horizontal and dip to the north. In the vicinity of the ore-bodies there is evidence of intense folding accompanied by faulting, both of which probably played a part during the period of deposition that formed the various ore-bodies. This sedimentary area is cut by a great variety of dykes, offshoots of the granitic intrusion flanking the area to the west and south. Some of these dykes show no evidence of having been the source of an enrichment of the ores through which they cut, whereas others show a decided evidence of their influence in ore enrichment.

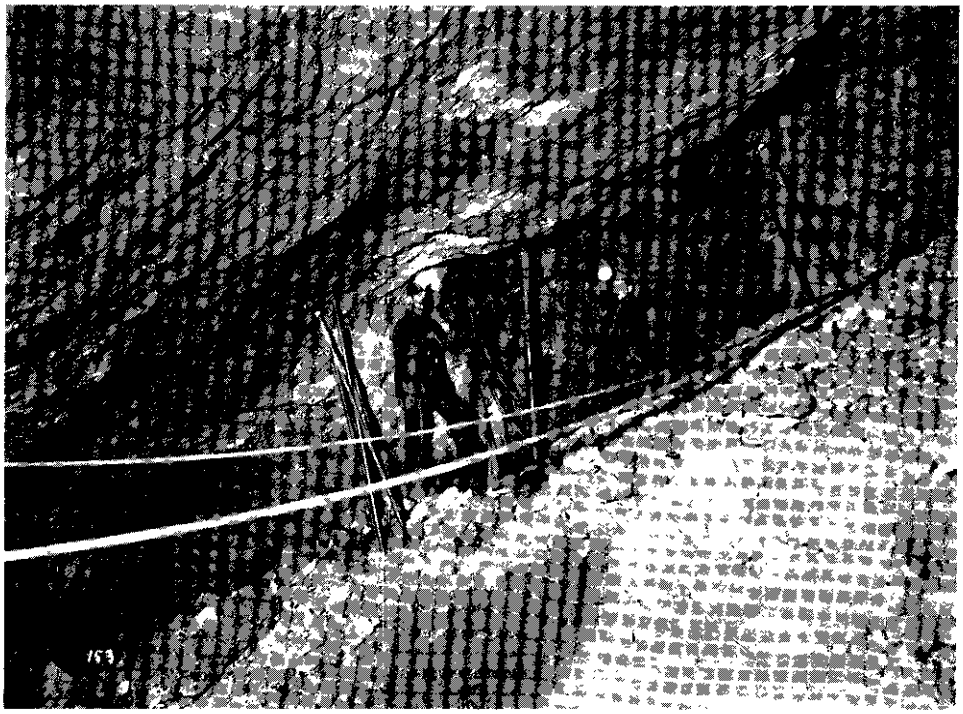
"In the mineral-zone area slates are found on the southern and eastern side more or less in contact with ore-body No. 1. North and west of the slate is a zone 100 to 400 feet wide, consisting of beds of siliceous material interbedded with occasional bands of limestone. In this zone are found ore-bodies Nos. 1, 4, and 5. To the north-west of this siliceous zone is an area of highly altered schist showing some epidote and chlorite, and in this area ore-bodies Nos. 2 and 3 occur.

"Ore-body No. 1, lying directly to the north of and in contact with the slate area, has a width varying from 100 to 250 feet, with an established length of about 1,500 feet. The general dip of this ore-body is about 75 degrees north-west, although in places, in following down the slate wall, the dip is reversed. This ore-body outcrops at an average elevation of 900 feet, and ore is proved to extend to sea-level.

"Ore-body No. 5, in the same general zone as that containing ore-body No. 1, is a lenticular shoot which was discovered by the diamond-drill and does not outcrop. It has a north-south strike and pitches steeply to the north.



Glory-hole, Granby Co.'s Mine, Anyox.



Stoping, Granby Co.'s Mine, Anyox.

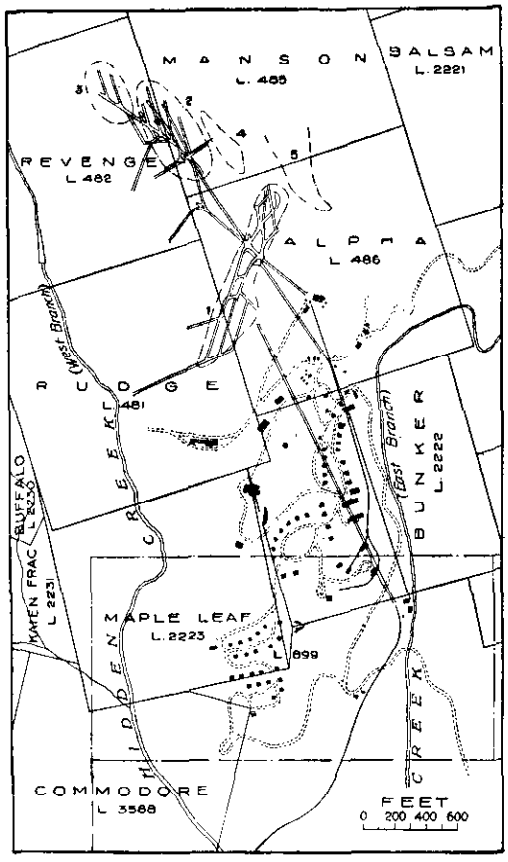


FIG. 1. COMPOSITE MAP OF HIDDEN CREEK MINES SHOWING RELATION OF OREBODIES NOS. 1 TO 5

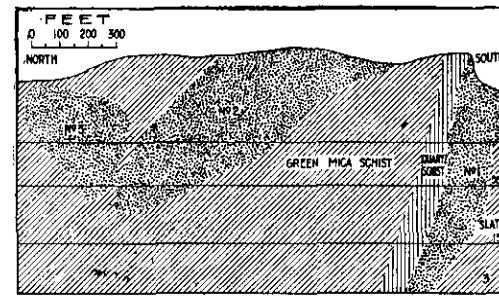


FIG. 3. GENERAL NORTH-SOUTH SECTION OF HIDDEN CREEK OREBODIES

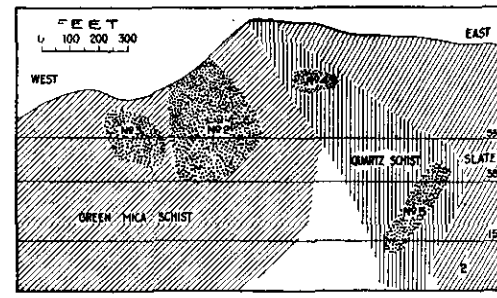
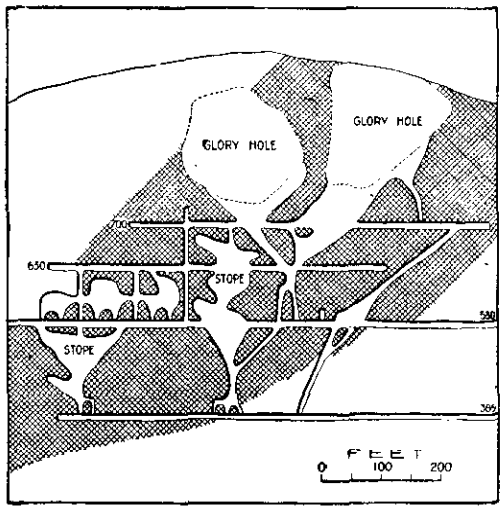
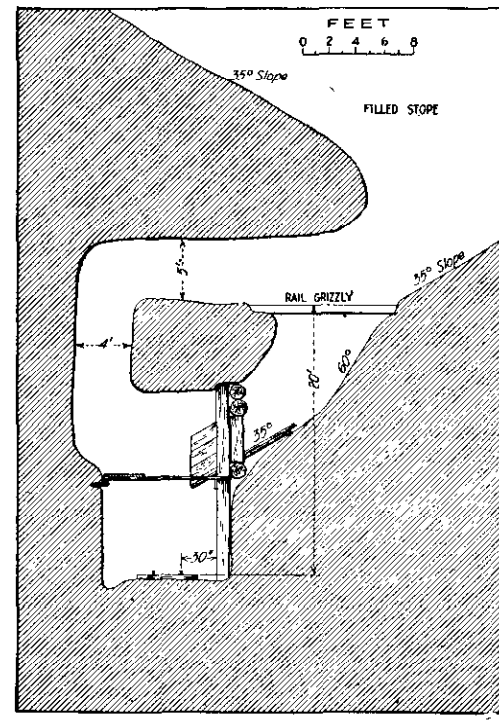


FIG. 4. EAST-WEST SECTION, HIDDEN CREEK OREBODIES





"Ore-body No. 4 lies between ore-bodies Nos. 5 and 2, and is also included in the siliceous and lime-bed area. This ore-body does not outcrop and, like ore-body No. 5, was found with the diamond-drill.

"Ore-bodies Nos. 2 and 3 occur in the schist area and both have an extensive outcrop. The average elevation of the outcrop of these ore-bodies is 800 feet, and their continuity is established down to an elevation of 350 feet. Ore-body No. 2 is a lenticular body about 400 feet wide, 300 feet thick, and 700 feet long, outcropping at the southern end and pitching to the north at about 45 degrees. Ore-body No. 3 is much smaller and is situated north-west of No. 2 and geologically in the same area.

"The ore constituting ore-bodies Nos. 1, 4, and 5 is essentially a massive sulphide, although in some parts of these ore-bodies siliceous zones with disseminated sulphides are found. Ore-bodies Nos. 2 and 3 have disseminated sulphides in a schistose gangue, with an occasional small lens of massive sulphide ore. There is little evidence of oxidation or surface enrichment in the ore-bodies, and unaltered sulphides appear at the surface. In Table II. is shown a general analysis of the ore-bodies established by underground development-work and diamond-drilling. In mining, calculated proportions from each ore-body are taken to make a mixture most desirable for smelting.

"*Table II.—General Analysis of Hidden Creek Ores.*

	Cu.	Insol.	SiO_2.	Fe.	CaO.	S.	Al_2O_3.	MgO.
No. 1	2.37	25.8	22.4	29.6	4.7	30.0	5.1	1.3
No. 2	2.24	40.7	33.2	25.6	3.0	18.0	10.8	4.0
No. 3	1.82	48.8	40.8	21.6	1.5	7.9	11.5	6.6
No. 4	1.52	12.2	9.2	37.0	9.8	30.5	3.0	0.8
No. 5	3.02	16.1	14.8	34.0	5.9	33.3	1.6	0.0

"The *Hidden Creek* mine in its initial development was opened up by six tunnels—namely, the 150, 230, 385, 530, 630, and 700, which numbers are identical with the respective elevation of each tunnel-level above sea-level. Fifty thousand feet of diamond-drilling was done prior to and contemporaneously with this first tunnel-work. The diamond-drill cores established the general outlines of the ore-bodies, and the tunnels served to develop them for mining at the most advantageous points. The haulage-tunnels are the 530, 385, and 150. The 630 and 700 were driven to prospect the ore-body No. 2 and are now used only as stope manways. The 230 level is used as a crusher-level only. On this level ore from the upper levels is crushed and dropped directly into pockets extending to the 150 level, where it is drawn into railway-cars for shipment to the smeltery.

"Mining consists of open-stope or milling methods underground, and 'glory-hole' or open-cut work near the surface. Stoping was started first on the 530 level, extended to the 630 and 700 levels, and thence to the surface. These first stopes served as pockets from which the ore broken above was drawn. By extending several stopes to the surface and widening them at the top, two glory-holes of considerable size have been formed and are now being worked in ore-body No. 2. An equal number has been developed in ore-body No. 1.

"The ore drawn from chutes on the 530 level is transferred to pockets extending to the 385, from which it is delivered to the crusher-bins. Several raises have recently been completed from the 385 level, into which all of the ore from the glory-holes in ore-body No. 2 runs direct, thus eliminating the transfer on the 530 level.

"A departure from the general mining methods is being made below the 385 level, which do not outcrop and have a heavy overburden of rock to carry. In such places a system of shrinkage stope is being developed which will give more support to the back and walls and make working conditions safer. The method adopted in a section now under way consists of shrinkage stopes 125 feet wide, with a length equal to that of the ore-body. Vertical pillars, 40 to 50 feet wide, also across the ore-body, are left between stopes.

"A manway rise is driven through the centre of each pillar to the surface, or to other workings opening to the surface. These manways serve for ventilation purposes and as entrances to the stopes. Manway drifts are driven from the pillar raises into the stopes at vertical intervals of about 30 feet progressively as the raises are advanced upwards. Drifts are driven under the stopes, and chutes are distributed so as to draw evenly the ore broken in excess of requirements for headroom in the stopes. Each chute is equipped with a bulldozing

Date: March 9th. Time: 11 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in a safe condition. A small cap of gas in return air from Main level round to counter-level.

J. McCOURT; J. B.; W. R. PUCKEY.

Date: March 10th. Time: 7 a.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from face of Main level round to counter-level; all other places clear and in a safe condition.

J. THOMPSON; J. B.; J. McCOURT.

Date: March 10th. Time: 2.30 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas from face of Main level to counter-level; all other places clear and in a safe condition.

W. R. PUCKEY; J. B.; J. THOMPSON.

Date: March 10th. Time: 11 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in a safe condition. A small cap of gas in return air from face of Main level round to counter-level.

J. B.; W. R. PUCKEY.

Date: March 10th. Time: 11 p.m.
Remarks: All persons being out of the mine, I have securely fenced off both entrances.

J. THOMPSON; J. B.; W. R. PUCKEY.

Date: March 11th. Time: 5.50 p.m.
Remarks: Removed fences to examine main roads to pumps and mine.

J. B.; J. THOMPSON.

Date: March 11th. Time: 10 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and main roads to pumps and found same free from explosive gas and in a safe condition.

J. McCOURT; J. B.; J. THOMPSON.

Date: March 12th. Time: 7 a.m.
Barometer: 26.1 inches. Temperature: 22° Fahr.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas; all places clear and in a safe condition.

W. R. PUCKEY; J. McCOURT.

Date: March 12th. Time: 2.45 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in a safe condition. A small cap of gas in return air from Main level round to counter-level.

J. THOMPSON; J. B.; W. R. PUCKEY.

Date: March 12th. Time: 11 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found same free from explosive gas and in a safe condition. A small cap of gas in return air from face of Main level round to counter-level.

J. McCOURT; J. B.; J. THOMPSON.

Date: March 13th. Time: 7 a.m.
Barometer: 26.1 inches. Temperature: 22° Fahr.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from Main level round to counter-level; all other places clear and in a safe condition.

W. R. PUCKEY; J. B.; J. McCOURT.

Date: March 13th. Time: 2.45 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in a safe condition. A small cap of gas in return air from Main level round to counter-level.

J. THOMPSON; J. B.; W. R. PUCKEY.

Date: March 13th. Time: 10.15 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from face of Main level round to counter-level; all other places clear and in safe condition.

J. McCOURT; J. B.; J. THOMPSON.

fire department has been organized. The general results of the campaign are undoubtedly good, and the ensuing years promise a further large reduction in the number and severity of accidents.

"*Smelting-works.*

"The smelting-works at Anyox, B.C., of the Granby Consolidated Mining, Smelting, and Power Company was built primarily to treat the ores from its *Hidden Creek* mines, but also with a view to handling other Granby and custom ores. Anyox is on the western shore of Observatory inlet, in north-western British Columbia; the mines and the smelting and power plants are all within a comparatively short radius of the town. There are five distinct ore-bodies developed by the Granby Company, known as Nos. 1, 2, 3, 4, and 5; they are irregular copper-sulphide ore-bodies in metamorphosed sedimentaries—schists, slates, and limestones—cut by dykes. Oxidation has been only slight and sulphides are found where the ore-bodies come to the surface.

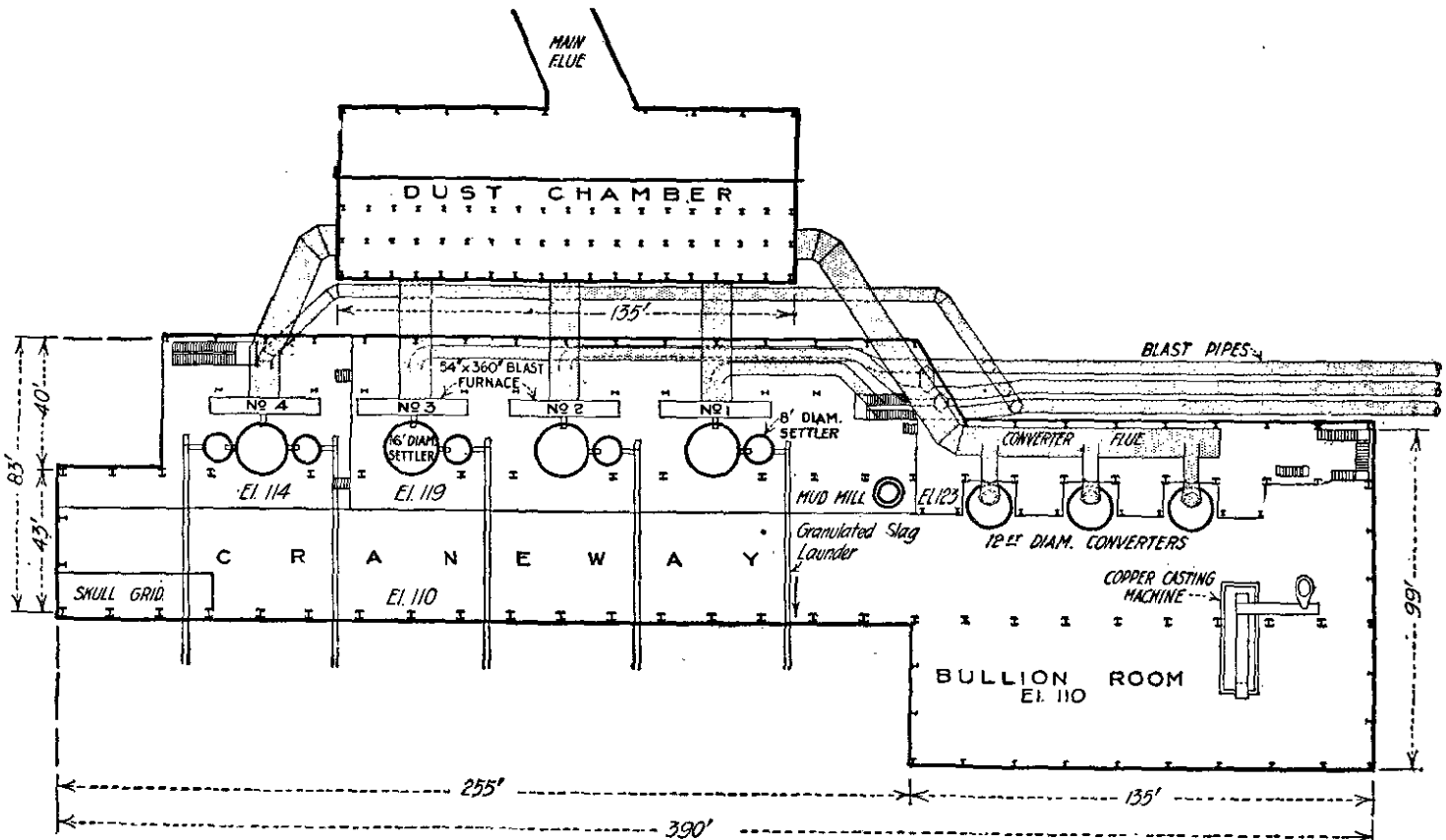
"When selecting the site for the plant, the three main considerations were: (1) Plenty of slag-dump room for future years; (2) sufficient ground for future enlargement of plant; and (3) availability of water-power. Since the mines, smeltery, and wharves had to be connected by railroad, minimum up-grades were provided from wharves to smeltery, and practically level grade from the mines to the smeltery. It is estimated that there is room at the site selected for 12,000,000 to 20,000,000 tons of granulated slag. On account of the steep, glaciated hillsides, all natural benches are narrow, and the one selected for the site was as wide and long as could be found in this vicinity. Falls creek, at the north end of the site, presented the only near-by water-supply available. An economical power arrangement was obtained by installing a high-pressure water-pipe line from the dam to the power-house, which is at the foot of the hill near the mouth of Falls creek. All timber and underbrush, and a layer of muskeg covering the surface of the ground to a depth varying from 2 to 8 feet, were removed, and all footings placed on rock or on a glacial-gravel foundation.

"From the plans it will be noted that the ore-bins are not directly back of the furnaces, but are situated to one side, making an angle of about 80 degrees with the line of the furnaces. The charge-trains enter the feed-floor between the furnaces and converters, and the sampler is at the end of the bins next to the furnace building. The arrangement is not exactly ideal, but, because of the length and narrowness of the bench, it was the best that could be designed under the circumstances, and in practice it has worked satisfactorily.

"The furnaces and converters are in one building. The building is a steel structure with wooden roof, having an asbestos covering. It is 80 feet wide and 390 feet long, having concrete retaining-walls both in front of and back of the furnaces. The furnace-floor elevation is 119 feet and converter-floor elevation 110 feet above sea-level. A common crane runway 40 feet wide serves both departments upon which operates two Niles, direct-current, 500-volt, 40-ton, quick-acting cranes with main and auxiliary hooks of the same size. In the southern end of the building there were originally three furnaces. Later a fourth was added.

"The long axes of the furnaces are in line and parallel to the long axis of the building. The furnaces are of the rectangular-bosh type. The original three furnaces are 50 x 360 inches at the tuyeres, which are of 4 inches diameter and spaced 10.8 inches from centre to centre. There are two tiers of jackets. The lower jackets are 10 feet 6 inches high and 4 feet 6 inches wide and rest on heavy, water-jacketed base-plates; the upper jackets are 6 feet 8 inches high and 5 feet wide. The furnace is supported by heavy-steel H columns and 20-inch box-type mantel-beams. These are exceptionally well braced with heavy I-beams and girders. Jackets and tuyeres are of the welded type. The latter are of the Anaconda type with ball-and-socket joint. Furnaces Nos. 1, 2, and 3 measure 13 feet 2 inches from the tuyeres to the top of the upper jackets, while on No. 4 furnace, which has a third tier of jackets, this distance is 18 feet 2 inches, the extra 5 feet of height having been gained by lowering the settler floor. With this exception No. 4 furnace has the same measurements. Steel water-jacketed spouts, having a trap of 15½ inches, discharge over a bronze-nose jacket and give excellent service. Cooling water which is ice-cold the year round ensures the permanence of a thick, protective crust which is never 'hulled' through a campaign. The furnaces work under a 45- to 50-oz. blast and use 900 cubic feet of air per minute per foot of furnace-length.

"Each furnace is served by one 16-foot and one 8-foot settler having a 9-inch chrome-brick lining. The brick stands 9 inches away from the shell, the intervening space being filled with

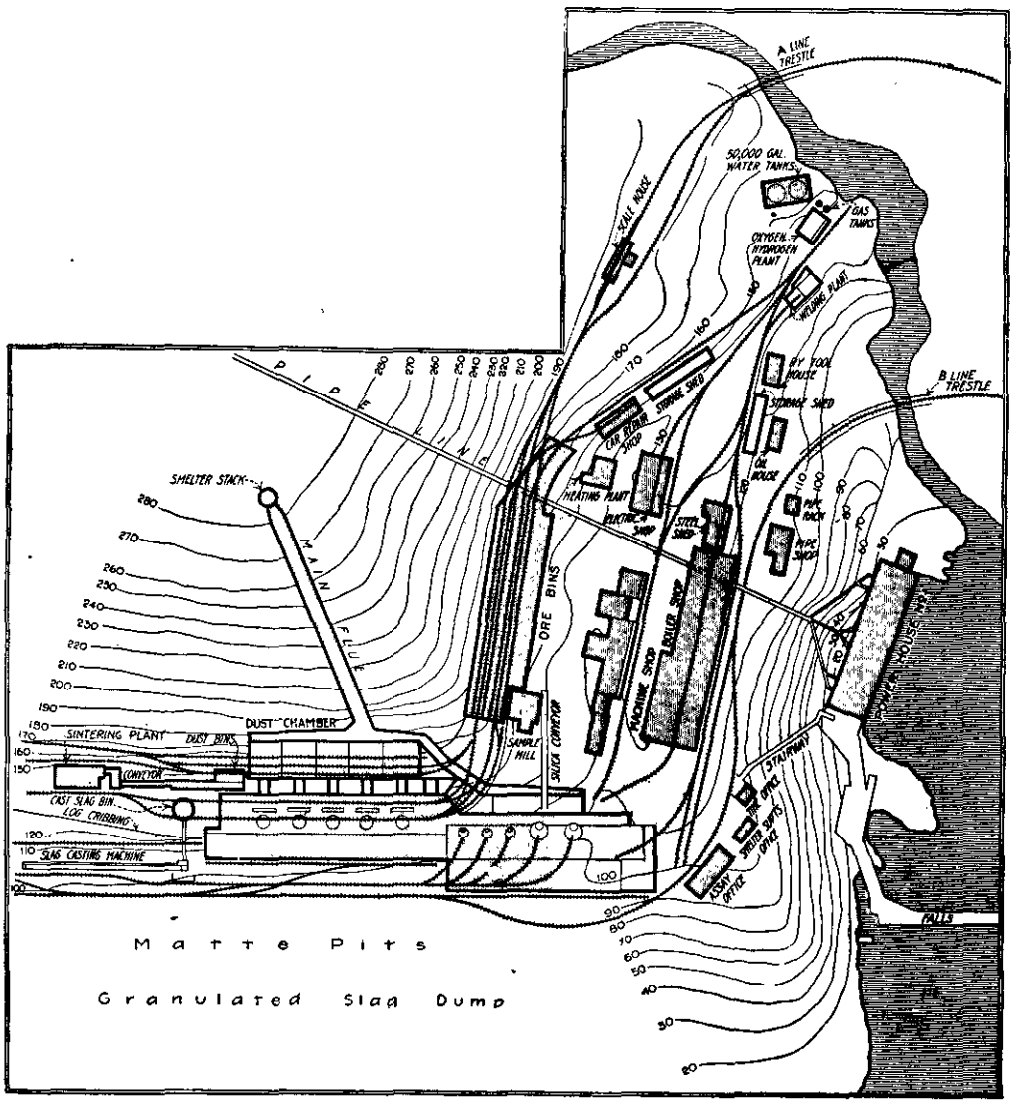


Plan showing arrangement of blast-furnaces and converters at Granby smeltery.

lightly tamped backing, consisting of common bats crushed to ½ inch, from which the fines have been removed by screening. At the tap-holes, of which there are two, 18 inches of chrome brick is used without backing. The tapping-block is a magnesite brick having a 1-inch hole, embedded in a plate of converter copper. Due to the frequency with which matte is tapped, a tapping-bar is rarely needed. Aside from renewing brick at the tap-holes, which is necessary about once a month, very little repairing or lining is necessary. The cooling spray has been abandoned. Slag flows from the 16-foot settler to the 8-foot settler, thence to the granulating-launders. An appreciable amount of matte is recovered from the second settler. Granulated slag is deposited on the dump through launders lined with slag plates and having a fall of ½ inch to the foot.

"The feed-floor is at an elevation of 145 feet. The furnace-tops are constructed of heavy, cast-iron lintels and columns, all well bound and braced. The side walls and ends are bricked with 18 inches of red brick, and the semicircular steel hood is lined with firebrick. A steel down-take, 9 feet in diameter, leads the gases from the furnace to the dust-chamber.

"Charge-tracks, of 3-foot gauge and 56-lb. rails, run on either side of the furnace and continue out of the building to the converter-slag bins and sintering-plant bins. The Anaconda



type of steel charge-cars of 5-ton capacity is used. Trains of twelve cars each are hauled by a 12-ton, Baldwin-Westinghouse, electric locomotive. There are two of these trains in service. Cars are dumped by overhead, horizontal, compressed-air cylinders running on trolleys, two to a furnace, one on each side.

"The manner of charging the furnaces is their most striking feature. The charging-space is divided into three sections by the columns supporting the lintels. The original bevel plates were removed and in their place were built hoppers with horizontal bottoms and cast-plate sides. They are 2 feet 6 inches deep and the bottom plate overhangs the top of the jackets 9 inches. At the back of the hoppers, held under the charge-floor, are heavy cast-iron ploughs operated by compressed-air pistons in cylinders working under 100-lb. pressure. The capacity of each hopper is 5,000 lb. of charge and each section has two, making twelve in all per furnace.

"When the charge is needed in the furnace, air is turned on and the plough pushes the charge from the hoppers into the furnace. Any hopper can be operated independently and the amount charged at any one time can be controlled. This arrangement permits charge-trains to be dumped and released without having to wait for the charging of the furnace. In this system of feeding the proper overhang with the proper drop of the ore have to be determined to get the right distribution of coarse and fines, so that the furnace may run properly. The amount of drop and overhang depend upon the character of the ore and whether or not it is desired to feed to the middle or to the jackets. It is possible to place the charge in any desired place and to favour any particular section of the furnace. The main idea was not original with the Granby Company, but was taken from Sticht's description of the smelting practice at Mount Lyell. The Granby Company worked out the mechanical details to suit its own construction only. The idea was first tried out on No. 4 furnace, and as the experiment showed a tendency toward smoother running of the furnace and kept it in better shape than any of the others, it was decided to adopt this feed system on the three remaining furnaces.

"In the northern end of the building there are three 12-foot, Great Falls type, electrically operated converters, each having twelve tuyeres of $1^{15}/_{16}$ inches diameter. Punch-rods are upset to 1½ inches and tuyeres reamed with 1⅝-inch bar. Blast-pressure is 13 lb. and air-consumption from 6,000 to 7,000 cubic feet per minute per converter. Ladles of 85-cubic-foot capacity are used, but are being replaced by ladles of 120-cubic-foot capacity. Converter-slag at present is poured into the settlers of furnaces smelting the ore charge. Charges of copper weigh about 8 tons and are cast into flat, bevel-edged bars measuring 30 x 18 x 3 inches. A straight-line casting-machine is used which dumps the bars into a cooling-tank, after which they are conveyed to the casting-floor. The blister-copper averages 99.25 per cent. Cu.

"The slag-skull grid is at the top of a steel bin having a sloping bottom and chutes for discharging the contents into railroad-cars. The top of the bin measures 12 x 45 feet, and is laid with 12-inch I-beams running lengthwise and supporting 12-foot lengths of 90-lb. rail laid crosswise and spaced 7 inches apart. Skulls are dumped on this grid, and pieces not sufficiently broken by the fall are further reduced by hand. Part of one man's time is required for this work.

"*Character of Hidden Creek Ores.*—About 75,000 tons of ore is smelted per month, of which the *Hidden Creek* mine at Anyox furnishes roughly 65,000 tons; the remainder of the ore comes from outside sources. Nearly all the *Hidden Creek* ores smelted to date have come from No. 1 and No. 2 ore-bodies.

"Ore-body No. 1, as developed to date, appears to be nearly neutral as regards Fe and SiO_2 requirements for smelting, though the output to date has been less siliceous than the average of the ore-body as sampled. An analysis of current production from ore-body No. 1 is given in the table on page 57. The Fe occurs principally as pyrite, most of the SiO_2 as free quartz, and CaO is present mainly as calcite. Some of the combined SiO_2 is present on account of the admixture of waste rock which cannot be avoided without hand-sorting. No. 1 ore carries a considerable proportion of fines; screening tests show over 25 per cent. passing a ½-inch screen. An intimate mixture of gangue and sulphides is typical, the particles of each being often granular and loosely cemented together, though this condition is not universal, as both sulphides and gangue also occur in larger masses. Analyses show a tendency to variation in the composition of the ore shipped to the smeltery. This is caused by a variation of the character of the ore, not only from different stopes, but also from different parts of the same stope. There is a steady fluctuation of ore composition, but the degree of variation is fortunately becoming less. In

the accompanying table, A and B each represent the average of a month's run and illustrate the extremes in SiO_2 contents by months; C and D represent two extreme analyses by lots of 1,000 tons.

"Ore from No. 2 ore-body is more siliceous and aluminous than that from ore-body No. 1. The average analysis of No. 2 ore for the last year is given in the accompanying table. The sulphide portion of the ore consists of chalcopyrite, pyrite, and pyrrhotite; CaO seems to be present with the silicates rather than as calcite. Unlike No. 1 ore, it can be mined with the introduction of little waste rock, which is fortunate in view of the already high amount of combined SiO_2, as implied by the high Al_2O_3 and MgO content. Physically, No. 2 ore is well adapted for the blast-furnace, containing only about 8 per cent. fines, being hard and not given to crumbling. It is by comparison fairly uniform in character, fluctuating in analysis much less than No. 1 ore. The table gives the average of analyses, E and F, for two different months and illustrates the extremes of the range of variation. There is another classification of *Hidden Creek* ores, a low-grade quartz-schist, of which several thousand tons per month is used in the concentration of matte. A typical analysis is shown in the accompanying table.

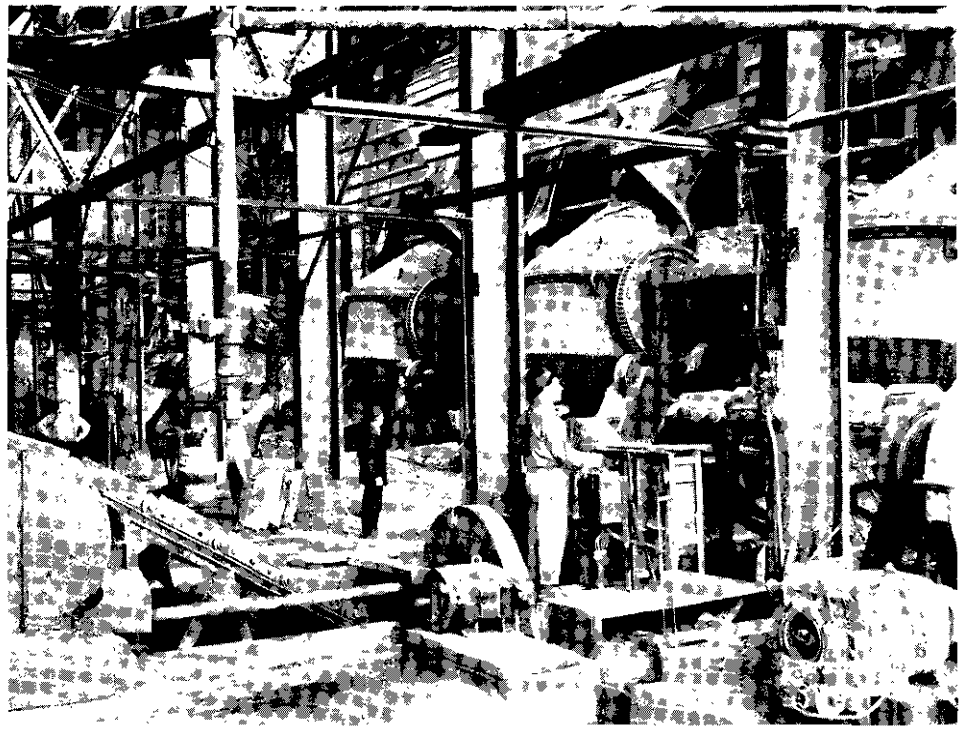
"Outside ores consist of custom ores and ores from the Granby Company's Alaskan mines. The *Midas* mine, a Granby property at Valdes, Alaska, is shipping about 3,000 tons a month of siliceous aluminous sulphide ore. From the *Mamie* mine, on Prince of Wales island, and from several custom shippers, a heavy magnetite ore to the amount of about 5,000 tons a month is received. Shipments of a copper-bearing, specular hæmatite from the White Horse district have been received; also miscellaneous siliceous ores from a number of different shippers amount to about 2,000 tons a month. In most of these ores the gangue consists principally of natural silicates of CaO, Al_2O_3, and MgO. "Clean ores," those wherein the SiO_2 is predominantly quartz, or the CaO is calcite, are sparingly offered. An analysis of outside ores is given in accompanying table.

"*Fluxes mined by the Granby Co.*—Lime rock of good quality obtained from the company's quarry at Swamp point, on the Portland canal, analyses: SiO_2, 5 per cent.; CaO, 50 per cent.; MgO, 2 per cent. The Granby Company operates several small quartz-mines in the immediate vicinity of Anyox. One ledge carries about $8 in gold and silver. The quartz is full of cracks and fractures, is very friable, and shatters so readily that by the time it reaches the smelter-bins fully 60 per cent. will pass through a 1-inch mesh.

"Coke comes from several sources. It contains from 18 to 26 per cent. ash, averaging 23 per cent., and physically it will grade from fair to inferior. Clay suitable for smeltery use is found in abundance near the works.

"Shipments of outside ores arrive on steamers or barges in amounts ranging from a few tons to 2,500 tons. The amount taken for a sample and the method of procedure are varied to meet requirements. *Hidden Creek* ores are lotted in forty-car lots weighing approximately 1,000 tons. An automatic sampler at the mine cuts out one twenty-fifth of the crushed ore, which is then sent to the sampling-mill at the smeltery. As the ore is usually smelted before its analysis can be obtained, a close examination is made, as it is dumped into the bins, for the purpose of estimating approximate percentages of SiO_2 and the general character of the silica, whether 'clean' or 'dirty,' and if dirty, whether due to gangue or included in waste. This inspection applies particularly to No. 1 ore, and is extremely useful in detecting radical changes which might otherwise manifest themselves in a disarranged furnace.

"*Analyses of Furnace Charges and Products.*—No. 1 and No. 2 ores are treated in equal proportions, and ordinarily such a half-and-half mixture requires flux of a basic nature. The basic ingredients used consist of matte, lime rock, or oxidized iron ores. It was the former practice, while smelting about 45,000 tons of ore a month, to convert the first fall of matte. The amount of matte thus made in excess of what the converters could handle was poured out, sent to the bins, and resmelted on the regular ore charge in amounts ranging from 5 to 15 per cent. of this charge. The addition of resmelted matte usually called for more SiO_2 in the charge which was supplied with quartz, thereby increasing the proportion of free SiO_2. The accompanying table gives a typical analysis of the charge, slag, and matte; the proportions used in such a charge are: No. 1 ore, 43.6 per cent.; No. 2 ore, 43.6 per cent.; matte, 8.7 per cent; quartz, 4.1 per cent. The Fe oxidized is 69 per cent.; coke to charge, 3.8 per cent.; matte fall, 23.4 per cent. This characteristically pyritic charge ran well as long as the ores remained fairly clean and not too unsteady in composition. By hard driving the three converter-stands were



Twelve-foot Convertors, Granby Co.'s Smelter, Anyox.

Blast-furnaces, Granby Co.'s Smelter, Anyox.

just about able to produce the required amount of copper from an average 15 per cent. Cu matte when smelting about 45,000 tons of ore a month. Later, however, increased ore tonnage made it necessary to supply converter-matte of a higher grade. This was accomplished by devoting one furnace to matte-concentration, and part time only is necessary when three furnaces are in operation; but with four furnaces in operation it takes one furnace full time to regrade matte from the other three.

"Under present practice the half-and-half mixture of No. 1 and No. 2 ores is smelted with lime rock or oxidized iron ores, or both. The addition of these basic materials to the charge is subject to frequent changes in much the same way as quartz is raised and lowered in ideal pyritic smelting of heavy sulphides. The analysis of a charge typical of the present practice is given in the accompanying table, the components of which are: No. 1 ore, 44.4 per cent; No. 2 ore, 44.4 per cent.; magnetite ore, 5.6 per cent; lime rock, 5.6 per cent. The Fe oxidized is 63 per cent.; coke to charge, 5.6 per cent.; matte fall, 21.1 per cent.

"*Analyses of Ores, Furnace Charges, and Products.*

Analysis of.	Cu.	Insol.	SiO_2.	Fe.	FeO.	CaO.	S.	Al_2O_3.	MgO.
	%	%	%	%	%	%	%	%	%
Ore No. 1 (current)	2.00	23.9	20.8	30.8	...	5.4	30.7	4.0	1.9
Ore No. 1A	2.80	17.3	14.7	33.3	...	5.2	34.2	2.5	0.6
Ore No. 1B	2.19	27.4	23.4	29.5	...	5.5	29.1	3.9	1.6
Ore No. 1C	2.40	12.0	10.4	34.9	...	5.0	38.8	1.3	...
Ore No. 1D	1.64	31.0	27.3	28.2	...	3.4	28.9	5.7	...
Ore No. 2 (current)	2.13	...	29.2	27.8	...	3.5	21.0	8.0	4.4
Ore No. 2E	2.32	34.6	26.9	27.5	...	3.7	20.7	6.8	4.1
Ore No. 2F	2.13	40.2	32.4	25.4	...	3.0	17.3	8.7	4.0
Quartz-schist ore	0.79	52.9	46.2	19.8	...	4.0	16.1	5.7	2.7
Outside Ores.									
Midas	4.3	47.6	37.3	19.4	...	1.5	17.6	8.5	6.1
Magnetite	1.8	21.4	14.0	47 0	...	5.0	3.5	5.0	5 5
Hæmatite	3.6	14.6	11.7	50.0	...	1.7	0.9	4.0	2.1
Custom siliceous	5.0	59.3	36.4	10 9	...	2.2	3.8	5.8	7.8
Swamp Point limestone	...	...	5.0	...	...	50.0	...	...	2.0
Smelting Results with 8.7 % Matte on Charge.									
Charge	3.14	...	22.5	30.3	...	3.8	26.2	4.0	2.1
Slag	0.28	...	37.0	...	44.4	6.3	...	6.6	3.4
Matte	16.0	...	...	...	...	...	...	...	...
Present Practice with no Matte on Ore Charge.									
Charge	2.05	...	23.0	28.9	...	6.3	24.9	6.1	3.3
Slag	0.18	...	35.6	...	38.1	9.8	...	9.4	5.1
Matte	11.0	...	...	...	..	...	...	...	...

"The use of 'ready' bases such as CaO and oxidized Fe for flux, instead of matte wherein the Fe must be oxidized to become available, is dictated by the increase in proportion of silicates in the ores and the disturbing degree to which they fluctuate in analysis. This is especially the case where Al_2O_3 is one of the variables and too close an adherence to pyritic conditions is bound to cause trouble. Slags commonly carry about 10 per cent. Al_2O_3, but occasionally go to 12 per cent. or beyond; the effect of the higher Al_2O_3 content is to increase coke consumption, decrease oxidation, and render the furnace more susceptible to irregularities of an unfavourable nature. Lime rock is nearly always in the charge, because, aside from its beneficial effect on diluting and increasing the fluidity of the slag, it reduces resistance to the blast and seems to keep the crusts undercut, thereby mitigating the evils of encrustation.

"Magnetite ore in amounts ranging from 5 to 15 per cent. usually forms part of the sulphide-ore charge. There is no trouble in effecting the proper reduction of Fe_3O_4 in spite of presumably unfavourable furnace conditions—namely, rapid running and oxidizing atmosphere in the focus. Furnaces have run steadily on charge consisting of sulphide ores 87½ per cent, magnetite ore 12½ per cent., and 5 per cent. of good-grade coke, with satisfactory results. Some Fe_3O_4 escapes reduction and finds its way into the matte, but rarely causes tap-hole troubles in the settlers. Various outside ores of a siliceous-aluminous nature are sometimes smelted in small quantities in the regular charges. Usually, however, a special charge is made up for their disposal and smelted in one furnace only.

"*Local Quartz used in Concentrating Matte.*—In concentrating first matte to converter grade, local quartz is the main source of silica. As before stated, it seems to run to fines and greatly increases encrustation troubles, but fortunately, in this regard, the ratio of concentration is not required to be high. *Hidden Creek* siliceous ores frequently replace part of the quartz and help to coarsen the charge. Lime rock also forms part of the charge. Converter-matte averages between 20 and 25 per cent. Cu, and slag from matte-concentration will average: Cu, 0.3 per cent.; SiO_2, 37 per cent.; FeO, 45 per cent.; and CaO, 8 per cent.

"In furnaces Nos. 1, 2, and 3 the charge column is carried about 12 feet above the tuyeres; in furnace No. 4, which is 5 feet deeper, a 15-foot charge column is carried. Less encrustation, smoother running, and longer campaigns seem to be the rule with this furnace—attributed partly to the greater fall and consequent better spreading of the charge.

"Under average conditions of ore charge, a furnace will take about 900 cubic feet of air per minute per foot of furnace-length at 48-oz. pressure. A matte-concentrating furnace runs more openly and receives sufficient blast at lower pressures. Numerous analyses of gas issuing from the 12-foot ore column as well as from the 15-foot ore column show little, if any, free oxygen. The volume of blast going to the different furnaces is ascertained by means of Pitot tubes. Each blast-pipe has one of these tubes inserted at a suitable point between the common, main, and the bustle pipe, and is connected to a meter reading the number of cubic feet of air per minute.

"An ore-furnace smelts on an average about 850 tons of ore per day, but sometimes exceeds 1,000 tons. The amount of matte produced is greater and its disposal at times a serious factor, especially when rapid running and low oxidation combine to cause a prolific fall. Furnace-crucibles are lined on the bottom and sides with chrome brick. The breast-jacket, which is made of converter-copper, cast around pipe-coils, did not give much life until the practice of bushing the outlet with 2 inches of chrome was introduced. This protects the metal against the cutting effect of the matte, and, by renewing the brick whenever the furnace is down, an unlimited life of the breast-jacket appears possible.

"Low-grade matte from the ore-furnaces goes to beds situated on the slag-dump in front of the building. On furnaces Nos. 1, 2, and 3 a system of brick-lined launders spanning the crane-aisle permits the matte to run directly from settler to bed. The maximum distance thus traversed by molten matte is about 200 feet. The No. 4 furnace, being at a lower level, has insufficient fall to dispose of matte in this fashion and requires the use of ladle and crane to get it into a launder leading out-of-doors. There are four matte-beds holding several thousand tons each, separated by walls of flue-dust. After cooling off a bed with water, it is broken up to some extent with a few shots and reclaimed with a back-haul, drag-line scraper-digger, as already described in the *Journal*.

"The grade of matte converted over a period of twelve months averaged 21 per cent. copper. Converter-slag analyses were: Cu, 2 per cent.; silica, 25 per cent.; FeO, 64.8 per cent. The blister-copper averaged 99.25 Cu. Siliceous flux is mostly quartz, while cooling material, of which a considerable amount is used, is derived from furnace cleanings, sweepings, converter-flue dust, and siliceous mine ore. The converting department is being enlarged by the addition of 135 feet of building to house two 20-foot Great Falls type converters. The copper-casting machine will be enlarged, and a straight-line machine for casting converter-slag is also to be installed. Converter-slag will be skimmed into slag-pot cars instead of ladles, and will be taken to the slag-casting department, cast into slabs, and returned to the blast-furnaces. It is intended to send to the converting department the first smelting-matte irrespective of grade, using the large converters for concentration and finishing in the 12-foot converters, thus allowing all four furnaces to operate on ore.

"There is a large tonnage of concentrating-ores in the various mines of the company, and a great deal of experimental work has been done with these ores during the last two years. There is being installed at present a 100-ton experimental flotation unit to obtain further data with respect to the handling of these ores.

"*Flue-dust, Settling, and Sintering.*—The 9-foot downtakes of the blast-furnaces lead into a settling-chamber, 225 feet long, 50 feet wide, and 30 feet high; this is a steel structure with brick walls, having three rows of hopper-bottoms each served with tracks for dust-removal. This chamber has deflecting baffles at each downtake for the purpose of reducing air-currents and distributing the gases, and it will also have suspended wires to give a better settling of flue-dust. The back wall will have holes leading to a breeching, after the manner of steam plants; thence to a 20- x 20-foot flue 400 feet long running up the hill to a reinforced-concrete stack 22 feet in diameter by 153 feet high. The elevation at the base of the stack is 280 feet and the elevation at the top of the stack is 433 feet above mean tide. The top of the stack, measured above the feed-floor, is 288 feet.

"The converter-stacks will lead directly to a brick-and-steel chamber, 25 x 20 feet, having two rows of hoppers with tracks below for dust-collection. Baffles and breeching are the same as in the big chamber, and the flue leads to the main flue and thence to stack.

"Flue-dust is made amounting to about 4 per cent. of the ore smelted, and a sintering-machine of the Greenawalt type has been installed for handling this material. The dust is brought in cars drawn by an electric locomotive, dumped into concrete bins feeding to a 24-inch conveyor-belt which leads to a bin directly over the mechanical mixer—in this case an ordinary cement-mixer. The flue-dust is moistened to the proper degree and elevated to bins over a specially constructed charge-car. There is one bin for crushed lime-rock and one for the material to be sintered—either flue-dust or concentrates. The lime rock is laid on the grates first, and flue-dust over this until the pan is full. The sintering charge is then ignited, down-draught being used. When the material is sintered, the pan is turned over on its trunnions, the product falls on breaker-cars, and thence into bins, from which charge-cars take it to the furnaces. The fines are returned to the mixer. The pan is 8 feet wide, 12 feet 6 inches long, and 9 inches deep, and has a capacity of 100 tons per twenty-four hours.

"*Ore Storage and Sampling.*—The furnace-charge bins are of heavy wood construction, with two ore-alleys underneath and chutes on both sides of the alley to deliver into the charge-cars. On the outside of the regular charge-bins there is a row of sample-bins. The charge-bin structure is 72 feet wide by 320 feet long and is suitably divided into pockets. There is storage for 525 tons of coke, 2,575 tons of secondaries, 2,340 tons of flux, and 8,600 tons of ore. The bins are served on top by five lines of track all leading to the main high line, and everything coking to the bins is weighed over 80-ton track-scales. Weighing-hoppers for coke and lime-rock and track-scales for ore comprise the weighing system for furnace charges.

"The sampling-mill is a heavy, wooden structure having five floors served by man elevators, and is well lighted. It is situated at the furnace end and alongside the bins. The design is such that the sample will feed to the main crusher from the sample-bins by means of a 30-inch conveyor-belt. All crushers are of the Blake type and the samplers are of the improved Snyder type. Ore is fed by belt to an 18- x 36-inch breaker, crushing to 3 inches, and is then elevated to the top of the mill, where a 60-inch sampler takes a 10-per-cent. cut. This sample is crushed to pass through a 1-inch ring by a 10- x 16-inch crusher. Another 10-per-cent. cut is then taken which goes to 14- x 40-inch rolls and is crushed to ½-inch size. A 10-per-cent. sample is again taken and goes to 10- x 18-inch rolls, where it is crushed to ¼-inch size. From this product a final 10-per-cent. cut is taken for samples to pipe-sampler or to sampling-floors. The large elevator has 8- x 14-inch buckets and the reject elevators 7- x 9-inch buckets. The mill is designed so that all rejects go to a conveyor-belt, and then out over the receiving-bins, and by a system of chutes to any desired bin. The final sample is taken to the assay office and is dried and bucked down for analysis and assay.

"*Power Plant.*

"The mines, smeltery, and hydro-electric power plant of the Granby Consolidated Mining, Smelting, and Power Company at Anyox, B.C., are situated on the west shore of Observatory inlet, an arm of the sea on north-west British Columbia. Ores from the Granby Company's *Hidden Creek* mines at Anyox are mined and smelted together with Granby and custom ores

shipped in by boat from the outside. Fuel, fluxes, and all supplies are brought in by steamship and unloaded at the company's wharves, from which they are distributed to the mines and various plants by the company's railroad. Power for the various operations of the Granby Company is secured from a hydro-electric power plant which utilizes the water from Falls creek, and from a 6,000-horse-power steam plant which operates during the winter months when there is a decreased water-supply.

"Falls creek, a stream of considerable size emptying into Granby bay at the north end of the smeltery-site, receives its flow from melting glaciers. The surrounding hills are steep and provide but little chance for storage. The company constructed a crib and rock-fill dam 110 feet high at a suitable point a mile distant, where the canyon is narrow and the stream could be deflected over a natural rock spillway 125 feet wide. From this dam the water is taken by a 6-foot wood-stave pipe down the creek and across the north end of the smeltery-site to the power-house. This plant is situated just below the smeltery and well toward the mouth of the creek. From the smelting plant to the power-house the penstocks are of steel, with branches leading to the various Pelton wheels. The arrangement and location of the pipe-line gives a water-pressure of 110 lb. at the smeltery-site. The head of water on the Pelton nozzles at the power-house is 375 feet, the effective head giving a pressure of about 165 lb.

"The power-house is a brick-and-steel structure and all foundations are on solid rock. A 15-ton crane running the entire length of the building handles the heavy machinery. The water-discharge from the Peltons is a little above the high-tide water-mark on Falls creek. The building is 50 feet wide by 180 feet long and has concrete floors. In this building are installed the following: One Nordberg variable-capacity water-wheel-driven two-stage air-compressor, with cylinders 22 and 36 x 42 inches, running at 84 r.p.m., with a capacity of 4,000 cubic feet of free air per minute delivered at 100-lb. pressure; one Nordberg water-wheel-driven special converter blowing-engine with duplex cylinders, 60 and 60 x 48 inches, running at 75 r.p.m. and giving a capacity of 20,500 cubic feet of free air per minute delivered at 16-lb. pressure; three Connersville high-pressure blast-furnace blowers, having a displacement of 400 cubic feet of free air per revolution and each with a capacity of 45,000 cubic feet of free air per minute at 48-oz. pressure. The Pelton-wheel buckets are directly bolted to specially designed fly-wheels. The blowers are connected by chain drive to 500-horse-power motors, and can be driven either by water or electric power. A pipe system leads to the furnaces and converters from the blowers, and high-pressure air is delivered to the mine by 9-inch and 6-inch pipe-lines. There are two direct-connected motor-driven pumps taking water from the raceways and delivering it to condensers at the steam plant.

"The present hydro-electric plant consists of two 938- k.v.a. alternators, with two 700-horse-power overhung Pelton-Doble water-wheels to each alternator. Alternating current at 2,200 volts is generated by Westinghouse 60-cycle three-phase alternators. They are separately excited by two 50-kw. Westinghouse motor-generator sets, one of which has an overhang water-wheel on an extension motor-shaft for initial starting. The excitation voltage is 125 volts. The 6-foot pipe-line from the dam branches to 25-inch pipes outside the power-house for delivery to each wheel. The effective head used is 372 feet. The 25-inch lines divide again at a Y near the Peltons into two 18-inch pipes, one of which leads to each wheel. The water-wheel driving the exciter is fed by an 8-inch pipe.

"There are two 300-kw. motor-generator sets, supplying direct current at 550 volts, for railroad and smeltery use. The generators are type M Westinghouse, and each is driven by a 440-horse-power, 2,000-volt, three-phase, 60-cycle, Westinghouse type CCL induction-motor.

"*Switchboard Control in Fifteen Panels.*—The switchboard is divided into fifteen panels. A synchronoscope is mounted on a bracket together with two voltmeters, one for each machine, and below these there is a Tirrel voltage-regulator. The first panel controls the street-lighting, which is a Westinghouse series tungsten system with a constant-current transformer on a gallery over the board. The second and third panels control the two generators. On them are mounted three ammeters, one for each phase, an indicating wattmeter and one three-pole, type B oil-switch; also there are a double-pole field-switch of 400 amperes, a main field-rheostat, an eight-point voltage receptacle synchronism plug, and a reversing-switch for operating the pilot governor control on the generator. Panel No. 4 has 125-volt, direct-current excitation. On this panel are mounted voltmeters and ammeters for each machine, a field-rheostat, two double-pole 400-ampere field-switches, and one 200-ampere double-pole double-throw switch for power-house lighting,

taken from the transformer or from the exciter bus as desired. Panel No. 5 is a totalizing panel on which is mounted a 3-ammeter, type TG static ground detector, a TI power-factor meter, a 2,400 kw. polyphase graphic wattmeter, and a type C watt-hour meter. Panel No. 6 controls the two 75-horse-power motors driving direct-current generators for excitation. Panel No. 7 controls the mine-feeder. The mine is supplied by one three-phase line from the town circuit for use in case of emergency. There are three ammeters on this panel, a circuit-breaker, and a watt-hour meter. Panel No. 8 controls the smeltery power-feeder. All the alternating-current motors in use around the smeltery and shops are connected to this circuit. Panel No. 9 controls the smeltery-lighting, town-lighting, and power circuits. On this panel there are two ammeters, one to each circuit, operating through meter-plugs to enable the reading of each phase. There are two circuit-breakers, one to each circuit, and two watt-hour meters. Panel No. 10 is for the 440-horse-power motors in connection with the motor-generator sets. Panels Nos. 11 and 12 control the direct-current side of the motor-generator sets. On each panel are mounted one carbon-breaker, one voltmeter, one ammeter, a field-rheostat, and a three-pole knife-switch. Panel No. 13 controls the railroad circuit and is provided with a circuit-breaker, an SPK switch, an ammeter, and a Columbia wattmeter. Panel No. 14 controls the direct current supplied to the smeltery for cranes, 12-ton locomotives, and some direct-current motors. All the cables between the boards and the machines are rubber-covered and braided. Stranded 220-volt, three-conductor, and single-conductor cables are laid in Orangeburg fibre conduits.

"*Five-panel Switchboard at Sub-station.*—All the power supplied to the mines goes to the mine sub-station, where there is a five-panel switchboard connecting incoming and outgoing power-lines. The outgoing lines are on No. 2 panel, which has one three-phase, 2,200-volt power-line for motors. No. 3 panel has two single-phase lines for small motors and heating and lighting around the plant. The fourth panel controls the motor for the motor-generator set which supplies 500-volt direct-curent for ore-haulage. The fifth panel controls the direct-current generator.

"The board at the sub-station is a Westinghouse type similar to the one at power-house No. 1, and with the panels similarly equipped.

"*Electric Locomotives for Ore-haulage.*—The direct-current trolly receives power from the 100-kw. motor-generator set installed in the sub-station, or else power is taken from the railroad-trolly feeders which receive power from power-house No. 1. At present one 6-ton locomotive operates on the 530-foot level of the mine on a 2-foot gauge track, hauling ore to the main pockets and hauling out waste. At the 385-foot or main shipping level three 6-ton locomotives are in service, hauling ore from the pockets to the bins, a distance of three-quarters of a mile. At the bins there are two crushers, each belt-driven by a 150-horse-power 2,200-volt, three-phase, Westinghouse type HF motor. In one case the motor has an extended shaft on which are mounted two pulleys in line with pulleys on either side of the crusher, while in the other case the motor is in the centre, between two pulleys, a combination that produces more equalized pull on the motor.

"On the 150-foot level of the mine a 6-ton locomotive is used for hauling waste from development-work. Each of these locomotives is of Baldwin-Westinghouse manufacture, and is smaller though similar to the 12-ton smeltery locomotives. The railroad runs into the mine tunnel at the 150-foot level, where eight and ten 25-ton cars are made up into trains for one of the 42-ton electric locomotives to haul to the smeltery storage-bins. The 42-ton locomotives are also employed to convey ore, coke, etc., from the dock to the smeltery bins. These locomotives are provided with four 84-horse-power, 500-volt, No. 909 mine motors, double-end series-parallel control with independent automatic air for breaking. When operating in series, two motors, one for each truck, are in series, and parallel operation gives full line voltage to each motor.

"The furnace-charge trains are hauled by three 12-ton mine locomotives of Baldwin-Westinghouse manufacture, and each locomotive has two No. 907, 500-volt, direct-current, series interpole motors. There is a pinion-drive, Westinghouse No. 141 controller with wiring protected by a railroad-type circuit-breaker. All brakes are hand-operated. The trolly is type D, of Nuttall & Co. manufacture.

"At the dam there is a 50-horse-power, 2,200-volt, type CCL motor which is used in pumping water for sluicing.

"The cranes used in the smeltery are of Niles-Bement-Pond manufacture. Each crane has two 40-ton hoists, without auxiliaries. This arrangement enables a pouring of metal at either end of a narrow span which could not be done with a long carriage, main hoist, and two

auxiliaries. Each hoist is driven by an 80-horse-power 500-volt series motor equipped with a Cutler-Hammer controller. The trolly and bridge are both driven by a 25-horse-power Westinghouse No. 7, type K, direct-current motor, equipped with an R 28, General Electric controller. The protection of each circuit is ensured by an Electric Controller and Manufacturing Company's type S crane switchboard. Each motor circuit has an overload relay, operating the main circuit-breaker. During daily inspection the safety-plug can be taken out, or locked in its off position, which makes it impossible to operate motors or obtain current beyond the main switch.

"The converters are tilted by Westinghouse type 47D, 500-volt, direct-current, crane motors; each motor being equipped with a Westinghouse R27 controller and the motor circuit protected by a Westinghouse railroad-type breaker.

"There are about six miles of track, including yards, all equipped with trolly 18 feet over the centre of the track. A 0000 copper feeder is carried on cedar poles spaced 55 feet apart and 7 feet 6 inches from centre of the 3-foot-gauge track. The trolly-support construction is mast and arm on the tangent track and double pole and span wire on the curves. About a third of the way between the mine and the smeltery there is a turnout and a spur track to the dock and a branch to the smeltery yards half a mile farther on. Along both tracks a No. 0000 feeder is installed, and both feeders and one No. 0000 trolly lead to the mine.

"The copper-casting machine has two 15 horse-power, 500-volt direct-current, Westinghouse type K motors, one of which is used for hoisting the pot and the other for moving the moulds. Both are equipped with an R122 General Electric controller.

"The mud-mill is operated by a 75-horse-power, 2,000-volt, type CCL induction-motor and is controlled by the standard auto-starter panel.

"The sampling-mill is driven by a Westinghouse type C, 2,000-volt motor, of 150 horse-power, controlled by standard auto-starter panel; also two 5-horse-power motors for conveyor-belts. The matte-digger is operated by a 440-volt, type CCL induction-motor, controlled by an overload circuit-breaker, and double-throw auto-starter switch.

"In the assay-office bucking-room there is one 5-horse-power, 200-volt, type CCL induction-motor, controlled by a double-throw, three-pole switch and fuse; a ½-horse-power, 200-volt, three-phase, 60-cycle, General Electric type DST induction-motor for running a fan; also a small motor-generator set comprising a ½-horse-power, 200-volt, type CCL induction-motor, direct-connected to direct-current 110-volt generator used for driving electrical apparatus.

"In the smeltery store there is one Otis-Fensom elevator driven by a 7½-horse-power, 200-volt, type CCL induction-motor, with rope control from the cab.

"*Machine-shop Equipment.*—The electrical and mechanical departments are in charge of all mechanical and electrical equipment at the mines, smeltery, railroad, docks, ships, and town. On account of the varied work required these departments have to be well equipped. The departments comprise the machine, boiler, blacksmith, electric, and tinsmith shops, and a foundry where all castings up to 8 tons can be made. There is a plant for generating oxygen in conjunction with a complete oxycetylene welding plant. The main mechanical shops, such as the blacksmith and machine shops, are housed in one building. This building is of wood, 58 feet wide, 254 feet long, with a craneway the length of the building, upon which is operated a Niles 20-ton electric crane. The construction floor is 30 feet wide and all machinery so placed that any piece can be reached by the crane. The line-shafting is in the lean-to part of the building over the work-benches and machines. The building is well lighted and has a hot-air heating system for winter.

"In the machine-shop there are two 15-horse-power, 200-volt, type CCL induction-motors, with auto-starter control for line-shaft; one 1-horse-power, 200-volt, Western Electric type KT 122 motor for grinder; one 20-horse-power, 500-volt, direct-current, variable-speed, Northern Electric motor operating a lathe, the speed variation of which is made by a field-rheostat, 300 to 900 r.p.m.; one 75-horse-power, type CCL induction-motor driving a turret-lathe; one 1-horse-power type CCL induction-motor for tool-grinder; one ½-kw., 250-volt generator for driving a ⅛-horse-power motor on grinder-table; one 50-horse-power, 2,000-volt motor for driving compressor and standard auto-starter panel. In addition there are two 15-horse-power motors for boiler-room, one 5-horse-power motor for foundry, and one 15-horse-power motor for pipe-shop.

"*Electric-shop Equipment.*—The electric shop is in a separate building, 42 feet wide, 76 feet long, with a craneway over the entire length of the construction floor and rooms for winding armatures and other work. All the shops are served by railroad-tracks in the centre of the construction floors.

"The motor equipment in the electric shop comprises: One 5-horse-power motor for the line-shaft; one 6½-kw., 125-volt generator for battery-charging; one 1-horse-power motor for drill-press; one 2-horse-power motor on banding-machine; and one 1-horse-power, 125-volt, direct-current motor on coil-winding machine.

"The company mess has a refrigerating plant and numerous electric appliances, and the butcher-shop has a refrigerator plant and sausage-machine.

"There are various small motors of 5, 10, and 15 horse-power used in the machine-shop, company mess-house, carpenter-shop, etc. The mines and all the houses are lighted by electricity. In the mines 220-volt current is used for lighting and 110-volt current for house-lighting. All small motors are of the three-phase 60-cycle type for 220-volt current.

"*Unloading Equipment at Docks.*—The unloading equipment at the docks is all electrically driven. On dock No. 1 there are four boom derricks; one with a 25-horse-power induction-motor for unloading quartz; and three derricks which have direct-current series motors for big ranges of speed and fast operation. These derricks are equipped with 50- or 80-horse-power motors for hoisting and a 15-horse-power motor on each boom. The 50-ton hoist has a 50-horse-power, direct-current, Westinghouse type K10 series motor, operating through mechanical brake to drums of hoist. These motors are equipped with Westinghouse R27 controllers for the 50-horse-power motors, Cutler-Hammer No. 5100 controllers for the 80-horse-power motors, and General Electric R122 controllers for the 15-horse-power motors. On this dock there is also a 10-horse-power motor which drives the matte-elevator.

"On dock No. 2 there are two unloaders. Each unloader has two motors, one for hoisting, which is a 35-horse-power, variable-speed, Westinghouse induction-motor equipped with a Westinghouse rheostatic controller, and one 20-horse-power type CCL, constant-speed induction-motor which is controlled by an auto-starter and drives the conveyor-belt.

"The two power-houses are situated facing each other on opposite banks of Falls creek, which is about 300 feet wide at this point. Close to each power-house a wooden four-pole structure is erected and the cables span the creek about 30 feet above the high water.

"In No. 1 power-house three 500-horse-power, 2,000-volt, three-phase, 60-cycle, Westinghouse type HF motors drive the blowers. One panel is allotted to each motor, and on it is mounted one three-pole type D circuit-breaker, six type DDPST oil-switches for cutting out resistance, and one ammeter and plug. Enough resistance is installed in the secondary circuit of each motor to obtain speed variation for continuous duty from half to full speed. One watt-hour meter will be installed for three motors.

"For additional 16-lb. air, there is being installed one 25,000-cubic-foot De Laval turbo-blower, driven by an 1,800-horse-power, three-phase, 60-cycle, 2,000-volt, Westinghouse type CCL motor. The control is mounted on one panel, and on the panel is one 3 DST overload circuit-breaker, and three interlocking starting-switches connecting the motor through the 2,000-k.v.a. auto-transformer, one ammeter, and one watt-hour meter. To obtain additional supply of power for the railroad, a new 500-kw. synchronous motor-generator set is being installed to run in parallel with the one at present in operation. The motor of this set will also be used for power-factor correction, and arrangements are made for future water-wheel connections on the extension of the motor-shaft.

"The cables from No. 2 power-house are brought to a panel in No. 1 power-house, on which is mounted a type B circuit-breaker, voltmeter, synchronizing-plug, and watt-hour meter.

"The two Ingersoll-Rand compressors will be driven by one 200- and one 400-horse-power type CCL motors.

"The power-line to the mine will be overloaded when these extensions are complete, and to remedy this the line potential will be raised to 6,600 volts, using a step-up bank of three 150-k.v.a., 2,200 to 6,600 to 2,200 volts at the mine sub-station. The distribution control of the whole equipment is kept at No. 1 power-house.

"*Auxiliary Steam Plant for Winter Months.*—On account of the glacier feed to Falls creek there is a period of three months in the winter of extreme cold, when the flow of water is not enough to give all the power needed to fully operate mines and smelter to capacity. To be ensured against this shortage of power there has been installed an auxiliary steam plant of 6,000 horse-power. For this purpose a reinforced-concrete building has been erected across the creek opposite and facing No. 1 power-house, with dividing walls separating the boiler and operating rooms. In the boiler-rooms there are five 550-horse-power, Babcock and Wilcox oil-

fired boilers with superheaters. All the necessary machinery is installed to make them easily and cheaply operated.

"In the operating-room there is installed: One 3,750-k.v.a., three-phase, 60-cycle, 2,200-volt Westinghouse turbo-generator; one 2,000-k.v.a., three-phase, 60-cycle, 220-volt Westinghouse turbo-generator; one 100-D.W. exciter; and one DeLaval turbo-compressor with 800-horse-power motor so arranged that it can be either driven by steam-turbine or motor. The capacity is 3,500 cubic feet of free air per minute at 100-lb. pressure. There is a space allowance for one extra turbo-generator. All the necessary condensers, vacuum-pumps, switchboards, etc., are installed to make an up-to-date and efficient plant.

"The warehouse building is of wood, 36 feet wide, 160 feet long, and has three floors. A complete stock of supplies and repair parts are kept on hand, more so than would be the case if the works were not so removed from the source of supply."

UNUK RIVER.

The Unuk river flows into the head of Burroughs bay, crossing the Alaskan Boundary about twenty-seven miles up from its mouth. Its total length is approximately sixty miles, of which about twenty-five or thirty miles drain the argillite-schist contact belt lying east of the Coast Range granite, and is the next means of access to that region north of Portland canal. The early history of the region is given in the Minister of Mines' Report for 1911, page 66.

During the summer season of 1917 prospectors again visited the district and staked several claims on the South fork and Glacier creek.

With the development of properties at the head of Portland canal, this belt will gradually be investigated farther north to the Unuk, Iskut, and Stikine rivers.

THE BELLA COOLA MINING DIVISION.

This Division has had no active mining during the year. There are about seventy claims in good standing, of which number forty were recorded this year, located principally on Dean and Burke channels, King island, and Seymour inlet.

SEYMOUR INLET.

Kitchener Group.

This group of claims, consisting of the *Kitchener No. 1* to *Kitchener No. 9* (inclusive) and the *Kitchener Frac.*, is owned by D. H. Martin, the original staker, and the Bonthrone Bros. and associates, of Vancouver. The claims are situated on the north shore of Seymour inlet, about seven miles from the head, on Wigwam bay, and about thirty-five miles from the mouth of the inlet where it opens into Queen Charlotte sound.

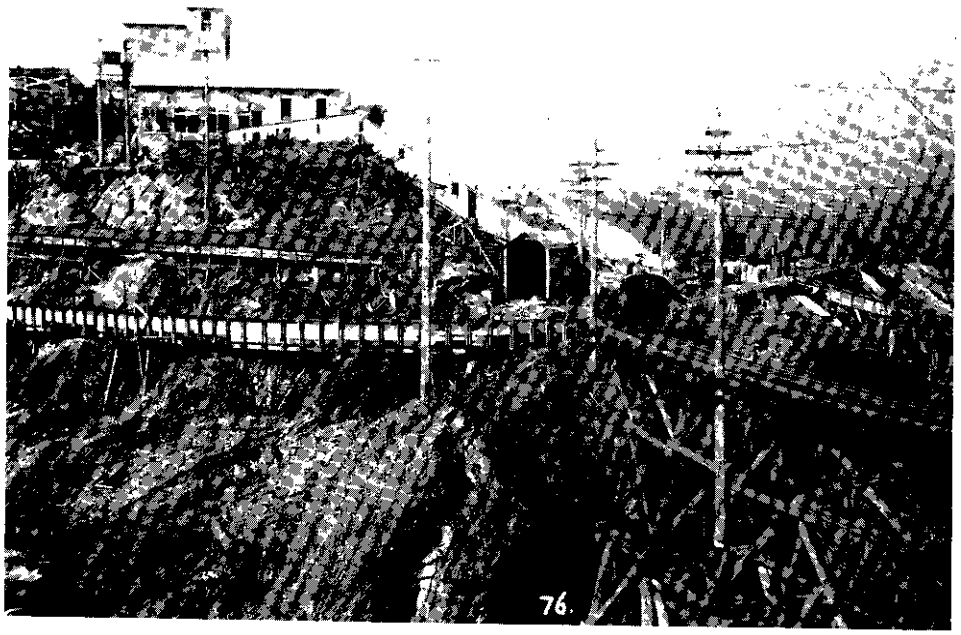
The claims are ideally situated for cheap mining, and have all kinds of timber for all purposes; a good water-power can be developed from a large creek flowing into the head of Wigwam bay, where there is deep water for any size freighter.

The rock-exposures show a dark, medium-grained diorite containing in places very coarse crystals of hornblende. In this general formation, and running in the same direction as the ore veins, are bands of crystalline limestone. The general strike of the veins is N. 50° W., with a dip of about 70 degrees east. There appear to be four veins exposed, so far, though, on account of the heavy overburden, it is impossible to trace the veins and prove the connections between the croppings. The work done consists of a few open-cuts and stripping of overburden in a few places. Sufficient work has not been done in any one place to conclusively prove the width of the vein, and no drifting whatever to show the continuity. The ore is magnetite, very clean and pure in some of the exposures, and enclosing small kidneys of rock in other places. The ore appears to be absolutely free of any form of sulphides.

No. 1 vein, on the *Kitchener No. 1* claim, is exposed at a point about 1,200 feet from the beach at an elevation of 250 feet. It has been stripped for a width of 20 feet, showing solid magnetite with small enclosures of wall-rock; further work will doubtless show a much greater width of vein. A fair depth can be obtained here by drifting to the north, and, in fact, such work should be done on all the croppings in order to better size up the vein content.

No. 2 vein, also on the *Kitchener No. 1* claim, lies about 150 feet east of the No. 1 vein and has the same strike and pitch. The cropping here is at an elevation of 250 feet, the work

Workmen's Houses, Granby Co., Anyox.



Experimental Flotation Plant, Granby Co., Anyox.

consisting of stripping and a few shots put in the ore, knocking off the surface and showing 10 feet in width of solid, clean, bluish-coloured magnetite, a sample across which gave assay returns of: Iron, 65.5 per cent.; insoluble, 4.6 per cent.; sulphur, 0.5 per cent. The showing here is worthy of further development.

No. 3 vein is exposed by two cuts on a small hill south from the open-cuts on veins Nos. 1 and 2. The first cut is not sufficiently deep to penetrate the surface filling, but shows the walls to be about 15 feet apart, the hanging of diorite and the foot-wall of crystalline limestone apparently about 2 or 3 feet thick. The second cut, at an elevation of 500 feet, is about 200 feet south of the other and about 800 feet south of the cuts on the first two veins. The foot-wall shows the continuation of the limestone-belt. The vein at this point is badly broken up on the surface, lying in huge boulders, from which a sample was taken of clean magnetite representative of everything exposed. The sample assayed: Iron, 64.4 per cent.; insoluble, 1.8 per cent.; sulphur, 0.1 per cent. A depth of 400 feet could be obtained under this cropping by drifting on the vein from the creek-bed. This vein appears to strike east of No. 2 vein, but might easily be its continuation.

No. 4 vein crops in a bluff farther up the mountain at an elevation of 700 feet; no work has been done on it, but it can be followed 100 feet along the face of the bluff, at the top of which it is buried under vegetation and at the bottom under slide-rock.

The four veins are contained in a width of approximately 700 feet, and could therefore be worked from a common crosscut tunnel driven from a suitable point near the beach.

More work is necessary in the shape of drifting or stripping and open-cutting at short intervals along the veins before diamond-drilling would be justified. Such work is warranted, judging from the quality and quantity of ore exposed by the limited amount of work done to date.

Alexander Group.

This group includes the following five claims: *Dolphin*, *Iron Pirate*, *Gillis*, *Gladys*, and *Tin Hat*, situated on the south shore of Seymour inlet, about four miles from its head. It therefore has the same natural mining and shipping facilities as the *Kitchener* group mentioned above. The property is Crown-granted and is, I believe, owned by Colin Jackson, of Vancouver, purchased from the original locator.

The upper croppings on the claims were unknown to me, and, having no guide with me familiar with the property, I therefore saw only the showing near the water. This is reached from the water's edge through a perpendicularly walled canyon down which a small creek was running, but which is no doubt a torrent at times. The ore-cropping is in a break in the right-hand wall about 500 feet from the beach and at an elevation of 300 feet. It consists of clean magnetite about 40 feet wide, in which are enclosed bunches of country-rock. No work has been done at this point, and it is therefore impossible to form any idea as to the extent of the ore-body, as it protrudes from the bottom of an inaccessible bluff.

The property has been thoroughly examined and reported on by engineers, and I presume all information can be obtained from the owner by any one interested.

I may quote the following analysis, taken from a private report, of an average sample taken from an outcropping on the upper portion of the property:—

	Per Cent.
Iron oxide, equivalent to 60 per cent. metallic iron (Fe_3O_4)	83.32
Alumina (Al_2O_3)	7.60
Silica (SiO_2)	6.37
Lime (CaO)	1.80
Sulphur (S)	0.30
Combined water, etc.	0.11
Phosphorus (P)	Trace.
Magnesia (MgO)	Trace.

PORTLAND CANAL MINING DIVISION.

This Division in area is the smallest in the Province, and includes a strip along the eastern side of Portland canal to the summit of the range between the canal and Observatory inlet, and from the head of the canal to the headwaters of Bear river, American creek, Salmon river, and tributaries of each.

The mineralized portion of the Division is mainly confined to the eastern contact of the granodiorites of the Coast range and the sedimentaries, being identical with the formation at the head of Observatory inlet. (*See* McConnell's report, 1911, Dominion Geological Survey.) There are about 180 Crown-granted claims and 400 mineral claims in good standing up to the end of 1917.

This district has had a very important revival of mining activities during this year. In both the Bear River and Salmon River valleys development-work has been under way this winter which may have far-reaching results. The rather remarkable progress made by the *Bush* property, the discovery of an apparently large body of similar ore some three miles farther up the valley, and the renewed interest displayed by large mining corporations in the low-grade complex ores of the *Big Missouri* group assure the Salmon River valley of a thorough investigation during the coming year.

A great deal of development-work has been done by the Granby Consolidated Company and the Fernie-Spokane people, who are developing the *Bush* property on Salmon river. The Granby Company has been mining at Maple bay and Swamp point, procuring limestone at the latter point. At Maple bay the company has under option a group of claims owned by Noble, Collison, and others, from which was shipped 5,341 tons of siliceous ore carrying a small percentage of copper and small values in gold and silver, which was utilized for fluxing purposes at the Anyox smelter. The company also shipped from Swamp point 64,604 tons of limestone.

The old *Brown Alaska* group of claims at Maple bay is at present being developed by Spokane interests. I am informed that their recent work has been very encouraging.

Georgia River Mining Co.

Farther up the canal is the *Guggenheim* group, consisting of eight claims—*John D., Guggenheim, J. P. Morgan, Danny, Lookout, Summit, Charlotte,* and *Hillside*—none Crown-granted. They are owned by the Georgia River Mining Company and are under the management of C. H. Dickie, of Duncan, B.C. They are situated about nine miles up the Georgia river, on the west bank, along which a trail has been constructed for about four miles from the canal, on a grade of about 7 per cent. Georgia river flows into Portland canal about seventeen miles south of Stewart, at the head. Access to the property at present is from a point about eight miles from Stewart, from which the summit of the first range, 4,000 feet elevation, is reached in three miles, thence dropping 1,000 feet in another mile to the camp. The completion of the trail up Georgia river was recommended by me and approved by the Department of Mines, which appropriated a sufficient amount, but which was not utilized on account of the lateness of the season.

Little need be said supplementing reports of 1914 and 1916, other than to note the advance in results of development-work. There are several veins cropping on the surface, but all development has been concentrated in the *Bullion* tunnel, which is at an elevation of 3,450 feet. It has been driven on the vein for 390 feet, of which 132 feet is in ore which varies in width from 4 to 12 inches. The ore-shoot has been further proven by a raise of 35 feet through to the surface, from which bonanza ore was taken, and a further depth of 32 feet by winze from the bottom of the tunnel. The more or less sorted ore on the dump taken from the tunnel averages $47 a a ton in gold.

The "Big Showing" on the property is a quartz vein outcropping at intervals for a length of 1,200 to 1,500 feet. It varies from 10 to 20 feet in width and strikes about N. 50° W., intersecting the vein on which the tunnel has been driven at an angle of between 20 and 25 degrees. The intersection of the veins is not apparent in the tunnel, but should be found with little difficulty, from which point the big vein could be drifted on, securing a depth of 300 feet under its surface exposure. An average sample across 19 feet on the surface gave assay returns of $22 a ton in gold (private report).

A small milling plant is planned by the company, with the improvement of transportation facilities. The numerous high-grade quartz-lenses occurring in the argillites should be tempting to the leaser when milling is available.

The region farther up the river has had little or no prospecting.

Prince John Group.

This group consists of three claims—*Prince John No. 1, Prince John No. 2,* and *Prince John No. 3*—owned by Nesbitt & Archie, situated about three miles north of Stewart, on the west bank of Bear river. The owners had done about 90 feet of work in a crosscut tunnel before optioning the claims to the Granby Company. It is reported that 60 feet of the distance was in a low-grade copper ore. The Granby

Company put in two diamond-drill holes and will continue the work all winter. The results so far obtained are not procurable.

Lakeview Group. This is an old group, owned by McKay & Bibeau, on Glacier creek, from which the owners have shipped several tons of high-grade grey-copper ore each summer for several years. The property is now under bond to a development syndicate that is driving a 200-foot crosscut tunnel to try to pick up the vein at depth. No definite information at this time is available.

George Copper-mines. This group is composed of nine claims—*Mamie*, *Bessie*, *Gold Crown*, *Copper Queen*, *Copper King*, *Copper Lord*, *Castle Rock*, *Helena*, and *Royal*—requiring survey for Crown grant; owned by W. B. George, of Stewart, and R. George, of Victoria, B.C.; situated on the south side of Bear river, four miles west of the Nass divide and six miles east of the head of rail, at Red Cliff, of the Portland Canal Short Line Railroad. At the base of the hill on which the claims are situated, Bear River valley has an elevation of 900 feet. The upper camp is 2,100 feet. The hill is very steep, but a horse pack-trail could be built with a good grade from the valley to the upper camp, to which at present there is a foot-trail. In the event of it becoming a producing property, no difficulty would be encountered in constructing an aerial tramway.

The country-rock is greenstone, locally called the "Bear River formation," after McConnell. There are on the property several veins and an extensive mineralized zone of from 70 to 80 feet in width lying very flat and striking N. 70° E. This large mineralization occupies an altered, more or less silicified area in the greenstone, and in which iron sulphides are disseminated, accompanied in some places by chalcopyrite. Combined pyrites and chalcopyrite also occur in bunches. There is a tunnel in this ore-body 105 feet long which is practically barren, the surface over the tunnel showing very little mineralization. This zone might develop a large tonnage of low-grade ore.

About 600 feet east of the tunnel, at an elevation of 4,000 feet, is a strong cropping of three veins contained in a width of 50 feet. Little mineralization can be seen on the surface in the filling between these veins, but it is very probable that they are all the same ore-zone. The best ore in all three will aggregate 10 feet, averaging $4 a ton in gold, 30 cents a ton silver, and 3 per cent. copper. The veins strike about N. 55° W., or a variation of 55 degrees from the strike of the main zone mentioned above, standing practically vertical and can be traced on the surface for over 1,000 feet. Shots have been put in at several places, exposing iron and copper sulphides.

East of the three veins, and no doubt intersecting or joining them, is what is called the "White vein," striking about the same direction as the main zone. It can be traced for 2,000 feet on the surface. A sample taken across the vein, just west of the "big gulch," gave 18 inches of quartz and chalcopyrite on the hanging-wall, 8.8 per cent. copper, 0.4 oz. silver, and trace of gold; the remaining 36 inches on the foot-wall assaying 14 per cent. copper, 0.4 oz. silver, and $1.20 gold. Another sample 400 feet west, across 36 inches on the foot-wall, gave 16 per cent. copper, 0.4 oz. silver, and a trace of gold. Another sample 10 feet east of the previous one, from 40 inches on the hanging-wall, gave 1.6 per cent. copper, 0.4 oz. silver, and a trace of gold.

Two hundred and fifty feet south of and parallel to the "White vein" is the "Green vein," cropping at an elevation of 4,900 feet. A sample across 5 feet gave 5 per cent. copper and $2 in gold and silver.

It would be good development to trace the three cross-veins down as low as possible to a good tunnel-site and drift on them to their intersection with the "White vein," and from that point drift on it. Though there is no timber on the claims, there is an abundance in the valley and on the opposite hill. Good water-power could also be developed from creeks on the opposite mountain.

The property looks promising, and credit is due W. B. George for the amount of prospecting and work done on the claims under difficult conditions.

Bear River Mining Co. This company holds a group of nine claims west of and adjoining the *George* copper-mine group. The ore-zone mentioned on the *George* group extends across this property. A tunnel has been driven 100 feet in a slightly mineralized greenstone, with some stripping and open-cuts above in the same material. The tunnel is at an elevation of 2,500 feet and is too low to tap the ore-zone unless driven a great distance.

Grey Copper Group.

Directly west of this group lies the *Grey Copper* group, consisting of three claims owned by Captain C. E. Clark and associates, of Victoria, B.C. The work consists of an open drift along the vein for 125 feet, giving the maximum depth of 10 feet. The elevation is 3,900 feet and about 3,100 feet above Bear River valley. The vein is composed of brecciated wall-rock of argillite cemented with calcite and has a width averaging 6 feet. The ore-seam, lying on the hanging-wall, is about 6 inches of high-grade grey-copper, from which several tons have been shipped assaying 375 oz. to the ton in silver; the balance of the vein is practically barren. The strike of the vein is N. 60° E. and dip about 60 degrees to the south.

A fair trail has been built by the Government from the valley to the camp of the Bear River Mining Company; from this a rough trail has been made to the group by the owners. The showings would warrant a couple of men mining and sorting ore, and therefore it is a leasing property.

Red Top Group.

This group is composed of *Red Top*, *Red Top No. 1*, *Hector*, *Superior*, *Superior No. 1*, and *Superior No. 2 Fract.*, and is situated on the north bank of Bear river opposite the *George* copper-mines. Considerable work has been done by way of surface stripping and open-cuts, with encouraging results. I was unable to visit the property on account of the snow.

Fitzgerald.

About eight miles beyond the *Red Top* group, or about six miles from the Bear River divide, on the Nass River slope, on Strohn creek, the Fitzgerald Bros. have located three claims, from which they brought into Stewart several hundred pounds of very fine-looking molybdenum ore. The vein-filling is quartz, which I was told varied in width from 3 to 6 feet, carrying clean molybdenite, and lies in a tongue of granite intruding the argillites or Nass formation at that point. (*See* geological map accompanying McConnell's report in Summary Report, 1911.) The ore shown me will average about 6 per cent. molybdenite and will concentrate to a clean product. Any one interested may obtain full information from S. Fitzgerald, of Stewart, B.C.

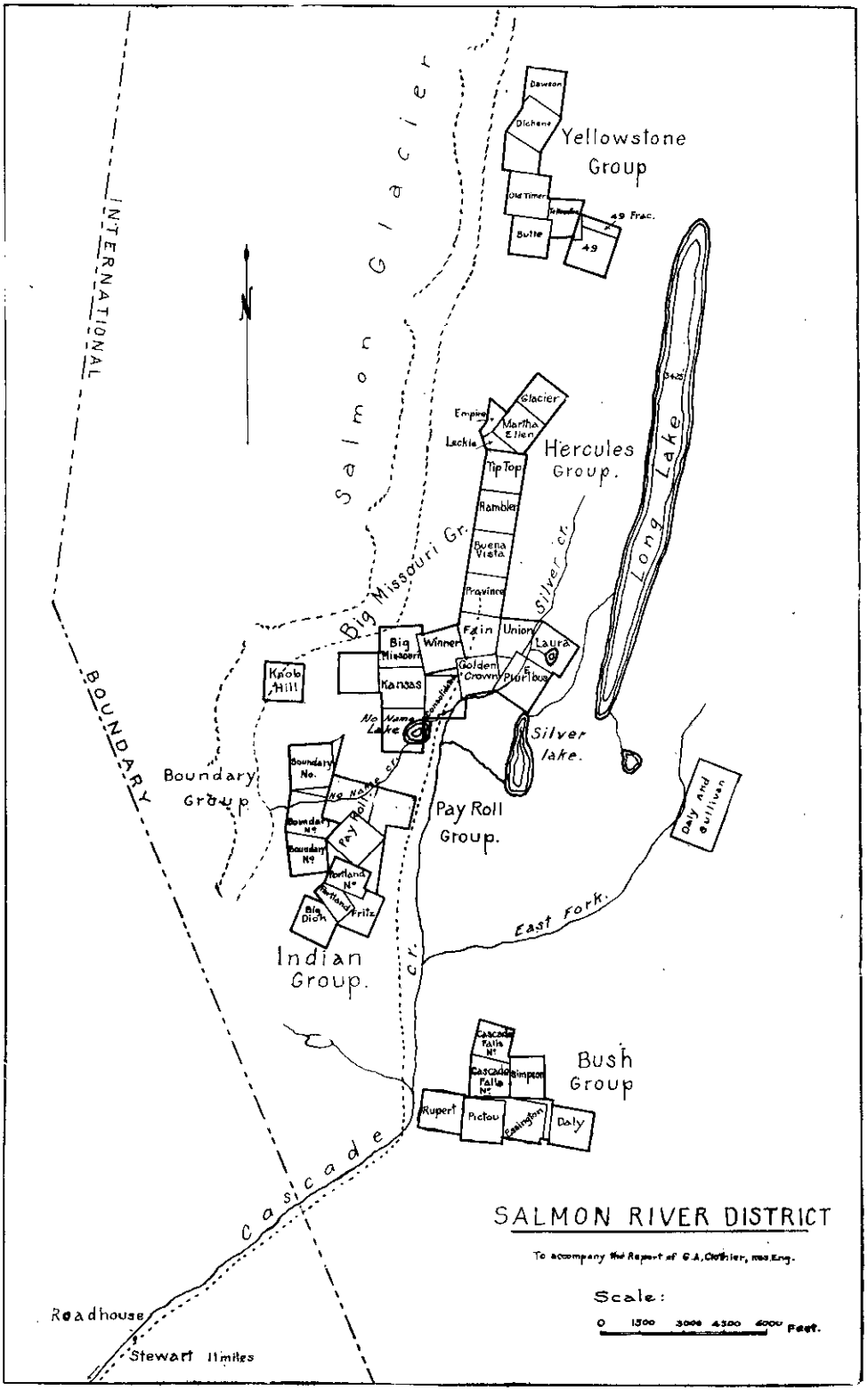
SALMON RIVER SECTION.

This section of the Portland Canal Mining Division has received considerable attention this year. The most important development has been the rather remarkable showing opened up on what is locally known as the *Bush* property. Three miles beyond this up the valley the *Joker* group has an exposure of ore on the surface that gives every promise of developing into a producer. The *Big Missouri* group, the holdings of the Indian Mines Company, Limited, the *Boundary* group, and the *Yellow Stone* and *Hercules* groups are all showing up well. Below the boundary-line, in Alaska, I am told that on Fish creek, a tributary of the Salmon river, the season's work has been exceptionally encouraging. Altogether the Salmon River valley bids fair to develop into a very productive and important mining section.

The mouth of Salmon river is at Portland City, which is about one mile and a half from Stewart, on the west or Alaska side of Portland canal. A good trail has been built from the dock at Stewart to Portland City, thence up the valley for twenty miles to the head of the Salmon river. From tide-water to Eleven-mile the grade is practically level, the elevation at Eleven-mile being 250 feet above sea-level; from this point the grade becomes heavier, rising in three miles to 1,800 feet at the *Bush* camps, and in nine miles to 3,500 feet at the *Big Missouri* cabin on the group of that name. A road was recommended from Eleven-mile to the *Bush* mine; it was approved by the Department and work commenced, but, owing to the abnormally early winter weather, the work was closed down before its completion. The extraordinary surface showings and results obtained from development-work to date warrant the construction of a wagon-road from tide-water at Portland City to the foot of the *Big Missouri* hill.

Salmon-Bear River Mining Co.

This company's holdings consist of eight claims—*Essington*, *Rupert*, *Simpson*, *Pictou*, *Cascade Falls No. 4*, *Cascade Falls No. 8*, *Dally*, and *Pat Fract.* They are situated on the east side of Cascade creek, a tributary of the Salmon river emptying into it about one mile and a half above Eleven-mile. The property is now under bond to Spokane-Fernie interests, and the mine is under the management of R. K. Neill, of Spokane. Before being taken over by the present syndicate it was held for a couple of years by New York people, who did about 1,600 feet of work, the results of which, however, did not prove sufficiently encouraging to warrant them exercising their option.


INTERNATIONAL
BOUNDARY
Salmon Glacier
Yellowstone Group
Dawson
Dichens
Old Timer
Butte
49 Frac.
49
N
Hercules Group.
Glacier
Empire
Martha Ellen
Lackie
Tip Top
Rambler
Buena Vista
Province
Big Missouri Gr.
Silver cr.
Long Lake
Big Missouri
Winner
Fain
Union
Laura
Golden Crown
Kansas
Knob Hill
No Name Lake
Silver lake.
Boundary Group
Boundary No.
No Name cr.
Pay Roll
Portland No.
Portland
Big Dick
Fritz
Indian Group.
Pay Roll Group.
Daly and Sullivan
East Fork.
cr.
Bush Group
Cascade Falls No.
Cascade Falls No.
Simpson
Rupert
Pictou
Lexington
Daly
Cascade
Roadhouse
Stewart 11miles
SALMON RIVER DISTRICT
To accompany the Report of G.A. Clothier, mg. Eng.
Scale:
0 1500 3000 4500 6000 Feet.

The present holders have, in a comparatively small amount of work, developed a sufficient amount of ore of good milling grade to justify the equipment of the property with power plant, concentrator, etc., the installation of which will be carried out as fast as possible. Several hundred tons of ore on the dump, sorted from development-work, is being rawhided to Elevenmile, and will be hauled on "double-enders" to the beach this winter for shipment. This ore will run $150, or better, to the ton in gold and silver values.

The mountain on which the claims are located is the dividing ridge between the Bear River valley on the east and the Salmon River and Cascade Creek valleys on the west. This whole ridge is almost entirely composed of greenstone, termed the "Bear River formation" by McConnell. There are, however, broad bands of argillite just south of the claims, apparently in contact with an intrusive tongue of granodiorite. The ore-body is a silicified zone in the greenstone, which is more or less schistose near the altered and mineralized portion. The quartz-zone is mineralized mainly with disseminated pyrites, although there are bunches of solid pyrite in places. The general value of the pyritized quartz is low, but in the ore-shoot now being opened up in the upper tunnel there are distributed with the pyrites the sulphides of silver, argentite, ruby-silver, and considerable native silver, making a very high-grade ore and raising the average value of a large body to a good grade of milling-ore. It would appear, from exploration-work so far, that there had been a fracturing of the original deposit of mineralized quartz and a second circulation of an enriched, or at any rate richer, solution, and deposition of its contents in the fissures. However, better conclusions on this point can be drawn when the ore-shoot is further explored.

Exploration-work on the property consists of extensive surface stripping, open-cuts across the ore-body in several places, and five tunnels, four of which are wholly or in part in the mineralized area, and one crosscut tunnel which was stopped before reaching the ore. From this work the general strike of the ore-zone is shown to be N. 80° E., with a probable dip, as shown by the enclosed parallel dykes, of about 60 degrees to the south. The lowest tunnel, at an elevation of 1,325 feet, is started on the lower limit of the claims, was driven 500 feet before encountering the vein, and continued 140 feet through it into the wall-rock beyond. At a distance of 520 feet from the portal, or 20 feet in the ore, a short drift, 40 feet long, was run following a small dyke. Some small bunches of galena were found, but the general character of the ore on this level is apparently very low grade. The drift of 40 feet seems rather inadequate exploration of the ore-body after driving a 500-foot crosscut tunnel to reach it. There appears to be no definite line of demarcation between the ore-zone and the surrounding wall-rock, but rather a lessening of silicification and mineralization grading from the ore-body to the enclosing greenstone.

A higher tunnel, 1,575 feet elevation, starts on the ore on the surface, crosscuts it for 15 feet to the dyke, which at this point is 8 feet thick, and follows it for 75 feet. At the face a crosscut 48 feet long was driven to the left and one 15 feet long to the right, both in low-grade ore. A grab sample taken from the muck-pile, which represented part of the material taken from the crosscut, gave 80 cents in gold and 2.6 oz. silver to the ton.

Farther up the hill, at an elevation of 1,750 feet, is the middle tunnel. This also was started in the ore-body, and cuts diagonally across it at N. 50° E. for 60 feet before getting out of the ore. In that distance there is 36 feet of practically solid pyrites assaying $2 in gold and 6.8 oz. silver to the ton; the balance is slightly mineralized; it was not sampled, but is evidently low grade. From the face of the tunnel a crosscut 30 feet long was run north in country-rock.

The most important development at present is the upper tunnel, at an elevation of 2,000 feet, or 675 feet vertically higher than the lowest tunnel. This tunnel had been driven about 200 feet when the property was taken up by the present holders, who have concentrated all their development on this level and the surface above it. The tunnel has been extended about 100 feet and four crosscuts, of varying lengths, driven across the ore-body. At the same time the surface has been extensively stripped and the ore-shoot exposed and sampled. The tunnel was started in the ore-body, whose general strike, as stated, is about N. 80° E., and was driven 55 feet at N. 25° E., 54 feet at N. 40° E., and 92 feet at N. 55° E. to the face at that time, from which bearings it can readily be seen that it runs diagonally across the ore-shoot, and after going through the ore gradually diverges from the vein, thus accounting for the rather discouraging showing disclosed by this work. The foot-wall limit of the ore was reached at about 100 feet from the portal; the direction was then changed, following a slip for about 80 feet, where broken-up ground was encountered and the remainder of the tunnel, about 12 feet, driven in that material.

When work was undertaken by the present bonders, a crosscut into the ore was started at a point 85 feet from the mouth of the tunnel. It was driven 8 feet, showing in that distance 6 feet of ore averaging about $60 a ton in gold and silver (company's sample and assay). Further work is necessary here to determine the direction of this high-grade shoot of ore.

Another crosscut 122 feet from the portal shows a good grade of milling-ore for its length of 37 feet. Thirty-two feet beyond this is another crosscut 40 feet long, following a fairly well-defined seam of ore, from which some very high assays were obtained.

At 201 feet from the portal the main crosscut has been driven about 75 feet, following a well-defined cross-vein the width of the cut. Sampled after each round, it shows remarkable values throughout, ranging from $60 to over $200 in gold and silver, the gold frequently running up to 6 oz. a ton and the silver to 300 oz. a ton.

The face of the tunnel was swung to the right into the ore-body and was driven only about 10 feet when high-grade ore was encountered. It has since been continued for 75 feet in high-grade ore all the way for the full width of the tunnel. I obtained, at the time of my visit, some very rich samples of native silver, ruby-silver, and argentite, carrying very high gold values as well, from the face. A grab sample from the muck-pile of the previous round in the face gave $54.40 a ton in gold and 166.6 oz. in silver a ton. I have recently been informed that the whole distance of 75 feet will average at least $100 a ton in gold and silver values. The present face is about 175 feet vertically below the surface, which has been proven high grade for a further distance of at least 150 feet; consequently it is safe to estimate the extension of the ore-shoot for another 200 feet on the tunnel-level.

Work has recently been started in the middle tunnel which will give an additional depth of 250 feet on the ore-shoot. This, I understand, is to be used as a working-tunnel.

All the upper workings have been thoroughly sampled and an accurate assay-map is kept up, to which I had access, with the request that specific samples and assays be withheld.

The manager, R. K. Neill, estimates that there is sufficient tonnage now in sight to run a 100-ton concentrator for three years on average feed of from $20 to $25 a ton, with a ratio of concentration of 6 or 7 into 1.

Good camps, blacksmith-shop, assay office, etc., have been built, and the wagon-road has been finished from the upper tunnel to over half-way down to the Government trail, which is being converted into a wagon-road.

This property should make a very important gold and silver producer within the next year or two, depending on transportation facilities.

Adjoining the *Bush* group, and no doubt containing the extension of the big ore-zone, is the property of the old Cascade Mining Company. Considerable work was done on this group in the early days of the camp, and interest will be revived in it with the opening of the *Bush* mine. No information is available as to the status of the old company or the property.

Farther up on the east side of Cascade creek are several claims on which assessment-work has been done yearly, which will doubtless receive attention with the stimulation of mining in this region.

Indian Mines Co., Ltd.

This company owns four claims on the west side of Cascade creek, opposite the *Bush* claims, on the south end of *Missouri* ridge, between the Salmon River glacier and Cascade creek. The claims are *Portland No. 1*, *Portland No. 2*, *Big Dick*, and *Fritz*, and are Crown-granted. They are at an elevation of about 2,400 feet and fourteen miles from tide-water at Stewart. No work has been done on the property since 1913.

Development consists of three open-cuts on the croppings and two tunnels. The open-cuts expose a vein from 12 to 20 feet in width, which can be followed on the surface to the end of the claims, about 2,000 feet. The vein is quartz and appears to follow a wide dioritic dyke which intrudes the greenstone-schists. The minerals included in the quartz are galena, sphalerite, and pyrites, in the order of importance mentioned. The first two open-cuts, going up the hill, show very little galena; the values are about $10 a ton in gold and silver for a width of 12 feet. The upper or main open-cut discloses the vein for a width of 20 feet, of which 5 to 8 feet in the centre is solid galena, with the same amount of zinc and galena on the hanging-wall, and the balance of the vein on the foot-wall of quartz and pyrites.

A tunnel has been driven about 150 feet vertically below and following the vein for a little over 400 feet, showing each of the ore-shoots exposed on the surface. The No. 1 shoot shows

considerable galena at this depth, with quartz and pyrites predominating, and is about 35 feet in length. The No. 2 shoot is entirely of quartz and pyrites and will average about $10 a ton, mainly in gold values. The No. 3 or main shoot, from the big cropping on the surface, was struck at about 400 feet in the tunnel and drifted on for 30 feet. The ore started from a seam on the foot-wall and has widened to 14 feet at the face, as exposed by two crosscuts. Three sectional samples across the face averaged $2.40 in gold, 3.5 oz. silver, 10 per cent. lead, and 16 per cent. zinc. The hanging-wall crosscut at the face is still in heavy zinc ore. Further work in driving this drift is very important, as the foot-wall portion of the vein, carrying the galena, is widening rapidly and has all the appearance of making into a good shoot of ore.

The lower tunnel, 150 feet below No. 1, has been driven about 60 feet on the vein, in which there is from 1 to 3 feet of good ore on the hanging-wall. On the upper end of the claims there is a 6-inch seam of ore on the hanging-wall assaying as high as $120 a ton in gold. There is a good cabin and a good equipment of all necessary tools, with a car and rails in the upper tunnel.

Boundary Group.

Adjoining the *Indian* group on the north is the *Boundary* group, owned by D. J. McIntominey and under bond to the Granby Company. East of this group and adjoining the *Indian* on the north is the *Payroll* group, owned by Bill Murphy, on which assessment-work only has been done for the past three years.

Big Missouri.

North of the *Payroll* group, just beyond Noname lake, is the *Big Missouri* group, consisting of sixteen full claims and four fractions, the principal showings being on the *Big Missouri*, *Kansas*, *Province*, *Laura*, *Golden Crown*, *Buenavista*, etc. They are owned by Dan and Andy Lindeborg, of Portland City, and the Stevenson and Proudfoot Estates, and are Crown-granted. They are situated about twenty miles from tide-water at Stewart and are reached by a good horse pack-trail.

The main mineralization and development is on the *Province* claim. The ore is a very complex one, consisting of the sulphides of iron, zinc, lead, and small amounts of copper. The insoluble or gangue content will, I should judge, comprise 80 per cent. of the total, making the ratio of concentration 4 or 5 into 1. The formation is greenstone, the Bear River formation, which has undergone alteration and silicification and has been eroded practically to the primary sulphides.

The development consists of a series of open-cuts paralleling the general trend of the ore-zone, and proves the ore to extend for a width of at least 1,000 feet on the *Province* claim. The average of hundreds of samples taken from all these cuts will run about as follows: Gold, 60 cents; silver, $1.05; lead, 2.16 per cent.; copper, 0.53 per cent.; zinc, 5 per cent.; iron, 14.3 per cent; silica, 75 per cent.

The *Golden Crown* has also a big surface showing, and has had, by way of development, a tunnel about 30 feet in length driven into the ore-body from the side of a steep bluff. This is a better-looking grade of ore than exposed on the *Province*. Some stripping has also been done on the *Laura* claim, along the bank of Silver creek, showing the same general mineralization as on the *Province*.

No samples were taken by the writer, because he realized that to get any comprehensive assays would entail a thorough sampling of the whole ore-body, which would take at least two weeks. The assays quoted on the *Province* were given by the owner and are thoroughly reliable.

With the ore-bodies proven at depth by diamond-drilling, and a process devised for the separation and recovery of the different sulphides, this property will make one of the big producers of British Columbia.

Hercules Mining Co.

North of and adjoining the *Big Missouri* group is the property of the Hercules Mining Company, of Victoria, B.C. No work of any account has been done on the property since the report in the Minister of Mines' Reports of 1910 and 1912. Full information can no doubt be obtained from the company by any one interested.

Yellowstone Group.

This group consists of three claims—*Yellowstone*, *Butte*, and *Old Timer*—owned by Bill Murphy and the Stevenson Estate. The formation is the continuation of the *Big Missouri* and the mineralization identical. Development-work consists of seven open-cuts opening up a vein up to 30 feet in width.

Lying just east of the *Yellowstone* group is the *49* and *49 Fract.*, owned by Dan and Andy Lindeborg. Opened up by three cuts, showing an average vein width of 20 feet. The highest open-cut is 37 feet wide and shows 8 feet of fine-looking ore which assays $7.20 a ton in gold,

31.4 oz. silver, 1 per cent. lead, and 2 per cent. zinc; further mineralization of 12 feet of lower-grade ore.

All the claims north of the *Big Missouri*, though having large surface showings, are practically dependent on the future of the *Big Missouri*.

Silver Tip Group. This group is situated on the east bank of Silver creek near its head. The vein has been exposed by three open-cuts, showing about 8 inches of galena in a quartz vein which lies on a dip of 45 degrees. A sample of the broken ore at the upper open-cut gave assay returns of 40 cents in gold, 1 oz. in silver, and 11 per cent. lead. A tunnel has been driven 40 feet on the vein from Silver creek, 200 feet below the upper cut. A sample taken from ore piled on the dump assayed: Gold, trace; silver, trace; lead, 8.5 per cent.

Little Joker Group. This group consists of three claims—*Little Joker*, *Mineral Hill*, and *Midas*—situated east of and adjoining the *Laura* mineral claim of the *Big Missouri* group. They are owned by Martin & Carter and, I understand, are under bond to P. Welch, with work to be undertaken early in the spring. These claims have been held by different prospectors for the past eight years, during which time no assessment-work has been done on them. This summer Martin & Carter, who are developing, under bond, the *Seven Mile* property on Salmon river, bought the *Little Joker* claim from the owner and staked the other two adjoining claims. They immediately began prospecting by shooting off the surface where the rock was exposed. I took six samples from these places which, I estimate, represent an ore-body at least 60 feet in width. The ore is identical with that of the *Bush* mine, carrying argentite, ruby and native silver so intimately mixed with the disseminated iron that it is doubtless a primary ore. The deposit appears to lie between the greenstone formation of the *Big Missouri* on the west and a wide slate-belt on the east, which extends south three or four miles to Slate mountain and probably overlies the greenstone.

The six samples assayed as follows: No. 1, from small outcropping: Gold, $4.40; silver, 11.88 oz. No. 2, trench 2 feet deep, 20 feet wide: Gold, $9.20; silver, 32.71 oz. No. 3, bluff, 30 feet below No. 1 sample: Gold, $13.60; silver 29.90 oz. No. 4, bluff, above No. 1 sample: Gold, $12.80; silver, 90.20 oz. No. 5, No. 1 after shooting off surface: Gold, $13.60; silver, 86.32 oz. No. 6, same as No. 2, best ore eliminated: Gold, 80 cents; silver, 3.60 oz.

About a mile of trail will have to be built from the main Salmon River trail to the property. The development of these claims will be of great interest to every one in the district because of the remarkable surface showings and values.

THE STIKINE MINING DIVISION.

ISKUT RIVER.

The writer made a trip up to the head of the Iskut river the latter part of September by river-boat from Wrangell, Alaska. The Iskut is a tributary of the Stikine river, flowing into it about six miles above the boundary-line between Alaska and British Columbia, about forty miles from Wrangell. It is navigable for a distance of thirty-eight miles from its confluence with the Stikine to what is called the "Big canyon," which is several miles in length. The river-boat is of the type developed on the Yukon river and operated by Captain Barrington from Wrangell to Telegraph Creek. The trip was made in twenty-four hours from Wrangell, lying overnight at the boundary.

The district is practically unexplored because of the difficulties of transportation, heretofore the only means of getting into the country being by means of poling and lining up in small boats. The prospects of ever being able to get anything out of the country were therefore not encouraging from the prospector's viewpoint. This experimental trip of this type of boat convinced me that, in so far as transportation is concerned, a comparatively small appropriation for the clearance of snags and sweepers each year will overcome all the difficulties. The prospector is therefore assured that in future he will not be so handicapped, for the river can be made navigable for at least five months in the year, from May 15th to about October 15th.

The rock formation, so far as I was able to see, is typical of the eastern contact between the Coast granodiorite and the older Interior sedimentaries, being very similar to the district at the head of the Portland canal and Observatory inlet. The predominating rock appears to be greenstone, through which run wide bands of silicified and altered rock, in places more or less schistose, also bands of slate and intrusions of granite. The general strike of the different

formations appears to be about east and west. In the greenstone-belts lie small veins of quartz carrying pyrites and chalcopyrites, while throughout the silicified bands or zones is disseminated iron pyrites. A sample was taken across 400 feet at intervals of about 15 feet and assayed only a trace of gold and a trace in silver.

Iskut Mining Co.

Two groups of claims have been held for a number of years by this company, whose head office is in Wrangell, Alaska. The upper group consists of nine claims—*Copper Queen, Marguerite, Iskut, Golden Pheasant, El Oram, Silver King, Brown Bear, Silver Dollar,* and *Blue Grouse.* The rock-exposures on this group are mainly greenstone containing a small copper vein mentioned above, but unfortunately they were covered with snow at the time of my visit, and I was therefore unable to get over them or any of the higher ground. About a ton of ore was shipped from one of these showings a number of years ago, assaying: Gold, $1.20 a ton; silver, 44.2 oz. a ton; copper, 12.45 per cent.

The lower group is composed of five claims—*Red Bird, Katherine Fract., Red Bluff, Homestake,* and *Mermaid.* In this group lies what is called the *Red Bluff* vein, which is a wide, highly altered, sheared zone in the greenstone, in which is disseminated iron pyrites carrying a little chalcopyrite. The ore is exposed in a huge bluff on the west end of the claim standing about 800 feet in height. This vein was sampled farther along across 30 feet, giving only small values in copper, with a trace of gold and silver.

In places along the side of the mountain the surface is covered with sand and gravel cemented together with iron oxide to a depth of over 6 feet.

Numerous small dykes up to 8 or 10 feet in thickness, of fine-grain, greenish-black basalt, cut across the series of formations at almost right angles.

It is my intention to make a reconnaissance of this district in the coming spring as soon as weather will permit.

There are a number of claims staked on the Stikine river, but I have no information as to what mining has been done.

QUEEN CHARLOTTE MINING DIVISION.

The Queen Charlotte Division has had one regular shipper in the *Ikeda* mines, which produced 1,000 tons of copper ore containing 153 oz. gold, 1,792 oz. silver, and 152,883 lb. copper. A later shipment of 50 tons has been made, from which no returns have been received. During the year extensive development and installation of equipment was planned but failed to materialize. I understand that the property may be equipped next summer with suitable power and concentrating plants.

The owners of the *Quinitsa* claim, on Copper island, just outside of Jedway harbour, shipped 40 tons of copper ore, assaying 13.7 per cent. copper to the Granby smelter. Several small shipments, of a few tons each, were shipped to the Granby smelter by claim-owners.

An Eastern company has bonded the *South Easter* group of claims, situated about a mile from Skidegate, and has done considerable hand development-work, and is now installing drilling-machinery to give the property a thorough testing.

About twenty-two leases have been applied for for beach claims east and west of Rose spit. The leasers propose to work the black sand for its gold and platinum content, and to that end have done considerable prospecting-work, but as yet have made no production.

No further development in the prospecting for oil on the west coast of Graham island has taken place.

UNUK RIVER.

Some years ago there was considerable mining activity on this river, and several miles of wagon-road were built at the time. Nothing, however, has been done for several years until this season, when J. Pederson and associates staked about a dozen claims. The results of any development-work in this section will be very interesting, as very fine specimens of ore have been brought out from time to time. I suppose transportation is the chief drawback to the prospecting of this promisingly situated area.

LIARD MINING DIVISION.

The Gold Commissioner at Telegraph Creek, H. Dodd, has furnished me with the following production from this Division:—

The total production of gold for the year was about $5,750; placer gold, from Boulder creek, Dease lake, $1,975; from Dease creek, $2,925; individuals, the balance.

ATLIN MINING DIVISION.

I am indebted to the Gold Commissioner, J. A. Fraser, for the following information of this Division:—

The Atlin Division, though suffering under a handicap of labour shortage, produced about $305,000 in placer gold, distributed as follows:—

Boulder creek was worked from May 15th to October 15th, employing on an average of sixteen men, and produced: Miller, $26,235; J. H. Black, $5,700; a total of $31,925.

Pine Creek: The Columbian Mines Company, operating from April 10th to October 25th, and employing an average of forty-two men for three months and thirty men for the balance of the time, produced $41,000.

Ruby creek: The Placer Gold Mines Company, operating from May 1st to October 14th, employing an average of seventeen men, produced $77,550.

Otter creek: Maluin, operating from May 1st to October 30th, employing an average of nine men, produced $15,000.

Spruce creek: Mr. Matthews, operating from January 1st to October 22nd, employing an average of thirty men, produced $57,400; Morse, operating from January 1st to October 15th, employing six men, produced $15,000; Foley, operating from October 7th, 1916, to November 5th, 1917, employing an average of four men, produced $9,300; Tintinger, with three men, from January 1st to October 30th, produced $5,300; Smith & Carlson produced $3,400; the *Tobacco Box* produced $1,860; Falconer, $1,200; total from Spruce creek, $93,460.

Birch creek produced $2,000.

Various properties, employing from two to five men for different periods, bring up the total number of men employed to about 250, and the total production to $305,000, as stated.

No returns have been received from the *Engineer* mines, though producing all year.

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, 1917.

I have to admit a slightly decreased output as compared with that of the previous year, for which, as usual, various obvious causes and reasons might be assigned, scarcity of labour and shortage of water on some of the creeks being two of the principal causes.

The season was marked by wide variations in temperature, in consequence of which there was experienced some of the warmest and again some of the coolest weather noted since the inception of the camp. Although the water-supply on some of the creeks was embarrassingly short during part of the season, yet owing to the cool weather and copious showers at intervals there was a fairly good supply provided on most of them, which was utilized to the fullest extent, but the supply of labour was the poorest and most meagre we have ever had, I believe, and in any event, for a number of years.

There was a marked decrease in output on two of the principal creeks, and on another there was practically nothing done, but the increased production on other creeks brought the aggregate well up to that of the previous year, notwithstanding that the number of producers was considerably less. As usual, also, the reported output does not represent the total, because of the number from whom no returns have been secured.

McKEE CREEK.

Taking the creeks in the same order as in former years, I will commence with McKee creek, where the Delta Gold Mining Company, under the management of George Adams, commenced operations on April 28th, and with a force of from twelve to fifteen men continued until September 30th.

The water-supply was rather intermittent, notwithstanding the contributing assistance of two reservoirs, and the progress of operations uncovered intrusions or upheavals of bed-rock where none was anticipated, so that, although a considerable area of bed-rock was uncovered, the results were not as satisfactory as in the previous season; and as the later operations appeared to indicate that the best "pay" was underlying a heavy overburden of gravel on the north side of the creek, work was suspended a little earlier than usual, and prospecting operations were commenced down-stream at a point below all previous operations, and a prospecting-tunnel is being run into the bank in search of the pay-streak.

I am pleased to be able to say that latest reports from this work are to the effect that very satisfactory indications are being encountered, showing the existence there of the desired formation and of gold in encouraging quantities. Should further development prove this gravel to be what the operators believe it to be, it means a new lease of mining life for the creek, for there will be sufficient ground between this point and the known point of disappearance above to keep them operating hydraulically for many years to come, and there is sufficient grade to provide ample dump.

PINE CREEK.

On Pine creek the Columbian Mines Company, representing the North Columbia Gold Mining Company, the Pine Creek Power Company, and the Atlin Consolidated Mining Company, under the general management of Paul W. Greyer, with a force of between forty and forty-five men, operated at two points on the south side of the creek, besides carrying on drifting operations on the Atlin Consolidated Mining Company's ground on the north side.

In a pit on the eastern group of leases twelve men operated for three months and moved over 28,000 cubic yards of gravel, from which fair returns were secured. On the south leases (so

called) about twenty-four men were employed from April 10th until near the end of October. This force operated in two different pits and moved about 165,000 cubic yards of gravel, recovering therefrom much better returns than were secured from the first pit above mentioned.

In these pits a different run of gold appears to have been encountered, and of a higher grade than that found elsewhere on the creek (fineness 836), and bed-rock in this channel was 7.5 feet lower than in the older workings. This deposit has already been traced for a distance of 1,800 feet along the course (or channel), and a crosscut of 100 feet has failed to discover or determine its width. It is also said to yield a higher value per cubic yard than the gravels in the older workings.

About six men were engaged in drifting operations upon the leases held by the Atlin Consolidated Mining Company (north side).

Upon the *Menzies* group of leases, formerly held by the Pine Creek Flume Company, but now owned by C. L. Queen, drifting operations were carried on by a few men, varying from four to eight in number; results very good at times.

The reported aggregate output from this creek was $40,000 less than in 1916. About ten men are drifting on this creek this winter.

SPRUCE CREEK.

On the Spruce Creek Power Company's leases a few men were drifting throughout the year with very indifferent results.

On the *Tobacco Box* bench lease drifting operations were in progress throughout the year. The results secured were moderate.

On the *Gladstone* bench lease and vicinity three men carried on drifting operations throughout the year. The results appear to have provided wages at camp rates, or thereabouts.

On the *Peterboro* bench lease H. O. Morse, on behalf of self and co-owners, with an average force of six men, prosecuted drift-mining throughout the year, apparently with very satisfactory results, the output aggregating over $16,000.

On the *Lovell* group of leases (three bench and one creek) Isaac Matthews had a force of from twenty to forty-three men (with an average of thirty) operating by drift-mining methods, and in ten months (period covered by returns) cleaned up over $57,000.

Those operations were practically all carried on by "laymen," who provided their own equipment.

On the *Mali* claim William Foley, with an average of four men, carried on drift-mining throughout the year with apparently gratifying results, and realizing an output of $10,000 or upwards.

On *Discovery* claim J. M. Ruffner's "laymen" prosecuted drifting operations throughout the year with fair results, but no new plant was installed as was foreshadowed in last report.

Mixed operations of open sluicing and drift-mining were carried on by Smith, Conroy & Carlson, Otto Miller and partners, Marco Pini and partners, and others, with satisfactory results in most cases; whilst J. R. Clay continued his resluicing operations in the creek-bed, as for a number of years past.

At Blue canyon W. G. Sweet operated with an hydraulic plant for about five weeks, but was compelled to close down early in June for want of water. Later in the season he commenced the construction of a dam for the conservation of the water of the South fork of Spruce creek, which will probably be utilized and made effective next season. There were about 110 people on this creek during the summer, of whom about eighty were engaged in mining.

There are about eighty people resident on Spruce creek this winter, of whom between fifty and sixty are engaged in drift-mining.

This was again the banner creek of the district from the standpoint of aggregate production, although the reported output is nearly $12,000 less than that of 1916.

BIRCH CREEK.

On Birch creek I regret having to report another season of unsatisfactory results, owing principally to the lack of sufficient water to move the overburden of material overlying the "pay." During the early part of the season the water-supply was fairly good, but an exceptionally heavy rainfall caused the partial demolition of the reservoir dam, and during the latter part the water supply was exceedingly limited and ineffective.

I am pleased to say that the manager reports the evidence of much improved conditions at the close of the season, and the indications are that successful results may be anticipated from next season's operations.

Only from five to eight men were engaged in mining on this creek during the past season.

BOULDER CREEK.

On Boulder creek from twenty-five to thirty men were employed during the season, and ordinary sluice, hydraulic, and drift mining were pursued, with very satisfactory results to the operators as a whole, although the intermittent nature of the water-supply was somewhat embarrassing to some of the operators at times.

On lower Boulder, and on what was formerly the property of the Société Minière de la Colombie Britannique, Charles Miller carried on both hydraulic and drift mining, the former on the *Riviera* creek lease, where three men uncovered upwards of 11,000 square feet of bed-rock and recovered therefrom nearly $5,000. The drift-mining was prosecuted on the *Micobri* and adjacent leases by a force of about ten men, and with very satisfactory returns, for they secured about $16,000 as the result of their operations from January 1st to the end of October, when the returns were made.

Those drifting operations are being carried on throughout the winter by a force of about fifteen men, and with apparently equally gratifying results.

Farther up the creek, Gus Anderson, with four or five men, and J. H. Black & Co., with seven or eight men, operated throughout the season; the former by ordinary sluicing and the latter hydraulically, with fair success notwithstanding the handicap caused by the lack of proper reservoirs and conservation of the existing water-supply.

The season's output from this creek exceeded that of 1916 by over $20,000. There are about twenty men on the creek this winter, most of whom are engaged in drift-mining.

RUBY CREEK.

On Ruby creek T. M. Daulton, manager for the Placer Gold Mines Company, with a force of from thirteen to nineteen, and an average of seventeen men, commenced operations on April 26th and continued hydraulicking until October 14th.

During the period of operations they advanced up-stream 108 feet on one side and 305 feet on the other, with an average width of 250 feet, and removed and washed about 60,000 cubic yards of gravel, from which was won nearly $80,000, thus completing a very satisfactory season's operations. The water-supply was satisfactory during the greater part of the season, but on at least two occasions the supply became so scarce as to very much hamper operations, and although said company had sufficient labour to meet its requirements most of the time, there was a month or six weeks during which an additional supply would have been very acceptable and useful, but it was unobtainable. The average depth of pay-gravel was about 40 feet.

Some prospecting-work was done farther up the creek and satisfactory results reported, but no formal returns of output were made. Altogether there were about twenty-eight people on the creek during the summer, and there are about eight people on it this winter who are engaged in drift-mining.

A number of leases have been located upon the upper reaches of the creek, upon some of which development-work will likely be in progress next season, and, altogether, the indications warrant the anticipation of another very successful season on that creek.

CRACKER CREEK.

On Cracker creek O. P. Zortman, with a small crew of miners, was doing prospecting development-work throughout the season, but had no output to report. He expects to continue it next season.

WRIGHT CREEK.

Nothing was done on Wright creek during the season, owing principally to the scarcity of labour and the absence of some of the property-holders thereon who are on the "firing-line" in France and Flanders.

OTTER CREEK.

On Otter creek the Mines d'Otter, under the superintendence of W. H. Brethour and the general management of H. Maluin, commenced operations on May 1st, and with an average force

of eight men continued hydraulic operations until the end of October. Water-supply was fairly good, as they had two reservoirs to draw upon. Two and sometimes three Hendy giants were kept in operation under 230 feet pressure, and banks 130 feet in height were washed down, although the average depth (or height) of the gravel was about 85 feet. Their sluices were extended 900 feet up-stream and about 200,000 cubic yards of gravel was moved. The cost of operations was reported to be 25 per cent. in excess of that of previous seasons, due to the higher cost of wages, explosives, and cost of living. Notwithstanding this, more than sufficient gold to cover the season's operations was recovered, this being the first season they were able to do so since installation was undertaken several years ago.

However, bed-rock was fairly reached at last, and $15,000 was recovered from a very small area of bed-rock, and the indications now are that those interested will soon recover the amount of investment and be rewarded with good dividends.

There are seven men on the creek this winter, some of whom are drifting.

On upper Otter J. E. Moran did not operate during the past season owing to the unsatisfactory conditions with respect to labour and water.

BULL AND FOX CREEKS.

Two or three men on each were operating on Bull and Fox creeks, but the water-supply vanished so early in the season that they were unable to make any satisfactory showing.

O'DONNEL RIVER.

On O'Donnel river the O'Donnel Placers Company did not attempt to operate, and nothing worth noting was done elsewhere on the stream, except that two men spent the season prospecting on O'Donnel at the mouth of Feather creek and were sufficiently encouraged to locate two leases there in addition to some already held at that point.

OTHER CREEKS.

Two men, and sometimes three, were prospecting on Slate creek throughout the season, but have not reported results.

Nothing was done on Wilson, Burdette, Consolation, Davenport, Hemlock, Horse, Lincoln, Rob Roy, or Volcanic creeks during the summer, but there are six or seven men on Volcanic this winter. The fact is that the men were not in the district to prosecute development or actual mining on the creeks above named.

On Graham creek two men were prospecting a good part of the season. Some gold was recovered, although none was reported.

A number of men were prospecting on outlying creeks as usual, but no new "strikes" have been reported.

Drifting operations are being prosecuted this winter on McKee, Pine, Spruce, Boulder, Ruby, Otter, Volcanic, and possibly on O'Donnel, and from 80 to 110 men are engaged in such work throughout the district.

I may remark in passing that the decrease in output this season has been on the part of the companies, the individual miners' output having actually exceeded that of the same class in 1916 by over $1,100, but both classes fell off in the matter of revenues, such as royalty tax, etc., but much the greatest falling-off was on the part of the companies.

Winter settled down upon this district last fall earlier than usual. The ground was completely covered with snow about October 20th and has not been uncovered since; there has been a much heavier snowfall up to date than for a number of years, and there was probably twice the depth of snow on the level on December 31st than there was at any time last winter. The weather was also exceptionally cold and stormy, and during a good portion of December the temperature was lower than for a number of years, or, in fact, since weather statistics have been kept at this point, the thermometer ranging from 30 degrees below zero to 65 degrees below for several days and nights together, and not rising above 30 degrees below during that period. Mining operations were suspended during the very cold weather, but are in full swing again, and a probable result of the severe weather and great snowfall is likely to be a very much increased water-supply for next season, which result is ardently desired by all who are in any way interested in the chief industry of the district.

MINERAL CLAIMS.

The scarcity of labour and capital for development purposes affected the quartz-mining industry also, so that very little beyond ordinary assessment-work was done upon any quartz properties throughout the district, with the exception of the *Engineer* mine on Taku arm and the *Maid of Erin* and associate claims in the Rainy Hollow section.

Even on the *Engineer* mine they seem to have been practically "marking time" pretty much all season, because there appears to have been one relay of "experts" after another on the property, sampling and prospecting it whilst negotiating for its purchase, but no sale has been reported up to date so far as I have heard. A force of from five to fifteen men was employed in and about the mine throughout the summer season, and a small force is operating there this winter, developing and prospecting.

I have not been favoured with any report as to methods, extent, and results of operations by either owner or manager, or as to output, etc., but from such information as I have been able to secure I am led to believe that each successive development exposes increased values and area of highly mineralized ground.

I have not received any report from the operators on the *Maid of Erin* either, but from other reliable sources I have learned that very satisfactory evidences of values resulted from the exploratory work performed upon it so far as it went, but operations were suspended in the fall and nothing is being done there this winter so far as I know.

About thirty men were engaged in prospecting and mining in one form or other in the Rainy Hollow section during the summer season.

On the Laverdiere properties the Laverdiere Bros. worked all last winter with a view to commencing to ship ore in spring, but not securing the transportation facilities and conditions they desired, they closed down in spring, and have since bonded their entire holdings to a representative of American capital who expects to commence active operations next spring or summer.

Nothing has been done towards the development of the coal-deposits in the district during the year.

Neither have any shipments of hydromagnesite been made, but the property has been bonded to English capitalists, and some activity and development may be looked for next season, provided they are not precluded by war conditions.

Following is a statistical report of work done and revenue collected at this record office during the year 1917:—

OFFICE STATISTICS—ATLIN MINING DIVISION.

Free miners' certificates (individual)	408
Free miners' certificates (company)	7
Placer records	2
Placer rerecords (representing 254 claims)	239
Leases located	10
Leases issued	8
Leaves of absence (representing 131 claims)	23
Filings	2
Bills of sale (placer)	20
Bills of sale (hydraulic)	35
Bills of sale (mineral)	19
Mineral records	40
Certificates of work	131
Filings	12
Certificates of improvements	11
Crown grants issued	10
Gold reported (individuals)	$146,646 00
Gold reported (companies)	145,937 00
Total	$292,583 00

Royalty paid (individuals)	$ 2,013 65
Royalty paid (companies)	2,029 45
Total	$ 4,043 10

Revenue.

Land revenue	$ 8 00
Water revenue (rentals)	121 60
Free miners' certificates (individual)	1,883 50
Free miners' certificates (company)	605 00
Mining receipts (lease rentals)	2,130 00
Mining receipts (lease applications)	200 00
Mining receipts (other sources)	2,240 70
Mineral-tax (royalty)	4,043 10
Receipts from all other sources	9,444 09
Total	$ 20,675 99

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, 1917.

The season's work, I regret to say, has produced very small returns, and in consequence a decrease in office revenue.

PLACER CLAIMS.

On Thibert creek the Dease Syndicate, handicapped by the labour shortage, made the best they could out of the unusual conditions, and to F. N. Fenton, the manager, I am indebted for the following report:—

"I arrived at the mine, on Thibert creek, April 29th, and found an unusual amount of snow remaining on the ground and the weather holding out cold. On May 1st secured what men were available and commenced the preliminary work, such as getting the flume and pipe-line in order for the early freshets.

"During the winter the large pipe-line had been hauled over by dog-teams to the Boulder Creek slope; this was laid in place, consisting of all 18-inch pipe, 800 feet in length, with an offset at foot of slope and two 18-inch valves attached, giving about a 300-foot head; a No. 6 giant was set at the foot of this line to open up pit No. 2, which is on the south side of Boulder creek; the other line was extended across to the north side of the creek to open up pit No. 3, with another No. 6 giant attached.

"This work was completed by the time the first freshets commenced on May 24th, and the Boulder Creek water was made use of, but owing to the three miles of flume, which delivers the water from Berry creek, being in such poor condition, it delayed starting a double shift until June 17th. About this date the frost commenced coming out of the ground, and the old Berry Creek slide started to settle and continued to do so until the middle of August; during this time the flume-grade had settled 27 feet, which caused considerable loss of time for those three months.

"On September 10th the water began to fall off, which made it necessary to store for four hours each day in order to get a full head for twenty hours; pits Nos. 2 and 3 were extremely rocky, and in order to get dump in pit No. 2 a great deal of rock-cut was necessary, and being almost impossible to procure rockmen in the country, progress was very slow. After piping ten days in pit No. 3 a strata of volcanic mud was encountered 30 feet in thickness, which was very tough and required blasting; old workings were uncovered lengthwise across the channel, 75 x 100 feet; these old workings seem to have been carried on at a much earlier period than

any uncovered in past seasons, judging from the condition of the timbers; none of the old-timers remaining in the country dating back to 1874 seem to know when it was done.

"Progress was slow and discouraging the entire season, being compelled to work short-handed owing to so few men left in the country, and these, with the exception of several, unreliable; Indians were tried, with very poor results, being unskilled and unsteady, not remaining on towards the close when the weather turned cold; this left a small crew to finish the season.

"On October 4th the flume broke at a point where it crossed a gravel-deposit; this occurred about an hour before daybreak, and was not noticed until the water went off at the mine. By the time the break was reached 100 feet of flume had been washed away and a cut 75 feet made, which, owing to the lateness of the season and such a small crew, it was impossible to repair; owing to this break I was unable to make the final clean-up, as had been planned for the next four shifts. A small portion of No. 3 sluice was cleaned, with satisfactory results; the other sluices were not cleared of heavy material, which made it impossible to clean up this season.

"Running-time per month as follows: June, 12 days; July, 22 days; August, 23 days; September, 24 days; October, 4 days; total for season, 85 days.

"*Rock-cut Work.*—Pit No. 2, 150 feet by 30 feet deep; pit No. 3, 125 feet by 10 feet deep.

"*Sluice Extensions.*—Pit No. 1. 48 feet; pit No. 2, 178 feet; pit No. 3, 252 feet.

"*Yardage handled.*—Pit No. 2, 148,000 cubic yards; pit No. 3, 200,000 cubic yards; total, 348,000 cubic yards."

Dease Creek.—Hanimann & Rueppe during the winter drifted out 850 square feet on the *Mabel* claim and 700 on the *Mabel Annex;* this was sluiced up and finished June 5th with good returns; the balance of the season was put in constructing a ditch and flume on the *Kangaroo* lease, on which they intend to operate the coming season.

Mosquito Creek.—Very little was done.

Deloire Creek.—With the exception of prospecting by Love & Cunningham, nothing worth mentioning was done on this stream.

McDame Creek.—Development-work was carried out on the *Princess May, Lion,* and *Clifton* leases, owned by the Princes May Hydraulic Company and under the management of Amos Godfrey.

QUARTZ-MINING.

The usual amount of development-work was carried out on all mineral claims to cover assessments; on the Iskut river application for Crown grants have been received from F. E. Bronson and associates for the *Red Bluff, Red Bird, Mermaid, Homestake,* and *Katharine Fr.*

During the fall the district was visited by R. G. Waylen, superintendent of the *Treadwell* mine, who with two assistants visited a number of mineral claims on the lower Stikine; owing to the lateness of their arrival, a short time only could be spent in their examinations; it is their intention, however, to return in the spring.

COAL.

Very little has been done the past season.

OFFICE STATISTICS—STIKINE AND LIARD MINING DIVISIONS.

Revenue collected from free miners' certificates	$ 373 75
Revenue collected from mining receipts	590 75
Revenue collected from other sources	2,902 90
Total	$3,867 40

SKEENA DISTRICT.

SKEENA AND BELLA COOLA MINING DIVISIONS.

BY J. H. MCMULLIN, GOLD COMMISSIONER.

These two Mining Divisions have been very thoroughly covered by Geo. A. Clothier, Resident Engineer, and I have nothing to add to his report. (*See* page 37 *et seq.* of this Report.)

OFFICE STATISTICS—SKEENA AND BELLA COOLA MINING DIVISIONS.

Free miners' certificates (individual)	679
Free miners' certificates (company)	6
Free miners' certificates (special)	2
Mineral claims recorded	597
Certificates of work issued	614
Bills of sale, etc., recorded	161
Filings	70
Certificates of improvements recorded	19

Revenue.

Free miners' certificates	$3,642 75
Mining receipts, general	4,021 15
Total	$7,663 90

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, 1917.

The renewed interest shown by investors in properties in this Division and encouraging reports received from properties on which development was being carried on were accountable for a decided increase in the number of locations recorded. One hundred and eighty seven records for locations were issued; the largest number of records issued since 1911. Options were negotiated on nine properties, and on three of those properties development-work was commenced and carried on until the end of the year. Unfortunately, an exceptionally short season, due to heavy snowfalls in the late spring and a continuance of severe rain-storms in the early fall, combined with a scarcity of labour, necessitated the postponing of work, which had been projected on several properties, until the following spring. The commencement of this work, combined with a continuance of the development-work carried on during 1917, would indicate prospects for a considerable activity in this Division during the coming season.

Following are the reports received from the different sections:—

MAPLE BAY.

Operations were carried on in a small way on the property owned by W. Noble and associates, under bond to the Granby Consolidated Mining, Smelting, and Power Company, Limited, and shipment was made of over 5,000 tons to smelter at Anyox. A small amount of development-work was also carried on. No further construction-work was done and the property was closed down for the winter about the middle of November.

* *See also* Report of Resident Engineer, page 37.

During 1908-9 over 10,000 tons of ore was shipped from the *Outsider* group (Brown-Alaska property), but it has lain dormant until this spring, when, under the direction of D. M. Drumhellier, camp buildings and wharf were overhauled, trails rebuilt, underground workings cleaned out, several short crosscuts from the main drift were driven, and the advancement of the lower drift a distance of 21 feet. In September a contract was let to drive the lower drift an additional 300 feet. At the end of the year this work had progressed well over 200 feet.

SWAMP POINT.

At the Swamp Point lime-quarry operations were carried on very steadily throughout the whole year by the Granby Consolidated Mining, Smelting, and Power Company, Limited. Shipments were heavier than in 1916, averaging slightly over 4,600 tons a month. A new six-room cottage was built and work was started on the foundations for a fuel-oil-driven compressor, which it is intended to install at this point. The quarry was well able to take care of all requirements. The construction-work connecting the reserve lime-quarry, situated about half a mile up Donahue creek, to the dock was completed during the year.

GEORGIA RIVER.

On the *Guggenheim* group of claims, under option to the Georgia River Mining Company, Limited, Duncan, B.C., 25 feet of 5- x 7-foot tunnel and a winze, 35 feet, were recorded. I understand the results obtained from this work were very satisfactory, and it is the intention of the mining company to erect a small mill on the property as soon as transportation arrangements can be made in the spring.

MARMOT RIVER.

On the claims in this section there is only the annual assessment-work to report.

SALMON RIVER.

On the *Bush* property, under option to R. K. Neill and associates, work was commenced towards the end of March under the direction of Mr. Neill. A gang of fifteen men was employed on this property during the past year, and at the end of the year work was still being carried on. Camp buildings were erected; trails constructed; 62 feet of tunnel, 5½ x 7 feet, driven on the *Simpson* claim, and considerable ore has been mined. Over 70 tons of ore has been sacked, which will be rawhided out in the early spring.

The eight claims of this group have been surveyed and applications for certificates of improvements applied for.

On the *Cascade Forks* group and the *Northern Light* group, owned by Bunting Bros., 28 feet of tunnel, 5 x 7 feet, a series of open-cuts and considerable surface stripping were recorded.

On the *Boundary* group, owned by P. Daly and associates, a series of open-cuts was recorded.

On the fractional claims of the *Big Missouri* group, the *Yellowstone* group, and the *Dumas and Dickens* group, owned by D. Lindeborg and associates, a series of open-cuts was recorded.

The Mineral Hill Partnership has been formed by Messrs. Martin, Carter, Welch, Fetter, and Carlton for the purpose of carrying on development-work on the *Little Joker* group, comprising three claims, *Little Joker*, *Midas*, and *Mineral Hill*, joining the *Big Missouri* group on the west. Specimens taken from a strong lead on this property assayed well over $100. Under the direction of Mr. Welch work will be commenced as soon as supplies can be hauled to the property in the spring.

Crown grants have been issued for the following claims in this section: *Edith*, *Sullivan*, *Lois*, *Daley*, *Brookland*, *Forty-five*, and *Cascade Falls No. 5*.

BEAR RIVER.

At the *Prince John* group, comprising twenty claims under bond to the Granby Consolidated Mining, Smelting, and Power Company, Limited, in the fall months a construction gang erected a bunk and mess house to accommodate a crew of twenty men. A setting shack was also built near here for the diamond-drillers. Storage-sheds for supplies were also erected on each side of Bear river on the trail to the camp. Up to the end of December approximately 1,100 feet of drilling had been completed. It is intended to keep a diamond-drill crew at work here through the winter months, the necessary supplies having been packed in.

On the *Molly B.* group of claims, owned by J. W. Stewart and associates, a series of open-cuts and clearing and grading 600 square feet for tunnel-site were recorded.

On the *Mayflower* group, owned by Gibson & Woodmore, 20 feet of tunnel, 5 x 7 feet, was recorded.

George Copper-mines.—Owners, W. B. and R. George. On the *Copper Queen* claim 32 feet of tunnel, 5 x 7 feet, was recorded.

On the *Rufus* group, owned by Erickson and associates, an open-cut of 46 feet, averaging 4 x 4 feet, was recorded.

On the *Casino* group, owned by H. McP. Martin, 5 feet of tunnel, 4 x 6 feet, and an open-cut of 52 feet, averaging 7 x 3½ feet, were recorded.

GLACIER CREEK.

The Alice Arm Mining and Development Company, bonders of the *Lake View* group of claims, let a contract for the driving of 150 feet of tunnel. This work was completed at the end of the year and a further contract will be let early in the coming spring.

On the *Ruth and Francis* group, owned by Nesbitt & Archie, 20 feet of tunnel, 5 x 6½ feet, was recorded.

OFFICE STATISTICS—PORTLAND CANAL MINING DIVISION.

Free miners' certificates (individual)	94
Mineral claims recorded	187
Mineral claims recorded (placer)	1
Certificates of work issued	174
Bills of sale, etc., recorded	56
Filings	29
Certificates of improvements recorded	7

Revenue.

Free miners' certificates	$ 448 75
Mining receipts, general	1,225 90
Total	$1,674 65

QUEEN CHARLOTTE MINING DIVISION.

The Gold Commissioner failed to submit an annual report on mining operations in the Queen Charlotte Mining Division for the year 1917, sending only the office statistics.

OFFICE STATISTICS—QUEEN CHARLOTTE MINING DIVISION.

Free miners' certificates	57
Mineral claims recorded	45
Certificates of work issued	85
Bills of sale recorded	3
Powers of attorney recorded	33
Placer leases applied for	8

Revenue.

Free miners' certificates	$241 75
Mining receipts, general	666 25
Total	$908 00

NORTH-EASTERN DISTRICT (No. 2).

REPORT BY JOHN D. GALLOWAY, RESIDENT ENGINEER.

INTRODUCTORY.

Under the provisions of the "Mineral Survey and Development Act," which came into force about May, 1917, the four Mining Divisions of Omineca, Peace River, Cariboo, and Quesnel were made to constitute the North-eastern Mineral Survey District, with the permanent survey station and office at Hazelton. The Resident Engineer assumed office about the middle of June and at once commenced field-work in the district, continuing until the middle of October, when weather conditions made further examinations impracticable.

Applications for assistance in building roads and trails to mineral claims and mining camps, as provided for in the "Mines Development Act," were numerous in various parts of the district. Examinations and reports on these applications occupied nearly the whole of the field season; but when going into a section to examine a particular claim or group for road requirements, opportunity was afforded for the examination of most of the more important claims in that vicinity; and, generally, in visiting the different parts of the district where applications for roads and trails had been made, it was possible to acquire all the needed information regarding the active mining going on.

The field season in this district was particularly short this year owing to the snow of the previous winter remaining in the mountains above timber-line until late in July, and also to the fact that winter came unusually early, the mountains being covered with snow early in October, which remained for the winter. Had the season been longer opportunity would have been afforded for examination of several camps and districts of which at present but little definite information is available, but which are believed to be of some promise.

An important geological investigation was carried out during the season by Dr. J. J. O'Neill, of the Canadian Geological Survey. This consisted of the topographic and geologic mapping of a fifteen-mile sheet, taking in Glen, Nine-mile, and part of the Rocher Déboulé mountains and including the towns of Hazelton and New Hazelton. The topographic work was under the direction of S. S. Falconer, of the Survey staff, and Dr. O'Neill was assisted by V. Dolmage with the geological work, which included, as well as the areal geology, a special economic investigation of the ore-deposits in this district.

The North-eastern District is so large, nearly 100,000 square miles of territory, that for the purposes of this report and succeeding ones it is advisable to subdivide it into a number of smaller areas. In the first place, it is already divided into the four Mining Divisions as already mentioned. The following subheads are proposed and will be used in this report:—

Omineca Division—Skeena River Sub-district; Hazelton Sub-district; Telkwa Sub-district; Manson Sub-district.

Cariboo Division—Barkerville Sub-district; Fort George-Fraser River Sub-district.

Quesnel Division—Quesnel River Sub-district; Timothy Mountain Sub-district.

PRODUCTION OF DISTRICT AND GENERAL SUMMARY.

The mineral production of the North-eastern District for 1917 was a little less than in the year 1916. The principal reason for this decrease in value of output was, first, a smaller production of placer gold in all parts of the district, and, secondly, to the fact that the two principal lode mines—the *Rocher Déboulé* and *Silver Standard*—were only shipping during one-half of the year. Both these mines are in shape, however, to make a good production in 1918. There were, however, a greater number of small shippers in 1917 than in any previous year, which is an encouraging sign for the future. The lode-mineral production of the district comes almost entirely from the Hazelton-Telkwa section, while the bulk of the placer gold is obtained from hydraulic mines close to Barkerville, in the Cariboo Division.

Lode-mining in the vicinity of Hazelton and Telkwa has not progressed as rapidly during the last three or four years as had been anticipated in 1913, when the first ore shipments were made. The Grand Trunk Pacific Railway was completed in 1914, and it was expected that following this a rapid development of the mineral showings would ensue. While the boom predictions have not been realized, still it must be remembered that many reasons for this slow development can be advanced. Chief amongst these are the *lack of capital for new mining* enterprises owing to the war, and the fact that many of the showings in this district are not large enough to attract the attention of the large mining companies. Several properties in the district which have undoubted merit have been taken up by individuals or small companies which have lacked sufficient capital to carry out a vigorous development policy. Many properties are situated at some distance from the railway-line, and the transportation problem is therefore a difficult one to overcome. The vigorous policy of the Government in building, or assisting towards building, roads and trails to these at present inaccessible properties will undoubtedly within a short time give results in the shape of increased production.

The following table shows the mineral production of the North-eastern Mineral Survey District for the year 1917:—

	Omineca.		Cariboo.		Quesnel.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold, placer..... oz	600	$12,000	6,750	$135,000	750	$15,000
Gold, lode..... oz.	931	19,244	....	....	....	....
Silver..... oz.	82,311	63,668	....	....	....	....
Lead..... lb.	271,885	21,506	....	....	....	....
Copper..... lb.	852,373	231,675	....	....	....	....
Zinc..... lb.	364,097	27,548	....	....	....	....
Miscellaneous materials.....	....	1,500	....	2,756	....	....
Total values.....	....	$377,141	....	$137,756	....	$15,000

Total value mineral production, North-eastern District, $529,897.

It will be noted that in the above table Peace River Division does not figure at all; so far as is known, no mineral production has ever been officially recorded from this Division. Prospecting for placer gold has been done on the Peace river and tributary streams, and probably small amounts of placer gold have been taken out in this way; it is certain, however, that this has never amounted to more than a few hundred dollars in a season. As a hopeful sign for the future, it may be noted that fifteen dredging leases were taken up in this Division during the *summer of 1917. Systematic prospecting of these leases, to test them for dredging possibilities,* will be carried out next year by the lessees, Wadley & Galbraith.

The production of zinc was entirely from the *Silver Standard* mine, and the greater part of the silver and lead production was also from this property.

The copper production comes largely from the Rocher Déboulé Copper Company's mine. This property made a smaller production than in 1916 owing to shipments being suspended almost entirely during the first half of the year. Development during that time was successful in finding ore-bodies from which shipments were made in the latter months of the year.

The production of silver, lead, and zinc from the *Silver Standard* was about the same as in the previous year, but only represents operation on a small scale. During the latter half of the year practically no mining was done, as all the available labour was placed on the work of equipping the property with a new power plant and the new buildings of various kinds at the mine, and the building of a 50-ton concentrator to treat the ore. A much larger production from this mine next year is confidently expected.

A little over 75 per cent. of the lode-mineral production credited to the North-eastern District comes from the vicinity of Hazelton. Of the remainder most of it comes from the Telkwa Sub-district, with, this year, two shipments recorded from the Skeena River Sub-district.

As before noted, the placer production comes mainly from the Barkerville section of the Cariboo Division, although each year some production is recorded from Quesnel Division and

the Manson Sub-district. The production comes mainly from half a dozen hydraulic mines, the percentage of the total returns which is made by the aggregate of small-scale individual operators being small.

In the following table is given a list of the shipping properties, with tonnages produced:—

Sub-district.	Mine.	Tonnage.	Character of Ore.
Skeena River	M. & K.	123	Silver-lead-copper.
"	Frisco	10	Silver-copper.
Hazelton	Rocher Déboulé	2,889	Copper.
"	Cap	29	"
"	Highland Boy	75	"
"	Silver Standard	671	Silver-lead-zinc.
Telkwa	Santa Maria	239	Copper-silver.
"	Cronin	79	Silver-lead.
"	Harvey	10	Silver-copper.
"	Higgins	10	Silver-lead.
"	Copper Crown	19	Copper.
"	Schufer	5	Silver-lead.
Total		4,159	

It will be noted that as yet there are only two important shippers—viz., the *Rocher Déboulé* and the *Silver Standard*, both situated in the Hazelton Sub-district. The Telkwa Sub-district contains a larger number of shippers than elsewhere, but the tonnage produced is small. With the improvement of transportation conditions there is every reason to look for a larger production in the future from this sub-district.

SUMMARY OF WORK.

The greater part of the field season was spent in examinations of properties with respect to which applications had been made for Government assistance in building roads or trails. Under the "Mines Development Act," any owner of a mineral property may apply to the Hon. the Minister of Mines for financial assistance in building a road or trail to his property. These requests are referred to the Resident Engineer, who examines and reports on each property. As might be expected, numerous applications for roads and trails are made to which aid cannot be given, as the mineral showings are not sufficiently encouraging to warrant the expense. When it is decided that assistance is to be given, the Public Works District Engineer reports on the estimated cost, a grant is made from the Mines Development Fund, and the construction is carried out by or under the supervision of the Public Works Engineer. The responsibility of the Resident Engineer ceases when he makes his report on the particular mineral property under consideration.

The number of requests for roads and trails in the past year in this district were undoubtedly more numerous than is likely to prove the case in future years, with the result that the Resident Engineer's time was chiefly taken up with them. Co-operation with the engineers of the Public Works Department was complete and many conferences were held.

The building of a thirty-mile sleigh-road from Telkwa to Cronin's mine was the most important piece of road-work in aid of mining carried out during the year. The road, which was not completed until late in the fall, is so laid out that it can be gradually improved until it is a good wagon-road.

Another road on which considerable improvements were made during the year was the *Santa Maria* mine road. This road, which commences at Telkwa, was built as a sleigh-road in 1916 by the owners of the mine. With the improvements effected this year, the road is a good wagon-road to within eight miles of the property, and also some heavy grades have been cut down. This road is a development road providing transportation for a large district. It runs from Telkwa up the Telkwa river for eighteen miles, and then up the North fork of the Telkwa river. There are a large number of mineral claims up the Telkwa river and its tributaries, on which more or less development-work has been done, which will be benefited by this road. Some further development on some of these properties should be induced, because of the fact that transportation of supplies, etc., is now easier than before.

Improvements and repairs to the *Silver Standard* road from Hazelton were effected during the year. The upper part of the *Rocher Déboulé* mine road from Skeena Crossing was relocated and built during the year, and this road was extended from the *Rocher Déboulé* camp to the *Highland Boy* tram terminal, a distance of two miles. Improvements and repairs to many trails were made.

In the Cariboo District several road and trail applications were reported upon, but most of the properties were found to be in such an undeveloped condition that roads were not warranted; improvements to trails were, however, made. This district is well supplied with trunk roads which are good enough for auto travel.

Many of the properties examined for road and trail requirements were claims not previously reported on in the Mines Department Reports, and so these are described fully in this report. As far as was practicable, when going into a district to examine one group of claims, adjoining groups were also looked at.

EXTENT AND GEOGRAPHIC FEATURES OF DISTRICT.

The North-eastern Mineral Survey District embraces four Mining Divisions—namely, Omineca, Cariboo, Quesnel, and Peace River—with an area of nearly 100,000 square miles. It occupies a large part of the northern central portion of British Columbia, its western boundary being, roughly, 100 miles from the Coast, its northern and southern boundaries being about 200 miles from the respective Provincial boundaries, and its eastern boundary being the British Columbia-Alberta Boundary-line.

The northern, western, and southern boundaries of this district are the arbitrary boundary-lines of the Mining Divisions, but these, where practicable, always follow the watersheds of the country. The western boundary is well marked, following, as it does, the divide of the Coast mountains. The southern boundary extends from the Coast mountains easterly across the Fraser plateau, following a much less definitely marked watershed to the Rocky mountains, where the line crosses obliquely the axis of the mountains. The northern boundary is country which is virtually unexplored, the Liard Mining Division.

This district is a part of the Province frequently referred to as "Northern British Columbia," all of it lying north of latitude 52 degrees, and extending up to latitude 58 degrees. A large part of the district is as yet very little known and many sections are hardly explored.

The North-eastern Mineral District covers such an immense area that its topography embraces many widely different types. An almost infinite variety of mountain shapes and reliefs can be seen, giving way in places to great expanses of plateau areas. Lakes are numerous and many large rivers are included in the district.

In a general way this district consists of a section from the divides of two systems of mountains, with a plateau area—including mountains—lying between. The Peace River Division is not included in this consideration, as it lies to the east of the Rockies system, and most of it belongs geologically and topographically to the Great Plains of the North-west.

MOUNTAIN NOMENCLATURE.

The following table gives a classification of the mountain systems and ranges and plateaux in this district, which follows a general and comprehensive classification for the Cordilleras of Canada which has been adopted by the Geographic Board of Canada.

In explanation of the plan it may be said that the Geographic Board is trying to secure uniformity in the scheme of nomenclature for the mountain masses of Western Canada. The Cordilleras of Canada are divided into three main belts, Eastern, Central, and Western. Each of these belts is divided into systems, which are in turn divided into mountains or plateaux; these are further subdivided into ranges, groups, peaks, etc. The scheme of classification is hoped to take in all mountain masses and plateaux in Western Canada in a comprehensive system which is sufficiently elastic to allow for expansion as is made necessary by the naming later on of at present unnamed mountains.

The accompanying table gives the classification for the whole Province as adopted by the Geographic Board, of which only a part, however, applies to the North-eastern District. This system of nomenclature will be followed hereafter in these Reports.

Cordilleras of Canada.

Belts.	Systems.	Mountains or Plateaux.	Ranges, Groups, or Plateaux.
Eastern	Rockies system	Rocky mountains	Hughes range. Bristol range. Livingstone range. Palliser range. Other ranges and groups.
		Franklin mountains	Unnamed ranges.
		Mackenzie mountains	Sayunei range. Tigonankweine range. Other ranges and groups.
	Arctic system	Richardson mountains	Unnamed ranges and groups.
Central	Columbia system	Selkirk mountains	Purcell range. McGillivray range. Moyie range. Slocan group. Nelson range. Other ranges and groups.
		Monashee mountains	Christina range. Midway group. Other ranges and groups.
		Cariboo mountains	Unnamed ranges and groups.
	Interior system	Fraser plateau	Bonaparte plateau. Arrowstone plateau. Other plateaux, ranges, or groups.
		Nechako plateau	Ootsa-Francois plateau. Nadina mountain. Other plateaux.
	Cassiar system	Stikine mountains	Klappan range. Groundhog range. Other ranges.
		Babine mountains	Unnamed ranges and groups.
		Un-named mountains	Unnamed ranges and groups.
	Yukon system	Yukon plateaux Isolated mountains	Teslin range. Glenryon range. Pelly range. Unnamed plateaux and ranges.
Western	Pacific system	Bulkley mountains	Zymoetz range. Seven Sisters group. Rocher Déboulé range. Hudson Bay group.
		Coast mountains	Tahtsa range. Whitesail range. Telkwa range. Unnamed ranges.
		Cascade mountains	Unnamed ranges.
	Insular system	Vancouver Island range Queen Charlotte mountains St. Elias mountains (part)	Unnamed ranges and groups.

The table given above will now be considered in further detail as far as it applies to this district. In the North-eastern District the Eastern belt is represented by the Rockies system, which is made up of the Rocky mountains and other mountains not yet named or wholly explored. The Rocky mountains at this latitude are made up, as in the south, of several distinct range units, but no definite names have yet been assigned to these ranges. Individual peaks, as Mount Selwyn and others, have been named, and in time names will be adopted for the ranges.

The Rocky Mountain trench, which is the most important master valley in the Cordilleras of Canada, is occupied in this district by the Fraser river, and to the north by the Parsnip river flowing north and the Finlay river flowing south. The junction of these rivers forms the Peace, which breaks easterly through the Rocky mountains and flows through the centre of the Peace River Division into Alberta. The Rocky Mountain trench forms the dividing line between the Eastern and Central belts of the Cordillera of Canada.

The Columbia system of mountains and plateaux lies immediately to the west of the Rocky Mountain trench; this system is represented in the south by the Selkirk mountains and others, and in the North-eastern District by the Cariboo mountains.

The Cariboo mountains embrace a number of ranges which are in part named, but for the present it is not advisable to attempt to fix definite names to these ranges.

Lying to the west of the Cariboo mountains is the great system of plateaux and isolated mountain ranges and units, to which the name "Interior" system has been given. This area is the typical plateau part of the Cordilleras, to which Dawson gave the name Interior plateau. It has been recognized that the country previously known as the Interior plateau should be subdivided into systems of plateaux and mountains; therefore the general name Central belt is applied to this area and the belt is divided into the Columbia, Interior, Cassiar, and Yukon systems.

The Interior system consists essentially of plateaux and isolated hills. The different character of the plateau area in the southern and northern portions of the Province is distinguished by the division of the system into the Fraser and Nechako plateaux. In the northern part of the Omineca Division cross mountain ranges running east and west are known to exist, and in time these will be given some distinctive names. The North-eastern District contains a portion of the Fraser plateau and all of the Nechako plateau.

The Fraser plateau is an uplifted peneplane which is dissected by deeply carved valleys. The general elevation is from 3,000 to 5,000 feet above sea-level, while the main river-valleys are from 1,000 to 3,000 feet below the general level. Conspicuous outstanding hills are not numerous, although some occur.

The Nechako plateau is reached by a gradual transition of the Fraser plateau at its northern end. No sharp line of demarcation can be drawn, but comparing areas far apart the difference can easily be seen. This plateau has a general elevation of about 3,000 feet above sea-level, but the river-valleys are not cut down as in the Fraser plateau; as a rule they are but slightly below the average level. Isolated hills, mountains, and small ranges rising from 2,000 to 4,000 feet above the general plateau-level are numerous and accentuate the physiographic difference between the Nechako and Fraser plateaux.

The Nechako plateau is the greatest lake region in British Columbia. This is caused by the flat nature of the country and lack of relief. Many large lakes occur, including Babine, Stuart, Francois, Oosta, Eutsuk, Whitesail, and Tahtsa, together with countless smaller ones ranging in size from a few miles in length down to ponds. This network of lakes with many connecting streams will some day prove of value in providing transportation facilities when the settlement of the country causes the necessity.

The Cassiar system includes a number of mountain ranges and groups and plateaux in the northern portion of the Province and east of the Pacific system. The Cassiar system is divided into the Stikine, Babine, and other mountains not at present named. These are further subdivided into ranges and groups, most of which are at present unnamed. In the North-eastern District the principal representatives of this system are the Babine and Groundhog ranges and other unnamed ranges around the headwaters of the Skeena river.

The Pacific system in this district is represented by the Coast mountains and the Bulkley mountains. The name "Bulkley" applied to mountains is a new one and has been coined in order to include in one definition a number of ranges which logically should be grouped together. These ranges—viz., the Zymoetz, Seven Sisters, Rocher Déboulé, and Hudson Bay ranges—are geologically and to some extent physiographically related to one another, and yet they, as a whole, form a series of mountains distinct from the Coast mountains. Their relationship to the Coast mountains, however, is such that they belong to the Pacific system of the Western belt rather than to the Cassiar system of the Central belt.

The Coast mountains embrace what was formerly understood by the Coast range, and while in places these mountains are a single defined range unit, as a rule many ranges are included.

As subdivisions of the Coast mountains the Telkwa, Whitesail, and Tahtsa ranges are recognized and many others will be named in the future.

WATER SYSTEMS.

Three large river systems provide drainage for practically the whole of this North-eastern District. These are the Fraser, Peace, and Skeena rivers, together with their network of tributary streams; of these the first two each have larger drainage-basins than the Skeena.

The Fraser river rises in the south-eastern corner of the district in the Rocky mountains and flows north-westerly in the Rocky Mountain trench for 250 miles. Near Fort George the river makes a great bend and flows nearly southerly, and continues in this direction with a slight trend easterly for a distance of 400 miles to Hope, where it turns sharply to the west and cuts through the Coast mountains to the sea at New Westminster.

At Fort George the Fraser river receives an important tributary in the Nechako river. This stream drains the large lake area lying south of the Grand Trunk Pacific Railway, including Francois, Ootsa, and Eutsuk lakes, and also takes the waters of Stuart lake and the surrounding district by means of the Stuart river.

Other tributaries of the Fraser in this district are the Salmon river from the north, the Blackwater river from the west, and the Quesnel river from the east. The last steam drains Quesnel lake—a big sheet of water—and joins the Fraser at the town of Quesnel.

The Peace river is formed by the junction of the Finlay river flowing south and the Parsnip river flowing north, both streams occupying portions of the Rocky Mountain trench. The Peace river from its commencement flows nearly due east, breaking through the Rocky mountains and flowing through the centre of the Peace River Division and into Alberta, where it joins the Mackenzie River system flowing into the Arctic ocean.

Important tributaries of the Peace River system in this district are the Ingenika and the *Omineca rivers from the west, which flow into the Finlay river, and the Nation river, also from* the west, joining the Parsnip river.

The Skeena river rises in the Cassiar system of mountains and flows in an irregular manner southerly to Hazelton, where it breaks through the Pacific system of mountains to the sea at Essington; this portion of the river has a general south-westerly course. The most important tributary of the Skeena is the Bulkley river, which rises in the almost imperceptible divide of the Nechako plateau and flows north-westerly to the Skeena at Hazelton. The valley occupied by this river forms a line of separation between the Babine mountains of the Cassiar system and the Bulkley mountain of the Pacific system and takes water from both.

Babine lake, lying to the east of the Babine mountains, drains to the Skeena by the Babine river, which comes in above Hazelton.

Summarizing, the drainage of this district is in part to the Arctic ocean by the Peace river and in part to the Pacific ocean by the Fraser and Skeena rivers.

GEOLOGIC DISCUSSION.

The purpose of this part of the report is to refer briefly to the different geologic investigations that have been carried out in the district; the references given will direct those interested where to look for further information.

Detail geological work has been done only in a few small areas in this district, most of the geological investigations having been of an exploratory and reconnaissance nature. The Geological Survey has carried out quite a good deal of investigation in many parts of the district, while the Reports of the British Columbia Mines Department contain many references to the geologic features, with special attention to economic geology.

More geological investigation has been done in the Hazelton-Telkwa region than in any other part of the district. In that section the work of Leach, Malloch, and McConnell, of the Geological Survey, from 1906 to 1912 outlined the rock formations and ascribed them to their proper time periods; some attention was directed also to economic geology. This work in this part of the district was also valuable, in that it worked out the geology of a relatively small area which is typical of a much larger area to the north and south along the eastern border of the Coast mountains. This work therefore provided a starting-point with which to correlate the results attained in reconnaissances to the north and south, and also to some extent easterly.

An important reconnaissance to the north was made by Malloch in 1912, when he examined up to and including the Groundhog coalfield. A reconnaissance to the south was made by the writer in 1916, from which considerable information was obtained.

The probable reason that a considerable amount of geological work was done by the Survey in the Hazelton-Telkwa region was, of course, owing to the interest attracted thereto by the construction of the Grand Trunk Pacific Railway, and by the widespread evidences of mineralization and the numerous exposures of coal-bearing formations. This work of the Survey has been of considerable value to the district not only in helping prospectors and miners, but also in bringing to the attention of the mining public the character of the ores found.

In continuation of this work, during the season of 1917 Dr. J. J. O'Neill, of the Survey staff, was detailed to make an examination of a small area surrounding Hazelton; in connection with this a topographic map of the area was made by S. S. Falconer, of the Survey staff. The country mapped was an area fifteen miles square taking in a part of the Rocher Déboulé range, Glen and Nine-mile mountain, and including the towns of Hazelton and New Hazelton.

Besides completing the geologic mapping of the area, O'Neill made an exhaustive study of the ore-bodies in the district, from which much useful information is expected.

This work of O'Neill's this year was of a small area, and the geological features were therefore worked out in much greater detail than had been previously done in any part of the Hazelton-Telkwa district.

Another area in the North-eastern District which received attention from the Geological Survey at an early date was the Barkerville region in the Cariboo Division. This was examined and geologically mapped in 1885 and 1886 by Amos Bowman, but since that time no further work has been done by the Survey.

This section of British Columbia has been reported on at intervals from 1860 onwards. In fact, the early reports of the Mines Department consisted almost entirely of a description of, and tabulation of returns from, the Cariboo District. The last detail report on the district as a whole was made by W. Fleet Robertson, Provincial Mineralogist, in 1902. In 1914 the writer spent a short time in the Barkerville section, his notes regarding the various properties being published in the Annual Report of that year. The Gold Commissioner's report each year records general information about the district.

Important reconnaissances of portions of the district from Francois lake southerly through the Fraser plateau were made by Dawson in 1875 and 1876. Reconnaissances by Selwyn and McConnell of the Peace, Omineca, Ingenika, Finlay, and Parsnip rivers were made many years ago. Further information about this vast expanse of almost unknown country was obtained by W. Fleet Robertson in 1906 and 1908. All this work was, of course, in the nature of extremely rough reconnaissance, and no attempt was made to classify the rock formations other than as to their petrographic composition.

The Peace River Division, which lies to the east of the Rocky Mountain divide, forms a distinct area, differing materially from all the rest of the district. Topographically and geologically it belongs to the North-western plains and is largely covered with rocks of Cretaceous age. It is unlikely that it will prove a promising field for metalliferous minerals, but it is known to contain immense resources in coal, which cannot, of course, be utilized at the present time.

A report on the coalfields of the Peace River Division was made for this Department in 1912 by C. F. J. Galloway, and published in the Annual Report of the Minister of Mines for that year. This report shows that there are cropping out along the Peace river a number of seams of bituminous coal of excellent quality. Most of the seams described in the report are small, from 2 to 4 feet thick, but there are said to be others which are larger. The analyses of this coal show it to be of such excellent quality that it is probable that the field will be investigated at some time in the future.

In some of the sedimentary horizons of the Cretaceous strata in this Division there is a possibility of oil and natural gas being found in commercial quantities. Indications of these are known to occur, but very little investigation has been carried out as yet.

In the following table is given a list of the more important reports on this district, in addition to which numerous references can be found in the Summary Reports of the Geological Survey and the Annual Reports of the British Columbia Department of Mines:—

Name of Author.	Publication.	Year.	Page
Dr. Geo. Dawson	Geological Survey of Canada	1875	233
"	" "	1876	17
"	" "	1879	Pt. B
"	" "	1888	73R
Amos Bowman	" "	1887-8	Pt. C
R. G. McConnell	" "	1894	5C
W. Fleet Robertson	Minister of Mines' Report	1905	89
"	" "	1906	101
"	" "	1908	66
"	" "	1911	95
"	" "	1912	65
W. W. Leach	Geological Survey of Canada, Summary Report	1906	35
"	" " "	1907	19
"	" " "	1908	41
"	" " "	1909	61
"	" " "	1910	91
G. S. Malloch	" " "	1911	92
R. G. McConnell	" " "	1912	55
G. S. Malloch	" " "	1912	69
"	" " "	1912	103
W. M. Brewer	Minister of Mines' Report	1914	101
John D. Galloway	" "	1914	176
J. D. MacKenzie	Geological Survey of Canada, Summary Report	1915	62
Chas. Camsell	" " "	1915	70
John D. Galloway	Minister of Mines' Report	1916	134

OMINECA MINING DIVISION.

SKEENA RIVER SUB-DISTRICT.

The Skeena River Sub-district may be defined as the territory contiguous to the Skeena river between Copper City and Skeena Crossing—both stations on the Grand Trunk Pacific Railway. Along this stretch of the Skeena a number of streams drain the mountains forming the Zymoetz and Seven Sisters ranges. In these ranges, and particularly around the headwaters of the different streams, mineral claims in great numbers have been staked in the last ten years. Most of these are quite undeveloped, and as yet only a few small shipments of ore have been made from any of them. The more important streams on which claims have been staked are the Zymoetz river, Kleanza, Chimdemash, Legate, St. Croix, and Fiddler creeks.

Kleanza Creek.

Kleanza creek is a small tributary of the Skeena river, entering it from the eastern side opposite the town of Pacific, on the Grand Trunk Pacific Railway. The creek is about twenty miles long, rises in the Zymoetz range, and flows almost due westerly. This name "Zymoetz range" has been used to designate a group of mountains lying to the east of the Coast mountains; the Zymoetz range is bounded by the Zymoetz and Skeena rivers on the south and west and merges into the Telkwa mountains on the east and the Seven Sisters group to the north. The range is drained by the Zymoetz and its tributaries and by Kleanza, Chimdemash, St. Croix, and Legate creeks.

This section of country is very rough; the mountains, while not attaining great elevations, are rugged in the extreme. The highest peaks rise to between 6,000 and 7,000 feet, but as timber-line is at about the 4,000-foot contour a considerable portion of the mountains are above timber-line. The influence of the moist Coast climate which prevails throughout this district is plainly evident, dense vegetation covering all the lower slopes, thus making progress through the bush difficult.

The Zymoetz range consists in part of rocks belonging to the Kitsalas series, in part of intrusive granitic and dioritic batholiths and dykes, and to some extent of the Hazelton formation.

The rocks showing at the head of Kleanza creek, on those claims examined, are mainly part of the volcanic complex assigned to the Kitsalas series. Some bands of highly altered limestone and other flint-like rocks, which are apparently highly metamorphosed sediments, were also noted. Intrusive diorite was seen in one place and also some granitic dykes of an acid type.

The volcanic rocks observed here and assigned to the Kitsalas series are as a rule porphyritic in texture and generally approaching an andesite in composition. Dykes are by no means plentiful, although some of the rock formation may consist of true dykes which have been so folded after injection as to appear part of the original volcanic complex. The whole series is considerably metamorphosed, folded, flexed, and broken, and is characterized by an abundant development of epidote throughout; this development of epidote is a typical feature of the Kitsalas series wherever it is observed.

The so-called "veins or mineralized dykes" occurring in this district closely resemble sheeted zones, but are often indefinite and irregular. These sheeted zones striking through the porphyritic volcanic rock are often of considerable width and carry varying amounts of copper minerals. They consist of parallel fractures stretched across a width of 10 to 100 feet, in which the fractures are wholy or in part filled with calcite and ore-minerals. The fractures vary in width from a knife-blade seam up to several inches. In places these fractures are quite close together, and in others are separated by from 1 to 10 feet of rock-matter. Replacement of the wall-rock of the fractures by ore-minerals has taken place in some instances, but is, as a rule, an unimportant feature. Where the parallel fractures are close together, the whole width of rock-matter and contained ore-filled fractures carries an appreciable copper content, which, under certain circumstances, may be of commercial value. The ore-carrying zones or "veins" are supposed to be continuous in length for great distances. While this cannot at present be proved or disproved, it seems probable that the zones are irregular and broken, and that, as there are many of them, some line up in position very closely with others at some distance away. The question of the continuity is not important at present, as many other features of the deposits remain to be proved first in a consideration of their economic value.

The claims at the head of Kleanza creek are reached by a trail commencing opposite the town of Usk. The trail follows up the north side of the creek all the way to the forks. For eleven miles the trail is in good condition, as it is on benches above the creek and keeps to a uniform grade. Beyond the 11-mile post the trail is in bad shape and should be repaired. This part of the route can be improved most effectually by putting in a new trail following the gravelly creek-bottom. This new route has been cruised out by J. D. Wells, who says it would prove satisfactory.

Very little development-work has been done on any of the claims yet, and none are in shape to ship any considerable tonnage of ore. It is impossible to say whether or not the district will develop any mines in the future, but the greatest possibility is along the line of developing a large tonnage of low-grade ore. Mining in a small way the small high-grade seams, hand-sorting and shipping by wagon, would not probably prove a profitable proposition. A great deal more development than has yet been done can quite easily be accomplished with the present mode of transportation—by pack-trail.

For the further development of the claims on this creek a wagon-road is not at present required, but a good pack-trail is, of course, a necessity. The building of a wagon-road would entail considerable expenditure, and the mineral-showings in their present stage of development do not warrant this expenditure.

Lowrie Group.

This group, formerly known as the *Avon* group, consisting of three claims owned by Richard Lowrie and L. E. Moody, is situated on a small tributary of the South fork of Kleanza creek, about half a mile above the forks. The showings are in a small gulch at an elevation of 3,250 feet. The work done consists of two open-cuts and a tunnel in 5 feet, which was blocked with the snow in the gulch at the time of examination.

At this place there is a band of limestone which has been intruded by dioritic rock. The limestone is highly altered to crystalline limestone, epidote, garnetite, lime silicates, etc. The limestone is broken up by the intrusive rock and brecciated zones are common. Slight mineralization with chalcopyrite and bornite occur through the garnetite, but in an irregular manner and without very definite strike. The showings seen were unimportant as regards copper content, and assays taken failed to show anything but traces of gold and silver. Another open-cut, which was not examined, is said to contain a nice showing of bornite.

Wells Group. This group is situated on the mountain at the head of the South fork of Kleanza creek, practically on the Kleanza Creek-Copper River divide. There are five claims in the group, which is owned by J. D. Wells, Lee Bethuren, and E. T. Hamblett, of Usk. The property is reached by trail from the cabin camp near the forks of Kleanza creek. This trail runs up the South fork of Kleanza creek to its head and over the mountain at the head, with numerous branch trails to various claims.

No permanent camp has been erected on this property as yet, tents being utilized when the annual assessments are being done. Comparatively little development-work has been done, not sufficient, in fact, to enable a fair determination of the possibilities of the property.

There are three ore-zones on the property designated as Nos. 1, 2, and 3 veins. No. 1 vein is a sheeted zone with a general strike of N. 85° W. (mag.) and dip to the south at 65 degrees. The small fractures are from ½ to 2 inches wide and are filled with calcite, chalcocite, and bornite. These fractures are in places close together, sufficiently so as to constitute good ore across 4 to 6 feet. Between the fractures some replacement of the wall-rock has taken place, minute grains of chalcocite predominating. At an elevation of 4,650 feet a tunnel 20 feet in length has been driven on this zone and at the face shows considerable mineralization. A sample taken across 4 feet at the face of this tunnel assayed: Gold, trace; silver, 2.3 oz.; copper, 9.5 per cent. Oxidation of the copper sulphides at and near the surface has produced some copper carbonates, cuprite, and native copper.

No. 3 vein is exposed nearly at the top of the mountain and striking N. 60° E. (mag.). An open-cut shows an irregularly mineralized sheeted zone at least 30 feet in width. The rock formation has a porphyritic texture and varies from andesite to diorite porphyrite, and again the mineralization is in small fractures, with some replacement in the wall-rock between. A sample cut across 10 feet on assay returned: Gold, trace; silver, 0.45 oz.; copper, 0.5 per cent.

The No. 2 vein is exposed in a bluff at an elevation of 4,800 feet; practically no work has been done on it, the exposure being natural. This ore-zone is of the same type as the others, and at this point fairly good mineralization is apparent across a width of 10 feet, with another 10 feet mineralized in a scattered manner. A sample taken across 10 feet of the best-mineralized portion of this ore-zone returned the assay: Gold, trace; silver, 3 oz.; copper, 4.2 per cent.

Peerless Group. This group of seven claims, which is owned by O. T. Lindland, of Usk, and partners, is situated at the head of Peerless creek, a tributary of the South fork of Kleanza creek coming in a short distance above the forks. The claims cover ground practically on the divide between Peerless creek and Salmon river, the latter stream being a tributary of the Zymoetz river. The elevations range from 3,500 to 4,800 feet.

There are two or three "veins" on this property which are of a similar type to the ore-zones on the *Wells* group, but differ somewhat in individual features. They belong, however, to the same general type of sheared or sheeted zones; in places definite sheeting with parallel ore-filled fractures occurs; in others the shearing movement has not left open spaces, but has produced crushed zones which allowed the circulation of solutions from which minerals have been deposited by replacement processes.

No. 1 vein is exposed in an open-cut on the Maple Leaf Creek slope at an elevation of 4,350 feet. The formation in which the veins occur is the prevailing andesitic type, but near by some well-banded flinty rock was noted which would seem to be a highly altered sediment; other rocks in this locality are apparently tuffs. This vein is about 8 feet wide and has distinct walls with some development of gouge. The vein-filling, however, is mainly wall-rock somewhat altered and changed from its original condition.

The ore-minerals occurring in the veing are bornite and chalcocite; chalcopyrite is nearly absent. A sample taken across 6 feet from the open-cut on this vein returned on assay: Gold, trace; silver, 0.2 oz.; copper, 1 per cent. Selected specimens can be obtained which will run high in copper content, but not much ore could be obtained by hand-sorting in this way.

Montana Group. This group, consisting of three claims, lies about a mile south-easterly from the *Wells* group, and is on the Copper River slope of Treasure mountain. The owners of the property are J. D. Wells, A. Hamblett, and Louis Edgar. The elevation of the *Montana* camp is 3,900 feet, while the showings are about 500 feet higher.

The ore-showing on this property occurs in a well-defined sheared or sheeted zone striking N. 50° E. (mag.) and standing vertically. The width of the zone is from 20 to 30 feet, but mineralization is irregular across this distance. From 8 to 10 feet (in width) of the ore-zone

is highly silicified, but the balance is rock which is not greatly different to the normal andesitic rock formation. The walls are fairly well defined and the silicified portion of the zone commences at one wall and extends inwards. Surface oxidation has taken place, giving a leached appearance to some of the zone and a plentiful distribution of copper carbonates. Development-work consists of an open-cut exposing a cross-section of the ore-zone. A sample cut across 20 feet, which is practically the whole width of possible ore in the cut, assayed: Gold, trace; silver, 1.9 oz.; copper, 1.1 per cent. Another sample across 8 feet, which represents the more highly mineralized and silicified portion of the ore-zone, returned: Gold, trace; silver, 2 oz.; copper, 2.5 per cent.

No. 2 vein outcrops up and down a sloping bluff for a distance of 300 to 400 feet. It is a mineralized zone 30 to 40 feet wide, but only across a width of a few feet is there sufficient mineral to be of importance; the most of the 30 feet is country-rock, with a few specks of mineral. In addition to bornite and chalcocite, some specular-iron ore was noted at this point.

Near the foot of the bluff a tunnel has been driven 50 feet on the strike of the ore-zone. It commenced with small stringers of ore, but at the face there is no mineral in the rock of appreciable importance. Above the tunnel fractures filled with chalcocite, bornite, and calcite are exposed which vary from 3 to 6 inches in width. Specimens taken from these narrow fractures would assay 20 to 40 per cent. copper, but such assays are misleading until the development shall have shown up a tonnage of this class of ore.

Crosscuts run to either side of the present tunnel would give a section of the zone, and would show whether or not any portion is so sufficiently mineralized as to constitute ore. The No. 3 vein on this group is similar to the others.

Below the tunnel a short distance there is a red rusty rock which is apparently a dyke of acid composition cutting the formations. This dyke carries a little iron, the oxidation of which on the surface gives the red coloration.

Kitsalas Mountain Copper Company.

Introductory.—The Kitsalas Mountain Copper Company is a company incorporated under British Columbia regulations for the purpose of operating the *Cordillera* group of mineral claims, situated near Usk, B.C. J. D. Wells and James Darby, of Usk, are the original owners of the property, and they took 50 per cent. of the stock in the company in payment for the claims. The company is capitalized at $500,000 in shares of $1 par value. Some of the stock has been bought locally, and a good deal in Portland, Oregon, the sale price being around 25 cents a share. With the money thus obtained from the sale of stock development of the property is now being proceeded with, and during the summer of 1917 four or five men were kept at work.

The property is situated a mile from Usk Station, and the main working is only 200 feet above the railway-track; the location is an ideal one, with abundance of timber available for mining operations. The present plan of development is the driving of a crosscut tunnel to tap the main vein exposed on the property. This tunnel is now in 135 feet, and will require to be driven at least as much more to reach the vein. A road from Usk Station which runs through the property was built by the Public Works Department during the summer; this road at this point will form part of the trunk road along the Skeena River valley.

Geological Features.—The rock formations exposed on this property cannot be definitely identified by an examination of hand specimens. There are a number of different rocks, most of which are in a highly altered condition, and which are apparently referable to the Kitsalas formation. Four specimens taken from the tunnel by J. D. Wells, and sent to the Geological Survey at Ottawa for identification, were named: "(1) A sediment; (2) a sediment; (3) diorite; (4) the weight of evidence indicates it to be a tuff."

It would seem that the rock formations in this locality consisted in the first place of interbedded sediments, tufaceous rocks, and basic volcanics, all of which have been profoundly metamorphosed. The resulting rocks may be classed as quartzites, tufaceous quartzites, argillites, tuffs, and chlorite, mica, and greenstone schists. The rock labelled "diorite" by the Survey is a very doubtful diorite. Its contact relations with the other rocks render it certain that it is not a true plutonic intrusive rock, nor yet a dyke, and hence the name "diorite" is inappropriate. It appears to be a rather coarsely crystalline and porphyritic volcanic rock, which might be called andesite porphyrite or diabase, intercalated with other flows and

sediments. Faulting of the measures has brought it into contact with a pronounced schistose rock of a basic nature.

Cutting these rocks are several roughly parallel but irregular quartz veins. These veins are undoubtedly of the fissure-filled type, but in places the fracturing of the strata has formed a sheared or sheeted zone instead of an open fissure. In other places "horse" material from the walls has in part filled the fissure, with quartz on the walls. Taken in all, though, the greater portions of the veins have been open fissures and the vein-filling is mainly quartz. Where the veins consist of sheeted zones some replacement of the wall-rock has taken place. A faint banded and ribbon structure occurs in places.

Although it cannot be entirely proved, it would seem that the first mineralizing action consisted of the circulation of solutions from which quartz, together with a little muscovite mica, were deposited. Later secondary action has altered some of the muscovite to chlorite. After the quartz-deposition the veins were subjected to a second fracturing, which did not produce any large open fissures, but made small fissures in the quartz. Along these secondary fractures copper minerals have been deposited from a secondary period of circulating mineral-laden solutions. The copper minerals deposited consist of bornite, chalcocite, and tetrahedrite, the last being in very minute quantities. These copper minerals are intimately associated and would seem to be primary in their origin. They fill fractures in the quartz up to an inch in width, and also in places the quartz has been replaced by them outside the fractures. Oxidation by surface waters has in places formed the copper carbonates, malachite, and azurite.

An interesting and commercially important occurrence in this ore is the presence of free gold in particles up to the size of a grain of wheat. This gold can be seen both in the quartz and *on* the bornite, in the latter form making very attractive specimens. From the evidence of assays it would seem as if this gold did not come in with the quartz-deposition, but later with the copper minerals; or possibly later still. Systematic sampling to determine this and other points has apparently not been done by the management.

The proportion of copper minerals to the quartz in the vein is quite variable and is always quite low. Where the main vein is a clean-cut fissure it is from 4 to 6 feet wide, but in places it consists of smaller bands of quartz irregularly scattered over a width of 20 to 30 feet. The copper minerals never form more than 5 to 10 per cent. of the vein-filling, and as a rule are so disseminated through the quartz as to make hand-sorting difficult.

Two small dykes are exposed which are cut by the main vein, which narrows where cutting through the dyke. These dykes consist of rocks of medium acidity, with well-developed needle-shaped phenocrysts of hornblende, which give a porphyritic structure to the rock. This dyke-rock may be classified as being of an andesitic type.

Description of Veins and Workings.—The main vein is the only one on which development-work to any extent has been done; it is exposed in a number of open-cuts and by stripping along the hillside for a distance of 300 to 400 feet, striking N. 15° E. (mag.) and dipping at from 30 to 45 degrees into the hill. This development shows the vein to have a width of at least 4 feet and often considerably more. In places it is irregular and consists of several bands of quartz from 6 to 12 inches wide, spaced across a width of 20 feet. While the average dip of the vein may prove to be about 45 degrees, in places it is almost flat. Some trouble may be expected in exploring this vein, on account of faults. Not much faulting of the vein is in evidence yet, but the topography of the country at least suggests that there has been some faulting in this locality.

An incline shaft has been sunk on this vein which has an average dip of 33 degrees, but near the bottom straightens up to about 45 degrees. The vein here is from 4 to 6 feet wide and the filling is roughly about 75 per cent. quartz, the balance being schistose rock-matter. Mineralization with copper minerals is continuous throughout the quartz, but somewhat irregular. The bottom of the incline could not be examined owing to water, but conditions are said to be identical with the rest of the working.

The crosscut tunnel has been started about 150 feet below the collar of the incline shaft. It is now in 135 feet and will require, depending on the dip of the vein, from 100 to 300 feet further driving to reach the vein. At a point 121 feet in the tunnel a small stringer of quartz was cut, the outcropping of which on the surface has not been discovered. This was drifted on for 22 feet to the south, and a winze was being sunk at that point, which at the time of

examination was only down 6 feet. In the winze the stringer had widened out to a vein about 3 feet wide, consisting of, roughly, one-third quartz and two-thirds schistose rock-matter. Bornite and chalcocite occur in sparing quantities, and specimens showing free gold are not infrequently seen. This vein occurs in schistose rock, but is cut off on the upper part of the tunnel, where the rock which has been called diorite comes in. There is apparently a fault contact between the schist and diorite and the vein is cut by the fault. Work is being continued in the winze and also in driving ahead the tunnel to strike the main vein.

No. 2 vein is exposed in an open-cut at an elevation of 725 feet. This vein is a clean-cut quartz vein about 3 feet wide, but is only mineralized very slightly with copper minerals.

No. 3 vein, which is exposed still higher up the hill, consists of several stringers of quartz which unite in places to form a 3-foot vein. Mineralization with copper minerals is very slight.

The No. 4 vein, which has been referred to as a "dyke," is a fracture-zone in blue quartzite, which is irregular, but in places has quite a development of quartz. Copper minerals only occur in traces.

These veins (2, 3, and 4) have not been developed and are not of importance at present. If the main vein should prove to be economically valuable, then these other veins would be worth prospecting to some extent. They can all be cut by a 700- to 1,000-foot tunnel.

Values.—The question of the value of the property and its chance of becoming a paying mine practically hinges upon the average values of the whole mass of the main vein. To arrive at this the only satisfactory method is to thoroughly sample the vein and prepare an assay plan, which, of course, would not be undertaken by a Government Engineer for obvious reasons. Mr. Wells and Mr. Thomson, manager, say that the vein will average $15 to the ton throughout, and, if so, it would pay nicely.

The commercial future of the property depends upon whether further development shows that the whole vein is sufficiently mineralized to be mined and treated at a profit by mechanical concentration. But in any case selective mining may enable the property to produce a small tonnage of shipping-ore.

The following samples were taken by the writer, which give some indication of the values:—

Across 4 feet at point 30 feet down incline: Gold, trace; silver, trace; copper, trace. Grab sample off dump representing about 10 per cent. of vein-filling: Gold, 0.25 oz.; silver, 2.8 oz.; copper, 4.5 per cent. White quartz selected from places where there were no copper minerals: Gold, trace; silver, trace; copper, trace. Selected solid copper ore: Gold, 0.30 oz.; silver, 20.5 oz.; copper, 65.16 per cent.

Conclusion.—This property can be classed as a prospect in the development stage, which has possibilities and may prove to be a profitable mining proposition. Its location so close to the railway-line, plentiful supply of timber and water-power, and generally ideal conditions for cheap and efficient working are factors which make it a reasonable venture to continue the development until the main vein has been explored on the crosscut tunnel level.

Legate Creek.

The 1916 Annual Report of the Minister of Mines contains a description by the writer of Legate creek and some of the mineral properties situated near the head of the creek. Several prospectors were at work on the creek during the summer developing their claims and examining the country.

M. & K.

This group was bonded from the owners, Whitmore & Orr, in the fall of 1916 by J. J. Price, who took out 130 tons of ore and shipped it in the early months of 1917. Later the bond was allowed to lapse. A description of the property will be found in the 1916 Annual Report.

The ore that was shipped was all float lying in the surface wash, and but little work was done by Price to find the vein from which this ore came. This float-ore occurred in pieces weighing up to several hundred pounds, and it does not seem likely that it has been moved any great distance from the vein in which it was formed.

During the summer considerable work was done by the owners in prospecting stringers and showings of ore close to where the float-ore had been taken out. Short tunnels have been run and cuts made and ore exposed, but it does not seem probable that the rich float-ore came from any of these showings.

The formation on this property consists of volcanic rocks, both acid and basic in type and somewhat altered. Porphyritic and brecciated phases are common. In the basic volcanics the hornblende is largely turned to chlorite.

The ore occurs in fracture-zones which are not sufficiently regular to be called true veins. The gangue is mainly wall-rock, together with a little quartz and calcite. The ore-minerals are galena, chalcopyrite, and specularite. The rich float-ore which was shipped consisted of an intimate fine-grained mixture of bornite and galena which was nearly solid mineral. In the ore-showings, occurring in the solid formation, which have been prospected very little of this type of ore has been found.

An open-cut and tunnel 10 feet long prospects a vein lying between walls of acid and basic volcanic rock, which is about 5 feet wide, with a streak of mineral on both walls. In places there is 6 to 8 inches of nearly clean chalcopyrite. The whole material taken out would assay 2 or 3 per cent. copper.

Another tunnel has been driven 60 feet on a parallel vein 50 feet to the east. This working shows the vein to be mineralized in a bunchy way with chalcopyrite and specularite, but very little galena. At the face of the tunnel there are two streaks of ore, each about a foot wide, that would probably assay 3 to 4 per cent. copper.

An open-cut above this, at an elevation of 4,800 feet, probably on the first vein, shows loose pieces of good ore lying in slide material and the bed-rock stained with copper carbonates.

This property is not yet sufficiently developed to tell much about how the ore occurs or the possibilities of finding fair-sized ore-bodies, but certainly the indications are such as to warrant thorough investigation by development. The clean ore is high grade, and the indications are that with development a fair tonnage of concentrating-ore may be found. The ore shipped returned about 25 per cent. lead, 20 per cent. copper, and 25 oz. silver to the ton.

M. & M. This group is owned by James Bell, Roy Moore, and Geo. McCarthy, and consists of three claims, situated on the mountain at the head of the forks of Legate creek. The formation here is granodiorite which is intrusive into the older volcanic rocks. On the *M. & M.* property a quartz vein, striking N. 48° W. (mag.) and dipping at 60 degrees to the south-west, outcrops for a considerable distance, lying wholly within the granodiorite. As a rule the vein is from 2 to 4 feet wide, with bands of quartz on both walls and a central portion of granodiorite. In places the vein is a solid quartz vein; in others it consists of parallel stringers and bands of quartz spaced across several feet, with rock-matter between. A little siderite occurs in places as a gangue-filling associated with the quartz.

The metallic minerals occurring in the quartz are galena, grey-copper, and occasionally a little zinc-blende. The metallic minerals, however, form a very small percentage of the total vein-filling. A selected sample of the best ore assayed: Gold, 0.02 oz.; silver, 83.2 oz.; copper, 1 per cent.

On the *Huron* claim the vein outcrops on a bluff several hundred feet away from the other showings. Here it is 16 feet wide, consisting of a band of quartz 2 feet wide on the foot-wall, and another on the hanging-wall 1 foot wide, with the central portion mainly granodiorite, with numerous narrow parallel stringers of quartz.

The mineralization with galena and grey-copper is again very slight. A sample across 1 foot on the hanging-wall side assayed: Gold, 0.02 oz.; silver, 25.2 oz. From another cut on the vein east of the bluff a sample was taken across 1 foot at a well-mineralized part of the vein which assayed: Gold, 0.26 oz.; silver, 199 oz. Another selected specimen returned: Gold, 0.06 oz.; silver, 360 oz.

The ore on this property carries good silver values, and further prospecting may reveal fair-sized shoots of this ore within the quartz vein.

Regina. This group, consisting of three claims and owned by Jones, Brown, Smith, Burns, and Jensen, is situated just above the forks of Legate creek, at an elevation of 4,200 feet. A cabin has been built at the forks, and from this a trail runs up the mountain to the claims.

This property has a well-defined quartz vein similar to the *M. & M.* and occurring in a granodiorite formation. It varies from 2 to 8 feet in width and consists of alternate bands of quartz and granodiorite. In places quartz fills almost the entire vein; in others the vein is a series of parallel stringers spaced across a width of 6 to 8 feet of granodiorite.

Mineralization is with grey-copper, a little galena, and occasionally a little chalcopyrite. The metallic minerals only occur in small amounts, but carry high values in silver. A selected specimen assayed: Gold, 0.06 oz.; silver, 386 oz.; copper, 13 per cent. An average sample across 1½ feet returned: Gold, 0.02 oz.; silver, 71 oz. A grab sample of a small dump from an open-cut assayed: Gold, 0.02 oz.; silver, 38.6 oz.; copper, 2.3 per cent.

Halliday. This property, which has been staked for several years, is situated at the head of the main fork of Legate creek. The showing is at the foot of and along a bluff which is practically surrounded above and below by glacial ice; to get there it is necessary to go over a glacier for about half a mile. The location is decidedly inaccessible and can only be reached at favourable seasons of the year.

The showing consists of a quartz vein lying in the contact between two highly altered rocks, apparently volcanics, one of which is green in colour and the other red. The vein, which is from 2 to 4 feet wide, is filled almost entirely with quartz, with but little inclusions of wall-rock. The metallic minerals, which occur in the quartz in sparing quantities, are galena, pyrite, and a little chalcopyrite. The vein crops out up and down the bluff for a few hundred feet.

The solid galena is said to carry good silver values, but the amount of clean galena in the vein is small. A sample taken across 2½ feet of the vein assayed: Gold, 0.12 oz.; silver, 10 oz.; copper, 0.5 per cent. A sample of clean quartz returned: Gold, trace; silver, 1.2 oz.

Fiddler Creek.

The *Fiddler* group, situated about four miles from Dorreen Station, was fully reported on by the writer in the 1916 Annual Report of the Minister of Mines. In the fall and winter of 1916 a wagon-road was built to the property, a temporary camp erected, and a crosscut tunnel commenced, which is expected to cut the vein and from which the mine would be developed; this tunnel was driven in 100 feet in slide-rock, clay, and gumbo, and for a few feet into solid rock, when operations were discontinued. The property is under bond from the owner to the Fiddler Creek Gold Mining Company, an Edmonton syndicate. It was expected that work would be resumed this summer, but this failed to materialize, and now nothing will be done until the summer of 1918. The property has undoubted merit, and it is probable that the cessation of development was due to financial reorganization of the company.

HAZELTON SUB-DISTRICT.

The Hazelton Sub-district includes the Rocher Déboulé range and Glen and Nine-mile mountains. This section is now quite well known through reports of the Geological Survey and the reports of the writer in the 1914 and 1916 Annual Reports of the Minister of Mines. For details of the early development of the various properties these reports should be consulted.

Rocher Deboule. This mine, situated on Rocher Déboulé mountain and distant about ten miles from Hazelton, is the most important productive mine in the district; it has been described at length in the Annual Reports of 1914, 1915, and 1916.

This year the low level, or 1,200-foot level, crosscut tunnel was completed to the point where it should have encountered the main vein, and was continued for some distance beyond, a total of over 3,000 feet. A fracture-zone was encountered which may or may not be the downward continuation of the main vein, but drifting on it to the east and west failed to reveal any ore. The management is apparently hopeful of still finding the main vein, and so a raise is to be put up from the 1,200-foot level to the 500-foot workings. This raise will be on the incline and will be a little over 900 feet in length. It will follow somewhat approximately the position wherein surveys indicate that the main vein should lie, and frequent crosscuts from it will be made. It is confidently expected that this work will reveal the whereabouts of the missing vein and the ore-shoots contained therein.

The 1,200-foot level has, however, proved very successful in developing other veins on the property. One of these, the No. 2 vein, gives promise of being quite as commercially important as the main vein. All the ore shipped from the mine in the last six months of the year came from this vein. In addition to the good shoots of shipping-ore exposed in this vein, a tonnage of concentrating-ore has been opened up which is nearly sufficient to warrant the installation of a small mill. The grade of shipping-ore from this No. 2 vein is the best that has been sent out from the mine, much of it averaging $5 in gold and 10 oz. silver to the ton, with 10 per cent. copper.

The No. 3 vein as exposed in the main tunnel also shows promise of becoming productive, but development of it has not yet been carried very far. Generally, conditions at this mine are quite satisfactory and a considerable productive period seems reasonably assured.

The tonnage of ore shipped during 1917 was considerably less than in the previous year. Most of the 1917 production was made in the last six months of the year, when steady shipments were made, mining in the first six months being mainly confined to development.

Delta Copper Co.

This company, which owns or controls the *Delta*, *Highland Boy*, and other groups of claims lying to the east of the *Rocher Déboulé* mine, has not been able to do very much this season. Some favourable showings on the upper vein on the *Delta* group were exposed by means of surface cuts, but no other development of importance was carried out. The property of the company is situated in a somewhat inaccessible place, with the result that transportation arrangements are difficult. A wagon-road was completed this year from the *Rocher Déboulé* main camp in Juniper creek to the terminal of the *Highland Boy* 2-bucket tram, and over this road ore will be hauled this winter.

In the *Highland Boy* workings from 1,000 to 1,500 tons of shipping-ore is blocked out, and further development may be expected to show much more ore. There are two main veins, known as the "Upper" and "Lower" veins, which are exposed on the surface for some distance and partially developed; both of these veins have indications of being of considerable value.

In general, it may be said that the property of the Delta Copper Company gives promise of becoming a productive mine if sufficient capital is forthcoming to carry out the necessary development.

Through the courtesy of Harrison Clement, manager, the writer was given a copy of the report presented to the annual meeting of the directors of the company, and from this the following extracts have been taken:—

"Work was begun on December 26th, 1916, and sleigh-roads constructed to the selected site of the Delta camp, a portion of the *Joe Fraction* claim of the Rocher Déboulé Copper Company having been leased as camp-site. A camp was built consisting of boarding-house, office and warehouse, two bunk-houses, stables, power-house, and blacksmith-shop. This camp will serve all operations from the west end of the property, the permanent development being from that end. A complete mechanical plant for development and mining was purchased at exceptionally good prices, consisting of a 65-horse-power distillate engine, 12 x 12 air-compressor, gasolene-hoist for surface tramway, drill-sharpener, engine and fan for ventilation of west end workings, air-power drills, and complete equipment of small tools. This equipment is completely installed and ready to operate. A 2,000-foot aerial 2-bucket tramway has been installed and put in operation on the east end from the *Highland Boy* camp to the bottom of the gulch; 1,200 feet of the 3,000-foot surface incline tram has been constructed to serve the west end workings, the lower terminal being at the power-house, rail and other material for the balance, 1,800 feet, being at camp; 1,200 feet of 4-inch air-pipe line from the power-house toward the *Delta* tunnel has been put in; and 1,800 feet more of 4-inch pipe is on hand, with two large air-receivers for the line, one being installed. To complete the mechanical equipment a small amount of pipe is necessary and the completion of the tram and pipe-line. A wagon-road has been graded from the *Rocher Déboulé* road to the camp, and from this, with the assistance of the British Columbia Department of Roads, a good wagon-road has been constructed to the foot of the aerial tram on the east end, these roads giving outlet to both ends of the property. A considerable portion of the main *Rocher Déboulé* road to Skeena Crossing was relocated and graded by the British Columbia Government during the summer.

"One thousand five hundred logs were cut and hauled from the *Gold Prince* claim, which was acquired by the Butte and Rocher Déboulé Copper Company and added to the *Highland Boy* claims for construction purposes and firewood.

"There has been done a considerable amount of prospecting, development, and mining work during the year, although curtailed to a considerable extent by difficulties of financing encountered by all enterprises during the period. On both the upper and lower veins on the south portion of the property several surface cuts have been put in, all showing a strong vein, although several were not carried deep enough to get below surface alteration. An excellent showing was opened up on the lower vein on the *Highland Boy* claims, exposing nearly 2 feet of ore in a vein

principally oxidized and leached out and about 12 feet wide. Several other shallow cuts were put in on this vein, but not deep enough to disclose unaltered ore.

"On the *Delta Fraction* claim, on the upper vein, the best surface showing on the entire property, and with one remarkable exception probably the best opened up in the district, was prospected by three open-cuts and some surface stripping, indicating an ore-shoot practically continuous for nearly 200 feet, ranging in width from 1 to over 6 feet at this depth, the main portion being defined by the three open-cuts. Considerable portions of this shoot have been oxidized, but widths up to 18 inches are practically unaltered, a sample assaying 20 per cent. copper. In the main cut a sample over 6 feet assayed 6 per cent. copper, large portions being leached material. This shoot will be developed at a depth of 575 feet by the *Delta* tunnel, and a very valuable and extensive ore-body is indicated.

"Development-work was prosecuted on the east end from the *Highland Boy* upper tunnel, a total of 265½ feet of drift, raise, and winze being driven after January 1st, 1917, when the work was taken over from the *Highland Boy* company, at an average cost, including all direct and overhead expense, of $18.20 a foot. This work has developed about 1,500 tons of ore that will ship on present copper prices close to $45 a ton. Incidental to development there were extracted from the two shoots and shipped to the Ladysmith smelter 74.92 dry tons of ore, containing 10,494 lb. copper, 4 oz. gold, and 35 oz. silver. The last shipment, representative of the ore blocked out, assayed 8.87 per cent. copper, 5 oz. silver, and 0.05 oz. gold. The net profit on ore smelted was used to partly defray the cost of development at this end. This work was discontinued in May until wagon-roads could be completed, and nothing further has been done on this end of the property. The ore blocked out is a considerable asset and can be mined and transported from this end, or held until reached by permanent development from the west end.

"On the west end the *Delta* tunnel has been driven 202 feet, crosscutting toward the vein, at an average cost of $20.41 a foot, 173 feet having been driven under contract. About 450 feet of crosscutting and drifting will bring us under the west end of the ore-shoot on the *Delta Fraction* claim, mentioned above, and it is probable that ore will be encountered sooner, as the well-mineralized vein dips under slide-rock with undiminished width.

"Assessment-work has been recorded on all claims, except on a portion of the north end of the property, where the desirable ground was better covered by a less number of newly located claims. The *Delta* group of five claims, the three claims of the *Crœsus* group, five claims of the *Chicago* group, and the *Drake, Duke, Dyke No. 2*, and *Dyke No. 3* claims have been surveyed. The five claims of the *Chicago* group are being advertised for Crown-granting, and eight claims of the *Highland Boy* group and three of the *Delta* group have sufficient work recorded to Crown-grant. All the claims of the company are in good standing.

"Your property is now well equipped for development and mining, and a comparatively small expenditure should open up the ore-shoot prospected on the *Delta Fraction* claim, and, if deemed advisable, to mine and ship the ore developed on the east end. The work done has proven the good opinion of those interested in the formation of the Delta company to have been fully justified, and with funds available for further development the property can be rapidly placed on a producing basis and able to carry on further development and make additions to equipment as may be necessary. At this stage I can state that I know of no property in the district that has larger possibilities, and its future productiveness seems assured, and that in the immediate future."

New Hazelton Gold-Cobalt Co.

This property was reported on by the writer in the 1916 Annual Report of the Minister of Mines, so that all that need be noted here is the development during 1917. Since acquiring the claims in 1916 the company has carried on steady development with a force of from five to ten men. Until the summer of 1917 Duke Harris was in charge of the work, but at the present time Dalby Morkill is superintendent. In December a bad accident occurred; a snowslide came down as the men were going up the trail leading from the camp to the tunnel-workings, and two men were killed and two severely injured.

At the time of examining the property in July a drift-tunnel on the vein had been driven 653 feet, which gave a depth of 650 feet on the vein. Since that time this tunnel has been driven farther, some raises have been put up, a winze sunk, and stopes from the tunnel-level upwards commenced. Throughout the tunnel the vein is continuous, averaging possibly 2 feet in width, and being as a rule well defined between walls of granodiorite.

Ore-shoots, Nature of Ore, etc.—The vein is filled with hornblende, quartz, and altered wall-rock, and in places with metallic sulphides; of these latter arsenopyrite is the most abundant, although in places a considerable amount of molybdenite occurs. In association with the arsenopyrite are found small quantities of pyrrhotite and pyrite.

Analyses of the ore show varying percentages of cobalt up to about 4 per cent. The higher percentages as a rule are from specimens in which there is a high percentage of arsenopyrite, and it is apparent that the cobalt occurs in association with the arsenopyrite. The isomorphous replacement of the iron in arsenopyrite by cobalt is not uncommon, and where the cobalt percentage is low the resulting mineral does not differ to the eye from ordinary arsenopyrite. Where the cobalt percentage in arsenopyrite ranges from 4 to 10 per cent. the name "danaite" for the mineral has been proposed, but is not in common usage. By oxidation the cobalt in the arsenopyrite is converted to erythrite (cobalt bloom), which is very easily identified by its characteristic pink colour. This bloom is plentiful on the surface outcrops of the vein. As is usual in this district, the vein at the surface, in most places, is considerably oxidized and leached out, and consists of rusty-coloured iron oxide and rotten rock-matter.

From the commencement of the tunnel to a point 85 feet in there is a shoot of ore varying from 3 to 14 inches in width. This ore is mainly arsenopyrite which will assay from $50 to $100 a ton in gold. From the end of this ore-shoot to a point 470 feet in the tunnel no further ore-shoots of much importance have been found, although small bunches of mineral occur.

At a point 200 feet from the portal a fault cuts the vein, but only causes a small displacement of a few feet to the south. The rather curious phenomenon of an open fissure was encountered in drifting along the tunnel. About 110 feet from the portal the vein became an open fissure which continued for 40 feet. This was simply the vein-fracture without any vein-filling in it; a part of the vein in which nature's processes were not completed. The open fissure varied from a narrow crack up to 4 feet, averaging about 2 feet, practically the same width as the normal vein. This fissure extended upwards nearly to the surface and downward for a considerable distance, at least 100 feet.

Beyond the fault the molybdenite content of the vein increased in amount, but very little arsenopyrite occurs as far as the face of the tunnel, which at the time of examination was in 653 feet. The molybdenite to some extent occurs in shoots, although these are not very well defined. Some of this molybdenite ore was mined during the summer, and from this by hand-sorting a car-load was produced which is expected to assay from 6 to 10 per cent. molybdenite (MoS_2). In November this shipment was packed from the mine down to Carnaby on the railway, but so far as is known it has not yet been shipped to Ottawa or elsewhere for treatment. This ore will also carry some gold, probably, however, not high values. Another car-load of this ore is ready at the mine for shipment. During the winter it was intended to stope some of the arsenical-gold ore from the shoot at the portal of the tunnel, which is expected to yield a few car-loads of good-grade ore.

American Boy.

Six claims constitute the *American Boy* group, which is owned by the Harris Mines, Limited, the control of which company is held by the Harris Bros. The property was operated in 1912 and 1913, when about 100 tons of hand-sorted ore was shipped, the smelter returns from which were about $7,000. The writer made an examination of this property in 1914, the report thereupon appearing in the Annual Report of the Minister of Mines for that year. This report contains a description of the location of the property, workings, vein system, and general remarks on the size, values, and character of the ore-bodies, so that there is no need for repetition in this report.

Very little work was done on the mine in 1914, but in 1915 the main shaft was sunk 90 feet deeper, but no ore shipments were made. Since that time the property has been idle until November of this year, mainly for the reason that the company had no funds to continue operation and development. The chief disability under which the property suffered was that to operate at a profit the ore has to be milled. And the present development has not shown up a sufficient tonnage of milling-ore to warrant the expenditure of erecting a concentrator. The property has been examined by many engineers, but for one reason or another never proved sufficiently attractive to cause them to recommend purchase by their principals.

The erection of the concentrator for the *Silver Standard* has to some extent solved the problem for this company. An arrangement has been entered into with the Silver Standard Company to mill the *American Boy* ore to the extent of about 200 to 300 tons a month. Work

has been commenced, and in the first place about 300 tons of milling-ore on the dumps is being hauled to the mill. The property is sufficiently developed to allow of stoping at least 1,000 tons more of ore of a milling grade. Provided the returns on this are as good as expected, the company will realize sufficient funds to continue the shaft to the 300-foot level and open up another level with 100 feet of backs for stoping. It is hoped that in this way the company will be able to pay its way and finance the further development of the mine.

Geological Features and Vein System.—This south-western slope of Nine-mile mountain on which the *American Boy* is situated consists mainly of sedimentary rocks of the Hazelton formation; sandstones, quartzites, and argillites are the common rocks, with locally on this property argillite predominating. This argillite as exposed in the workings of the main vein is a blackish rock, soft as a rule and often blocky. At least two, and possibly more, dykes of an acid type, and provisionally named quartz porphyry, occur cutting the sediments. Since the surface is heavily covered with wash but little information on the relation of these dykes to the veins is obtainable from the surface outcrops. In the main vein workings one of these dykes is exposed and some knowledge of the relations has been obtained. The dyke occurs on the hanging-wall at the mouth of the shaft and down the shaft for some distance. It occurs on the foot and hanging walls, but faulted apart, on the 100-foot and intermediate stopes below, but only occurs on the foot-wall on the 185-foot level. This dyke varies from 12 to 16 feet wide and its strike makes an angle with the strike of the vein of 30 degrees. It is evident that the dyke cuts the sediments, and also that it was injected prior to the formation of the vein, as the latter cuts the dyke. The faulted relation of the dyke with the vein, occurring on the foot-wall and again from 15 to 30 feet along the vein on the hanging-wall, makes it certain that a faulting movement along the strike of the vein took place. Possibly the earth-movement which produced the vein-fissure was accompanied by a lateral movement of the rock on one side of the fissure, thus faulting the dyke.

The relations are complicated by another fault, which had a nearly horizontal movement and which offsets the vein along its strike by about 15 feet; this fault occurs in the portion of vein lying between the faulted ends of the dyke on foot and hanging walls.

It has been noted that rich ore occurs in the main vein close to where the dyke is cut by the vein. From this it has been inferred that the dyke had played an important part in the mineralization of the vein. It is, however, not at all plain how this could be, as it is certain that the dyke was there long before the vein was formed. The only action that the dyke could have had in the mineralization was that it formed a more suitable wall-rock than the argillite for precipitating minerals from solution. The writer is of the opinion that the rich ore near the dyke is only incidental and not directly attributable to the influence of the dyke. Rich portions of the ore-body are found in the vein at considerable distances from the dyke, and in some instances the vein near the dyke is not particularly well mineralized.

This point is of importance, as if the vein only carries pay values in the vicinity of the dyke, then the amount of ore to be expected from the development of the property is relatively quite small; whereas if the vein is mineralized without reference to the dyke (as the writer believes to be the case), then a more promising future is in store for the mine. It may be noted here that none of the other veins on the property are contacted by any dykes. These veins are to some extent mineralized, but are not as promising as the main vein.

There are three well-defined veins on the property and others which may be extensions or offshoots from these. They are good examples of the fissure-vein type with a gangue-filling of quartz. The metallic minerals present in their respective order of abundance are galena, zinc-blende, arsenopyrite, tetrahedrite, pyrite, and chalcopyrite. The galena carries from 1 to [illegible] oz. of silver to the unit of lead, while the tetrahedrite is as a rule very rich in silver; one sample of pure mineral returned 1,677 oz. silver to the ton. (Summary Report, Geological Survey, 1912, page 102.) The zinc carries practically no silver, but owing to the dissemination of fine grains of tetrahedrite through the zinc, assays running well in silver are often obtained from the zinc-blende.

The arsenopyrite carries from $6 to $12 a ton in gold, but is not present in sufficient amount to be of material importance. Ore shipments from the property generally run $2 or $3 a ton in gold. The chalcopyrite does not occur in sufficient quantity to be of any economic importance. All ore shipped so far has been sent to Trail, the lead and silver being paid for and a penalty

paid on the zinc content, which varies from 10 to 18 per cent. It may be expected that milling the ore will produce both a lead and zinc concentrate; the latter will contain a certain amount of silver, due to the inclusion of some grey-copper.

The minerals in the veins are to some extent arranged in a banded structure, but not very continuously. There is nothing in these veins to suggest that they were formed by two successive fracturings and mineralizations as with the *Silver Standard* veins. The two sets of veins do not resemble one another to any great extent, other than that they are of the same type and similarly mineralized.

Some calcite and siderite, but in very small amounts, were noticed in the No. 3 vein.

The workings on this property were described in the 1914 Report, and since that time the only further work done has been the sinking of the shaft on the No. 3 vein from the 185-foot level to 270 feet. The shaft follows the vein on an average incline of 70 degrees to the 185-foot level. Shortly below this the vein flattens somewhat and the shaft continues down in the foot-wall. It is intended to continue the shaft to a depth of 300 feet and then crosscut to the vein and drift on it. The shaft was sunk to 185 feet by a horse-whim for hoisting, but for the further sinking a 6-horse-power distillate-driven Fairbanks-Morse engine and hoist was put in position. This worked satisfactorily and with it the shaft could be easily sunk to a depth of 500 to 600 feet. No additional equipment has been added to the property lately, but none is required as there is a good camp with all the usual equipment, tools, etc.

Higgin's Property.

This property is situated in the Babine range, about thirty-one miles from Hazelton, and is reached by the old Babine pack-trail. It is owned by Fred Higgin and is now under option to the Exploration Department of the Goldfields Consolidated Company, with J. B. Rowley in charge. Work was commenced in September, a camp erected, and a crew of six to eight men will be kept at work all winter.

The showings consist of several quartz veins varying in width from a few inches to several feet, which are exposed on the surface for considerable distances. Galena, zinc-blende, and grey-copper form the ore, and high silver values are associated with the grey-copper. The property apparently has promise, but is as yet undeveloped; but a winter's work will probably prove the veins to some extent.

Silver Standard.

The steady progress of this mine during the last two years, under the superintendency of W. G. Norrie, has been most gratifying. The crosscut tunnel started last year to tap the 250-foot level of the main shaft has been completed, and much other development and general betterments to the property have been accomplished. The crosscut tunnel cut several veins before reaching the main shaft veins, and some of these give promise of being of considerable economic importance. The No. 4 vein especially is showing up well and contains some good shoots of high-grade ore.

In the fall of the year the conclusion was reached by the management that the mine had reached a stage of development which made it advisable to erect a concentrator to treat the milling-ore already blocked out in the mine. After some experimenting and consideration it was decided to erect a 50-ton plant on Two-mile creek about three miles from the mine. The Faust system is to be used, which is, in principle, a water-concentrator with some special features in the crushing-rolls, tables, etc. The plant will be run by steam-power, with cordwood as fuel; mill-water will be secured from Two-mile creek. The ore will be delivered at the mill by means of a 3-ton auto-truck, the road being sufficiently good for this means of transportation. Erection of buildings and installation of plant is being rapidly proceeded with, and it is expected that the mill will be in operation in March.

When the crosscut tunnel was completed the power-plant arrangements at the mine were changed. The old steam plant at the shaft was dismantled and taken away. A 75-horse-power distillate-engine and 6-drill compressor were installed at the tunnel. Blacksmith-shop, warehouse, power-house, ore-bins, etc., have been erected and new buildings put up at the main camp as well as at the new camp at the mill-site.

Mining operations were suspended during the last half of the year on account of the construction-work and various rearrangements. The only ore shipments made during this period were from the leasers who were at work hand-sorting old dumps. The production, however, for the year was approximately the same as in 1916, and will be greatly increased in 1918.

This property has been repeatedly described in the Annual Reports of the Department from 1911 onwards, so that for details of geology, earlier development, etc., these reports should be consulted.

Surprise. This group, consisting of four claims, adjoins the *Silver Standard* to the north. In the fall of 1917 the property was purchased from the original owner, Wm. Thompson, by B. R. Jones, and it is believed development will be carried on in the summer of 1917.

The property has three or four small quartz veins outcropping on it which are believed to be extensions of the *Silver Standard* veins. Some years ago these veins were prospected on the surface slightly, and in 1912 a crosscut tunnel, which is 770 feet in length, was driven to cut the veins.

The first vein was cut in the tunnel at a distance of 200 feet from the portal. It was drifted on and a raise put up to the surface. The next vein was cut at 430 feet and at the face a small stringer is showing.

These veins where developed are only a few inches in width and carry small amounts of galena, zinc-blende, tetrahedrite, and arsenical iron; the mineralization is identical with that of the *Silver Standard*.

No ore-shoots of commercial size have been so far found in the veins on this property, but further development may show that they contain valuable shoots, as in the *Silver Standard*.

The second vein cut in the tunnel is apparently the No. 4 vein of the *Silver Standard*, which carries good ore close to the *Surprise* line. Drifting southerly on this vein from the tunnel-level is expected to be done this summer and may be successful in finding good ore.

The further development of the veins on this property is a speculation, but the fact that the veins are probably extensions of the *Silver Standard* veins makes the proposition attractive.

Nine-mile Mountain. None of the properties on Nine-mile mountain were worked to any appreciable extent during the year. The *Barber Bill* group was bonded to Mr. Carleton, but the bond was relinquished within a few weeks. The *Sunrise* group has a good showing of silver-lead ore and is well worth further development, but the property has remained idle for two or three years, apparently from lack of funds.

Cap. This group of claims, situated near the foot of Rocher Déboulé mountain and a mile from Carnaby Station, was described in the 1914 Annual Report. During 1917 further work was carried out by the owners, Comeau & Johnson, and 29 tons of ore was shipped. The development now is being concentrated on the driving of a long tunnel to get under the ore-shoots showing in the shaft-workings above.

Golden Wonder Group. This property is situated about one mile from Carnaby Station and only slightly higher in elevation. It is practically in the valley of the Skeena river at the foot of Rocher Déboulé mountain. The claims were owned by Harris & Comeau, but are now under option to M. W. Sutherland, who has associated with him J. B. Tyrrell, of Toronto. Previous to being taken over by Sutherland the development consisted of a 20-foot shaft and some surface cuts. The present owners worked the property more or less steadily during 1917 with from two to five men.

The geological formation in this section consists of a sedimentary horizon of the Hazelton formation, the rocks exposed being generally quartzitic or argillaceous. There are two or three veins on the property with a general strike of S. 65° W. and standing nearly vertical. These veins are similar in appearance to the typical *Rocher Déboulé* veins and are mineralized in much the same way; they differ from the *Rocher Déboulé* veins, however, in that they occur in sedimentary rock and not in granodiorite.

The gangue-filling is partly the ordinary wall-rock, but in places there is a considerable development of quartz and also a little siderite and hornblende. Pyrrhotite, arsenopyrite, pyrite, and chalcopyrite are the metallic minerals present. The order of deposition of the various minerals would appear to have been, first, siderite, quartz, and hornblende, then pyrrhotite a little later, and finally arsenopyrite, pyrite, and chalcopyrite, together with a little more quartz last of all. Hornblende in radiating and needle-shaped crystals is fairly plentiful in the gangue. This occurrence of hornblende is similar to the hornblende in the gangue of the *Rocher Déboulé* veins, but occurs in much smaller amount. The usual oxidation on the surface is apparent, but does not extend below a foot or two.

The vein to which Sutherland has confined his attention was not prospected by the original owners. It averages about 4 feet in width, but is not in all places well defined. At the end of July a shaft had been sunk on this vein to a depth of 20 feet. The bottom of the shaft was practically all in ore, possibly assaying 4 to 6 per cent. copper. From the material taken out of the shaft about 15 to 20 tons was put to one side as ore, which will assay from 4 to 6 per cent. copper. Shortly after this a contract was let for sinking the shaft 100 feet. By November this shaft was down 50 feet, when on account of bad weather and excess of surface water the work was stopped for a time. It is not known whether the work has been restarted yet, but in any case it will be in the spring. While the contractors were at work on this vein Sutherland was prospecting another outcropping of ore, presumably another vein. Some encouragement in the shape of good ore was found here and further development will probably be undertaken.

The original owners had prospected a vein on the property by means of a 20-foot shaft. There is a considerable development of pyrrhotite in this vein, but not very much chalcopyrite. This pyrrhotite carries some gold value which is apparently quite variable, making it difficult to arrive at an average. Mr. Sutherland considers from assays he has made that in any case the average gold content would be low, not to exceed $2 to $4 a ton.

The *Golden Wonder* group is as yet only a prospect, but the outlook for the future is encouraging. The similarity of the veins and mineralization to those of the *Rocher Déboulé* mine make it a reasonable speculation to suppose that commercially valuable shoots of ore will be found by development.

TELKWA SUB-DISTRICT.

The town of Telkwa, situated on the Grand Trunk Pacific Railway at the confluence of the Bulkley and Telkwa rivers, is the central point for a number of mining camps, none of which, however, is as yet much beyond the prospecting and developing stage. The different claims are at some distance from Telkwa, but this town is the outfitting-point for prospectors and those properties which are being developed.

The principal sections tributary to Telkwa are the Babine range and the territory drained by the Telkwa river. Transportation into these two areas was much improved in 1917 by the building of two roads; the sleigh-road to the property of the Babine-Bonanza Mining and Milling Company gives access to a portion of the Babine range in which many mineral locations are held, and the improvements to the *Santa Maria* road provide mineral claims along the Telkwa river and the South fork with wagon-road transportation.

Babine-Bonanza Mining and Milling Company.

Introductory.—The property owned by the Babine-Bonanza Mining and Milling Company is situated in the Babine range three miles to the east of the divide at the head of Driftwood creek. James Cronin is the largest stockholder in the company, and has been in charge of all work since the property was acquired in 1909.

Until the completion of the sleigh-road in the fall of 1917 the mine was reached by a sixteen-mile trail from the end of the wagon-road on Driftwood creek. This trail goes up the creek over the divide—elevation 6,000 feet—and down to the mine, 700 feet lower, which is just barely above timber-line. By this route the mine is distant about twenty-five miles from Smithers and twenty-eight miles from Telkwa. Another route into the mine is by trail from Moricetown, about thirty-five miles long, but this has not been used for some time and is now impassable for horses at the upper end. Another trail was used for a time coming in by Canyon creek, but this is also out of commission. In 1916 a wagon-road was cruised out and partially slashed by the Public Works Department, the work being under the supervision of P. Jens. This route, starting at the mine, goes down Cronin creek three miles and a half in a south-easterly direction (towards Babine lake), then swings southerly and westerly and comes out through a low pass in the Babine range lying between Deep and Canyon creeks, and thence into Telkwa, a total distance of about thirty miles. In 1917 this road was completed from Telkwa to the mine as a sleigh-road, the work being carried out under the supervision of A. L. Carruthers, District Public Works Engineer. Three miles and a half from the mine out was constructed by the mining company.

The writer reported on this property in 1914 and again in 1916, the reports appearing in the Annual Report of the Minister of Mines for 1914, and Bulletin No. 2, 1917, of the Mines Department. These reports should be consulted for details in regard to the earlier developments of the property, as this report gives only a brief summary.

Since 1909 development of the mine has been carried on fairly continuously, some work being done each summer, and during several winters a small crew of men was kept at work. To date about $60,000 has been expended on the property. All work has been by hand, there being no machinery on the property. The work has been expensive owing to the cost of taking in supplies, but, considering this fact, a lot of development has been done for the money spent. The total footage of shafts and tunnels amounts to about 2,500 feet.

The mine is equipped with cook-house, bunk-house, office building, blacksmith-shop, etc. A site for a concentrator down Cronin creek below the mine has been selected by Mr. Cronin. Water-power to run the mill is available from Cronin creek. Timber is plentiful, and now that the mine is equipped with a sleigh-road, working conditions are not unfavourable. For further development machinery is not absolutely essential, but would be desirable. Water-power for driving a compressor is also available, although an auxiliary steam plant might be required in the winter.

Ore-bodies and Development.—The ore-bodies exposed on this property are of two types, viz.: (1) Fissure-veins in rhyolite; and (2) contact replacement bodies lying between rhyolite and schistose argillite. In both of these types of ore-bodies galena carrying good silver values is the most important ore-mineral, but in places a considerable amount of zinc-blende occurs. Small amounts of grey-copper, chalcopyrite, and pyrite are sometimes seen, but they are unimportant. In the veins shoots of nearly solid galena and zinc-blende occur, but in the contact deposits the ore-minerals are disseminated through the gangue and comparatively little clean ore could be extracted. These deposits will probably, however, prove to be the more important by providing sufficient tonnage to warrant the erection of a concentrating-mill. The gangue consists of quartz and altered wall-rock.

There are at least four veins exposed on the property, and on three of these development-work has been done. The first vein was developed several years ago by a drift-tunnel (referred to as tunnel No. 1) 450 feet in length. This shows some small shoots of ore, but at the face the vein has faded away into stringers. Some ore could be stoped out here, but no very large tonnage of clean ore can be expected.

Two hundred and thirty-five feet above this tunnel two veins are exposed on the surface, one of which may be the same vein as in No. 1 tunnel. Incline shafts have been sunk on these to a depth of about 80 feet. The veins as exposed in these shafts are from 2 to 5 feet wide and carry a considerable amount of solid ore. A good deal of ore has been taken out in sinking these shafts and from open-cuts near by. These showings are promising, and it is quite reasonable to suppose that a fair tonnage of ore could be stoped out from these workings.

Another vein is exposed on the eastern side of the hill on the face of a bluff. No work has been done here, but the showing is promising, consisting of a vein 4 feet wide, with bands of solid galena up to 2 feet in width.

Another small vein is exposed in an open-cut, but it is too small to be of much importance, although in places it is mineralized with galena.

The development-work so far done on the veins shows that there is probably a few hundred tons of high-grade silver-lead ore which can be classified as "reasonably assured," although not "blocked out."

The contact ore-bodies are represented by one on which a good deal of development-work has been done, and another on the *Homestake* claim, on which but little work is done. The main contact ore-body has proved so far to be very irregular and puzzling in its underground developments. In the last three years most of the work on the property has been directed to determining the strike, dip, and general character of this ore-body.

It is exposed on the sloping side of the hill just up from the camp, and it would appear as if the schistose rock had been removed by erosion and left the ore exposed lying on top of the rhyolite. Mr. Cronin considers that this is the end of the ore-body in this direction; that is, erosion has removed it near surface, and if continuous to the north it is covered by wash in the creek. More work is necessary to determine this.

To the south the ore-body is exposed along its strike and partly on its dip by erosion for a short distance; then it is covered by talus material, but it is presumably the same ore-body exposed in the Wardell shafts, which are down 70 to 80 feet on the contact. The *Homestake* ore-body is a similar contact deposit, and it is probable that it is the southern continuation of the main contact ore-body.

Tunnel No. 1, the first working on the property, was a drift run to prospect the No. 1 vein. Tunnel A was run to prospect the contact ore-body, which it did by crosscutting obliquely through 25 feet of ore of milling grade. Crosscuts were then run from tunnel No. 1 (which is 100 feet lower than tunnel A) to pick up the downward extension of the ore-body. Although considerable exploring was done on the No. 1 tunnel level and several contacts of schist and rhyolite were crosscut, no appreciable ore-body was found.

Tunnel B, distant 60 feet from tunnel A and 30 feet lower in elevation, was then driven, which runs nearly on the strike of the contact ore-body and shows good ore throughout.

An incline raise was put through for ventilation from one of the workings in No. 1 tunnel up to No. B tunnel, which is 90 feet in length. Thirty feet above No. 1 tunnel level this raise broke into good ore, continuing up to No. B tunnel level. At the foot of this raise a drift extends to the north-east for 80 feet, and a crosscut from the end of this going 3 feet to the north-west broke into 4 feet of milling-ore. Work is being continued here in order to prove continuity of the ore between tunnel B, the 90-foot raise, and this drift.

The schist-contact lies 90 feet west of the ore exposed in this drift, and at first it seems unlikely that this ore is part of the contact ore-body exposed in No. A tunnel and on the surface. It is quite possible, though, that the contact ore-body only follows the contact in places, and this would account for some of the disappointments on the No. 1 tunnel level, where the schist-contact was reached and no ore found. It is also certain that this ore-body is quite irregular and bunchy, and that it cannot be assumed to be anywhere until blocked out on all sides.

Since the property was examined in July tunnel C has been extended to cut the contact ore-body, and there is now a good showing of milling-ore in this tunnel. This working is on the same level as tunnel No. 1, and so, having now found the ore on this level, its continuation to the south will be found by further development.

After crosscutting the contact ore-body tunnel A was continued for 173 feet into the foot-wall until the No. 2 shaft vein was struck. The vein here carries but little ore, and on drifting 20 feet to the east the vein was cut off by a fault. A raise is to be put up from this level to the bottom of the shaft, 50 feet above.

Summary of Ore proved.—The present stage of development on the different ore-bodies does not allow of any estimate of proven ore tonnage. In tunnel A, tunnel B, and the 90-foot raise the showings of milling-ore would indicate a considerable tonnage of "probable ore," but a good deal more development is necessary before any figures of tonnage could be attempted. In addition to milling-ore there are exposed in this ore-body several bands of clean ore which could be stoped out and shipped with a little hand-sorting. Mr. Cronin considers that he has practically enough milling-ore "in sight" to warrant the erection of a small concentrator. If further development should prove more continuity in the ore-exposures, then another lower tunnel can be put in to gain at least 100 feet more depth. The ground at the present level is considerably twisted, folded, and somewhat faulted, and Mr. Cronin has a strong conviction that at greater depth the ore-bodies will be more regular and continuous.

On the *Homestake* claim an ore-body is exposed which is vein-like in form, but lies practically on a contact between the schist and the rhyolite. It is developed by a 25-foot shaft and a 100-foot tunnel tapping the bottom of the shaft. This ore-body is more irregular and bunchy than any of the others. It is evident from the dump that a lot of ore has been taken out, but it is hard to see in the workings where the ore came from. The ore is broken in places by small faults and is very much twisted. By exploring the contact thoroughly and following up the streaks of ore showing in the workings a good ore-body may be found. This ore runs well in silver, assaying at least 2 oz. silver to the unit of lead. The showing is promising and warrants further development.

Values in the Ore.—The main valuable mineral in the ore is galena, although zinc-blende is also present in considerable quantity. The solid or closely hand-sorted galena will carry from 60 to 80 per cent. lead. The silver in the ore is apparently carried in the galena, neither the zinc-blende nor the grey-copper showing much silver on assay. The ratio of silver to lead in the different showings varies considerably. In the No. 1 tunnel and No. 1 shaft veins (possibly the same vein) the proportion is about 1 oz. of silver to the unit of lead. In the No. 2 shaft vein the proportion is 2 oz. of silver to the unit of lead. The ore in the main contact ore-body shows variation in the proportion of silver to lead in different exposures, varying from less than 1 to over 2 oz. to the unit of lead, but will average well over 1 oz. to the unit.

On the *Homestake* ore-body the proportion is about 2 oz. of silver to the unit of lead. Averaging throughout, it is safe to say that 1½ oz. silver to the unit of lead may be expected. Hand-sorting of the ore should yield a product assaying 50 per cent. lead and 75 oz. silver to the ton. This product would also contain from 5 to 10 per cent. zinc. In shipping to a lead-smelter the zinc content should be kept below 8 per cent., as above that it is penalized at 50 cents a unit. Ore such as this at the present time would be worth form $80 to $100 a ton, depending on market prices of silver and lead.

Conclusion.—The Cronin mine has been more or less steadily developed for eight years. At first the work proved disappointing, especially the No. 1 tunnel on the first vein developed. The showings on the surface were, however, favourable, and Mr. Cronin persisted in the work, putting down shafts, running tunnels, and digging surface cuts.

During the last three years the development-work has proved more successful and the position of the property is better to-day than ever before. The property is not even yet developed to any great extent, but in the opinion of the writer it is reasonable to expect that further development will prove satisfactory and that the mine may yet make a large production.

While a few hundred tons of hand-sorted ore could be shipped this winter over the sleigh-road and quite probably further shipments in future years, the future of the mine is dependent on the development of sufficiently large bodies of milling-ore to warrant the erection of a concentrator.

The construction of the sleigh-road to the property will serve two purposes: (1) It will allow the shipment of sufficient high-grade ore this winter to provide capital for further development; and (2) it will make it possible to take in machinery by means of which the property can be more efficiently developed. The gradual conversion of the sleigh-road into a good wagon-road in the course of a year or two as the development of the property warrants will provide the necessary transportation facilities for hauling the concentrates produced at the mill to the railway.

Cassiar Crown Copper Company.

The property of this company is situated on Grouse mountain, about eighteen miles from Telkwa. The 1914 and 1916 Reports of the Minister of Mines contain reports by the writer giving full description of the work previous to 1917, as well as geological features, etc. During the last two years the driving of a crosscut tunnel to prospect the surface showings at depth has been proceeded with. Owing to the failure to locate the ore-body where it was expected, a good deal of lateral drifting and crosscutting was done which it is now apparent was wasted work. The company's finances were reorganized this summer and new management put in; careful surveys were made which showed the errors in the past work, and a fresh start was made. The tunnel was deflected at a considerable angle from its previous course, and a crew of three men put to work to drive ahead. It was reported in November that the tunnel had entered into some low-grade ore, and as the drift is now in over 1,000 feet, if appreciable ore-bodies exist they should soon be encountered. The property is equipped with a 1-drill gasolene-driven air-compressor.

J. V. Pohlman, managing director of the company, inspected the property in January, and on his return to Spokane gave out the following information for publication:—

"Recent disclosures at the Cassiar Crown Copper property in the Cassiar District, British Columbia, have proved conclusively that the ore-bodies exposed on the surface are continuous to depth.

"My inspection was for the purpose of satisfying myself as to the facts about the recent strike in the long crosscut tunnel, driven to open the property at considerable depth. I found this tunnel had been driven 1,025 feet, at which point it intersected the ore on its downward dip. This was at a depth of about 330 feet on the slope of the vein, approximately 200 feet vertically below the bottom of the shaft.

"The fine ore-channel encountered in the tunnels, news of which was received by the company early in December, measured 5½ feet in width, 4 feet of which averaged 5.9 per cent. copper and 3 oz. in silver, while 16 inches alongside of it averaged 14.9 per cent. copper and 6.8 oz. in silver. At the time of my examination, January 14th, the ore-body had been opened by drifts extended 57 feet northerly and 14 feet southerly, or an aggregate distance of 71 feet. At one point an average sample taken across the entire width of the drift gave results of 7.3 per cent. copper and 3.1 oz. in silver.

"Drifting is proceedings steadily at a satisfactory rate. It is the purpose of the management to increase the working crew to make faster progress. After sufficient development, and as soon as the equipment for economical extraction can be installed, the stoping of ore will begin, with a view to placing the property on a shipping basis as early as possible.

"The surface showings are impressive. The mineral zone varies in width from 15 to 100 feet, and has been opened up at 13 to 15 points on the surface for 3,200 feet along the strike of the vein. The main ore vein within the zone is 5 to 12 feet wide. Samples from these openings reveal a copper content ranging from 5 to 15 per cent. and ½ oz. silver to the per cent. of copper.

"Owing to the fact that the vein had flattened out considerably at depth it was found necessary to extend the tunnel several hundred feet farther than originally calculated; otherwise the ore-zone would have been reached several months ago.

"The Cassiar Crown group consists of five claims situated four miles and a half in a direct line from Walcott Station, on the Grand Trunk Railway, 260 miles east of Prince Rupert, the western terminus. It is situated at an elevation of 4,100 feet, or 2,000 feet above the railway.

"A tramway four miles and a half long will be built from the portal of the main tunnel to the railway, thus connecting the main tunnel with the railway at the nearest point. The property is served with a fair wagon-road, which with some changes can be put in shape for hauling ore."

Bulkley Valley.

Three Lake Group.

This group of four claims, owned by Wilson Bros. and partners, is situated three miles from Knockholt, a station on the Grand Trunk Pacific Railway thirty miles east of Telkwa. During the summer an option on the property was acquired by D. M. Haynes acting as agent for the Tonopah Mining Company. Work was commenced in August with six to eight men and the sinking of a shaft commenced. At the time of writing this report (January) it is reported that development of the property has been discontinued.

The showings on the property are situated at an elevation of 3,500 to 3,700 feet, and in country that consists of rolling hills; the timber has been largely burnt off and now only poplars, small balsam, and pine are left.

The vein on this property is a fracture-zone in which mineralization has taken place by replacement. The gangue-matter is wall-rock, with a considerable development of specularite. Chalcopyrite is the main valuable ore-mineral, although some higher sulphides and oxides are occasionally noted. Low gold and silver values are found in the ore, but copper is the important value.

The rock formation exposed on these claims is an altered complex consisting of sedimentary, tufaceous, and some volcanic members. These rocks are similar in some respects to those on Grouse mountain, and probably belong to the Hazelton formation.

On the north end of the vein a number of open-cuts, short tunnels, and a shaft were made by the owners. Very little ore was found here, but specularite occurs in considerable quantity. On the south end more chalcopyrite is found in the vein, and so here a shaft was sunk by Mr. Haynes. This shaft showed a width of 4 feet of ore extending down the shaft for 15 feet and then gradually faded away, possibly dipping into the wall. At the time of examining the property the shaft was down 30 feet, and since then it has been sunk 20 to 30 feet more and some crosscutting done. No information has been received about the results of this work.

Independent.

This claim is owned by Joe Bussinger and is situated half a mile up the hill from the Government ranch. The development consists of a shaft 40 feet deep and some open-cuts. The vein on this property is from 3 to 4 feet wide, with a well-defined hanging-wall but a very indefinite foot-wall. The wall-rock is a metamorphosed sediment varying from argillite to quartzite. This rock also forms the gangue or vein material, but is somewhat more silicified and contains some bands of true quartz. Chalcopyrite is the important metallic mineral present, with which some pyrite is associated. A shoot of good-grade ore is exposed going down the shaft for 25 feet, averaging about 2 feet in width. Below this the vein is still continuous, but does not contain as much ore.

In October a lease on the property was taken by the Chisholm Bros., who intend to drift on the vein from the bottom of the shaft and also stope out ore. The ore will be hand-sorted and a car-load or more may be extracted during the winter. In the work of sinking the shaft

about 15 tons of ore was produced, which will assay about 12 per cent. copper and 3 oz. in silver. The property is nicely situated for easy operation, being connected with the railway by a good wagon-road, the distance being about four miles.

Hudson Bay Mountain.

In the 1914 and 1916 Reports of the Minister of Mines the writer described a number of claims situated on different parts of Hudson Bay mountain. During the summer of 1917 there was a certain amount of activity in this section, and besides the ordinary annual assessment-work development was carried out on some properties. Two groups were bonded during the year, one of which is still held under option. Only one small shipment of ore was made, consisting of 6 tons from the Schufer property. A car-load of ore was taken out and sacked on the *Victory* group, but was not hauled out to Smithers before the end of the year.

Mamie Group. This group consists of three claims—the *Mamie*, *Evinrude*, and *Lone Cedar Fraction*—and is owned by J. Aldrich, of Smithers. The property was bonded to C. H. Sproat in the fall, but work had hardly been well started when the bond was relinquished. The property is situated on the southern slope of Hudson Bay mountain, at an elevation of 4,000 to 4,500 feet.

In 1914 a sleigh-road was constructed from Smithers to the *Coronado* camp, a distance of twelve miles. This road serves several properties, including the *Mamie* group, all of which are connected by short trails to the end of the road. This sleigh-road is not in very good condition at the present time, and in summer-time the road is only partly used, the old trail being followed in places.

Hazelton formation rocks form this side of Hudson Bay mountain, with rhyolites and andesites prevailing on the *Mamie* group. These rocks are in part brecciated and in places porphyritic.

The vein consists of a sheared zone 4 to 12 feet wide, occurring in a light-coloured volcanic rock of a rhyolitic type. The hanging-wall rock is porphyritic, while the foot-wall is fine-grained. The gangue-matter consists of wall-rock, practically unaltered; the ore-minerals disseminated through the gangue in bunches and stringers are zinc-blende and arsenopyrite, together with a little chalcopyrite. The main value in the ore is zinc, but the arsenopyrite carries low gold values. Some silver occurs with the zinc, but as a rule the silver content is low.

The development consists of a shaft 20 feet deep, and open-cuts and stripping which expose the vein for 400 feet up and down the hill. These workings show the vein to be fairly well mineralized with zinc-blende. A grab-sample from the dump from the 20-foot shaft assayed: Gold, 0.22 oz.; silver, 7.3 oz.; zinc, 7.5 per cent.

Development of the property by a drift-tunnel on the vein at a point some distance below the shaft was started by Mr. Sproat, but the tunnel was not driven more than a few feet when work was stopped.

White Swan. This group adjoins the *Mamie* group to the east and is owned by Mark Hanna and Geo. Charlton. A description of this property was given by the writer in the 1914 Annual Report of the Minister of Mines. The ore-showings on this property consist of impregnations along dykes and in sheeted zones in the volcanic rocks. Some of the stringers in places come together so as to form a more or less definite vein, but as a rule the mineralization is irregular.

Galena, zinc-blende, and arsenopyrite occur in the gangue, and in one place a width of 1 foot of clean galena was noted. Development consists of open-cuts, stripping, and shafts. The workings described in 1914 have not been developed further, but cuts have been made on showings discovered since then.

Victory. This group was described by the writer in the 1914 Annual Report. Since that time ore has been stoped out, sorted, and a few car-loads shipped and the tunnels advanced a little. During the fall of the year Donald Simpson, owner, mined out and sorted a car-load of ore, but this has not yet been hauled to the railway at Smithers.

The best showing on the property is in the No. 4 tunnel, the face of which is all ore of a milling grade. A sample taken there across 4½ feet assayed: Gold, 0.52 oz.; silver, 14 oz.; lead, 13 per cent.; zinc, 16 per cent.

Last Chance.

This property consists of the *Last Chance* and *Lost Dollar* claims and is owned by Geo. Smith and Gus Timmermeister. The claims, which were staked several years ago, are situated on the face of Hudson Bay mountain, directly above and overlooking Lake Kathlyn and at an elevation of about 4,800 feet. The rocks exposed on the property are argillite, quartzite, and conglomerate, belonging to a sedimentary horizon of the Hazelton formation. A small and irregular vein somewhat sparingly mineralized crops out on the surface, striking N. 10° W. and dipping into the hill at about 60 degrees. Pyrite is the main mineral showing, with an occasional speck of galena.

Practically no work has been done on the surface, but a crosscut tunnel 180 feet in length cuts the vein, and a further 27 feet of drifting on the vein has been done. This vein does not look promising anywhere, and two selected samples taken by the writer and assayed for gold and silver did not return any appreciable values.

Grand View.

On the same slope of Hudson Bay mountain, but to the south of the *Last Chance* group, some showings of mineral were staked during 1917 by Jenning Bros., which are known as the *Grand View* group. Hazelton formation rocks consisting of quartzites and argillites cut by porphyritic dykes occur on this slope of the mountain, and in places irregular mineralizations along fracture-zones occur. Pyrite occurs in places, but no other metallic mineral is appreciable quantities was noted. No work has been done on any of these showings. A few samples were taken and assayed for gold and silver, but only traces of the precious metals were found.

A fairly well-defined quartz vein outcrops in one place which carries in the quartz gangue a little pyrite and pyrrhotite, together with specks of galena and chalcopyrite. Samples taken, however, only assayed traces in gold and silver.

Development of these showings is not advisable unless in some place appreciable values in some metal are obtained.

Schufer Property.

This property was reported on by the writer in the 1916 Annual Report, but was re-examined this year in order to see new development, and, in company with the owner, to get a more comprehensive view of all the showings. The description last year was mainly with regard to the zinc-pyrrhotite ore-body on the property, about which it is unnecessary to say more. Showings of mixed zinc and pyrrhotite are numerous in different cuts on the claims, but as a rule the zinc content is not much above 10 per cent. In places the pyrrhotite carries from $2 to $5 in gold.

The main work done since last year was the driving of a tunnel 25 feet in length on the upper vein, which has exposed a nice shoot of ore. This vein is from 1 to 2 feet wide and is heavily mineralized with galena, zinc-blende, pyrite, and small amounts of chalcopyrite.

The tunnel shows practically continuous ore, and at the face the vein is 2 feet wide, consisting of mixed sulphides of lead, zinc, and iron. Sorted ore from this vein will run from 100 to 200 oz. in silver to the ton. A shipment of 5½ tons of this sorted ore was made in the fall of the year which averaged nearly 250 oz. in silver to the ton. The property is owned by P. Schufer, Smithers, and L. Woods and will probably be developed further in 1918.

Carroll Property.

This group of claims, which is owned by Dan Carroll, is situated on the north-eastern slope of Hudson Bay mountain and about a mile from the Schufer property, on another ridge of the mountain. The property is at present under option to Mr. Jobe, who last year had three or four men at work developing the showings by tunnels. This work was stopped when the winter weather set in, but will probably be resumed in 1918.

The formation exposed on these claims consists of volcanic rocks of the Hazelton formation, chiefly andesites and diabases. Two veins are exposed on the property, which strike, roughly, south-west and dip rather flatly to the north-west. On the surface these veins are very much oxidized and leached out. They vary in width from 2 to 4 feet and carry in places narrow bands of galena. The balance of the vein is a gangue similar to the wall-rock. Owing to snow on the ground at the time of examination it was impossible to see the surface croppings of the veins properly; but they are said to be exposed for considerable distances up and down the mountain-side by open-cuts.

The lower vein has been prospected by a tunnel 100 feet long, which shows that the vein to this depth is leached out and decomposed into loose, crumby rock-matter. No sulphides at all were seen in the tunnel. A sample taken across 3 feet of leached vein material in the tunnel

assayed: Gold, 0.12 oz.; silver, 6 oz. Another grab sample from a 3-ton dump from the tunnel returned: Gold, 0.24 oz.; silver, 7.8 oz. A sample across 18 inches of oxidized vein material in a surface cut assayed: Gold, 0.36 oz.; silver, 9.3 oz.; lead, 6 per cent. It is probable that the vein at these points carried some galena and arsenopyrite which is now completely oxidized.

The upper vein is similar to the lower one and is developed by a 90-foot crosscut tunnel. This vein is also very much leached and therefore shows very little sulphides. At the face of the tunnel the vein is represented by streaks of leached-out material separated by bands of harder unaltered rock. Above the tunnel an open-cut exposes the vein, which at this point carries a 3-inch band of clean galena; a selected sample of this galena assayed: Gold, 0.04 oz.; silver, 160 oz.; lead, 73 per cent.

Camp buildings have been erected at an elevation of 4,100 feet; the lower tunnel is at 4,600 feet and the upper tunnel at 5,200 feet.

More extensive shoots of galena may be found in these veins below the zone of surface oxidation.

Howson Basin.

The name "Howson basin" is applied to a district lying around the headwaters of the South fork of the Telkwa river and Howson creek, a large tributary of the South fork. At the head of Howson creek there is an actual basin around and in which a number of claims are staked, but the name "Howson basin" includes the larger district described. This section is distant some thirty miles from Telkwa and is now provided with transportation facilities by means of a wagon-road.

Claims were staked in this district as long ago as 1905, but until last year no production had been made. A fair amount of development-work on various properties has been carried out in the past years, but still many claims are quite undeveloped. The district has been reported on by W. W. Leach, of the Geological Survey, in 1906, the Provincial Mineralogist in 1911, and brief mention is given in last year's Annual Report of the Minister of Mines.

Until last year access to the district was by means of a wagon-road five miles in length up the Telkwa river and pack-trail for the balance of the distance. In the fall of 1916 a rough sleigh-road was built by the Jefferson-Dockrill Syndicate from Telkwa to the *Santa Maria* mine, and this year this road was very considerably improved. It is now a good wagon-road for twenty miles and a sleigh-road for the remainder of the distance. This last work was done under the supervision of the Public Works Engineers, and matters have been finally arranged so that one-half of the total cost of the road has been paid by the Jefferson-Dockrill Syndicate and one-half by the Government, the latter coming from the "Mines Development Fund." This road, besides serving the *Santa Maria* mine (Jefferson-Dockrill), should prove of benefit in opening up the district generally. The knowledge that transportation of ore from the district is possible should encourage the development of other properties which have lain idle for years, as well as provide an incentive for further prospecting.

Topographic and Geologic Features.—Physiographically, this district lies in the Coast mountains of the Pacific system. The Coast mountains in this portion of the Province do not consist of a single defined range unit, as is the case farther south, but are rather a system of ranges, with the western range forming the main Coast range. The easterly groups may be considered as spurs from the main range, but nevertheless they reach equal or greater elevations as compared with the main range and in part are physically separated by important valleys. Geologically, these easterly ranges should be connected with the main Coast range on account of their being formed in varying degrees from west to east of granitic rocks contemporaneous in age and identical in lithological character with the Coast Range batholithic rocks.

In this district the Telkwa range forms the eastern portion of the Coast mountains. This range is not separated from the main Coast range by any very definite trench, but merges insensibly into the main western range. The small valleys occupied by the northerly swinging portion of the Zymoetz river, the Kitnaiakwa river, and a small northerly branch of the Morice river may be considered as defining in an indefinite way the western edge of the Telkwa range. The Telkwa range may be considered as extending easterly nearly to the Bulkley valley from the western boundary outlined above. To the north this range decreases in height and gives way to a plateau-like country, finally dropping down to the low country surrounding Hudson Bay mountain. Similarly, to the east the mountains gradually descend in elevation until the

wide terraced valley of the Bulkley river is reached. To the south the Telkwa mountains gradually merge into the main Coast range, which trends south-easterly, around the headwaters of the Morice river.

Hudson Bay mountain, an impressive rugged pile of rocks reaching an elevation of 8,800 feet, is surrounded on all sides by plateau country not higher than 3,500 feet in elevation, and therefore forms a most conspicuous feature on the landscape. It is one of the most striking scenic spots along the line of the Grand Trunk Pacific Railway, and while not equal in elevation with the more widely advertised peaks, it loses nothing in majestic grandeur; on its western face a glacier rests which can be seen from the railway for several miles. Hudson Bay mountain is a mountain mass separated from all other mountains and cannot be connected definitely with the Coast mountains, although possibly its age and origin are similar.

Howson Basin camp is situated in the Telkwa mountains, but on the westerly slope of the divide; this divide of the range is the watershed between the Telkwa and Zymoetz rivers. The country is mountainous and rugged and the relief is considerable. The highest elevations reach about 6,500 feet, while the valley of the South fork is about 3,500 feet.

The geology of this section of country has been worked out in considerable detail by W. W. Leach, of the Canadian Geological Survey; his bulletin entitled "The Telkwa River and Vicinity" contains a topographic and geologic map covering an area from the Bulkley valley to the Coast range and including a considerable portion of the Telkwa range.

From this it is seen that the Hazelton formation covers about 90 per cent. of the map-sheet. Small remnants of the Skeena coal-bearing formation occur on the eastern edge of the sheet. Near the western border of the sheet there is an irregular area of granite and syenite porphyry covering about twenty-five square miles, which rocks are assigned to the Bulkley eruptives. No other formations are shown, although the possibility of Tertiary rocks occurring is pointed out in the bulletin.

On the western border of the geologic sheet the contact of the Hazelton formation with the Coast Range granitoid rocks is placed. The contact relations are not discussed, but it would seem likely that here, as has been found in many other places, the Coast Range batholithic rocks are intrusive into the Hazelton formation. On closer examination it will probably also be found that the area of granite and syenite porphyries classed as Bulkley eruptives can be genetically correlated with the Coast Range rocks. They form one of the offshoots of the Coast batholiths, which are of frequent occurrence along the eastern border of the main range.

This intrusive area of granite and syenite porphyries is of great importance economically, as it is in the contact-zone of these rocks that the mineral showings of Howson Basin camp are found. It is apparent that the intrusion of these granitic rocks has been the agency by which mineralization in the district has been effected. The Hazelton formation consists here almost entirely of volcanic rocks, of which a red andesite is the most common member; this andesite shows many variations, being sometimes amygdaloidal, often porphryritic, and frequently brecciated. Tuffs, agglomerates, and occasionally basic flows make up the rest of this series of volcanic rocks. The whole series has been subjected to considerable regional metamorphism, which is a typical feature of Hazelton formation rocks wherever found. Near the borders of the intrusive granites local metamorphism is evident, and in places the volcanics are altered into bands of schist. This volcanic series has in part at least been laid down under water and all are more or less regularly bedded. Leach estimates the thickness of these rocks in this district to be at least 5,000 feet.

The Hazelton formation in this district has no definite direction of strike and dip, but in common with the other mountain ranges of the Province the general trend is north-westerly. The series is twisted, folded, and bent into anticlines and synclines in all directions, varying from one locality to another.

The ore-bodies in the Howson Basin camp are as a rule developed along fractured zones in the Hazelton formation volcanic rocks; some of them have been classified as mineralizations along the walls and in dykes cutting the volcanics. The only property in which the ore occurs in a well-defined vein is the *Santa Maria*.

The important ore-mineral present in the different showings is chalcopyrite, with which is associated some pyrite and pyrrhotite. Gold values are either absent or very low, and the silver content is also quite low. The *Santa Maria* ore differs from the others in consisting of the higher copper sulphides, bornite, and chalcocite. Oxidation on the surface is usual, resulting in

an "iron-cap" which is a marked feature of the outcrops. The gangue in which the metallic minerals occur is the volcanic rock, together with a little quartz and calcite; alteration of the normal constituents of the volcanic rock has caused the occurrence of epidote, chlorite, sericite, and other secondary minerals.

Duchess. This property is situated at the head of Howson creek and is owned by the Telkwa Mines, Limited; the claims constituting the group were Crown-granted some years ago. In 1915 the Jefferson-Dockrill Syndicate bonded the property and developed it for a year, but finally allowed the bond to lapse.

The ore-zone is prospected by two tunnels, but owing to the irregular nature of the mineralization and surface features it is by no means certain that the true strike of the ore-zone has been ascertained. Apparently at the upper tunnel (elevation 5,300 feet) the strike is N. 5° W., but the tunnel after going in on the ore for 90 feet passes out into country-rock which continues to the face, a total distance of 253 feet. At a point 90 feet in the tunnel a half-crosscut going 20 feet to the west is in ore. All the rock exposed along this first part of the tunnel (90 feet) can be called ore and would probably average 4 to 5 per cent. copper. Beyond this point the tunnel passes out of the ore, and although several crosscuts were made no continuation of the ore-zone was found. In all, the tunnel workings total about 500 feet.

The lower tunnel is 167 feet below the upper one and is supposed to be driven on the strike of the same ore-zone. It is 60 feet long and throughout its length is in altered volcanic rock of a diabase type. Very little mineralization is apparent; specks of chalcopyrite occur disseminated through the rock, together with some pyrite.

At an elevation of 5,700 feet a large cut 20 feet in length and with a 20-foot face shows a clean-cut dyke of dioritic affinities, which is 4 feet wide, cutting the volcanic rocks. On either side of this dyke a little mineral, consisting of pyrite, specular iron, and chalcopyrite, is developed.

In the main (upper) tunnel the rock formations exposed consist of both acid and basic volcanic rocks, with the latter type predominating. Some of these rocks may be fine-grained dykes or sills injected into the volcanic members, but the exact relations are difficult to ascertain. The supposition has been that this ore-zone was a large dyke cutting through the older rocks, which dyke had been mineralized. It seems much more likely that mineralization has followed along lines of fracturing and cross-fracturing in the volcanic rocks and possibly intercalated dykes; and so very irregular ore-bodies might be expected.

A careful study of the property from this view-point might repay the time spent. By abandoning the "dyke" idea and tracing up the fracture-lines and doing some surface prospecting, much information as to the origin of the mineralization might be obtained, which would result in more extensive ore-bodies being found. The writer only had time to spend an hour on the property, so that these ideas are simply put forward as suggestions, not opinions.

Evening. The Telkwa Mining, Milling, and Development Company owns 44 Crown-granted mineral claims situated near the head of Howson creek; the most important of these is the *Evening* group. At an elevation of 5,500 feet and on the sloping face of a bluff an open-cut working has been made which shows some mineralization. At this point there occurs a contact between andesite and diabase, with 6 inches of crushed rock and gouge along the contact. The diabase is mineralized in an irregular and bunchy manner with chalcopyrite, and it is apparent that as a whole the mineralization is not sufficient to constitute the rock-matter as being ore.

Numerous other similar showings have been slightly prospected on these claims, but time was not available to see them.

Silver Heels. Two claims—the *Silver Heels* and *Whispering Wind*—constitute this group, which is situated at the head of Silver Heels basin, which drains into Howson creek. Jefferson & Dockrill are the owners and the claims are held by annual assessment. The main showing is on the *Silver Heels* claim, at an elevation of 5,800 feet. There is here a fairly well-defined mineralized zone 10 to 15 feet wide, striking N. 35° W. and occurring in andesite rock. A sample cut across 11 feet assayed: Gold, trace; silver, 1 oz.; copper, 2.3 per cent.

No other showings in the Howson Basin camp were examined, but there are said to be many occurrences of disseminated chalcopyrite. The possibilities for the camp are that some of these may on development prove to contain considerable tonnages of low-grade copper ore.

Santa Maria.

This group consists of the *Telkwa, Howson, Santa Maria,* and *Catherine* claims. The claims were staked in 1916 by Jimmy Michelle, Felix George, and Father Godfrey Eichelbacher. Shortly after being staked the claims were secured under option by Chisholm Bros., who transferred their rights to the Jefferson-Dockrill Syndicate, the present operators. The property is situated in the section of country known as Howson basin, although, strictly speaking, it is not in the basin. It lies about a mile west of Howson lake and about three miles up Howson creek from where the creek joins the South fork of the Telkwa river. The route used in getting to the property is up the Telkwa river, South fork, and Howson creek, a total distance from Telkwa of twenty-seven or twenty-eight miles.

A pack-trail was put into the Howson Basin section several years ago, and by last year a wagon-road from Telkwa extended six miles up the Telkwa river. In the fall of 1916 the Jefferson-Dockrill Syndicate commenced at this point and cut out and partially graded a sleigh-road to the *Santa Maria* mine. This road, of course, became useless in spring for wagon transportation, and for the efficient working of the property a wagon-road is required.

On securing the property the Jefferson-Dockrill Syndicate immediately commenced active development. An incline shaft was sunk 82 feet, and from the 60-foot level drifts have been run 120 feet to the south and 102 feet to the north. From the south drift a stope 40 feet in length was put up to within 12 feet of the surface, and a smaller one on the north drift 20 feet long at the bottom and apexing into the shaft. From the ore taken out of these stopes 239 tons was hand-sorted, hauled out on sleighs, and shipped to the Anyox smelter. The average assay of this ore was 17 per cent. copper and 9.5 oz. in silver, with a trace of gold.

In the early months of 1917 machinery as follows was taken in and installed: A Mietz & Weiss semi-Diesel engine of 50 horse-power; an air-compressor with a capacity of 236 cubic feet a minute, sufficient to run three drills; a small hoist capable of sinking from 300 to 400 feet; pumps, tanks, piping, and miscellaneous fittings of all kinds that were necessary. All ore was stoped by hand before the machinery was installed.

At the time of examination of the property the shaft was filled with water to within about 20 feet of the surface; therefore the vein could only be examined on the surface and along 40 feet on the top of the south stope. After getting the machinery installed and a little drifting done work was discontinued on May 15th. By that time the snow had gone and the sleigh-road was in disrepair. In July road-work was commenced and the road made into a wagon-road to within eight miles of the property.

In the fall work was resumed at the mine and the shaft was sunk to 120 feet depth. The shaft was kept on the incline, and as the vein had straightened up a crosscut 15 feet in length was necessary to pick up the vein from the bottom of the shaft. Some drifting was done on the vein, but at this level no ore was found, although the vein is well defined. After some prospecting and crosscutting at this level work was stopped at the end of the year and the mine closed down. Nothing is known regarding plans for further development.

Geological Features.—The vein on the *Santa Maria* is a replacement ore-body lying in the contact between two different rock formations, which are provisionally classified as quartz porphyry on the hanging-wall and andesite porphyrite on the foot-wall. Both rocks are probably pyroclastic in origin, at least to some extent, as in places they exhibit an incipient bedded structure. On closer examination both may be listed as tufaceous rocks. The vein is well defined and regular, the hanging-wall being extremely well marked with a 2-inch layer of gouge next to it. The foot-wall is indefinite, but mineralization does not extend into the foot-wall proper to any appreciable distance. The vein-filling is made up largely of the foot-wall rock which has been altered, silicified, and mineralized. A considerable development of bluish-black quartz occurs which is frequently associated with the ore. The width of the vein is from 4 to 7 feet, with an average of perhaps 5½ feet. The strike of the vein is practically north and south; the dip at the surface is 45 degrees, but in the shaft the vein straightened up to 60 degrees, and then to 70 degrees near the bottom.

The ore-minerals occurring in the vein are chalcocite and bornite, and occasionally a little black oxide of copper. Pyrite occurs in small quantities, but as far as can be ascertained no chalcopyrite has been detected as yet in the shaft-workings. Malachite, azurite, and iron oxide are plentiful throughout the ore, and the vein has the general appearance of an oxidized ore-body. It is impossible as yet to say whether or not the bornite and chalcocite occurring in the

vein are of a secondary nature derived from primary chalcopyrite in the vein. It seems possible that at least some of the bornite is primary, but that the chalcocite is secondary from the bornite. It would seem probable, though, that at greater depth some chalcopyrite will be found in the vein. At greater depth the ore may be found to consist of bornite and chalcopyrite, with a gradual elimination of chalcocite, which would mean a lessening of the grade of the ore. Sufficient information is not yet available, however, for any definite statement on this point.

The copper minerals do not occur disseminated all through the vein-filling, but run in bands and streaks of fairly concentrated ore, alternating with strips of waste. A part of the vein can therefore be rejected in mining as waste and only the mineralized portions are hand-sorted, from which the shipping-ore is extracted. The top of the 40-foot southern stope shows some nice ore in the vein in small streaks, the largest one noted being about 1 foot in width. The best showing of ore at any time seen in the mine was 5 feet of nearly solid chalcocite and bornite occurring in the southern stope. At 48 feet from the shaft on the north drift an ore-shoot was encountered which continued to the face, a further distance of 54 feet. From 1 to 2 feet of 12-per-cent. ore is exposed in this shoot.

The vein is exposed on the surface a short distance south of the shaft in an open-cut which shows it to be slightly mineralized. Three hundred and fifty feet to the south the vein is again exposed in a surface cut. Here the vein carried from 1 to 2 feet of nice ore; it is of the same average size as in the shaft and looks quite promising at this point. The occurrence of ore here may be taken as an indication that the vein will be mineralized for this distance southerly from the shaft. Such mineralization will probably be intermittent, as is the case in the shaft-workings. Taken with the north drift, this makes a distance of 450 feet along the strike of the vein in which ore may be expected to be found. An air-pipe has been laid to this open-cut and it was intended to sink a prospect shaft here; a large surface stope was made and a shaft started and put down 14 feet when work was stopped. At this place the vein shows 4 to 5 feet of ore of milling grade, but not of high enough grade for shipment.

At a point 800 feet southerly from the shaft, and practically on the line of strike of the vein, a cropping of ore has been partially uncovered. Sufficient work has not been done here to determine the true character of this occurrence of ore, and the writer was unable to determine whether or not this is a continuation of the main vein. At this point the ore is chalcopyrite, together with some pyrite and oxidation products of those minerals. No strike or dip to the ore occurrence could be made out, but the bottom of the cut shows 3 to 4 feet of rock in which there is disseminated chalcopyrite, the whole averaging possibly 2 to 4 per cent. copper. If this is a continuation of the main vein, then it is quite likely that chalcopyrite will be found in the shaft-workings at greater depth.

These open-cuts just described are the only places in which the vein is exposed on the surface, a layer of wash covering the rock formation nearly everywhere.

General Remarks.—The *Santa Maria* mine is situated at an elevation of 4,300 feet, well below timber-line. Timber for mine purposes is plentiful and the water for the camp is obtained from a small creek near by. The camp buildings erected are a cook-house, bunk-house, root-house, and office. The mine is situated in a convenient place and it is at present well equipped for further work. All development for some time will have to be by shaft-sinking.

Several small water-powers are within about three miles of the property. From 260 to 300 horse-power could be developed on Howson creek or on the South fork of the Telkwa river. If the mine develops to a stage to warrant it, there will be no difficulty in developing plenty of hydro-electric power to operate with.

Telkwa River.

Many claims have been staked in the past ten years in the country surrounding the head of the Telkwa river and its tributary creeks. None of these have, however, been developed to any great extent, although annual assessment-work is done on some of them. The wagon-road up the Telkwa river to the South fork brings these claims closer to transportation, and if any of them on development reach the shipping stage the road can be continued so as to serve them.

Copper Queen. This group consists of three claims situated on the West fork of Wingfield creek, a small stream coming into the Telkwa river near its head. The owners are Ben Peterson and Fred Griffin. The property is reached by a very poor trail leaving the main Telkwa River trail at the flats above the South Fork bridge; the branch trail is six or seven miles long.

A large open-cut 15 x 20 x 8 feet has been made which exposes an irregular vein in andesitic rock. The vein, while not well defined, may be considered to be from 2 to 4 feet wide, but much of this vein material is the same as the wall-rock. Within the vein a pay-shoot of rich copper ore occurs, varying in width from 1 inch up to 12 inches. This pay-shoot is irregular and cuts off abruptly and then comes in again. The copper ore consists of bornite and chalcocite, with a very little chalcopyrite. Solid ore occurs in bunches, and some also occurs which is a mixture of gangue and disseminated copper minerals. By hand-sorting a product running 20 to 30 per cent. copper could easily be obtained. The smallness and irregularity of the pay-shoot, however, make the costs of mining very high. A shipment of 7 tons was packed out and shipped by the owners late in the year, but nothing is known regarding returns. The property is an undeveloped prospect, but it will pay the owners to develop it somewhat to see if it contains a continuous pay-shoot of fair size of the rich copper minerals.

The same men staked a group of six claims, known as the *International* group, about two miles distant from the *Copper Queen* group. Some slight impregnations of chalcopyrite and associated copper-stain occurring along fracture-planes in amygdaloidal basaltic rock were prospected slightly, but the showings are of no importance.

Big Four Group.

This group, consisting of the *Big Four* and *Hidden Treasure* claims, and owned by P. Powers, J. Beaman, R. Hamilton, and Geo. Charlton, is situated on the mountain lying between Milk creek and the Telkwa river. The principal showing is at an elevation of 3,250 feet, in heavy timber, and on the slope to the Telkwa river. The claims were staked in 1910, reported on by the Provincial Mineralogist in 1911 and again in 1914. On reading these old reports it is apparent that comparatively little work has been done since 1911. The claims are held by annual assessment.

The surface is heavily covered with wash, trees, and fallen timber, and at the present time sufficient development has not been done to disclose the exact nature of the ore-body exposed on this property. As far as could be determined, the rock formation consists of altered volcanic rocks intruded by quartz porphyry and granitic dykes. Possibly the volcanic rocks so called are intrusive dykes cutting a fine-grained acid granitic rock. There are several showings of quartz, more or less mineralized, and of considerable size exposed in shallow cuts. The most important of these is an exposure roughly 17 feet square, in which, to judge by the eye, there is sufficient mineralization with galena and pyrite to constitute it milling-ore. Other cuts show from 5 to 20 feet of quartz with more or less mineralization. It is difficult to tell in which way the vein or ore-body strikes, but apparently it is north-westerly. If the ore-body is a definite vein, as would seem apparent, then it is faulted and probably cut by several dykes. More work is required before anything definite can be ascertained regarding the property. The indications are that this property may have an ore-body of considerable size of milling grade, and therefore it warrants further development. It would be good policy for the owners to make the small expenditure required to put the property in such shape that it could be systematically sampled and sized up, which is impossible at present.

Besides galena and pyrite, the quartz carries some chalcopyrite; sufficient to be a source of value if the ore was concentrated. The galena is unfortunately low in silver; a selected sample of this mineral returning on assay: Gold, 0.02 oz.; silver, 13 oz.; lead, 68 per cent. A sample taken in 1914 from a small lot of roughly selected ore from the main showing returned: Gold, 0.02 oz.; silver, 7.2 oz.; lead, 36.3 per cent.; copper, 2.5 per cent.

Sweeney Mountain.

Emerald.

This property is situated on Sweeney mountain, in the Sibola district, some sixty miles south of Houston, on the Grand Trunk Pacific Railway. It was reported on by the writer in the 1916 Annual Report, and during the past summer was further developed and examined by several engineers for intending purchasers. In November the property, together with an adjoining group, was secured under lease and bond by James Cronin, the well-known silver-lead operator, who is acting as agent for New York capitalists. Development will be commenced as early in the spring of 1918 as is practicable. Several parties of prospectors were in this district during the season.

COAL.

It has been known for several years that the Omineca Mining Division contained many areas of coal-bearing formations, and at one time the probability of there soon being a number

of producing coal-mines in the Division was regarded as almost a certainty. D. B. Dowling, in compiling the "Coal Resources of the World" for presentation to the International Geological Congress in 1913, credited the "Northern Interior" with a "probable reserve" of 8,200,000,000 metric tons of coal. This estimate included all kinds of coal and included "seams of 1 foot and over to a depth of 4,000 feet." These hopes were based mainly on the coalfields along the Skeena, Bulkley, Telkwa, and Morice rivers, and the Groundhog field, which lies partly in the northern part of Omineca Division and partly in the Skeena and Stikine Divisions; from 1910 to 1912 considerable interest was shown in the Groundhog field.

It is to be regretted that these early expectations have not materialized, as there is not yet a producing coal-mine in the Omineca Division; but it must not, however, be concluded that all the possible coal-bearing areas have been thoroughly tested. There is no question but that there are some areas in which commercial coal exists in fairly large tonnages, and it is quite probable that eventually some of these will be mined.

Many other conditions besides the actual existence of coal are necessary before profitable coal-mining can be established. Transportation and market are vital factors; of these the market question is perhaps the most important. Given a good coalfield and a good market, the transportation problem can be overcome. The coal areas on the Bulkley and Skeena, which are close to the Grand Trunk Pacific Railway, where tested have unfortunately not as yet been proved to be commercially successful. A number of these have been drilled, and the conclusion arrived at from these drillings has been that none of these areas was promising enough to warrant the expenditure of opening up and equipping a coal-mine. In some instances the area of coal-bearing rocks proved to be too small; in others the measures are so badly faulted, twisted, and broken as to make mining unduly expensive; in others, where other features are favourable, the ash content in the coal is so high as to render it unmarketable. It must not be assumed that all the coal in the Northern Interior is so uniformly high in ash as to make it unsaleable, as there are at least some areas where the average analyses show a lower ash content than in the average coal mined in the Province.

A combination of unfortunate factors has made the areas contiguous to the transcontinental railway of slight economic value, but there are other areas at some distance from the railway where such particular disadvantages do not exist. With these, however, the transportation question is the difficulty, as it is necessary that a coal-mine should ship its product by rail. The market question comes in here, as an assured market for a large tonnage of coal must be available before the expense of building branch railways to these far-removed areas can be considered. When the Grand Trunk Pacific Railway Company was unable to secure a coalfield in the immediate vicinity of its railway-line, the company was more or less forced to equip the line with locomotives using crude oil as a fuel. This oil comes from California and Peruvian oilfields, and the company hauls it from Prince Rupert as far east as Alberta. While this policy was more or less forced on the railway company, a more vigorous effort to develop other known coalfields might have been successful, and the opening of a productive coalfield would have quickened the general development of the country.

Another possible market for coal from this district is the coastwise and ocean-going ships which make Prince Rupert a port of call. Some years ago, however, the cheapness and desirability of crude oil as a fuel became evident, with the result that nearly all of the boats plying on the Coast were converted to oil-burners. Another possible market was therefore shut off and the local market in northern British Columbia is very small. The owners of undeveloped coalfields had perforce, therefore, to adopt the wait-and-see policy.

During the last two years the economic changes wrought by the war have again brought coal back to its rightful place in the economic life and development of the nation. Coal on the Pacific Coast, and it may be said the world generally, is in great demand, as the high and ever-increasing price of fuel-oil and its derivatives has caused the users of oil to consider the advisability of reverting back to coal as a source of energy. At the present time the balance is very much in favour of coal as compared with oil in point of cost per horse-power developed. This high price of oil is not entirely due to the heavy demands for oil occasioned by the war, but is in part due to the gradual exhaustion of the known productive oilfields. The best authorities, such as Director Manning, of the United States Bureau of Mines, are of the opinion that the price of oil must continue to gradually rise.

Zymoetz River Coalfield.

In 1914 the writer examined the coalfield lying on Chettleburgh creek, a tributary of the Zymoetz river, and distant about forty miles from Telkwa. There are two good seams of coal exposed at this place, respectively 9 and 6 feet in thickness, which are slightly developed by short prospect-tunnels. The coal-measures are exposed up and down Chettleburgh creek for two miles, but owing to concealment of the rock formation by surface wash the other dimensions of the basin are unknown.

The property, consisting of seventy-five leases, is owned by the Copper River Coal Company. The National Finance Company, now in liquidation, handled the property as fiscal agents until 1914. The property is now being handled by the Yorkshire and Canadian Trust, Limited, Vancouver, liquidators of the National Finance Company. In the 1914 Annual Report of the Minister of Mines the writer gave a complete description of this field, with sections, analyses, etc.; to this report the reader is referred, as there is nothing further to record since that time.

A diamond-drill was taken in to the property during the winter of 1913, but has never been used, all work having been stopped since 1914.

Diamond-drilling on this property is the easiest and cheapest way in which this coalfield can be prospected and tested. The present showings are of sufficient promise and importance to warrant the expenditure necessary for drilling, as a reasonable speculation for anybody desirous of securing a supply of coal. It must, of course, be remembered that a railway thirty-five to forty miles long is a necessity for opening up this coalfield, and it is obvious that the existence of a large tonnage of coal of commercial grade must first be proven before the construction of such a railway can be considered. When, however, the demand for coal becomes acute, as seems likely to occur in the near future, then the drilling of this coalfield will undoubtedly be undertaken by some one.

Prince Rupert Coalfields Company.

The property controlled by the Prince Rupert Coalfields comprises two areas of ten sections each, covering 12,800 acres. The northern area lies along and on each side of Goldstream, a tributary of the North fork of the Morice river, while the southern area extends along the east side of the North fork of the Morice; the two areas being only separated by one mile of territory.

This coalfield lies practically on the low divide separating the Morice river and the South fork of the Telkwa, and at an elevation of 3,750 feet. It is distant about thirty-five miles from Telkwa, the nearest point on the Grand Trunk Pacific Railway. The route to the property is up the Telkwa river to the junction of the South fork, and thence up that stream to its head and a few miles beyond. Until recently the means of communication was by pack-trail, but now the wagon-road to the *Santa Maria* mine provides better transportation. The distance from the *Santa Maria* to the coal property is about ten miles, which distance is covered by an indifferent pack-trail. In the event of further development of the property ten miles of easily constructed wagon-road would link up the property with the *Santa Maria* road.

The property was reported on by Leach in 1907, who found that the main basin covered an area of two by two and a half miles, and that there were exposed three seams of coal, of which the following analyses are given:—

Sample.	Moisture.	V.C.M.	Fixed Carbon.	Ash.
From 8-foot seam.....	4.67	30.55	55.23	9.55 (non-coking).
From 6½-foot seam.....	6.36	28.36	58.75	6.53 (non-coking).
From 3½-foot seam.....	6.86	27.24	59.47	6.43 (non-coking).

This property is mentioned again in the 1915 Summary Report of the Survey, when a very unfavourable comment is made as follows: "On two of the headwaters of Goldstream, a tributary of the Morice river, small coal-basins occur. These areas were outlined by the writer and both found to be very small, the larger not over two or three square miles in area. Details of structure could not be ascertained owing to the lack of exposures, but the remote location and the small possible area of coal renders these coal-basins economically unimportant." By taking the facts as stated in the Survey Reports of 18 feet of coal underlying two and a half

square miles, we get approximately 30,000,000 tons of minable, recoverable coal, or, roughly, a production of 1,000 tons a day for ninety years; surely not such a small possible area of coal.

This coal property is controlled by the Jefferson-Dockrill Syndicate, which is financed by New York capital. After some preliminary prospecting of the seams by open-cuts and short tunnels a diamond-drill outfit was taken into the property in 1912 by way of the Morice river from Houston. Several coal-basins in this district were drilled, and the final conclusion arrived at was that the two coal areas now held by the company were the only areas worth holding; the other coal leases being therefore abandoned. Of these two areas the northern one is considered to be of considerable importance, while the other is of possible value as an adjunct to the former. The northern area was tested with two drill-holes, as will be described later, but more testing would be desirable before the approximate tonnage of coal in the basin could be definitely ascertained. The prospecting of this coal area, however, which has been done is quite sufficient to allow of a tonnage estimate of probable coal being made which is very likely to prove approximately correct.

The writer has never examined this coal area and there would be little to be gained by such examination. The outcrops of coal are all that could be seen, as the prospect tunnels are all caved in, but the report by Leach gives the facts regarding the seams and their size and quality. From Mr. Jefferson information regarding the drilling has been obtained. A report on this coalfield was made for the syndicate by G. B. D. Turner, M.E., in 1915, and through the courtesy of Mr. Jefferson this report was loaned to the writer with permission to publish extracts from it.

This report is decidedly favourable in tone and says that the property is worthy of exploitation. The following excerpts give the more important information in the report, besides which there are sections on situation, acreage, machinery equipment, construction-work, railway, market, etc.:—

"*Geology.*—The geology of the region covering the area, when studied out, is very simple, and has been dealt with quite extensively by the late W. W. Leach in the Reports of the Geological Survey of Canada under the title of the 'Telkwa River Vicinity'; these reports have provided a large amount of valuable information on the subject. Briefly, the area under consideration consists mainly, in the first instance and underlying the coalfield, of a series of bedded volcanics belonging to the Porphyrite group; immediately overlying these rocks occurs a series of sedimentary rocks, composed of clay shales, containing three important coal-seams; at the foot of this series and overlying the volcanics is a bed of coarse conglomerate, which is recognized as the floor of the coal-measures.

"A great deal of work has been done in trying to establish the coal areas in the Telkwa district, which has presented many difficulties owing to the exceedingly soft nature of the coal-bearing strata, which in most places have been eroded from the higher ridges and there only remain isolated basins and a few detached remnants; however, the coal area under consideration, especially on Goldstream basin, is of great commercial importance, the extent of which has been proven by the outcrop of the seams followed by diamond-drill work. During 1907 Mr. Leach examined this discovery and reported to the Dominion Government as follows:—

"'On Goldstream, a little below its junction with Coal creek, a new coal area was discovered last year. This area, about two by two miles and a half at its greatest diameters, is in the form of a basin, the coal outcropping on both sides, at from 400 to 500 feet above the floor of the valley. The coal dips towards the creek from both sides, with a slope rather greater than that of the hills, so that it underlies the bed of the stream, although at no great depth.

"'Up Goldstream this area is separated from that of Coal creek, probably by an anticline, the coal-measures having been removed from its axis by denudation. At the lower end the limits of the coal-bearing strata are not so closely defined, but in all probability the creek has there cut through the coal-measures to the underlying volcanics, this cutting being accentuated by another anticlinical fold.

"'The coal has been opened up at only one place, where two seams have been uncovered, the upper one showing 5½ feet of clean coal, overlain by about 1½ feet of soft, impure coaly material, the cut not having been extended far enough to locate the roof clearly. The lower seam shows 3½ feet of clean, bright coal. No analyses have as yet been made of these coals, but in appearance they closely resemble the coal from Coal creek. At several other points across the basin the coal-outcrop was noted, but no time was available to open up the seams.

"'No evidences of local disturbances or faulting of any great extent were noted. Another and smaller area was seen about two miles farther down Goldstream, but has not been opened up.'

"*The Northern Area.*—The basin represents a syncline and in shape takes the form of a saucer, with as high a pitch as 30 degrees at the outer edges. The outcrop of coal is well defined at places where exposed, so that there is no doubt as to the boundary of the coalfield, and diamond-drilling has effected its purpose of determining the coal in place under cover.

"The coal as exposed on the surface, even though it has been exposed to the weather for a number of years, is clean, bright, and hard and of good cleavage. It will stand considerable handling without much loss in slack. A general analysis of the coal gave the following result:—

Moisture	2.5
Volatile matter	30.5
Fixed carbon	60.8
Ash	6.2

And sulphur not more than ½ of 1 per cent.

"It will be readily seen that this coal will make an excellent fuel; the two upper seams, according to tests, will coke, but the lowest seam, which it is proposed to work in the first place, is essentially a steam-coal.

"The actual area of this coalfield covers a surface of approximately 3,200 acres, under which there are three seams of coal of a thickness of 4½, 5½, and 7 feet respectively, amounting to a total thickness of 17 feet, and taking the usual recognized custom of computation of 1,000 tons per acre per foot, which includes 40 per cent. loss of coal, gives a gross total of 54,400,000 tons recoverable coal.

"Inasmuch as there is no doubt as to the extent of the coalfield and quality of the coal, the question now to be considered is the opening-up of these mines on a profitable scale. I would recommend in the first instance that a plan of development be carried out to produce 1,500 tons per day, which will also entail the expense of constructing a wagon-road and railway from Telkwa to the mines to connect with the Grand Trunk system, a distance of approximately thirty-five miles.

"*General Comments.*—I have stated under the heading of 'Northern Area' that the contents of coal within the area is estimated by me at over 50,000,000 tons in three seams of 4½, 5½, and 7 feet in thickness, computed on 1,000 tons per foot-acre recovery. The following statement gives the contents arrived at on each seam separately:—

Seam.	Thickness.	Area.	Contents.	Quality.
	Feet.	Acres.	Tons.	
No. 1 upper	4½	3,200	14,400,000	Coking-coal.
No. 2 middle	5½	3,200	17,600,000	Coking-coal.
No. 3 lower	7	3,200	22,400,000	Steam-coal.
Partially developed tonnage			54,400,000	

"It must be distinctly understood that only two diamond-drill holes have been put down to the coal within the area, the approximate positions of which are shown on the surface map. The results obtained from the first one, 380 feet deep, has been certified to by two mining engineers, who agree as to the thickness of the three different seams and the quality of coal; the second hole, about 740 feet in depth, cut through the upper seam only, which was found to be similar to that encountered in the first drill-hole. The surface outcrops fully confirm the results of the drilling, which, together with the drill-work, prove the existence of the seams as continuous throughout the area. There are no evidences of local disturbances that would present difficulties in mining. The coal-measures are about 150 feet thick and the seams approximately 75 feet apart.

"In the foregoing paragraphs I have dealt with an estimated output of 1,500 tons per day. This does not mean that the output could not be greatly increased, but I think it better in the

first instance to work to this unit until the market is established for this amount of coal. It will be noted that the coal from the two upper seams will coke and the lower is non-coking, but is a good steam-coal.

"*Conclusion.*—In the event of my recommendations of development being carried out, and the railway constructed and a satisfactory arrangement made with the Grand Trunk Pacific Railway Company to operate the road, the colliery should be in shape to produce and market 1,500 tons of coal by January 1st, 1918, and by equipping another shaft the output can be increased to, say, 3,000 tons per day at a further outlay of say $300,000, including four miles of railway and sidings. This ought to be accomplished by January 1st, 1920.

"It has already been shown that, according to present market prices of coal on the Pacific Coast, this colliery working 1,500 tons per day should earn a profit of $2.12 per ton, or $3,123 per day. However, it is impossible to foretell the market conditions over a long period of years to permit me, with any degree of accuracy, to estimate an average sale price over, say, fifty years, but to be on the safe side, and with due consideration to conditions prevailing, this coal delivered at Prince Rupert would sell for at least $4 per ton f.o.b. The cost of mining, freight, weighing, bunkering, and standing charges are estimated at $2.81 per ton, and taking the average sales price at $4 per ton, a net profit of $1.19 can reasonably be expected over a long period."

Turner's report estimates that to develop and equip the property for a production of 1,500 tons a day and construct the required wagon-road and railway would take an expenditure of about $1,234,000. The syndicate controlling this coalfield says it is prepared to and is financially able to do this whenever a market for the coal is obtained. At the present time the market is not available, but, as has been pointed out previously, this conditions may be expected to change before long. A market for 1,000 tons a day of coal would be quite sufficient to warrant the opening-up of this field.

Lake Kathlyn Coal Property.

This property consists of ten coal leases near Lake Kathlyn owned or controlled by Frank X. Frank. The showings of coal are on the lower slope of Hudson Bay mountain and distant about five miles from Smithers, the Grand Trunk Pacific divisional point. The nearest point on the railway is the flag-station at Lake Kathlyn; from this point a wagon-road has been constructed to the camp, a distance of two miles, and the seams outcrop a few hundred feet above the camp. The property is nicely situated for economical working, but has not yet been developed to any great extent.

The formation exposed on this property is not the usual Skeena coal-bearing formation of the Skeena and Bulkley valleys. The rocks in which the coal occurs are slates, argillites, and sandstone which is nearly changed to quartzite. These rocks are a portion of the Hazelton formation, which formation forms the greater part of Hudson Bay mountain. Regional metamorphism has affected these rocks to a considerable degree, so that now they are considerably altered from their original condition as sediments. Since their deposition these rocks have been twisted and tilted considerably, and in this section are standing at an angle of from 40 to 70 degrees.

The coal-seams found in this formation are in part true coal and in part are bands of highly carbonaceous slate. The metamorphic action which has affected the rock formation as a whole is plainly shown in its effect on the bands of coal, which in places have been changed nearly into graphite. The coal-seams are enclosed usually in walls of slate, and as a rule show a band of coal in the centre, with alternating bands of slate and coal to the walls.

There are a number of seams exposed on the property which vary from 1 foot to 5 feet in thickness, but only a part of the seams consist of coal. The seams run up and down the mountain with a strike of S. 75° E. and dip at about 60 degrees to the north-east. These coal-seams look more like veins than ordinary seams of coal, as they stand up firmly and are enclosed in walls of fairly hard rock.

The first seam on which work has been done is at an elevation of 2,700 feet and is developed by a tunnel 40 feet long. This shows the seam to contain a width of 1 foot of coal and 2 feet graphitic material, and it is therefore of no commercial value.

One hundred feet above this a 50-foot tunnel has been driven on another parallel seam which shows from 2 to 4 feet of coal. Three samples were taken from this seam—No. 1 across 2½ feet at the face, excluding 4 inches of bone; No. 2 across 3½ feet, excluding 4 inches of bone,

at a point 10 feet in from the mouth of the tunnel; and No. 3 selected coal from the dump. The analyses of these samples are as follows:—

No.	Moisture.	V.C.M.	F.C.	Ash.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1	4.8	5.2	73.2	16.8
2	9.9	12.2	61.2	16.7
3	9.3	7.3	67.4	16.0

This seam from which the samples were taken was the only one seen by the writer which was of sufficient size to be of possible importance, but it is claimed that there are, higher up the mountain, seams outcropping similar to or better than this one. Samples were submitted to the writer by Geo. H. Ballard from these upper seams which are said to be representative of the clean coal. The analyses of these samples are as follows:—

No.	Moisture.	V.C.M.	F.C.	Ash.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1	13.9	9.7	64.5	11.9
2	13.5	8.9	60.9	16.7
3	14.3	8.3	72.3	5.1

In considering these analyses the most striking feature is the high percentage of moisture, which is unusual in a coal such as is indicated by the ratio of volatile matter and fixed carbon. Taking the average of the six samples analysed and recalculating the analysis free of ash, the resulting analysis is: Moisture, 12.8 per cent.; V.C.M., 9.9 per cent.; F.C., 77.3 per cent. By applying Dowling's Split Volatile ratio this coal is seen to have a numerical value on the scale of 4.6, which places it as a bituminous coal. It is evident, though, from the low volatile matter and high fixed carbon that the coal should really be classed as a semi-anthracite. The high moisture content affects the formula in Dowling's Split Volatile ratio so much as to render it not suitable for classifying this coal.

Coal Area on the Bowron River.

This coal area is situated east of Fort George and about fifteen miles from a point on the Grand Trunk Pacific Railway. The property has never been examined by any engineer of the Bureau of Mines, but was reported on by William Blakemore, C. F. J. Galloway, and James Ashworth.

The 1914 Annual Report of the Minister of Mines contains a synopsis of these reports, giving details of the seams, analyses, etc. Nothing further has been done with the property since that time. A. E. Hepburn, of Vancouver, has an interest in and is agent for the syndicate holding the coal leases.

At present the property is reached by trail, so that very little serious development can be undertaken until some better transportation is provided; a good wagon-road at least being required.

The property is distant some fifteen miles from the main line of the Grand Trunk Pacific, and before it could be placed on a productive basis a branch line of this distance would require to be built. This railway would be an inexpensive one to build, as there would be but little rock-work and the grade is very easy.

A market for the coal is expected from the Grand Trunk Pacific, Canadian Northern, and Pacific Great Eastern Railways—the first two of which are completed and in operation—and in addition a domestic market in the Cariboo district generally, especially the town of Fort George.

CARIBOO MINING DIVISION.

The Cariboo Mining Division occupies an important place in the history of mining in the Province. The great gold-rush to the Cariboo in the early sixties formed the commencement

of mining in British Columbia. These early placer-mining operations centred around the old town of Barkerville, where for some years the creeks yielded phenomenally rich pay. From two miles and a half of Williams creek and two miles of Lightning creek at least $30,000,000 of gold has been taken out and the end is not yet in sight. At the present time there are several large-scale hydraulic mines being worked, and also certain gravel areas are being tested with the view of putting in dredges.

The placer production of the Cariboo Division reached a maximum production about 1863; since then the annual output has gradually decreased, although fluctuating up and down. During the last ten years it has averaged about $225,000 a year.

As the rich diggings were worked out, many extensive plants have been put in to handle the large quantities of low-grade ground left behind by the old miners, but in many cases these have been failures, chiefly because of inefficient management. There is now sufficient indication to warrant the assumption that, before long, some of these abandoned properties will be profitably worked by means of dredges.

It is unnecessary in this report to enter into a detail description of this district, as this part of British Columbia has been reported on at intervals from 1860 onwards. In fact, the early reports of the Mines Department consisted almost entirely of a description of, and tabulation of returns from, the Cariboo District. The last detail report on the district as a whole was made by W. Fleet Robertson, Provincial Mineralogist, in 1902, but since that time the general progress of, and information about, the district is given in the annual reports of the Gold Commissioner. In 1913 Mr. Robertson spent a week in the Quesnel section examining a few of the placer properties.

At the end of the field season of 1914 the writer spent ten days visiting some of the placer mines at Barkerville and Stanley; some abandoned quartz properties were also looked at.*

BARKERVILLE SUB-DISTRICT.

The hydraulic placer mines in the vicinity of the old town of Barkerville made about the same production this year as in 1916. The production as a rule varies directly with the supply of water, and this year the water-supply averaged about the same as usual. A heavy snowfall during the previous winter provided a plentiful supply of water for the first part of the season, which was in part offset by a dry summer. The ground handled was of about the same grade as in former years.

Hopp Mines. The mines operated by John Hopp—viz., *Lowhee*, *Stouts Gulch*, and *Mosquito Creek* mines—were worked as usual, and from them comes the major portion of the production of the district. The *Stouts Gulch* mine was not worked as much as in former years, as it has been worked up to nearly the head of the gulch; the ground still remaining to be worked lies on benches and tributary gulches. *Mosquito Creek* again yielded some very rich ground; the water-supply on this mine is small, which prevents any large-scale operation. *Lowhee* mine was operated at full capacity throughout the season and made a good return, some of the ground being richer than usual.

Point Mine. This property, owned by Loo Gee Wing, of Vancouver, was worked during the season under Chinese management, and made about the same output as in former years.

Fountain Creek.

A placer deposit on Fountain creek has been prospected and worked to some extent during the last few years by J. F. Williams and J. Powell, of Stanley. The ground is held under a number of leases and is known as the Eureka Mining Company. Fountain creek is a tributary of Swift river, and the property is distant some eight to ten miles from Stanley in a south-easterly direction. A rough wagon-road extends half the distance, the remainder of the route being a trail.

The placer deposit on this creek which is being worked is an old channel of the stream, and some portions of it have been worked in a small way by hydraulicking with a limited head of water. These different workings may be considered as tests of the ground, and from the results attained Mr. Williams has arrived at the conclusion that the ground will run from 20 to 40 cents a yard.

* Annual Report of Minister of Mines, 1914.

There is a fair supply of water in Fountain creek and an unlimited supply could be obtained from Little Swift river. The grade is sufficient for hydraulicking, and generally conditions are good for working the property on a fairly large scale. Before going to the expense of putting in a costly system of ditches, flumes, penstock, pipe-line, etc., further testing of the ground may be required.

The existence of an old channel has been more or less proved by a drift-tunnel starting on the side of the creek and running into the hill. The ground is not deep where the small hydraulic pits have been started, being only from a few feet up to 25 feet in depth. The ground is free from large boulders. For the large-scale equipment and working of the property wagon-road transportation from Stanley would be required.

Swamp River.

Some placer prospecting was carried on during the season of 1917 on a tributary creek of Swamp river. In a letter to the Hon. the Minister of Mines dated January 3rd, 1918, J. A. McPherson, of Stanley, gives the information that Kinny & Reid, prospecting on a small creek entering Swamp river from the east, recovered from a bench of the creek a few ounces of quite coarse gold.

This part of the Barkerville Sub-district has not received much attention in the last few years, and probably has never been as thoroughly prospected as the better-known creeks.

Chisholm Creek.

Chisholm creek is a small stream that comes into Lightning creek at the town of Stanley. Work has been carried on here for some time past to prospect an old channel which lies to the south of the present creek-bed. The property is held by the Cariboo-Chisholm Creek Mining Company, consisting of three bench leases and two creek leases. J. A. McPherson is manager in charge of the work.

In the 1914 Annual Report the writer gave some notes on this property and detailed the work up to that time. Since then a tunnel has been driven into the channel; for 550 feet it goes through clay and then is in rock for 505 feet to the face. From the face an upraise was made for 40 feet, and by drifting 60 feet to the west the old channel was broken into.

On breaking into the channel the water-pressure was very great and some difficulty was experienced. Two openings had to be abandoned and timbered up. Pipes were driven into the gravel 10 to 12 feet, from which a steady flow of water was coming at the time the property was visited; by this means the pressure will be gradually reduced. A third opening was being carefully extended into the channel, but progress was slow. After extending this drift across the channel it is intended to continue the main drift ahead to cut the channel.

Nothing is known of the values contained in the gravel, other than that it is said that two test drill-holes put down from the surface showed workable pay values.

In addition to the drifting-work, the company for two years back has been hydraulicking in a small way the bed of Chisholm creek. This is a shallow deposit of gravel resting on clay. Sufficient "pay" was evidently found to warrant continuing the work and further mining will be done next season.

Proserpine Mountain.

Proserpine mountain is a low flat hill lying to the east of Barkerville, across Williams creek. Claims were staked here many years ago and some work done on them, all of them being later abandoned. About ten years ago Seymour Baker relocated some of these claims, and has since done a little work on some of the veins in an endeavour to find shoots of ore of commercial grade. In the 1914 Report of the Minister of Mines the writer described these claims (pages 65 and 66). Since that time but little further work has been done, and there is therefore nothing further of material importance to be reported.

A few years ago E. E. Armstrong started prospecting in this section, and finally located claims on Proserpine mountain, about three miles from Barkerville and to the east of Baker's claims. Mr. Armstrong spent a long time in tracing up indications of gold in the stream-gravels and panning the country far and wide, and now believes he has found the "mother-lode" of Proserpine mountain. It is to be hoped that his toil and optimistic faith will in the future be adequately rewarded.

Other claims adjoining Armstrong's were staked a year ago by Blair, Tregillus, and partners.

There are a number of large quartz veins exposed on these different claims on Proserpine mountain which have a general strike of N. 60° to 80° W. These veins vary from a few feet up to 30 feet in width, and in many places are made up of alternating bands of quartz and schist. The formation in which they occur is the Cariboo schists, consisting of black slates, shales, and schistose rocks, all of these are soft and often quite graphic.

These veins contain pyrite, arsenopyrite, and small amounts of galena associated with the quartz gangue. Generally, however, the ratio of total sulphides to quartz is quite low, and in many places the quartz is devoid of metallic minerals. The bands of slate and schist occurring in these veins carry pyrite in varying amounts, being as a rule as well mineralized as the quartz is. The galena, however, so far as was observed, is confined to the quartz.

Gold occurs in these veins, but in an irregular manner. Some of it may occur free in the quartz, but it is probable that most of it occurs in the pyrite and arsenopyrite. Near the surface the veins are partially oxidized, the iron sulphides being in part converted to limonite, thus liberating any gold contained therein and making it appear that the gold occurred free in the quartz.

The gold values are irregularly distributed, and sufficient development has not been done to determine whether the gold occurs in definite pay-shoots or not. Considerable sampling would be required to determine what portions of the veins carry gold. From the evidence available it does not seem probable that the veins as a whole carry high enough average gold content to pay to mine and mill (although this may later prove to be otherwise), but there may be considerable parts of the vein carrying sufficient gold to work at a profit. From the assay of several samples it is evident that the galena carries very little silver content.

Britisher. This claim is owned by Carey, Tregillus, and Blair. A surface cut 50 x 10 x 10 feet shows a large exposure of quartz and interbanded soft slate, which is apparently striking N. 75° W. (mag.) and dipping at 60 degrees to the north-east. The quartz carries bunches and bands of pyrite.

Three samples were taken in sections across the vein; the widths sampled being 4½ feet, 4 feet, and 5½ feet; these assayed respectively 0.7 oz., trace, and trace in gold. A selected sample from the foot-wall returned 1.64 oz. gold and 0.26 oz. silver to the ton. These results show that some of the vein carries appreciable gold values, and more extensive sampling may show that the values follow along the walls with a barren zone between.

Warspite. This claim is also owned by Carey, Tregillus, and Blair, and adjoins the *Britisher*. An open-cut 30 x 6 x 6 feet shows an irregular outcrop of quartz and slaty rock. The cut had water in it and had partly sloughed in, so that it was impossible to tell the width of the vein, true strike, etc. The dump shows plenty of quartz carrying pyrite and some galena.

A grab sample of the main dump assayed: Gold, 0.04 oz.; silver, 3.6 oz. A selected sample of the galena assayed: Gold, trace; silver, 0.3 oz.; lead, 30 per cent.

This vein apparently consists of stringers and bands of quartz occurring in schistose rock across a total width of about 20 feet.

Vimy Ridge. This claim and the *Anzac* are owned by Tregillus & Blair. The vein on this property is well defined, striking N. 85° W. (mag.), and from 4 to 6 feet wide. It carries a little arsenical iron and galena in a quartz gangue. Development consists of an open-cut 10 x 10 x 4 feet.

A sample taken across 4½ feet of the vein only returned traces of gold and silver, but from the general appearance of the quartz and associated minerals it might be expected that other samples would show some gold values.

Kitchener. An open-cut on this claim, 20 x 10 x 10 feet, shows a quartz vein in graphitic schistose rock, which is probably the same vein as is exposed on the *Vimy Ridge* claim. It is here from 6 to 10 feet in width and slightly broken up. A sample taken across 6 feet assayed: Gold, 0.06 oz.; silver, 20.5 oz. to the ton.

Independence. This claim is owned by E. E. Armstrong and is the most important of the claims recently staked on Proserpine mountain. After this claim was staked by Armstrong the others were located. There are two veins on the property, approximately parallel, and known as No. 1 and No. 2.

No. 1 vein is a large compound vein of banded quartz and schist, in one place reaching 30 feet in width, of which possibly two-thirds is quartz. Galena and pyrite occur in the quartz, but form a very small percentage of the total vein-filling. The vein has been prospected by several open-cuts and shallow shafts, which trace the vein for a few hundred feet on the surface. The values are scattered, but according to the owner much of the vein material, after crushing, pans well. To arrive at the average gold content of the whole vein or certain portions of it would require extensive and systematic sampling, which has not as yet been done. Some samples were taken by the writer which are sufficient to show that in places at least the quartz is gold-bearing. A sample across 5 feet near one wall returned a trace of gold. Another across 4 feet next to the last sample returned: Gold, 0.28 oz.; silver, 0.16 oz. Another across 1½ feet assayed: Gold, 0.82 oz.; silver, 0.1 oz.

The No. 2 vein is about the same size as No. 1 and similar in characteristics. It is developed by several open-cuts. On the surface the vein is considerably oxidized with development of limonite. A sample taken across 28 feet in one cut assayed: Gold, 0.8 oz. No other samples were taken for assays, but the quartz pans well in many places.

In the opinion of the writer these claims are worthy of serious investigation, as it is probable that at least some portions of the veins carry sufficient gold to pay to work. Small quantities of gold have been taken out from the oxidized quartz by Armstrong working with a rocker.

Hard Cash.

Three thousand feet from the *Independence* and 800 feet lower in the gulch occupied by Grouse creek, quartz-outcroppings have been staked by E. E. Armstrong. Two veins are exposed on the sides of the gulch which are supposed to be extensions of the veins on the *Independence* claim. These veins were known of many years ago and some old tunnel-workings were made on them.

The creek follows very closely the contact between the Cariboo schists and an igneous rock which is intrusive into the schists. The veins here are similar to those on Proserpine mountain, containing small quantities of pyrite and galena. It would seem, though, that at the time the old workings were made sufficient pay values were not found in the quartz. A selected sample from this locality taken by the writer returned on assay 1 oz. gold to the ton.

On the *Independence* claim a cabin camp has been constructed by Armstrong, the elevation of which is 5,600 feet.

The location of these claims is at the present time a long way from railroad transportation, and at first sight the development and working of them might be considered to be very expensive. It should be remembered, however, that the claims are connected to Barkerville by a good trail three miles in length, and that Barkerville is reached by a good road, over which auto transportation is used during a large part of the year. If development should prove that these veins or portions of them carried sufficient gold content to pay to work, then the ore would be milled on the ground. The present transportation is good enough to take in machinery and the final product of milling could be transported out.

A few samples of galena were taken to determine what silver values were contained in it; the following table shows the results:—

Name of Claim.	Gold.	Silver.	Lead.
	Oz.	Oz.	Per Cent.
Kitchener	0.32	18	56.0
Kitchener	0.02	29.5	70.0
Warspite	0.06	38.4	64.6
Warspite	Trace	0.3	30.0

It is apparent that the galena in this district does not carry high silver values, and, as the actual galena content of the veins is very small, the values in the ore accruing from silver and lead can be disregarded. Such galena, even if the pure mineral, from hand-sorting or mechanical concentration would not pay to ship when the high transportation costs are considered. At the present time, therefore, only the gold values need be considered.

Hardscrabble Creek.

A deposit of scheelite (tungsten ore) on Hardscrabble creek has been known of for several years, the first mention of it being in the Annual Report for 1904 in a report by Austin J. R. Atkin. Further mention of the occurrence is made in a "Report on the Tungsten Ores of Canada," by T. L. Walker, issued by the Mines Branch, Ottawa, in 1909.

These reports indicated that the deposit of scheelite, although undeveloped, was quite promising. The scheelite-bearing zone is said to be from 3 to 8 feet wide and to carry a fair percentage of scheelite throughout.

Since that time no further work has been done on the property until this summer (1917), when the old workings were cleaned out and put in shape for examination.

The property is controlled by J. A. Macpherson, of Stanley, and it is probable that further development will be carried out this summer. Tungsten ore is now in considerable demand and the market price is high. Ore containing 60 per cent. WO_3 (tungstic acid) is worth from $18 to $20 a unit.

The property has not been examined by the writer, but will be during the coming season.

FRASER RIVER SUB-DISTRICT.

Tertiary Gravel Company.

The old "Killam gravel-mine," situated at Cottonwood canyon, on the Fraser river, about eighteen miles above the town of Quesnel, was acquired in the summer of 1917 by a Chicago syndicate which is now incorporated as the Tertiary Gravel Company; S. J. Marsh effected the sale. The property was examined by Mr. Hamilton, engineer for the Chicago people, previous to the sale being made.

For many years past this gravel-deposit has been worked in a small way by Killam and his partners. The cemented gravel was mined, exposed to the weather for six months or longer, thus disintegrating it by loosening the cement, and then washed in sluice-boxes. This method was not successful in securing all the gold in the gravel, as the disintegration of the cement was only partial. No records are available of the value per ton or yard by this method of working, but the operations apparently paid in a small way. The company now owning the property was preparing during the fall to mine the gravel and treat it in a more modern way and also on a larger scale. No information is available yet as to the results attained.

This deposit of gold-bearing gravel lies on the east bank of the Fraser river and practically at the water's edge. The thickness of the deposit is considerable, but it is not known how much of it carries gold. For 20 feet up from bed-rock the gravel is so well cemented as to be virtually a conglomerate. Above this the gravel is freer and changing to clay at the surface. Mr. Marsh is of the opinion that the cemented gravel is of Tertiary age, but evidence in support of this theory is inconclusive.

So far as is proved by the present prospecting, gold in appreciable quantities is contained in the cemented gravel, from bed-rock upwards to a distance of 8 to 10 feet. The upper gravels are also said to contain some gold, but for the present attention will be centred on the lower gravels.

The company commenced operations by building a two-mile wagon-road connecting the property with the main wagon-road to Quesnel. A sawmill was erected, and lumber cut for buildings, flume, etc. A mill has been erected in which the gravel is to be treated, and the usual bunk-houses, office building, etc., were put up. At the time the property was visited in September construction-work was proceeding on the mill and the completion of the plant was expected in about a month.

The mill consists essentially of a jaw-crusher, ball-mill, and Pearce amalgamators, together with accessory bins, elevators, screens, etc. The cemented gravel will be partially crushed in the jaw-crusher and then goes to the ball-mill, where the pebbles and boulders in the gravel will be separated from the cementing matrix. The matrix thus becomes sand, while the boulders are hardly ground at all. The material from the ball-mill then will be screened, removing the boulders from the sand. The boulders will then be ejected as waste material, and the sand, which contains the gold, treated in the Pearce amalgamators for the recovery of the gold. It is believed the mill was in operation towards the end of the year, but no information as to results has been received.

This gravel-deposit has been developed by a tunnel with lateral drifts from it, and the workings total several hundred feet. The areal extent of the deposit is considerable, but only a small part of it has yet been tested for gold values.

The following information relative to the affairs of this company was contained in a letter dated February 5th, 1918, received from Donald D. Fraser, secretary, Tertiary Mining Company, Limited:—

"The present company began work on the property last May. All the work done up to October was in construction. During this time a boarding-house, an office building, and a mill building were constructed. The road between the mine and the mouth of the Cottonwood river, which you inspected last fall, was also built at this time.

"During the last three months of the year 1917 we started to develop the mine. Considerable work was done through waste and lean ground, so that any figures that I could give you concerning metal content would be misleading. The gravel carrying any values was run through the mill for test purposes. Probably not over 1,000 tons was treated.

"We are now beginning to get the mine in shape, so that we hope to be able to give you definite figures for the year 1918."

Government Creek.

A number of placer leases were taken up a few years ago on Government creek by Dougald Cameron and partners. This creek is a tributary of Hixon creek, which latter joins the Fraser about thirty-five miles south of Fort George. Gasolene-launches run regularly on the Fraser river between Fort George and Quesnel, so this section is easily reached; the landing-place on the river is Woodpecker Island Landing.

From the landing a rough wagon-road extends nearly to the placer property on Government creek, a distance of about eight miles. Two or three ranches have been taken up in the district. On the placer property a cabin has been erected by Cameron.

This property consists of eight creek leases, each one-half mile in length, extending up-stream from a point two miles above the junction of Hixon and Government creeks. The ground along the creek and for some distance on either side is from 5 to 20 feet deep to bed-rock; beyond this, gravel and clay banks rise from 100 to 150 feet. The general level of the country is plateau-like, into which the creek-valley has been cut 100 to 150 feet.

The testing of the ground which has been carried out consists of test-pits, ground-sluicing, rocking, and panning. Nearly 100 test-pits have been dug, varying in depth from a few feet to 15 feet, some of which reached bed-rock and some only went part way. From the results of panning and sluicing the material from these test-pits, Mr. Cameron has reached the conclusion that the ground carries from 15 to 40 cents a yard. It cannot be said that this sampling of the ground is conclusive and some systematic testing would be required to check these figures. The gold is in part coarse, nuggets worth from 50 cents to $4 being frequently found; one nugget was recovered worth $25.60, at a value of $17 an ounce. Part of the gold is fine, but very little flour gold is present. From a brief inspection of some of the gold recovered from these workings it would seem that it had not travelled very far and was of local origin.

Government creek carries from 750 to 2,000 feet of water, according to the season of the year, but during the spring and summer at least 1,000 inches should be obtainable. By fluming and ditching the water about one mile a head of 75 feet could be secured and a greater head could be had by a longer ditch-line.

At one point the creek goes through a small canyon which has a considerable grade, and by starting here there would be sufficient fall to handle the gravel above by hydraulicking. Generally the property should prove capable of hydraulicking at a profit provided the values to the yard are as claimed.

The country-rock exposed in places along and on the sides of the creek consists of soft slates and schists, practically identical with the Cariboo schists as exposed in the vicinity of Barkerville. A number of veins, stringers, and bunches of quartz occur in this formation, with strikes following approximately the line of strike of the slates and schists. These quartz veins in places consist of stringers of quartz spaced across a width of 30 to 40 feet of slate; in other places bands of quartz up to 8 feet in width occur. Generally the quartz-outcroppings are irregular, broken, and twisted, but some of the masses of quartz are of considerable size. The only mineralization in the quartz is with iron, which occurs as limonite. Some iron existed in the quartz as sulphide and this has been oxidized on the surface.

A number of samples were taken from a dozen different outcrops which were assayed for gold and silver, but the results showed that only traces of the precious metals were present. While no place has been noted yet where these veins carry appreciable gold values, it is possible that the placer gold in the gravel had its origin in the upper parts of these veins, removed by erosion and the gold content concentrated in the stream-gravels.

QUESNEL MINING DIVISION.

QUESNEL RIVER.

Very little information is available about the mining operations in this section, as it was not visited by the writer during the year. During the last few years placer gold to the value of $20,000 to $40,000 a year has been produced. No lode-mining is carried on in this section, although reports of mineral showings are heard from time to time. In former years a considerable placer-gold production was made from this section but in recent years the larger operating companies have done but little. Small-scale individual placer-miners are at work each season and now make most of the annual output, which this year amounted to $15,000.

The Quesnel Hydraulic Mining Company, which a few years ago constructed a very elaborate and expensive water system to handle ground on Twenty-mile creek, Quesnel river, continued operations on a small scale. The work carried out in 1912 and 1914 on this property showed that the hydraulic plant worked excellently, but that the gravel handled contained but little gold. Since 1914 the company has been engaged in carefully prospecting its holdings in order to determine where pay-ground is situated, and this prospecting was continued during the past season. The manager says this work is turning out satisfactorily.

ALEXANDRIA.

Rainbow Group.

Mineral claims have been staked by Joseph Briand and partners near Alexandria, a post-office on the Cariboo road, distant thirty-five miles south of Quesnel. These claims are situated ten miles easterly from Rhodes ranch, on the Cariboo road. Rolling country characterizes this district, which viewed in a general way is flat, but is given local relief by the rolling hills and irregular gullies and stream courses. The elevation varies from 2,500 to 3,500 feet at the claims, which are situated on a flat-topped hill rising slightly above the general level of the country. This is a grazing country with grass plentiful; groves of jack-pine are scattered here and there over the district. Rock-exposures are not plentiful, as a mantle of soil and vegetation as a rule covers the country.

On the claims the rock formation exposed is granite and no other types of rock were noted. The showings consist of several large quartz veins which are sparingly mineralized with copper minerals. These veins, which are from 5 to 20 feet wide, are somewhat irregular and in places appear to be masses of quartz rather than true veins. The quartz is milky and as a rule barren-looking. It is quite evident that the quartz was first deposited and that later fracturing allowed the circulation of mineral-laden circulations, from which the copper minerals were deposited, partly filling small fractures and partly by replacement of the quartz. The total amount of copper minerals in proportion to the quartz is small; too small, in fact, to be of commercial importance. Very little development has so far been done, and it is therefore possible that further work would find larger bodies of the copper minerals; conversely, the limited mineralization now apparent in the quartz may not be continuous and may disappear with further work. The copper minerals occurring are chalcopyrite, bornite, cuprite, malachite, and azurite. The occurrence of cuprite is interesting as this mineral is decidedly rare, at least in British Columbia. In this deposit chalcopyrite was the primary mineral and the other higher sulphides, oxide, and carbonates are due to secondary action, and very probably represent a surface condition which would disappear at a little depth. Some very good specimens of cuprite, which is an oxide of copper, were obtained; the total amount of the mineral present in the showings is, however, quite small.

As it was evident that the copper minerals in the quartz did not occur in sufficient quantity to make the property of commercial value as a copper-ore producer, careful samples were therefore taken to see if gold in appreciable quantities was contained in the quartz. Ten samples in all were taken across widths varying from 1 to 6 feet, and in addition samples from small dumps; the assays on these show only traces of gold and silver. Samples taken, including the best showings of copper minerals, ran from 5 to 6.3 per cent. copper; the latter result was

obtained from an average sample of a small dump of selected ore. A selected specimen of copper ore returned 26.7 per cent. copper, a trace in gold, and 1 oz silver to the ton; this was the highest silver assay obtained. It is evident, therefore, that gold and silver values in the deposit are negligible and the only thing to be considered is the copper. And as pointed out before, the copper minerals are too disseminated to make the vein-matter valuable as a copper ore. The remote location of these claims from railway transportation would in any case make the mining of copper ore impracticable at the present time.

Development consists of open-cuts, the largest of which is 14 feet long by 6 feet wide by 8 feet deep.

While these particular showings are not promising, they indicate that there are large quartz veins in this district containing at least some valuable minerals. This section of country has never been prospected, and as an indication of a possible mineralized zone these claims are significant and should be noted. More extended prospecting may result in finding more highly mineralized veins, or quartz veins carrying appreciable gold values. There is a large area of country between here and Quesnel Forks which is practically virgin ground for prospecting.

TIMOTHY MOUNTAIN.

A few years ago a number of claims were staked on Timothy mountain by Ryan, Foster, and others. This mountain is distant about thirty miles in a north-easterly direction from Lac la Hache Post-office, which latter is 103 miles northerly from Ashcroft, on the Cariboo road. The present route into the claims from Lac la Hache is a roundabout one, consisting of a rough wagon-road for thirty miles and then fifteen miles of trail. A direct route would shorten the distance ten to fifteen miles.

Showings of copper ore on the mountain were first staked and some development was carried out, principally by Ryan. During 1917 exposures of molybdenite were discovered by Ryan, and claims were staked covering them. An interesting occurrence of peridots also is found here, which will be described later.

The main body of Timothy mountain is formed of a coarse-grained holocrystalline granodiorite. Part of the flat top of the mountain is, however, covered by volcanic rock which is later in age than the underlying granodiorite. One well-defined contact of the two rocks was seen, and from this it is evident that the volcanic rock was laid down on the eroded surface of the granodiorite. The volcanic rock has slightly baked the granodiorite near the contact, but the effect has been very little.

The volcanic rock is predominantly basic in composition, although showing some variations. It is mainly an ash rock, but would appear to be in part a true lava rock. From examination of hand specimens the rock might be classified as approximating the composition of an augite andesite to a diabase. The outstanding feature of this volcanic formation is the number of volcanic bombs contained in it. These bombs are so numerous in some places as to constitute over 50 per cent. of the total rock-matter. They vary in size from an inch in diameter up to at least three 3 feet, and are of many shapes, but as a rule tending to an ovoid form.

The filling of these bombs is chrysolite; some of the bombs may carry other minerals, but none were noted. This chrysolite in different bombs varies considerably in chemical composition; the most common form is dark bottle-green in colour, crystalline, but with the crystal forms not well developed. In many cases the iron in the chrysolite is sufficiently oxidized to cause the mineral to assume various colours, brown, dark blue, and purple shades being noticed; an irridescent sheen is also frequent.

The granodiorite formation is cut by a well-defined and approximately parallel series of mica-lamprophyre dykes. Diorite dykes also occur in places cutting the granodiorite. So far as was observed, neither of these dyke systems cut the volcanic rock.

The copper-showings which have been slightly developed consist of veins in the granodiorite which are in reality sheeted zones of varying widths. These zones consist of narrow stringers of quartz spaced across a total width of 15 to 20 feet. The rock lying between the quartz stringers is granodiorite partially altered by silicification and pyritization.

The quartz stringers carry metallic minerals consisting, in their relative order of abundance, of pyrite, chalcopyrite, arsenopyrite, pyrrhotite, galena, and zinc-blende; but the total percentage of these minerals to that of quartz is quite small. The only mineral which has to any extent entered and replaced the granodiorite between the quartz stringers is pyrite.

The surface of the veins are always partially oxidized with a plentiful distribution of limonite and copper carbonates, which make the croppings somewhat impressive to the eye. The line of strike of the veins is nearly always a depression due to erosion below the level of the surrounding granodiorite on account of the softness of the oxidized upper portion of the vein. The veins distinctly cut through the mica-lamprophyre dykes.

The introduction of pyrite was the most important and apparently first mineralization of the veins; the chalcopyrite came later, either accompanied or followed by the small amounts of galena, *etc.*

It is apparent on inspection that the total amount of chalcopyrite in the veins is much too small to admit of the veins being mined at a profit for the copper content. It was considered possible that the mineralized parts of the vein might carry gold and silver values, and to determine this a number of samples were taken. These samples were taken across widths of from 3 to 6 feet and were intended to be representative; on assay they only returned traces of gold and silver.

The conclusion must be arrived at, therefore, that at the present time these claims are not of economic value. The veins may somewhere contain appreciable shoots of chalcopyrite, but considering the remote location of the claims it is unlikely that further work will be carried on for the present.

The development consists of open-cuts, shallow shafts, and short tunnels on several different veins, but further details are not of importance.

Molybdenite.

The showings of molybdenite are situated at the other end of Timothy mountain from the copper claims, and distant a mile or more to the east. The exposures are in the timber not far below timber-line. Two claims known as the *Tipperary* and *Molyb* have been staked in the names of W. J. Ryan and John Foster.

The formation exposed here is granodiorite, and in it occurs the molybdenite. A small stream known as McDonald creek cuts down into the granodiorite, exposing it for some distance along the sides of the creek. Molybdenite occurs here in a scattered and irregular manner throughout the granitic rock. This molybdenite is disseminated along joint planes, fractures, and slip planes, but does not occur in any definite ore-body or vein. The main jointing of the granodiorite is along north-and-south lines and molybdenite occurs in thin scales or plates along these joints. No development has been done, and it is as yet hard to form an idea what percentage of molybdenite the granitic rock as a whole carries. It is evident that there is a considerable quantity of rock more or less mineralized with molybdenite, but it is clear that the average would be quite low grade. With development it is quite possible there may be shown to be a considerable tonnage of ore here carrying from 2 to 4 per cent. molybdenite.

Four samples were taken which give some idea of the molybdenite content; the following table shows the results:—

Description.	Molybdenite (MoS_2), Per Cent.
Across 5 feet at good-looking place	4.0
Grab sample from open-cut 100 yards west of creek	1.6
Across 7 feet	3.2
Roughly selected ore	9.2

On the eastern side of McDonald creek, and up the creek a short distance from the low-grade molybdenite showings, the granodiorite formation is exposed by upturned trees and other natural exposures. On one of these a cut 4 x 4 feet has been made which shows a quartz vein 2 to 4 feet wide. In about the centre of this vein there is a stringer of pure molybdenite 2 inches wide which is continuous as far as it could be seen. Smaller stringers from ⅛ to ½ inch in width parallel the main one in the centre. Several other quartz-seams containing narrow stringers of molybdenite were also observed.

The surface wash and trees cover the formation nearly everywhere, but sufficient could be seen to indicate that these different showings of molybdenite are worthy of serious prospecting. During the fall some of this pure molybdenite was mined by Mr. Ryan, and a shipment of 800 lb. was packed out to Lac la Hache and sent to Ottawa.

So far as was observed, no other metallic minerals occur with the molybdenite in this locality, and it would therefore be free from impurities. Some pyrite may be associated with it in places.

This locality is at present far removed from a railway, but if development should show a considerable tonnage of molybdenite ore, a mill could be erected and transportation of the concentrates arranged.

Peridots.

"Peridot," or "evening emerald," is the name applied to a yellowish-green transparent form of the mineral chrysolite, which, when cut and polished, forms a semi-precious gem. Large grains or crystals without flaws are valuable gem material. Chrysolite is a silicate of iron and magnesia and is of fairly common occurrence in nature; it occurs usually in granular masses and disseminated grains, while the crystal form known as peridot is comparatively rare.

The occurrence of an andesitic ash rock on Timothy mountain containing volcanic bombs filled with chrysolite has already been described (*see* preceding pages). In some of these bombs well-developed crystals occur which are peridot; these occur in masses of crystals and also as single crystals amongst fine-grained chrysolite.

These peridots had attracted the attention of Mr. Ryan while he was developing his mineral claims on the mountain. He selected a number of these stones and sent them to Tiffany & Co., New York, for expert examination as jewels. Tiffany's report was that the specimens sent were of a remarkably good colour, but that they were more or less flawed and therefore of but slight value as gem material. In size these peridots vary from $^1/_{16}$ inch up to about 1 inch in length. Elongated crystals are most common, but square shapes are also found.

The writer had only a short time to spend examining this occurrence of peridots, but from what was seen it is evident that these stones occur here in considerable quantities. The volcanic rock contains a large percentage of the chrysolite bombs, and crystals of peridot are numerous in some of the bombs.

It is quite possible that on further search crystals which are not flawed may be found which would be valuable. Considerable interest has been shown over this discovery of peridots, several inquiries having been made about the matter to the Mines Department. There would seem to be a considerable demand in the jewel trade for peridots as gem material. Further investigation of the occurrence will be made during the coming summer.

CARIBOO DISTRICT.

CARIBOO MINING DIVISION.

REPORT BY C. W. GRAIN, GOLD COMMISSIONER.

I have the honour to submit herewith my annual report on the progress of the mining industry in the Cariboo Mining Division for the year ending December 31st, 1917.

I regret to have to state that the past season has undoubtedly been the quietest in the history of the district. A very small amount of new ground has been taken up and comparatively very little of that worked, and many of the old properties have been unworked.

Last winter brought an exceptionally heavy snowfall, which, being augmented by wet summer, made an ideal water season, and one could only regret that owing to the small number of mines working, such a poor use was made of it.

STOUTS GULCH.

The property on this creek owned by John Hopp was worked as usual and a good season's piping was put in. As stated in last year's report, the plant was moved down-stream, considerably nearer the mouth of the gulch, and pits were opened on each side of the old workings; considerable of the bench ground on either side of the creek was worked with encouraging results, the last clean-up of the season being very satisfactory.

LOWHEE CREEK.

On this creek is situated the largest of Mr. Hopp's mines. A very good season's piping was used to great advantage, and whilst considerable old workings were encountered, some very good ground was struck, and on the whole the amount of gold recovered was pretty well up to average.

MOSQUITO CREEK.

On this creek another of Mr. Hopp's mines is located. A very fair water season for this mine was experienced, the work consisting chiefly of working off some of the top benches on the east side of the creek, some of them being very rich; thus the amount of gold recovered at this mine was somewhat better than usual. It is a great pity that more water is not available for this mine.

SLOUGH CREEK.

This creek is now practically given over to the Chinese, there being three Chinese outfits working thereon—two more or less in a small way, and the third, the Point Hydraulic Mining Company, working on a fairly extensive plan. This year this company was somewhat handicapped by having to do without the very able help of Joseph Wendle as manager, who has run this mine for several years, and I gather that this season the output was hardly up to average.

JACK-OF-CLUBS CREEK.

On this creek, from which in old days a considerable amount of gold was taken, two or three men have been working during the past season and have done a vast amount of work. The work done by one John McDougall, single-handed, was really amazing; he has sunk a two-compartment shaft for a depth of over 90 feet, and as he was badly troubled with water he had to resort to the process of puddling it. He has also built an 18-foot overshot wheel and enclosed same in a house 50 x 25 feet and 25 feet high; he has also built various other buildings, and has got out a large amount of mine-timbers and lagging. One can only hope that this man will find good "pay" after his strenuous labours.

WILLIAMS CREEK.

Very little work was done on this famous old creek, the proposed dredging scheme not yet having materialized. A certain amount of work, however, was carried out by Mason & Joule on the old *1st of May* property, but as considerable old working and waste ground had to be removed the results were not very satisfactory.

GROUSE CREEK.

On this creek practically no work was carried on; the old Waverly Company, the lessees of the first lease granted in the district, again not working.

EIGHT-MILE LAKE.

The Thistle Mining Company this year again carried on no operations; however, a certain amount of work was carried on by R. Rees with a small staff on his two leases in that vicinity.

LIGHTNING CREEK.

The Lightning Creek Hydraulic Mining Company carried on operations with a small staff, but I have not been able to gather with what results.

On the upper benches, in the vicinity of Perkins gulch, Sparkes & Felker worked on their leases during the duration of the water season, and, as I gather, with better results than heretofore.

At the lower end of this creek, on the property of the Lightning Creek Gold Gravels and Drainage Company, work again started up in October. At the present time I am unable to learn just exactly what is being done.

CHISHOLM CREEK.

The Cariboo-Chisholm Creek Mining Company worked both its hydraulic and deep ground with a considerable staff. The manager and one of the chief shareholders, John A. Macpherson, has kindly supplied the following report:—

"In response to your request, I beg to report as follows:—

"In the early part of the spring of 1917 we cross-sectioned the surface gravels, putting down fifteen holes, using a Keystone drill; during the hydraulic season we widened out an open-cut and opened up a pit. We are now in shape for, and intend to install, an up-to-date hydraulic plant.

"We have successfully opened up the channel-gravels, and are now at this date just about finished with a crosscut drive running from rim to rim.

"Towards the west rim we lost the bed-rock, the channel at this point conforming to a gutter; the drain-tunnel being on a lower level than the crosscut, it is now our intention to drive the drain-tunnel about 75 feet farther and tap this gutter.

"In opening up the ground we first raised up from the drain-tunnel into the east rim and drifted out in the rock, from the top of the upraise to the channel, tapping it and along the channel for a distance of 150 feet; at intervals we again tapped the channel at three other places, making in all four openings through the rim-rock into the channel-gravels. This work drained and took the pressure off the water, so that later on, and at the lower level, we experienced no trouble in opening up the channel and running this crosscut."

FRASER RIVER.

On the Fraser river, in the vicinity of the Cottonwood canyon, a company by the name of the Tertiary Mining Company has taken over the leases owned and worked by Dom Killam for a number of years. This appears to be a cemented-gravel proposition. I should judge it is of very much the same formation as that worked by the late J. B. Hobson on the Horsefly River. Powder had to be used all the time to move the ground.

Mr. Killam, who only worked in a small way, used to get out this cemented gravel and let the weather disintegrate same, and then in the summer put it through a sluice-box, and I believe obtained very good results from this primitive way of working the ground.

The present company has installed some kind of crushing plant, but as yet have hardly got things into working shape.

Donald D. Fraser, the present manager, has kindly supplied the following report:—

"I beg to submit the following report covering the operations of the Tertiary Mining Company, Limited, for the year 1917 on its cement-gravel properties near the mouth of the Cottonwood River:—

"Work was begun by the present company during the month of May. Up until October the work was practically all construction. During this time a sawmill was operated and lumber

cut for the necessary buildings. A two-story bunk-house, an office, and a mill building were built. A road connecting the mine with the mouth of the Cottonwood river was also constructed during these months.

"The property had previously been worked as a large stope. At the time the present company began operations this stope was nearly filled with rock which had caved from the roof. To get into the pay-ground it was necessary to put tunnels around the old workings. The driving of these tunnels consumed the remaining portion of the year. Much of this work was of necessity put through lean ground, so that the returns were comparatively small. With the beginning of the new year, we are, however, in a position to begin systematically to develop the mine.

"The ore leaving the mine was hoisted over a trestle to the top of the mill and dumped into the mill-bin. From the bin the ore fell into a ball-mill and the cement gravel broken up. The fine gravel was then passed over an amalgamator.

"During the last three months of the year 1917 about 1,000 tons was treated in this manner for test purposes."

QUARTZ-MINING.

As mentioned in last year's report, lode-mining has again received a certain amount of attention in this vicinity—namely, as regards Proserpine mountain, situated about three miles from Barkerville; there are now in all some twenty claims located on this mountain. During the past season a certain amount of work was carried on, as certificates of work were taken out in connection with seven of these claims.

However, I have thought it wiser to refrain from making a report in connection with any of them, as J. D. Galloway, District Mining Engineer, visited sundry of these claims last fall, and naturally he is very much better qualified to report thereon than I am; in fact, it would be presumption on my part to now do so.

OFFICE STATISTICS—CARIBOO MINING DIVISION.

Free miners' certificates (individual)	157
Free miners' certificates (company)	6
Free miners' certificates (special)	1
Placer claims recorded	5
Placer claims rerecorded	23
Mineral claims recorded	86
Certificates of work issued	57
Leases granted	10
Leaves of absence granted	18
Conveyances and other documents recorded	61

Revenue.

Free miners' certificates	$1,540 50
Mining receipts	6,655 15
Leaves of absence	45 00
Water rights revenue	326 05
Firearms licences	120 00
Miscellaneous receipts	7 75
Poll-tax	265 00
Total	$8,959 45

QUESNEL MINING DIVISION.

REPORT BY R. M. MCGUSTY, ACTING 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, 1917.

The output of gold reported for the year 1917 was less than the preceding year; the chief causes for this decrease are accounted for through shortage of labour (very many of the miners having enlisted for overseas service with the Canadian Expeditionary Forces) and the continued lack of cheap transportation.

In the Keithley Creek section the *Kitchener* mine, operated by Harrison & Worth, continued active, but only a very small crew was employed; consequently results have been proportionately less than the previous year.

A certain amount of prospecting has been carried out on Harvey creek.

On Twenty-mile creek the Quesnel Hydraulic Gold Mining and Development Company employed a large crew, but no authentic report has been furnished me as to results obtained; however, it is reported that they intend resuming operations next season.

In the Harpers Camp section, beyond the fact that a number of applications for mining leases have been made, there is nothing of note to report.

In the Timothy Mountain section, where a considerable amount of development-work has been done during the past three years on the group of claims owned by W. J. Ryan *et al.*, active work has been carried on this year. Molybdenum has been found in quantity and a sample shipment of 850 lb. made, but no advices have as yet been received as to the grade of this. These claims are distant by the old trail from the Cariboo road approximately fifty-five miles, but a new trail has been made which will reduce the distance about fifteen miles; however, considering the elevation of these claims, it is possible that an aerial tramway from the claims to somewhere in the vicinity of Anderson's cabin (whence there is a good trail to the main road) will be found to be the most satisfactory method of handling the output.

OFFICE STATISTICS—QUESNEL MINING DIVISION.

Free miners' certificates	115
Mineral claims recorded	29
Certificates of work	17
Placer claims recorded	4
Placer claims rerecorded	13

OMINECA MINING DIVISION.

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

I have the honour to forward herewith office statistics for the Omineca Mining Division for the year 1917. As an official Resident Mining Engineer has been present in this district throughout the season, and who will undoubtedly have visited all the properties which are undergoing systematic development, I am refraining from reporting, as in the past, *in extenso*, feeling that a person who has scientific knowledge and first-hand information is far more able to do justice to the industry which this rich district deserves.

There is no doubt that, although lode-mining in this district did not create the great excitement in the year 1917 as had been anticipated, the industry made great progress during that period, and is gradually but very quietly assuming a permanent aspect, as the older properties which are in a more advanced stage of development are acquiring and installing up-to-date machinery, together with concentrating plants, properties which for some years have been practically lying idle and in abeyance owing to their ores being unable to stand high freight rates, together with cost of treatment, are now being sought after, some of which will be placed on a shipping basis within the next few months.

There has not been a great deal of activity in placer-mining in this Division during the past season. None of the older leases received any attention, but this must be explained by the scarcity of capital, as all available money in this present day is required for war purposes.

As will be noted in the statistics given below, eight placer-mining leases were applied for in this Division, four of which were granted and four are still pending decision.

The possibilities of remunerative gold-dredging operations on the Ingenika river are now attracting attention. A few individual miners were at work all the season on McConnell creek, a tributary of the Ingenika, but with indifferent success owing to lack of sufficient water on account of the dryness of the season.

It is satisfactory to observe that revenue derived from mining sources in this Division is again increasing, it being for the year 1917 almost $2,500 in excess of the revenue derived from the same source in the year 1916.

OFFICE STATISTICS—OMINECA MINING DIVISION.

Free miners' certificates issued (ordinary)	617
Free miners' certificates issued (company)	9
Free miners' certificates issued (special)	4
Mineral claims recorded and issued	333
Placer claims recorded and issued	15
Certificates of work recorded and issued	774
Bills of sale and other mining documents	239
Powers of attorney recorded	42
Mining documents filed	56
Certificates of improvements recorded and issued	12
Crown grants of mineral claims	12
Applications for placer-mining leases (Omineca Division, 8; Peace River Division, 35)	43
Placer-mining leases granted (Omineca Division, 4; Peace River Division, 13)	17

Revenue.

Free miners' certificates	$ 3,372 25
Mining receipts, general	11,421 25
Total	$14,793 50

PEACE RIVER MINING DIVISION.

REPORT BY STEPHEN H. HOSKINS, GOLD COMMISSIONER.

I have the honour to submit a report for the Peace River Mining Division for the year ending December 31st, 1917.

During the past summer the entire length of the Peace river was staked for a distance of seventy-five miles as dredging leases, and a company of miners is now engaged in taking in machinery for the adequate development of the ground.

Other applications for leases were received, but are still in abeyance. A busy season for the Peace river is predicted for the year 1918.

A few prospectors were working on the bars of the Peace river, but it is claimed, owing to the scarcity of water, very little of real value was accomplished.

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

EASTERN DISTRICT (No. 5).

REPORT BY A. G. LANGLEY, RESIDENT ENGINEER.

This district includes the following Mining Divisions: Golden, Windermere, Fort Steele, Revelstoke, Lardeau, Ainsworth, Slocan, Slocan City, Trout Lake, Nelson, Arrow Lake, and Trail Creek. During the year the mining activity throughout the various districts compares very favourably with last year, which was a banner year in mining for British Columbia.

Regarding the value of the production of silver, lead, and zinc for this district, from the available information at hand it also compares very favourably with that of last year, in spite of industrial troubles and the decrease in the demand for lead for munition purposes.

However, more zinc was produced by the electrolytic plant at Trail than in any previous year. The year's zinc production at this plant is estimated at 10,000 tons, representing a value of $3,000,000. The lead production for the district, although not as great as the previous year, shows an increase in value; the same applies to the silver production.

There has been little activity in the gold-mines, on account of economic conditions not being favourable at the present time for the mining of this metal, which has remained the same in price, while the cost of labour and supplies have increased. However, the gold production would have been much greater had it not been for industrial troubles, which curtailed the output of the Rossland mines to about one-fourth of the normal amount.

After many years of comparative inactivity, the high prices of metals has again attracted attention of mining men to the district, which is the leading producer in Canada of silver-lead-zinc ores. The result has been that many old properties, which could not be worked in the old days at a profit on account of low prices of silver, lead, and zinc which was of little commercial value, are now being reopened with satisfactory results, and should market conditions remain favourable we will see many more new shippers in the course of the next few years. Further, the improved methods of mineral separation by the flotation process offers additional encouragement to the mining of the more complex silver-lead ores, and has done a great deal towards enhancing the value of such properties.

With few exceptions the mines in this district can be worked by adit or crosscut tunnels, doing away with expensive hoisting and pumping equipment; they are within reasonable distance of transportation facilities, their ores can be treated at near-by smelters, and water-power is generally available, as is also timber for mining and fuel purposes; in fact, general conditions are favourable for the economical mining and handling of the ore.

Regarding the field-work this year, the number of applications the Department of Mines had for assistance in the building of roads and trails necessitated hurried trips, which were made more with a view of determining whether assistance was warranted by the general conditions than of making extensive examinations necessary for writing more comprehensive reports.

GOLDEN MINING DIVISION.

THE MIDDLE FORK OF THE SPILLIMACHEEN.

The present means of access to properties near and beyond Spruce Tree camp, which is twenty-two miles and a half from Carbonate Landing, is by a winding trail which crosses two divides before finally arriving at the Middle fork. The first divide is between the Columbia river and the Spillimacheen river, and the second between the last-mentioned river and the Middle fork.

Some twenty-two years ago, when there was quite an influx of mining men to this district, numerous claims were staked on the Middle fork, notably the *Bobbie Burns* group, the *International* group, both of which are gold properties, and the Carbonate Mountain claims, which were silver-lead properties. At this time the trail down the Middle fork connected with a sleigh-road to Well's Landing, at the summit of the divide between the Middle fork and the Spillimacheen. This road is now grown over. It would appear from the general contour of the country that the best location for a road to tap the properties on the Middle fork would have been down this fork and the main river to Spillimacheen Landing.

The properties referred to above have lain idle for a number of years; in this connection the following information obtained from the Provincial Mineralogist's report of 1898 may be of interest: The formation at the *International* and *Bobbie Burns* groups is composed of slates and shales cut by large quartz ledges, with a secondary series of smaller cross-course veins, which are more highly mineralized than the main ledges. The mineralization consists of iron pyrites, a little galena, and some arsenical pyrites. Gold was found to occur free near the surface. Below surface oxidation the gold occurs in sulphides.

Tarheel Group.

A company called the Tarheel Copper Company, Limited, has been formed by C. J. Lincke, of Golden, for the purpose of acquiring and mining a group of six claims, which are situated on the Middle fork of the Spillimacheen river, at a distance of twenty-three miles from Carbonate Landing, on the Columbia river. C. J. Lincke is managing director and H. G. Lockwood, of Golden, is secretary-treasurer. The lowest claims in the group were exploited many years ago, and there still remains an old cabin on the property. The elevation of the workings is 6,200 feet, or 1,200 feet above Spruce Tree camp, on the Middle fork.

The work done some years ago consists of approximately 120 feet of tunnelling on a strong, well-defined quartz vein, which can be traced for some distance on the surface. The ore is chalcopyrite associated with iron pyrites in a quartz gangue. So far the development-work has only proved the ore to exist in pockets in the vein, and no bodies which could be considered of commercial importance have yet been opened up.

The country-rock is composed of schists and laminated slates, having a dip of 55 degrees and a north-westerly strike. The strike and dip of the vein is almost identical with that of the strata. The ledge-matter exposed for a short distance above the tunnel, consisting of intercalating bands of quartz and schists, carries copper-stains for over a width of 16 feet.

The *Rainbow* claim is situated above the other claims near the upper end of a basin at an elevation of 7,800 feet. Here also the work was done some years ago, and consists of a tunnel 100 feet long, driven along a quartz vein which outcrops along the top of a narrow ridge. The face of the tunnel is in waste, as is also the face of a short crosscut which was driven near the end of the tunnel, and if it had been continued for a few more feet would have struck daylight.

The old dump would not indicate that any appreciable quantity of ore had been extracted from these workings. The character of the ore here is similar to that at the lower workings. Immediately above this tunnel the vein is well mineralized for a width of 12 inches and is exposed for a short distance along the apex of the ridge. There is another small vein showing mineralization exposed near the top of ridge, and apparently joins the other.

Adjoining and in the vicinity of the vein the country-rock consists of argillites and some limestone, the whole being stained with oxide of iron for a considerable width, but the formation is very much broken and contorted. Some 200 feet along the ridge from the portal of the tunnel all trace of the vein is lost.

In conclusion, it is a prospect upon which further work may possibly disclose ore in larger quantities than have as yet been found, but it is not considered that present conditions justify any heavy expenditure.

Tennessee Group.

This group of claims is situated on the same mountain-side and adjoins some of the lower claims of the Tarheel Company's holdings. J. W. Conners, of Golden, who is the owner of the property, has done a little work during the last two years, which consists of driving a tunnel for a distance of 18 feet along the vein. Last year a small trial shipment was made to Trail, which is said to have assayed 11.92 per cent copper. This ore was extracted from near the portal of the tunnel, where there is a well-mineralized width of about 18 inches.

At the present face of the tunnel, although the quartz vein is strong, the ore is not of such high grade. The ore occurs here in the schist wall of the vein, and also replacing the quartz near the contact of the vein and the schist.

In an open-cut 50 feet above the tunnel an 8-inch width of ore is exposed along the wall of the vein. The formation here is greatly broken and squeezed over towards the west, and the vein seems to terminate in a large blow-out of quartz which is stained with oxide of iron.

Below the tunnel the quartz vein, which is strong and well defined, can be traced for a considerable distance down the hill, and is exposed in many places in the bed of the creek, but only shows narrow seams of chalcopyrite occurring at infrequent intervals. The vein has a

north-westerly strike and a dip of 50 degrees, which is also the general dip and strike of the strata, which consists of schists and slates.

Two men were working on the property last summer, but work was discontinued for the winter.

OTHER PROPERTIES.

At Field.—Mr. Adkins, the owner of the *Couvercapce* mineral claim, adjoining the *Monarch*, has shipped 272 tons of silver-lead ore during the year.

Monarch.—A small shipment was made from this property, but work has been discontinued.

I.X.L. and Condor.—These claims are situated near Castledale and are owned by R. McKeeman and A. W. Logan. Very little work has been done, but according to reports there is a strong surface showing of low-grade ore. Assays received show the ore to run as follows: ½ to 1 oz. silver, 4 to 6 per cent. lead, with zinc values varying from 3 to 37 per cent. The owners anticipate work being done on this property next spring.

WINDERMERE MINING DIVISION.

Paradise.

This property is situated at the headwaters of Spring creek, at an altitude of 7,300 feet. The camp is situated near the bottom of a basin, the sides of which are rugged and steep opposite the mine-workings, but where they are situated, and immediately above to the summit of the divide between Toby and Boulder creeks, the hillsides have a more rounded appearance, with uniform slopes, the surfaces of which are covered to a depth of 3 or 4 feet with small broken fragments of slates and argillites, and few rock-exposures are visible.

The ore occurs in irregular and somewhat disconnected bodies in a crushed and sheared zone of slates and argillites, which formation is greatly oxidized, and is so soft that it can be mined by pick and shovel without the use of powder, but has to be carefully timbered. Above the mine-workings the formation shows uniformity in dip and strike.

The sheared zone lies between the limestone on the west and a wide band of quartzite on the east. The ore probably replaces the limestone, and general conditions would indicate its continuity with depth, and that further development-work might be carried on from the lower tunnel to advantage.

The mine, which has been worked intermittently for a number of years under the careful management of R. Randolph Bruce for the Hammond Estate, has now been acquired by him. In spite of numerous obstacles to overcome, principally in the way of transportation facilities and lack of funds for development, it is the largest producer in the Windermere district. During the year 2,100 tons was shipped to Trail. The typical ore known as "sand carbonates" is soft and crumbly and earthy in appearance. The average values run 30 oz. silver and 30 per cent. lead.

The methods of handling the ore from this mine are somewhat unique in this district; hence the following description may be of interest: From the present mine-workings, which are some 500 feet above the camp, the ore is transported by a 2-bucket tramway to ore-bins near the camp; from here it is hauled by teams down the mountain for a distance of seven miles to Pinehurst, and thence partly by teams and partly by motor-truck over the first seven miles of the road (which is not suitable for the tractor). From this point the ore is hauled by a large motor-tractor, which takes the wagons in tow, and finally delivers the ore at Athalmer, making the total distance of haul twenty miles.

In order to do away with adverse grades, sharp turns, and to shorten the length of haul from Pinehurst, a new road is being built along the south side of Toby creek, which will connect with the old road at the eight-mile point, and will permit the use of tractors from Pinehurst. Besides shortening the length of haul by three miles, this road will be of great benefit to the *Paradise* mine and to any other properties up Toby creek which may have ore to ship. The long haul down the mountain from the mine to Pinehurst is the most serious drawback to the economical handling of the ore at present, and an aerial tramway is needed. With a view to making this installation a right-of-way was surveyed last summer.

Silver Belt Group.

This property comprises a group of six claims, which are staked across the bottom of the basin, below the *Paradise* mine, and is owned by the Silver Belt Mining Company, of which C. M. Keep, of Kendrich, Idaho, is president. The property has been lying idle for a number of years, although I believe a

little work was done this year. In 1901 a trial shipment of 15 tons to Trail netted $1,456 and averaged 218 oz. in silver to the ton.

Surface workings consisting of open-cuts and two small shafts show mineralization similar in character and occurrence to that at the *Paradise*. On account of the flat contour of the surface in the vicinity of the best showings, no backs can be obtained by drifting, and the property will eventually have to be developed by a shaft. General conditions would appear to fully justify more development-work being done.

Shamrock. This claim has been staked adjoining the *Paradise* group on the north. Its northern boundary overlaps the cliff which forms the northern side of the divide above the *Paradise*. The claim is located on the strike of the *Paradise* ore-bodies, but as there is nothing to indicate the presence of ore on the surface of the hill, which is covered with detritus, any definite opinion cannot be formed of the possibilities of this claim until it is further exploited. (For further reference regarding the *Paradise* basin properties *see* W. Fleet Robertson's report, 1903, and J. D. Galloway's report, 1915.)

Hot Punch Group. This property is owned principally by E. Stoddart and C. Perry, of Windermere. It consists of a group of five Crown-granted claims situated at the head of the North fork of Toby creek, at a distance of twenty-four miles from Athalmer, the nearest point on the railway. The claims are easily accessible by road, which follows an easy grade up Toby creek for a distance of fifteen miles from Wilmer, then branches off up the North fork for a distance of about seven miles.

Last spring part of this road was washed out, on account of which the trip to the *Hot Punch* was made in order to ascertain whether assistance towards repairing the road should be given by the Government. When the new road up the south side of Toby creek is completed, the distance will be shortened by three miles and transportation facilities greatly improved.

J. D. Galloway reported on the property in 1915 for the Department of Mines. Since his examination was made very little work has been done, so I will only briefly describe the conditions as I found them at the time of my visit.

The camp is situated in a patch of heavy timber on the mountain-side, the elevation being approximately 6,000 feet. The cabins, which are in good repair, are well built and commodious, and there is an abundant supply of water and timber.

The uppermost working, which is about 500 feet above the camp, consists of an old abandoned shaft; how much of it has caved and filled in is difficult to say, but I was only able to examine it for a depth of 30 feet. The vein here has a width of from 2 to 3 feet, and is well mineralized with galena, iron pyrites, in an oxidized gangue. Although there is not sufficient ore exposed here to be of any commercial importance, general conditions would appear to warrant further work being done in the vicinity of this outcrop. Other workings consist of tunnels driven along the vein, and described in Galloway's report.

Two car-loads of ore is said to have been taken out of the upper tunnel, and there is now about 30 tons of ore on the dump. A grab sample from a pile of 6 tons of carefully sorted ore for shipment gave the following returns: Gold, 0.02 oz.; silver, 62.4 oz.; lead, 2 per cent.; zinc, 4 per cent.

The formation consists of schists, quartzose schists, and thin beds of limestone, having a north-westerly strike and a dip of 50 degrees. The mineralization occurs in a fissure-vein following the bedding-planes of the strata. Although the ore has only been found to occur in small lenses at intervals along the vein, it is of high grade, and with the present price of silver it should be possible by careful mining on a small scale to extract more ore at a profit; at the same time there is always the possibility of further work disclosing other ore-shoots of commercial importance.

Sitting Bull Group. This property is situated at the top of a deep canyon which cuts the south side of Boulder mountain. The distance from the nearest shipping-point on the railway is approximately twenty miles, ten miles of which have to be travelled by trail up Boulder creek. The nearest town is Wilmer. The property is now being operated by F. W. Wonn, of Seattle, and associates, and E. D. Smith is in charge of the mine.

The cabin, which has accommodation for about twelve men, is built on a small bench excavated in the side of the canyon. The country surrounding the camp makes it not only

difficult and expensive to get in supplies, but also almost impracticable to pack down ore. To overcome this serious drawback, Mr. Smith informed me that he proposed erecting a light aerial tramway from the mine to the valley of Boulder creek. From latest reports I understand that this has been done. The elevation of the camp is 7,200 feet, and that of the workings on the vein varies from 7,700 feet at the lowest working to over 9,000 feet at the uppermost.

The lowest workings consist of a crosscut 124 feet in length. At 85 feet from the portal the vein was cut, exposing a width of 3 feet of quartz and iron oxide; no values were found at the time, and the tunnel was continued for another 40 feet in barren ground. They have since found some nodules of galena in this vein, and were proceeding to drift on it at the time of my visit. Above this tunnel and along the strike of the vein there are several surface showings of galena varying from 6 to 16 inches in width. A shaft was sunk on one of these showings some years ago and is said to be 80 feet deep, but I was unable to investigate it on account of rotten ladderways and water. Since my visit I am informed by the manager that it has been retimbered, and that there is some good ore in the bottom, which assays as follows: Silver, 57.6 oz.; lead, 40 per cent.

Following the vein up the mountain, at an elevation of 8,500 feet a 10-inch width of ore is exposed in an open-cut. Here the ore occurs as an impregnation in a talcose schist, in streaks and small bunches, associated with small stringers of quartz. In the bed of the creek above this work small lenticular pockets and stringers of galena occur over a width of 10 feet, but the mineralization is so scattered that no economic importance can be attached to the amount of ore exposed at this showing. Farther up the mountain-side a dark-coloured intrusive dyke cuts the formation. This dyke apparently is post-mineral in age and bears no relation to the deposition of the ore.

At an elevation of 8,800 feet a tunnel has been driven along the vein for a distance of 35 feet. At the portal the vein is 30 inches wide, but gradually squeezes down to a width of a few inches at the face. Some 500 feet above this working another tunnel has been driven along the vein for a distance of 18 feet, exposing 18 inches of galena. I did not see this uppermost working, as it began to snow and sleet; had the weather been fine we intended to go over the ridge and investigate the *Relief* group, which is situated near the top of the ridge on the northern slope of the mountain.

There are two veins on the *Sitting Bull* property, which run almost parallel and show marked continuity for almost the entire length of the claims. So far the development-work has been confined to the lower vein. The formation consists of alternating bands of limestone and slate, with occasional beds of schist. The limestone is characterized by numerous quartz stringers. The ore is a massive fine-grained galena and has an average value of: Silver, 45 oz.; lead, 40 per cent.

Five men were steadily employed last summer, and work is being continued during the winter. Small shipments will probably be made in the near future, but until transportation facilities are improved it is not likely that any large quantities will be shipped.

Relief Group. This property is situated on Boulder mountain at an elevation of between 9,000 and 10,000 feet, just over the ridge above the *Sitting Bull* group. Mr. Chamberlain, of Wilmer, and partner have been working this property under a lease and bond. Twenty tons of ore has been packed and hauled down to Wilmer. The ore is similar to that at the *Sitting Bull*. In order to appreciate the difficulties that have to be contended with in these outlying districts, the following facts may be of interest: This ore had to be packed down a steep mountain-trail from an altitude of 9,000 feet to Boulder creek; then again packed over a rough trail for a distance of about nine miles to a wagon-road; then hauled for eight miles to Wilmer.

Delos Group. This group, consisting of three Crown-granted mineral claims, is located on the Boulder Creek trail and is easily accessible. The property is controlled by E. J. Scovil, of Golden. The ore is principally chalcopyrite associated with a quartz gangue. Assays on selected ore from surface cuts ran 0.8 oz. silver and 27.6 per cent. copper. It is a prospect worthy of further exploitation.

Mabel R. This property is situated on Law creek. Frank Anderson, the lessee, has about 20 tons ready for shipment. The ore is said to run 8 to 12 oz. silver and 80 per cent. lead.

Isaac.

This property is situated on Frances creek and belongs to H. E. Forster, who reports that 116 tons was shipped. The property is now closed down for the winter. The ore is an argentiferous galena.

Lead Queen.

This group, which is owned by Tom Brown and J. McLeod, of Wilmer, consists of five claims situated on the north side of Frances creek, at a distance of eighteen miles from Brisco, on the Kootenay Central Railway. The company which operated this mine as late as 1916 completed the road to the mine, erected large and substantial log buildings at the Half-way House, consisting of a stable of sufficient capacity for thirty or forty horses, a large bunk-house, cook-house, manager's house, office, and blacksmith-shop.

Sufficient development-work had not been done on the property to justify all of this latter expenditure, and finally after doing a little mining the company went into liquidation, and the property reverted to the original owners.

This property is described in J. D. Galloway's report of 1915, so I will only deal with those workings from which it is intended to ship ore this winter, the object of the examination being to determine whether Government assistance for a winter road in this case is justified.

The upper, which at present are the main workings, are at an elevation of 7,000 feet. The vein is approached by a crosscut tunnel, which intersects it at a distance of 150 feet from the portal. This tunnel after going through 96 feet of slide material cuts the quartzite formation in which the vein occurs. It has been continued in country-rock for a distance of about 140 feet past the point of intersection of the vein.

From the crosscut 80 feet of drifting has been done along the vein in a westerly direction and 125 feet in an easterly direction. The vein has a width of about 3 feet and is well defined between quartzite walls. About a 3-inch thickness of talc gouge marks the foot-wall. The vein-filling consists of broken and crushed quartz stained with oxide of iron and in places carrying values in lead carbonates; in this a streak of high-grade massive galena occurs, which can be traced for almost the entire length of the drift. Generally speaking, it has a good workable width, although in places it squeezes down to a seam of a few inches in thickness. The vein has a dip of 58 degrees to the south-west and a north-westerly strike.

In a 5-foot winze, which was recently sunk at a distance of 25 feet from the intersection of the crosscut and the drift, a 20-inch width of massive galena is exposed. Above the drift all the ore has been stoped out, the stope running up to a height of about 30 feet above the drift. At the face of the westerly end of the drift a 2-inch seam of galena is exposed; the easterly end of the drift is caved and is not in ore.

At an altitude of about 125 feet above the tunnel an open-cut and a short tunnel driven near the surface expose a shoot of galena which has a length of about 10 feet and an average width of 18 inches. The ore from this property runs from 30 to 40 oz. in silver and about 65 per cent. lead. Future work will consist of drifting on the vein and mining the ore under the floor of the drift by underhand stoping.

In the underground workings the walls of the vein are well defined; both the gouge along the foot-wall and the crushed nature of the vein-filling demonstrate that there has been considerable movement along the line of the fissure. Following this movement, indications would denote that the deposition of the mineral had taken place along the line of least resistance in the loose and crushed material of the vein-filling; conditions which should be favourable for the making of good-sized ore-shoots.

Last year three cars of ore was shipped to Trail during the winter months, which owing to present transportation facilities is the best time to handle the ore. The present owners are now working, and further shipments will probably be made this winter. Further development-work might be carried on to advantage, but the owners are handicapped by lack of funds.

FORT STEELE MINING DIVISION.

Burton.

Only a brief examination was made of this property, with a view of determining whether conditions at the mine warranted Government aid being given towards the building of a short stretch of road to the railway-siding near Elko. The property consists of a group of three claims situated at a distance of two miles from Elko and at an elevation of 3,900 feet. Work, which is being carried on under the direction of

J. L. Parker, is being financed by a syndicate principally composed of Calgary people. The mine is being developed by means of two adit-tunnels, the vertical distance between which is 209 feet. The ore occurs in a fissure-vein having a strike of N. 55° E. and an almost vertical dip. The country-rock in which the vein occurs is a highly siliceous limestone of the Cambrian or Devonian age.

The upper tunnel from which the ore is being extracted has been driven along the vein for over 300 feet. In this tunnel two shoots of ore are exposed; the vein between the shoots does not show a workable width of ore along the drift, although in places it is well mineralized.

The present stope from which shipping-ore is being extracted extends for 30 feet above the drift, and is between 30 and 35 feet long. The westerly end of the stope shows a width of 3 to 4 feet of ore, which will average 6 per cent. copper and between 5 and 6 oz. in silver. The width of the stope gradually decreases towards the easterly face, where the ore pinches out. For the length of the stope as given above the average width of ore can be safely taken as 2 feet, and that of the vein, including ore, oxidized gangue material, and quartz, as 6 feet.

A 40-foot winze has been sunk on this ore-body from the drift, and exposes 3 feet of good ore at the bottom. The ore here consists principally of carbonates of copper carrying a few ounces in silver, and the deposit, on account of the high state of oxidation, is crumbly and easy to mine.

Following the vein in from this working, it is narrow and only slightly mineralized for a distance of about 60 feet; at this point a width of 2 feet of chalcopyrite and iron pyrites associated with a quartz gangue is disclosed, and can be traced for a distance of approximately 50 feet. Some stoping has been done on this ore, and a 16-foot winze demonstrates that it continues below the floor of the drift. The remaining 20 feet of the drift is in waste.

The lower workings consist of a crosscut which is in 230 feet, and at which work is being carried on, with the expectation of striking the vein within the next few feet. Should the development in this lower level come up to expectations, it is the intention of the management to use it as a shipping-tunnel, and it will be connected with ore-bins at the bottom of the hill by means of a gravity-tramway, the material for which has already been purchased.

Eight men were employed; the mine cabins are well built and afford good accommodation, while the camp is well and favourably situated. The mine shipped two car-loads of ore last year, and 85 tons has been shipped to Trail during 1917.

Victor.

This property, consisting of three claims, is owned by R. Abernethy, of Spokane, and associates, and is being managed by his son, Elmer Abernethy. The claims are located at the headwaters of Maus creek, at a distance of nine miles from Fort Steele. A good road was built this year for a distance of six miles from the mine to connect with the wagon-road to Fort Steele.

The present owner has held the property for ten years, and has worked it in a small way almost continuously during this period, with the result that there is now a considerable amount of development done. The country in the vicinity of the mine is rugged and steep, but where the camp is situated, and immediately below, the slopes are less steep and are covered with small timber. About 600 feet below the workings there is sufficient water to run a mill of small capacity.

Viewing the steep and rocky mountain-side from the camp, the vein can be distinctly seen, cutting at an acute angle the stratification of the country-rock. Two tunnels have been driven along the vein; the upper tunnel is 387 feet long, and the lower, which is 125 feet vertically below the upper tunnel, has been driven for a distance of 412 feet.

The vein can be traced to the summit of the ridge, some 800 feet above the upper tunnel. By strenuous climbing we were able to follow the vein for a short distance above the upper tunnel, and no doubt could have followed it a good deal farther had the mountain-side been less steep.

The vein is massive quartz, varying in width from a few inches to 5 feet. The general direction of the strike is S. 15° W. and the dip vertical. The country-rock consists of shale, the strike of which is north and south and the dip 70 degrees. The metallic contents of the vein are argentiferous galena and zinc-blende associated with iron pyrite in a quartz gangue; the mineralization occurs in small lenticular shoots and thin streaks along the foot-wall, also occasionally disseminated through the quartz, and, although persistent for the length of vein at present exposed, has only a workable thickness in places. The ore is complex, and, although

a fairly clean galena and a zinc product can be obtained by careful sorting, a large percentage of the ore consists of an intimate mixture of galena and zinc-blende.

A sample taken across a 34-inch width of vein in the upper tunnel gave the following results: Gold, 0.06 oz.; silver, 14.3 oz.; lead, 16 per cent.; zinc, 8 per cent. Another sample taken across a 4-inch streak of galena at the face of the upper tunnel gave: Silver, 7 oz.; lead, 12 per cent.; zinc, 3 per cent.

Most of the recent work has been confined to the lower tunnel, where the ore shows greater continuity than in the upper tunnel, and values appear to be more concentrated. A sample across a 16-inch width of the vein gave the following returns: Gold, 0.02 oz.; silver, 13.2 oz.; lead, 27 per cent.; zinc, 17 per cent. A sample of the sorted ore for shipment ran as follows: Gold, 0.02 oz.; silver, 21.5 oz.; lead, 43 per cent.; zinc, 9 per cent.

Since my visit to this property Mr. Abernethy informed me that he has installed a 6 x 7 Ingersoll-Rand compressor and a 10-horse-power Fairbanks-Morse gas-engine for the purpose of operating hammer-drills, which will greatly reduce the cost of mining by hand-drilling. Also that from the numerous samples recently taken at the mine he estimates that there is sufficient ore in sight to justify the erection of a small concentrator next spring. In the meantime shipments of sorted ore will probably be made to the Trail smelter.

Hand-sorting for this class of ore seldom, if ever, pays; besides being a costly operation, a large percentage of the values associated with the waste and fines go into the dump, never to be recovered. A clean separation cannot be obtained, zinc values are lost, and when in excess zinc is not only lost, but the mine-owner has to pay a penalty if his ore is being treated for silver and lead. In other words, hand-sorting is one way of robbing a mine. In this case a concentrator of such capacity as the ore in sight would warrant can be installed at moderate cost, and the results should fully justify the installation.

St. Eugene. During the year shipments of lead ore amounting to approximately 2,000 tons were made from this property. The upper workings were operated under lease, the Consolidated Mining and Smelting Company's operations being confined to below the 10th level.

Sullivan. This mine, which is being operated by the Consolidated Mining and Smelting Company, produced by far the largest tonnage in the Kootenays. The smelter receipts for the year show 112,000 tons to the credit of this property. Of this about 90,000 tons was zinc ore for the electrolytic plant, 5,000 tons of pyrite for the acid plant, and the balance silver-lead ore. The usual amount of mine-development was carried on, and the new double-track tunnel from the railway-siding on Mark creek was extended 3,000 feet. This tunnel when completed will give an additional depth to the present workings of 700 feet, and will greatly reduce the present cost of handling the ore.

Stemwinder, Ontario, North Star. These properties have been bonded to the Federal Mining and Smelting Company. This company intends to systematically exploit the mountain-side with the diamond-drill, and is reported to have two drills working at the present time. The ore at the *Stemwinder* is a fine-grained mixture of galena and zinc-blende, occurring in quartzite, and resembling the *Sullivan* ore in composition and occurrence.

PARK — The *Pork* group on Luke creek, owned by W. A. Chisholm, is being worked by Spokane interests under lease and bond.

Federal GP. At Skookumchuck a new find has been reported. It is said to be a large surface showing of pyrrhotite and pyrite, carrying native copper in seams and druses. The owners intend putting in a winter's work on the property.

Dibble Group. Work was started on this property last fall by W. M. Lindsay and associates, who have it under lease. The claims are situated at the head of Lost creek, at an elevation of 6,200 feet, and at a distance of ten miles from Fort Steele. This is an old property, upon which a considerable amount of work was done as early as 1898. The metallic contents of the vein are said to consist of high-grade copper ore, probably chalcopyrite and tetrahedrite carrying silver and gold values; the principal values being the precious metals. Reports of recent work done are encouraging.

Society Girl. Work was carried on at this property during the year, a few men being employed. The showings are said to be very encouraging, and further shipments will probably be made in the near future. The property is situated

near Moyie, close to the *St. Eugene* mine. It is an old working which has been steadily operated for a number of years, and from which a considerable quantity of ore has been shipped in the past.

Guindon Group. This property, consisting of three Crown-granted claims—*Alice Fraction*, *Guindon*, and *Fereole*—is owned principally by Frank Guindon, of Moyie. The claims are situated on the south side of Moyie lake and opposite to the *St. Eugene* mine. Mr. Guindon, who is an old-time miner of Moyie, has done a considerable amount of work on this property, and is now endeavouring to secure sufficient capital to complete a crosscut, which is being driven to tap the vein at a greater depth, and with this object in view is forming a company.

There are two veins on the property. No. 1, on which most work has been done, has a strike of S. 44° E. and a dip of 60 degrees to the south. The No. 2 vein is exposed in a drift at an altitude of 800 feet above the lake, and has a strike of almost due west. The formation which the veins traverse is the Aldridge formation, consisting of argillaceous quartzites, and has a north-easterly strike and a dip of 20 degrees to the north-west.

The principal work done has been devoted to the No. 1 vein, and consists of a crosscut 185 feet in length, at the end of which 180 feet of drifting has been done along the vein. Along this drift the ore, which is galena associated with iron pyrite and some zinc-blende, occurs at intervals in lenticular lenses along the foot-wall. At the easterly face of the drift a 3-foot width of low-grade ore is exposed, but work was discontinued, as they discovered that they were getting into the sandy clay which covers the surface of the bench under which the tunnel was driven for a depth of 100 feet. A sample from 5 tons of sorted ore from these workings assayed as follows: Silver, 16 oz.; lead, 54 per cent.

The lower crosscut being driven to tap the vein is in about 60 feet. On the No. 2 vein 200 feet of drifting and a little stoping has been done, with the result that there is 25 to 30 tons of ore on the dump. Generally speaking, the ore is complex and would require concentration.

REVELSTOKE MINING DIVISION.

Big Bend District.

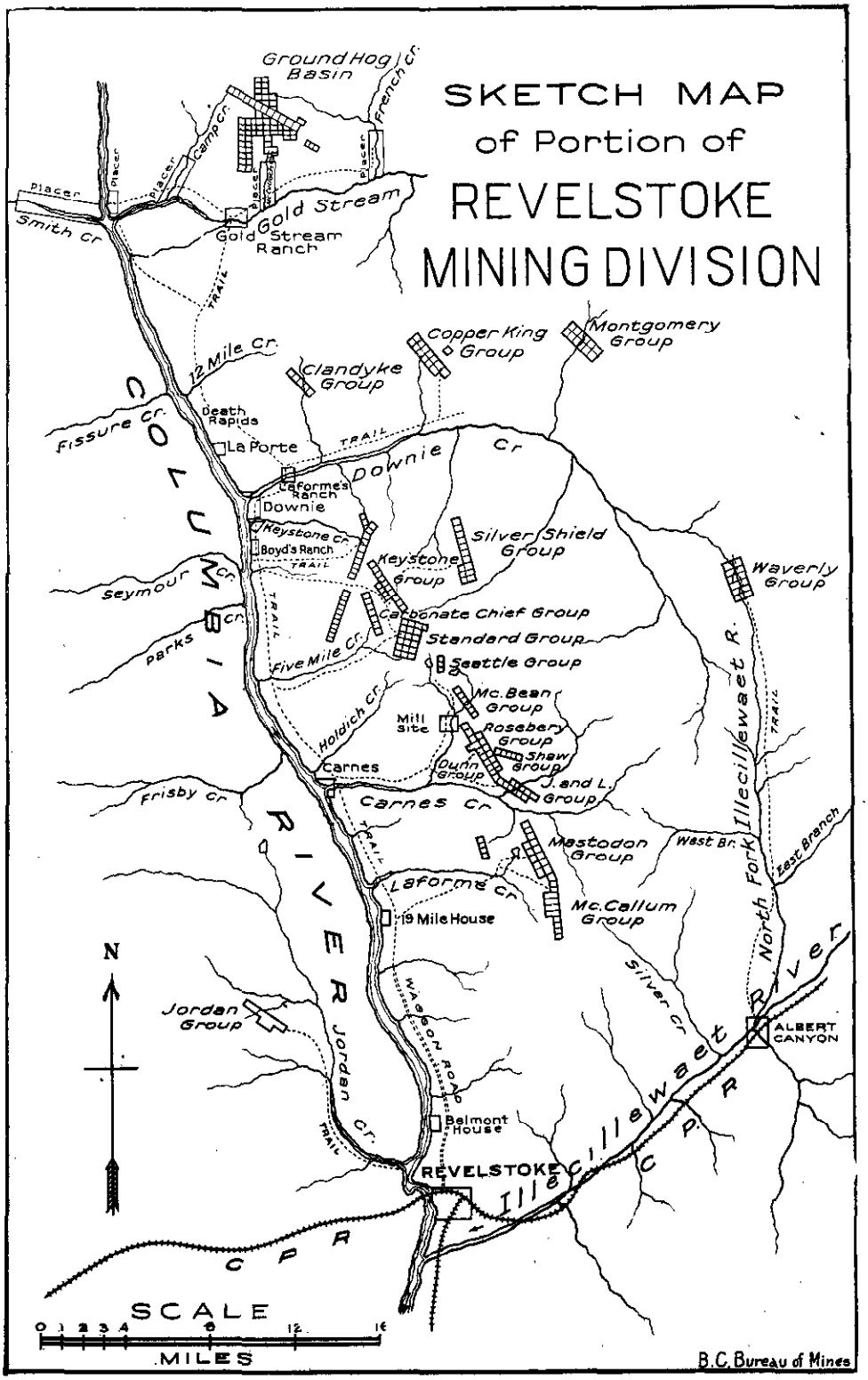
Mastodon Group. This property, consisting of fifteen claims, is situated on the divide between LaForme and Carnes creeks, at a distance of twenty-five miles from Revelstoke, and is owned and operated by the Mastodon Mining Company, Limited, of which Amos Peterson, of Lethbridge, is president, and D. E. Harris, of Lethbridge, is secretary. J. W. Evans, of Revelstoke, is manager, and under whose direction the property is being systematically developed. The claims were staked some ten or twelve years ago and were known as the *Noble Three* group, but little work had been done on them until the present company acquired same.

The company built a good 4-foot trail down LaForme creek this year to connect with the proposed sleigh-road to Revelstoke. The camp is well situated on the saddle of the divide at an elevation of 4,700 feet. New cabins of suitable accommodation were erected this year. The country surrounding the camp and the mine-workings is well timbered, while there is an excellent mill-site available at LaForme creek, which is a short distance from and about 2,000 feet below the present workings.

Present development-work is being confined to two veins, which run parallel, following the dip and strike of the strata and cutting the hillside at an oblique angle. The formation, consisting of limestone with occasional thin beds of schist, shows uniformity and does not appear to be greatly broken or contorted. The strike is N. 18° W. and dip 36 degrees to the east.

At the lower vein, which is 500 feet above the camp, a shaft has been sunk for a distance of 110 feet on the lead. The surface showing at the top of the shaft consists of a 5-foot width of oxidized and leached ledge-matter, mineralized with galena, zinc-blende, and carbonates. The ore here is cemented together by a matrix of lime, which gives it the appearance of clinker. A sample of the sorted ore for shipment assayed as follows: Gold, 0.02 oz.; silver, 36.8 oz.; lead, 60 per cent.; zinc, 7.6 per cent.

This width of ore can be traced down the shaft for a depth of about 25 feet, when it is cut off by a "horse" or a bulge in the foot-wall. Below this and about 15 feet from the bottom of the shaft a body of high-grade zinc ore comes in along the foot-wall, the thickness of which it was difficult to ascertain, for during the sinking of the last few feet the foot-wall was missed and ran over the top of the zinc.


SKETCH MAP
of Portion of
REVELSTOKE
MINING DIVISION
Ground Hog Basin
French Cr.
Camp Cr.
Placer
Gold Stream
Gold Stream Ranch
Smith Cr.
TRAIL
12 Mile Cr.
Copper King Group
Montgomery Group
Clandyke Group
Fissure Cr.
Death Rapids
La Porte
TRAIL
Laforme's Ranch
Downie
Cr
COLUMBIA
Keystone Cr.
Boyd's Ranch
Keystone Group
Silver Shield Group
Waverly Group
Seymour Cr.
Carbonate Chief Group
Standard Group
Parks Cr.
Five Mile Cr.
Seattle Group
Mc. Bean Group
Holbich Cr.
Mill site
Rosebery Group
Shaw Group
Dunn Group
J and L. Group
Carnes
Frisby Cr.
Carnes Cr.
RIVER
Mastodon Group
West Br.
East Branch
North Fork Illecillewaet R.
Laforme Cr.
19 Mile House
Mc. Callum Group
Silver Cr.
N
Jordan Group
Wagon Road
Jordan Cr.
ALBERT CANYON
Belmont House
REVELSTOKE
Illecillewaet R.
C P R
SCALE
0 1 2 3 4 8 12 16
MILES
B.C. Bureau of Mines

Since my visit to the property the manager reports that a drift was started from the bottom of the shaft along the hanging-wall, and a short crosscut driven at a distance of 14 feet from the shaft disclosed a 5-foot width of high-grade zinc ore carrying 51.5 per cent. zinc on the foot-wall of the vein, which at this place has a width of about 15 feet. At a distance of some 200 feet from the shaft a crosscut is being run from the surface, and was in 80 feet at the time of my visit.

The other vein outcrops higher up the mountain-side and at a distance of 300 feet from the shaft, and occurs in a massive blue limestone. A small shaft which has been sunk on this vein exposes a width of vein-matter of 18 inches, in which a 4-inch streak of high-grade silver-lead ore occurs.

Twenty tons of ore has been sacked for shipment, and the prospects that the mine will become a steady shipper are encouraging, providing sufficient funds are supplied for carrying out the necessary development-work; but until the sleigh-road is completed to LaForme creek it is not likely that many shipments will be attempted.

Other properties up LaForme creek, which unfortunately I did not have time to visit, are as follows:—

The *Lyttle* group, staked to the east of the *Mastodon*, on which there is claimed to be a good surface showing of galena; on the *Adair* group, adjoining the *Lyttle* group, there is considerable amount of work done, according to old reports. The principal values are said to be in gold, silver, and copper. The *McCallum* group has also been well prospected. All of the above-mentioned properties have been lying idle for a number of years. The *McBean* group, which is situated on Cairnes creek, is owned by Mr. McBean, of Revelstoke, who has been carrying on development-work continuously for a number of years. The *Grimes* group adjoins the *Mastodon* on the south. Recent work has been done on the property, and there is reported to be a fairly good surface showing.

Montgomery Group.

This property is situated on Downie creek, which flows into the Columbia at a distance of thirty-six miles north of Revelstoke. The property consists of eight claims and is owned by J. C. Montgomery, of Revelstoke. The Granby Consolidated Mining and Smelting Company hold an option on this property, and during the summer had a gang of men stripping and trenching the surface. From reports received there is a large showing of pyrrhotite, carrying values in copper and gold. No definite information is to hand as to whether the Granby Company will continue the work next year or not.

The Government road which is being built up the Columbia river to the 19-Mile post is now completed to the 16-Mile post, and is already proving to be a great benefit to the miners and prospectors in the Big Bend country.

ILLECILLEWAET DISTRICT.

Lanark.

This property is situated near Illecillewaet, on the main line of the Canadian Pacific Railway. This mine has been working steadily during the year under the management of W. B. Dornberg, of Revelstoke. A little over 200 tons of concentrates has been shipped to Trail. It is reported that there is a good showing of ore in a 130-foot winze sunk from the bottom of the old workings, and that the ore runs: Lead, 10 per cent.; silver, 9 oz.; zinc, 7 to 8 per cent.

Mr. Dornberg is planning to add to the mill, thereby increasing the capacity to 150 tons. The additions will include a ball-mill, three tables, and a Zeigler flotation plant. The installation of a water-power plant is also being contemplated. Twenty-five men have been employed during the season, but very little work will be attempted during the winter months.

Key of Wealth Group.

This group is situated near the headwaters of Cariboo creek, which flows into the Illecillewaet river at Flat Creek Station, on the main line of the Canadian Pacific Railway. W. A. Thomason, of Revelstoke, has been doing some work on this property.

Silver Creek Group.

D. W. Woolsey is developing a group of seven claims situated on Silver creek at a distance of approximately seven miles from Albert Canyon. Most of the season's work was devoted to the building of a trail, which was necessary to enable supplies to be taken up to the property. The ore is reported to run high in silver and lead, with a small percentage of zinc.

Dunvegan Group. This is an old property on which a considerable amount of work was done as early as 1899, when about three cars of silver-lead ore was shipped. The property is situated at the headwaters of Fish creek, near the dividing line between the Lardeau and Revelstoke Divisions. Work this season was carried on under the direction of R. A. Grimes, who has the property under bond. The season's work consisted of building a new trail, and driving an adit-tunnel to develop the vein at a depth. Four men were steadily employed during the summer, but were laid off for the winter months. The work will be continued in the spring of 1918.

LARDEAU MINING DIVISION.

Multiplex. This group consists of eighteen claims owned and operated by the Multipex Mining Company, of Revelstoke. O. T. Bibb is manager and P. S. Wrightson is secretary. The camp is situated at a distance of one mile and three-quarters from Camborne, at the Junction of Poole and Mohawk creeks. The elevation of the camp is 3,600 feet. The principal work done has been the development of the *Spider* and *Excise* claims; the results are reported to be satisfactory and future prospects encouraging. The ore is an intimate mixture of galena, zinc-blende, and iron pyrites in a siliceous gangue.

Satisfactory milling tests were made at the Faust concentrating plant in Vancouver, but for further guidance, more especially in connection with flotation, a small pilot plant, consisting of a small Zeigler flotation-machine, a No. 6 Wilfley table, and a ball-mill, has been ordered for installation at the mine.

Winnipeg Group. This property is situated near the end of the Camborne wagon-road and has been operated by Arthur Evans, who is reported to have about 20 tons of high-grade silver-lead ore ready for shipment.

Goldfinch Group. Three men are reported to be working on this property, the work at present being confined to development.

King Solomon. This property, comprising three claims, is situated on Fish creek, and is owned by O. Woolsey, H. Bruce, and W. Kinnel, of Revelstoke. Over 300 feet of tunnelling was done some years ago. During 1917, 20 feet of drifting was done, with encouraging results. It is the intention of the owners to continue work next year.

AINSWORTH MINING DIVISION.

Eden and Crescent. This property consists of nine claims and a fraction and is owned by the Eden and Crescent Mining Company; A. L. White, president; W. Y. Williams, managing director. The mine is situated about three miles south of Ainsworth, on Coffee creek. Elevation of main tunnel, 1,000 feet above Kootenay lake.

The work done since the present company acquired the property consists of driving a crosscut 550 feet long to tap the vein, which outcrops on the surface 150 feet above the tunnel and is exposed in a 40-foot shaft. At the end of this crosscut they have drifted along the vein for a distance of 30 feet, exposing an average width of 4 feet 6 inches. The vein is strong and well defined, dipping 50 degrees to the west, the ore being zinc-blende and galena, which in some places carries silver values. A sample taken across a width of 4.3 feet at north face of drift assayed: Gold, trace; silver, 0.7 oz.; zinc, 35.6 per cent. Another sample taken across a width of 4.5 feet, 8 feet from south face of drift, gave: Gold, 0.02 oz.; silver, 2.5 oz.; lead, 17 per cent; zinc, 15.6 per cent. The walls are well defined; the foot-wall appears to be a silicified limestone, the hanging-wall a schist. The vein can be traced on the surface by open-cuts for a distance of about 1,000 feet. The ore being mined at present is milling-ore. There is a good mill-site directly below the present workings, where water-power is available.

The present means of access is by road for two miles and a half from Ainsworth and by trail for the balance of the way. The road from Ainsworth zigzags up the side of a steep ridge, attaining an elevation of 1,300 feet, where a trail leaves it for the *Eden and Crescent Mine*. This trail has several reverse grades, and near the end drops abruptly to the camp. This is a very expensive way into the mine at all times, and is said to be impassable in the spring on account of water. The natural outlet to the property is down Coffee creek, which would mean not more than one mile and a half of trail; the company has asked the Government to assist in building this trail.

The property is still in the development stage. The company has already spent a considerable amount of money on the property, and intends spending a lot more in development-work during this winter and next spring; hence desires to have the transportation facilities improved as soon as possible.

Silver Hill.

This mine is situated at an elevation of 5,630 feet, or 2,355 feet above the lower terminal of the tramway, which is situated on Crawford creek, nine miles from Crawford bay, in the Ainsworth Mining Division. In the vicinity of the mine the formation is of sedimentary origin, consisting of shales, schists, and sandstones, which have a uniform dip and strike and appear to be free from volcanic disturbance.

There are two known veins on the property, the upper being 60 feet above the lower. The upper vein has not been prospected to any great extent, but appears to be similar to the lower one. The veins are formed between the bedding-planes of the shale, which in places has a schistose structure. The dip of the formation is 10 degrees to the north, the strike east and west.

The vein is of the fissure type and shows a banded structure. The walls of the vein are well defined, the surfaces of which are smooth and show evidence of lateral movement. The vein, though persistent, varies greatly in width; while in places it is of a workable thickness, in others it squeezes down to a few inches, and in some instances divides into two small veins, separated by a band of from 2 to 3 feet of shale. There appears to be a greater concentration of mineral in the narrow places, which are said to contain streaks carrying high silver values. The mineralization consists of zinc-blende, tetrahedrite, chalcopyrite, iron pyrites, and galena, the galena predominating. The gangue consists principally of quartz. A small trial shipment to Trail gave a net return of $64.35 a ton.

The mine was worked between 1898 and 1901; since then it has remained idle. The amount of tunnelling done is approximately 2,650 feet. There has also been a considerable area stoped out. A number of drifts and open-cuts expose the vein on the hillside for a distance of at least 1,000 feet along the dip of the strata and above the main tunnel, continuing along the dip for another 700 feet from these workings; two tunnels on the *Richelieu* claims again expose the vein in-place.

The amount of development-work already done gives sufficient access to the vein to allow systematic sampling, from which the economic contents of the mine could be arrived at with a very fair degree of accuracy. Further, the old workings are in such a condition that they would prove of value in the future development of the property.

There are between 2,000 and 3,000 tons of second-grade ore on the dumps, which, judging by the surface appearance, would make good mill-feed; a grab sample of dump gave: Silver, 18.5 oz.; lead, 6.3 per cent.; zinc, 13.7 per cent. Although a certain amount of high-grade ore could be extracted for direct shipment, generally speaking the ore lends itself to concentration; and for the continual and successful operation of this mine, in the opinion of the writer, after a somewhat hasty examination, it would be necessary to install a mill. However, before making the installation of additional plant for the treatment of the ore, considerable money would have to be spent on repairing the tramway, buildings, ore-bunkers, etc., before this work is gone ahead with. The company would be well advised, if it has not already had it done, to have the ore in-place and that in the dumps systematically sampled and surveyed, which expense, judging by the surface and underground showings, would be amply justified.

Bluebell.

This property is being operated by the New Canadian Metal Mining Company, S. S. Fowler is general manager, and from him the following information was obtained: The mine was worked continuously during the year, and employed an average of eighty-three men. The mine is now opened to the fifth or E level below the adit. Elevation of adit station is 1,773 feet and of E station 1,403 feet.

The ore-bodies have not yet been sufficiently exposed to permit one to say whether or not the lowest level will reveal any change of importance in physical or mineral conditions. There is noticeable, however, a decrease of both zinc and lead tenure and an increase of silver, and water as depth increases. Tons of ore mined, 58,620. Out of this, 1,030 tons was low-grade oxidized ore, the greater part of which was shipped direct to the smelter; the remainder was concentrated.

Comfort.—This property, which adjoins the *Bluebell*, has been worked during the year by A. D. Wheeler, and shipped 51 tons.

WOODBURY CREEK.

Sacramento Group.—This property has been worked under lease and bond by C. F. Caldwell, four men being employed. Cabins have been erected and everything is in readiness to commence operations next season. The ore carries lead and high silver values.

Sun.—This property has been worked by B. H. Nellis. Shipment to Trail, 34 tons.

Lavina Group.—Three or four men have been working on this property.

St. Patrick Group.—This property is being developed by the British Alberta Mining Company, of which A. J. Flood, of Vulcan, Alberta, is president and W. R. Allen, of Nelson, secretary. Active development-work has been carried on and substantial camp buildings erected.

Silver Gable.—This property is situated half a mile north of Duncan lake. Development-work has been carried on under the direction of W. R. Smith, of Kaslo.

Argenta.—This property is situated on Hall creek. Two men have been working here during the season.

PROPERTIES NEAR AINSWORTH.

Highland.—Operated by the Consolidated Mining and Smelting Company. The shipments to Trail show 1,480 tons concentrates.

Florence.—Under the management of C. R. Wolfle, the mine has been operating steadily during the year and has given satisfactory results. Tonnage to Trail, 852 tons concentrates.

Other shippers are: *Spokane-Trinket*, 136 tons; *Silver Hoard*, 84 tons concentrates; *Little Phil*, 34 tons; *Banker-Maestro*, 27 tons; *Albion*, 44 tons; *Gallagher*, 31 tons.

Skyline.—Development-work has been done on a fairly large scale during the summer, but latterly the property has been closed down pending the settlement of labour troubles.

PROPERTIES NEAR KASLO.

Cork-Province. This property was visited on August 13th regarding an application for Government aid for road-repair work. The group, consisting of thirteen claims, is being operated by the Cork-Province Mines, Limited, of which J. Zwicky is manager and W. Burgess secretary. The mine is situated on Mansfield creek, at a distance of eight miles from Kaslo and four miles from the nearest point on the railway; the elevation of the camp is 3,350 feet. The vein, which has a strike of north-east and south-west, is well defined and has a width of about 9 feet, widening in places where the ore-shoots occur to 20 feet. The country-rock is slate. The ore occurs as massive galena, a mixture of zinc-blende and galena, and zinc-blende associated with spathic iron. Bands of crystalline limestone cut the vein at regular intervals; at these contacts the greatest deposition of mineral has taken place and large ore-shoots have been opened up.

The development now being carried on is the continuation of the main drift along the vein in an easterly direction, in order to strike the contact of another limestone-band which has been located on the surface. Average samples of the mine-run give the following values: Silver, 6 oz.; lead, 8 per cent.; zinc, 10 per cent. The first car-load of concentrates assayed: Silver, 26 oz.; lead, 38 per cent.; zinc, 9 per cent.

There are two parallel veins on the property, but the work is being principally confined to the lower. Access to the underground workings is obtained by an adit-tunnel, which intersects the vein at 930 feet from the portal and gives 200 feet of depth on the vein at this point. All the ore comes out of this tunnel and is transported in the mine-cars to the mill-bins, the top of which is on the same level as the mine-track. Another adit-tunnel 300 feet long taps the vein at a higher elevation. The mine is well developed and there is a considerable quantity of ore in sight. A very nice body of ore was developed this year in a side-shoot from the vein on the lower level.

The mill has a capacity of 120 tons a day; on the concentrating-floors there are eight 4-compartment jigs, three Overstrom tables, and three vanners. Later reports state that an addition is being made to the mill with the view of installing a selective flotation plant for the separation of the concentrates carrying lead and zinc.

Shipments to Trail during the year totalled 461 tons of concentrates. Providing market conditions remain favourable, next year should show a considerable increase. The camp buildings are well built and have good accommodation. There is abundant timber available for mining purposes. The equipment includes a small sawmill. About thirty men were steadily employed during the year.

Manganese Group.

This property is owned by A. J. Curle, of Kaslo, and A. G. Larson, M.E., of Spokane. It is situated on the Kaslo & Nakusp Railway at a distance of six miles and a half from Kaslo. The deposit occurs on the gentle slope of the hillside immediately above the railway-track. Very little development and mining work has been done as yet. Some 600 sacks of ore has been recently taken from shallow surface diggings.

A few shallow pits demonstrate that the ore occurs as a blanket deposit on the surface or at a few feet below, forming a layer of from 1 to 3.5 feet thick in the soil. So far the deposit has not been found to be closely associated with or bounded by any rock in-place, and, the ore being principally a wad, manganese can be extracted at small cost by pick and shovel without the use of powder. The thin layer of soil covering the deposit also contains manganese in varying quantities.

It is estimated by the owners that there are from 3,000 to 5,000 tons of this class of ore available for extraction. At the time of my visit there was not enough work done to enable one to arrive at any definite conclusion as to the amount of ore in sight, but was favourably impressed with the showing and the possibilities of further development-work exposing a considerable quantity of ore. Average assay values in the possession of the owners run as follows: Manganese, 42.06 per cent.; iron, 1 per cent.; moisture, 13.12 per cent.; silica, 4 per cent.; phosphorus, 0.01 per cent.

Farther down the hill and almost on the same level as the railroad-track, in some small exposures, the manganese is found to occur underlying a layer of soft decomposed limestone, and it is possible that the ore may be found to exist in-place under the limestone which has been eroded away farther up the hill, leaving the manganese exposed on the surface. Further exploratory work should be done to determine definitely the extent, character, and origin of the deposit.

Since writing the above report I am informed that the owners now have a permit from the Munitions Board to export 10,000 tons to approved consignees in the United States.

According to reports the property has been recently bonded to an American syndicate, who propose to work it on a large scale during 1918. Plans for mining and exploiting the ore-body have been prepared by A. D. Nash, of Nelson, and in all probability shipments will be made at an early date.

Although the ore is freely exposed on the surface and is easily noticeable along the old Kaslo-Slocan road, which traverses part of the property, it has been overlooked for years, and was only staked by A. J. Curle, of Kaslo, since the beginning of the war. This fact should be of particular interest to the prospector, as it illustrates the possibilities of finding ores which have become of great commercial importance owing to the unusual demand brought about by the war.

OTHER PROPERTIES.

Utica.—The No. 7 adit-tunnel of the *Utica* mine is reported to be in 2,000 feet, and is being driven to develop ore-shoots exposed in the upper workings at an elevation of from 350 to 1,600 feet above the tunnel. The ore is silver-lead-zinc, carrying high values in silver. Shipments to Trail during the year totalled 396 tons.

Sunset Group.—The lower adit-tunnel is said to be in 1,800 feet; it is being driven to tap the ore-body at a distance of 270 feet below the present workings.

Bell.—This property is being operated by the Jackson Basin Zinc Company. An adit driven from the Jackson Basin side is reported to have developed the *Bell* zinc-shoot. Shipment to Trail, 569 tons.

Whitewater.—Ten men have been working at this property during the year under lease. Shipment made, 900 tons.

Charleston.—This property is situated above the *Whitewater*. A. J. Harris is doing some development-work.

Eureka.—This property is being developed by J. C. Ryan.

Helen.—This property, which has been lying idle for some years, is now being developed on a small scale by W. English, of Kaslo. It is a silver-lead ore carrying high silver values.

Gibson.—This property is situated about two miles up the creek from the *Cork-Province* mines. Active development has been carried on under the direction of D. K. May, and encouraging results have been obtained.

Index.—This property is being developed under the supervision of C. F. Caldwell. Four men are now employed.

Gold Cure Group.—Some development-work has been done on this property by a company organized by C. F. Caldwell.

Flint and Martin.—A little development-work was done during the season. Shipment to the Trail smelter, 7 tons.

Revenue.—Two men were employed at this property.

SLOCAN MINING DIVISION.

The Slocan Division, which leads all others in the Kootenays and British Columbia in the value of the production of silver-lead-zinc ore, shows an increase in silver and zinc and a slight decrease in lead. There has been increased mining activity, however, and if it had not been for the curtailment of shipments, caused by industrial troubles and unfavourable market conditions, in all probability the production would have shown a considerable increase over that of 1916.

SILVERTON CAMP.

The following is a list of the properties which shipped during the year, giving the approximate tonnage of shipments:—

	Tons.
Standard Silver Lead Mining Co., lead concentrates	2,580
Standard Silver Lead Mining Co., zinc concentrates	12,500
Galena Farm, silver-lead-zinc concentrates	2,797
Van Roi and Hewitt, silver-lead-zinc concentrates	1,250
Lucky Thought, silver-lead-zinc ore	880
Echo, silver-lead ore	79
Comstock, silver-lead ore	17
Hartney, silver-lead ore	12

Standard. After many years of steady production this property still heads the list of Slocan shippers. L. de Lachmutt, mine superintendent, reports that during the past year the most noteworthy development has been the finding of a supposedly new ore-body at a point 400 feet east of the main shoot, from which the bulk of the production has been obtained. This ore makes its appearance at about 100 feet above the No. 6 tunnel. Access to this is at present gained by means of a 100-foot winze from No. 5 tunnel, drifting from near the bottom of which has disclosed an average width of 4 feet for a distance of 150 feet. Grab samples from the broken muck gave the following values: Silver, 20.6 oz.; lead, 11.5 per cent.; zinc, 23.2 per cent. No raising of any importance has yet been done on this ore. A raise is now being started from the face of the No. 6 tunnel. A series of small lenses, which are apparently side-shoots from the main ore-body, have also been opened up between the fourth and fifth levels.

A considerable amount of work has been done on the *Emily Edith* ground on two distinct lenses, which are at a distance of approximately 3,000 feet west of the main ore-body. Low-grade lead and zinc ore suitable for mill-feed, which was left untouched during the early days of the mine, is now being extracted. Recent development in this direction has opened up additional tonnage.

Galena Farm. This property, which is largely owned by the estate of the late Patrick Clark, of Spokane, has been operated during the year under the management of P. W. Clark, and is reported to have paid handsome dividends. The manager reports that a new body of ore was recently struck on the 100-foot level.

Van-Roi and Hewitt. These properties, which have been recently acquired by Clarence Cunningham, of Sandon, have been systematically developed by him, with encouraging results.

Echo. This property, comprising a group of six claims—*Echo, Duke, Duchess, W.H.R., Graphic,* and *Boston*—is owned by the Echo Silver Lead Mining Company, of which Martin Welsh is president and L. J. McAtee is secretary.

The *Echo* claim, upon which development-work is now being carried on, adjoins the *Alpha* claim of the Standard Silver Lead Mining Company on the north, and is staked along the strike of the *Standard* vein.

The property was visited by the writer on August 18th; at this time there was some 2,600 feet of drifting and about 1,400 feet of crosscutting. The main workings consisted of two adit-tunnels driven along the strike of the vein; that known as No. 1 tunnel has an elevation of 4,550 feet and E tunnel an elevation of 4,450 feet. There is not a great deal of ore exposed in the upper tunnel, and zinc and spathic iron are more in evidence than in the lower workings.

The E tunnel is started on the *Alpha* claim, and cuts a shoot of ore, part of which is on the Standard Silver Lead Company's ground and is being mined by them. This shoot or lens shows a width of 5 feet of solid galena in a 25-foot raise on the *Echo* ground, and can be traced for some distance along the drift, but gradually becomes more associated with gangue material and narrower until it pinches out. Streaks of galena occur farther in along the roof of the drift and continue to the face.

The country-rock is slate, and along the line of fissuring great movement has taken place, as is evidenced by the crushed and slickensided nature of the country-rock, which has been converted to a soft crushed graphitic slate. The ore is found to occur in lenses as a massive galena in this crushed material, and would appear to have been deposited after the movement had taken place. The width of the crushed zone varies from 30 to 70 feet. The vein has a strike of approximately N. 30° E. and a dip of 45 degrees to the east.

Another tunnel is now being driven along the vein at vertical distance of 130 feet below the E tunnel. The surface showing, which in places is from 25 to 30 feet wide, is oxidized and leached, and only small quantities of galena and zinc-blende are in evidence. The general conditions would appear favourable for the finding of more ore at a depth, and it is to be hoped that this property will soon rank among the important shippers of this district. Fifteen men were working on the property at the time of my visit. A new camp, having accommodation for forty men, was built this fall, and from which a good road was constructed to connect with the road from the *Standard* mine to Silverton.

L. H. Group. This group, comprising eight Crown-granted claims, is situated five miles and a half in a south-easterly direction from *Silverton*, at an elevation of 5,530 feet. The owners, A. R. Fingland and Chas. Brand, have done 70 feet of drifting in the No. 3 tunnel during the year. A considerable amount of development-work has been done in the past, with the result that there is now estimated to be 33,000 tons of positive ore and 18,000 tons of probable ore available for extraction. The ore consists principally of native arsenic, mispickle, pyrite, and pyrrhotite in a quartzose or siliceous gangue. The values are principally in gold, and from numerous samples taken by engineers who have examined the property the ore will average $5 to $6 a ton.

Bosun. This property is situated near the shore of Slocan lake, half-way between New Denver and Silverton, and according to old reports was worked in 1904 by the Bosun Mines, Limited, of 5 Fenchurch street, London; since this time it has apparently lain idle. Shipments were first made from the property in 1898, and from this time until 1904 the mine was a steady producer. The ore then shipped ran as high as 110 oz. in silver and 55 per cent. lead. Mining of the high-grade zinc ores was not attempted in those days, with the result that there was a considerable quantity of zinc ore left in the mine and on the dumps.

The vein is a large fissure filled with crushed and broken country-rock, in which lenses of galena and zinc-blende occur at irregular intervals. A considerable amount of development-work has been done by means of five adit-tunnels driven along the vein, the lowest of which gains a depth of about 400 feet.

Since the Surprise Mining Company took hold of the property this year, the old workings have been cleaned out and some of the old drifts are being extended. There is a considerable quantity of zinc ore available for extraction, and the prospects for opening up new bodies are encouraging. The zinc ore runs high in silver values and assays about as follows: Silver, 70 to 90 oz.; zinc, 45 to 54 per cent. It is estimated that there is 15,000 tons of ore on the dumps, which from numerous samples taken will average: Silver, 10 oz.; lead, 2 per cent.; zinc, 7 per cent.

A 2-bucket tramway 600 feet long was recently installed and connects the mine with ore-bins on the lake-shore, and in all probability ore shipments will shortly be made to the Rosebery concentrator, where the ore will receive treatment. Forty men were employed on the property at the time of my visit.

Rosebery Concentrator.

This plant was leased by the Surprise Mining Company during the latter part of 1917. In the earlier part of the year it was operated by J. H. Keen, who was treating ores from the *Whitewater* mines. It was originally built by the owners of the *Monitor*, *Ajax*, and *Bosun* properties with a view to treating the ore from these mines and also custom ores. The buildings are well designed and constructed, the only drawback being that the level nature of site does not allow the use of gravity for handling ore to the same extent as on a hillside location, but this is compensated by the convenience of the location to lake and rail transportation facilities. The mill is run by water-power. Briefly, the old plant consists of: Two 2-compartment, one 4-compartment, two double 5-compartment, and one 5-compartment jigs; and seven Wilfley tables, with necessary crushing, screening, and classifying equipment.

Since the Surprise Mining Company took over the plant $30,000 has been spent in additions and improvements, including the installation of a flotation plant consisting of a K. & K. and a Hynes machine, two large settling-tanks, a Portland filter, and ball-mill.

The mill-feed, which at present is ore from the *Surprise* mine, runs: Silver, 62 oz.; lead, 19.4 per cent.; zinc, 16.3 per cent. The jig zinc runs: Silver, 78.7 oz.; lead, 3.8 per cent.; zinc, 40.6 per cent. Table zinc: Silver, 71.2 oz.; lead, 7.2 per cent.; zinc, 44.2 per cent. Flotation zinc: Silver, 69 oz.; lead, 7.8 per cent.; zinc, 33.5 per cent. Flotation tails: Silver, 5.4 oz.; lead, trace; zinc, 3.2 per cent.

The silver in the tailings is in grey-copper or ruby-silver. Experiments are now being made which will probably lessen the loss of the silver and zinc in the tailings. The ratio of the total concentration is 2.3 tons of ore to 1 ton of concentrates.

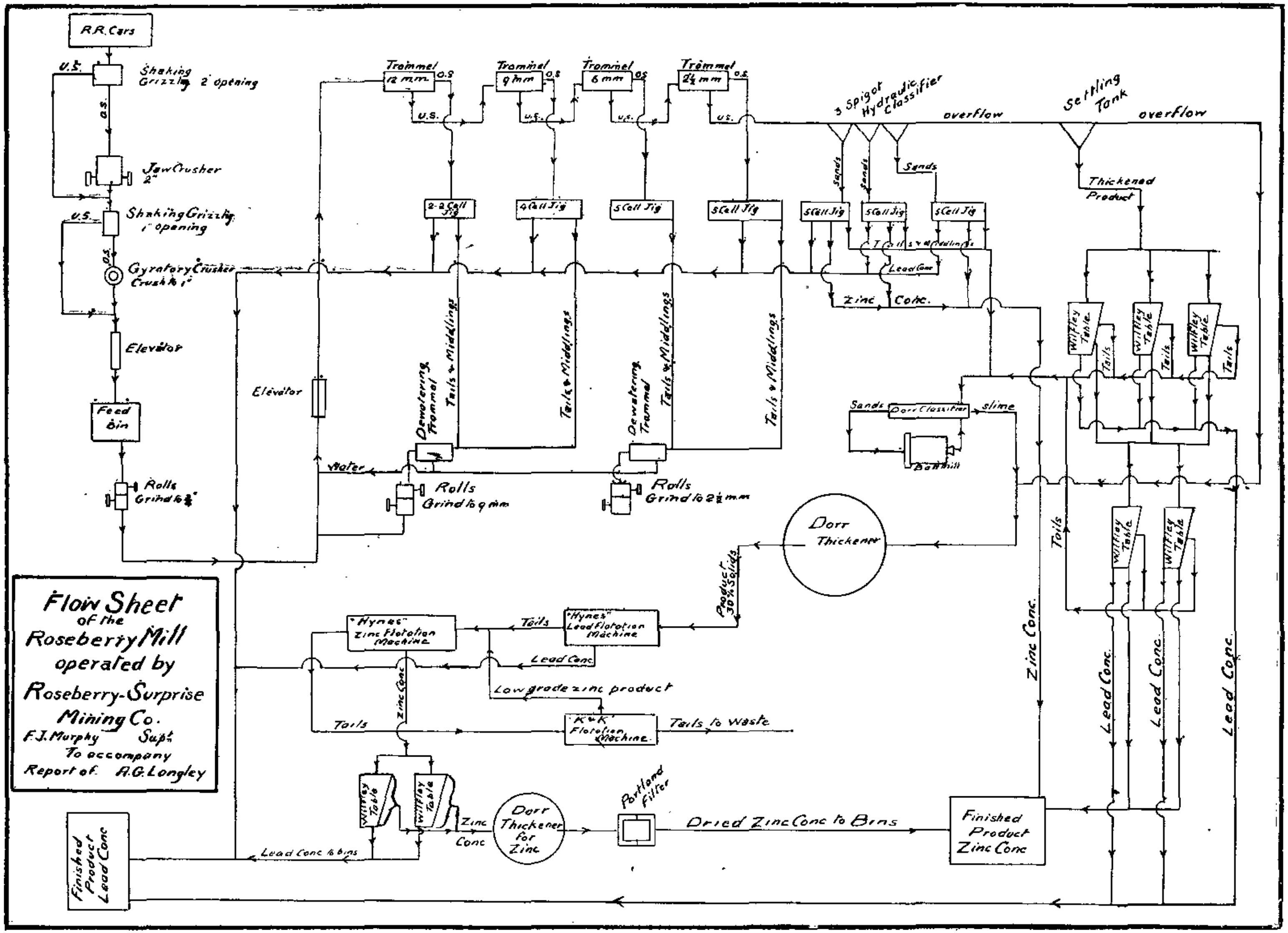
SANDON CAMP.

Surprise. This mine, which is owned by the Surprise Mining Company, is the second largest producer in the Slocan Division. The ore is milled at the *Surprise* mill at Sandon, and also at the Rosebery mill, which has recently been taking care of the overflow from the former mill. The mill-feed runs as follows: Silver, 62 oz.; lead, 19.4 per cent.; zinc, 16.3 per cent.

The Surprise Mining Company has extended its operations during the year and has recently acquired the *Bosun* mine, near New Denver; the *Ajax Fraction*, near the *Last Chance;* and the *Monitor* claim, near Three Forks. The company has also done some work on the *Elkhorn* group, of which George Gormley is one of the principal owners. In order to increase the milling capacity the Rosebery concentrator has been leased by the company, and to which considerable improvements have been made.

Queen Bess. Old records show that this mine was a steady producer from 1898 to 1903, and up to 1904 shipped $225,000 worth of ore, which had an average value of: Silver, 100 oz. to the ton; lead, 70 per cent. During the period in which these shipments were made the property was owned and operated by the Queen Bess Proprietary Company of England. At the end of 1903 it passed into the hands of the Bank of Montreal, and at this time there was little or no ore developed. In 1904 the mine was acquired by the Queen-Dominion Mining Company, Limited, which started in to systematically prospect and continue the development of the property. The company's efforts, however, apparently did not meet with much success, as evidenced by lack of shipments from this date. In 1916 Clarence Cunningham took over the property, and after doing a little crosscutting from the old workings developed a large shoot of high-grade silver-lead ore; the mine has since been shipping steadily, and has already become one of the most important shippers in the district.

The *Idaho* and *Alamo* claims, which lies to the south-west across Howson creek from the *Queen Bess*, have also been taken over by Mr. Cunningham and are being systematically developed. During the year an aerial tramway was completed to transport the ore from these properties and the *Queen Bess* to the railway at Alamo.


Flow Sheet
of the
Roseberry Mill
operated by
Roseberry-Surprise
Mining Co.
F. J. Murphy Supt.
To accompany
Report of A. G. Longley
R.R. Cars
Shaking Grizzly 2" opening
U.S.
O.S.
Jaw Crusher 2"
Shaking Grizzly 1" opening
Gyratory Crusher Crush to 1"
Elevator
Feed Bin
Rolls Grind to ¾"
Trommel 12 mm
Trommel 9 mm
Trommel 6 mm
Trommel 2½ mm
2-2 Cell Jig
4 Cell Jig
5 Cell Jig
Tails & Middlings
Dewatering Trommel
Water
Rolls Grind to 9 mm
Rolls Grind to 2½ mm
3 Spigot Hydraulic Classifier
overflow
Settling Tank
Sands
Thickened Product
Lead Conc
Zinc Conc.
Wilfley Table
Tails
Sands
Dorr Classifier
slime
Ball mill
Dorr Thickener
Product 30% Solids
"Hynes" Lead Flotation Machine
"Hynes" Zinc Flotation Machine
Lead Conc
Low grade zinc product
K & K Flotation Machine
Tails to Waste
Zinc Conc
Dorr Thickener for Zinc
Portland Filter
Dried Zinc Conc to Bins
Finished Product Zinc Conc
Lead Conc to bins
Finished Product Lead Conc

Other properties which are being operated by Clarence Cunningham near Sandon are the *Sovereign* and *Wonderful*. About 250 men were steadily employed at the various properties operated by him during the year.

Noble Five Group.

This property, which is owned by the Hon. Jas. Dunsmuir, of Victoria, has been extensively developed during the last six or seven years, but there is no record of any ore being shipped during this period. More recent work has been carried on under the direction of Paul Lincoln, who is managing the property. Extensive crosscutting and drifting has been done on the lower level at a vertical distance of 1,100 feet below the upper workings.

In these workings the *Last Chance* vein was intersected, and a strong shoot of high-grade ore has been developed at a depth of approximately 3,000 feet below the apex of the vein. Ore is also exposed in this vein on the upper levels. There is evidently ample ore available for extraction to justify further expenditures being made for the erection of a suitable concentrator, and it now only remains to win and handle the ore in the most economical manner. With this object in view a 4-compartment vertical raise has been started from the lower level to connect with the upper workings. The ore will be dropped down this raise, and the lower crosscut will become the shipping-tunnel of the mine. The length of the raise will be 1,100 feet, and it will consist of two chutes, a manway, and skipway. At every 200 feet hopper-bottom pockets will be built to break the fall of the ore.

Between thirty and forty men have been steadily employed during the year. The development-work done on this property is the deepest exploratory work yet done, and is of great importance to the district, as it proves the continuity of the veins with depth and throws a new light on the character of the ore-shoots.

Slocan Star.

This property, which is one of the best known in the Kootenays, was discovered in 1891 by Bruce White and others. The Byron N. White Company, which was incorporated in 1892, acquired and operated the *Slocan Star* group. The mine proved very productive. After an examination of the property by W. A. Carlyle, the Provincial Mineralogist, in 1896, he states: "This property has not only paid a larger amount of dividends, or $300,000, than any other mine in British Columbia, apart from the coal and placer mines, but has also proved itself to be the largest silver-lead mine so far developed in the Province."

After a period of productive activity the holding company became involved in costly and protracted litigation with the Star Milling and Mining Company. The case arose over the "extra lateral rights" of an adjoining claim named the *Rabbit's Paw*. In 1911, R. S. Lennie, of Vancouver, amalgamated the conflicting interests and incorporated a company under the name of the Slocan Star Mines, Limited, which company has operated the property up to the present time, Oscar V. White being retained as superintendent.

To give an idea of the production of this mine over a period of twelve years the following figures are submitted: Tons of crude ore shipped, 17,870; Gross value, $1,291,728; net value, $933,398. Tons of silver-lead concentrates shipped, 15,594; gross value, $1,229,461; net value, $896,804. Tons of zinc concentrates shipped, 3,445; gross value, $154,061; net value, $45,170. Total gross value, $2,675,430; total net value, $1,875,372.

The mine was closed down in October of this year, shortly after the Trail smelter gave notice that ores containing more than 4 per cent. zinc would not be acceptable. Evidently the affairs of the company could not have been in a very flourishing condition at this time; the creditors became restless on account of the cessation of operations and the company was forced into liquidation. It is to be hoped that a reorganization will be effected and that more funds will be available for further development-work.

McAllister Group.

This, property consisting of four claims—*Silver Queen*, *Silver King*, *Ridgeway*, and *Rouse* Fraction—is situated at a distance of five miles by trail from Three Forks, the nearest shipping-point on the Canadian Pacific Railway. Elevation of camp, 5,625 feet. The trail is in good condition and the property is easily accessible. The group is owned by the McAllister Mining and Milling Company, of which Geo. Clark, of Sandon, is one of the principal parties interested, and who in former years was in charge of the development-work.

A considerable amount of work was done in the past, including surface work, crosscutting, raising, and drifting. That which is of most interest at the present time is about a total of 500

feet of drifting, which exposes a strong and well-defined quartz vein, having a width of from 3 to 5 feet for a length of nearly 200 feet, in the lowest drift. The mineralization consists of tetrahedrite and argentite, with small quantities of galena and iron pyrites. Numerous samples in possession of the owners would indicate good average silver values.

The vein, which almost follows the contour of the hillside, is approached by three crosscut tunnels from the surface; on the upper level, which has been driven too near the surface to allow much backs, 50 feet of drifting has been done; on the next level, 280 feet of drifting; and on the lowest level, 185 feet. The strike of the vein is S. 15° W. and dip 53 degrees to the south-east. The hanging-wall is schist and the foot-wall quartzite.

On the surface the vein can be traced for over 2,000 feet. The formation is typical of the Slocan series, and is cut by a well-defined granite-porphyry dyke which almost parallels the strike of the strata and intersects the vein to the south of the main workings. These dykes are genetically connected with the ore-zones and are of common occurrence in the Slocan district.

The mine-workings are in good shape and the cabins are in first-class repair. Although some high-grade ore can be extracted for shipment, in order to work the property to the best advantage it would be necessary to install a mill, an excellent site for which is available immediately below the mine on the North fork of Carpenter creek; but at present the company is not operating the property.

Owing to the rush of work this season the writer did not have sufficient time at his disposal to either make an extensive examination or to systematically sample the property, but in his opinion it is a property which has possibilities and is worthy of investigation. A considerable length of the vein being uncovered at depth allows sampling to be done, from which a fair idea of the value of the property can be derived and conclusions drawn as to the advisability of continuing operations.

Among the other properties on the North fork of Carpenter creek upon which work was done during 1917 are: The *Milton*, which is owned by S. McGregor and R. McPherson, is said to have a good showing, the formation and the character of the deposit being somewhat similar to that at the *McAllister* group; the *Black Grouse* was worked by G. H. Murhard, and a shipment of 11 tons was made to the Trail smelter; the *Evening Star*, owned by J. D. Ryan, is reported to have had some work done on it; the *Alps and Alturis*, situated near the headwaters of the North fork of Carpenter creek, was worked during the year by W. J. McMillan. The ore is stibnite.

Carnation Group.

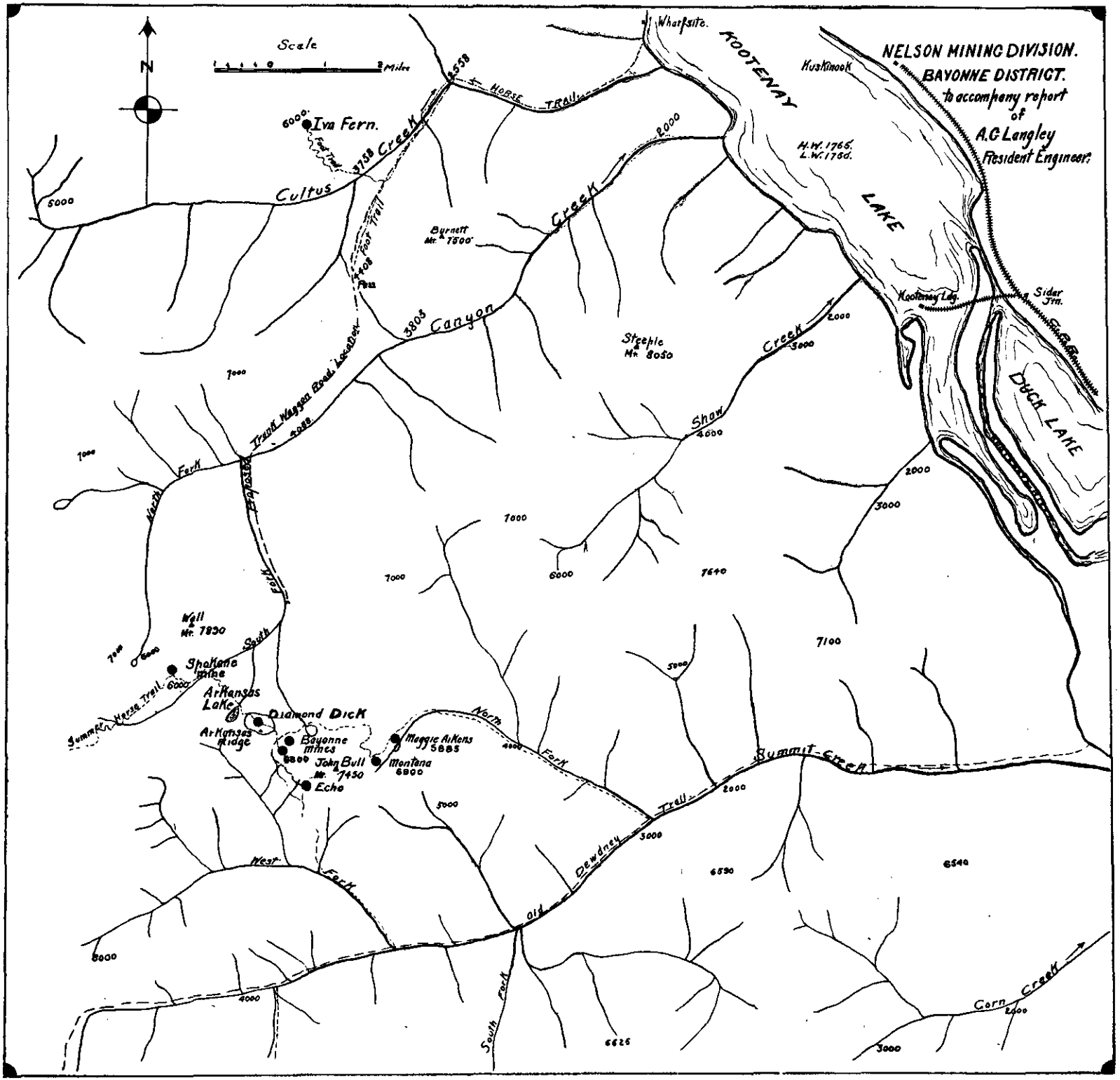
A. R. Mann and George Clark are operating this property under a lease and bond. There are five claims in the group—*Violet*, *Violet Fraction*, *Evening*, *Jennie*, and *Carnation*. The elevation of the workings is 6,000 feet and the distance from Sandon by trail is five miles. Development-work was started late in the fall and is being carried on under the direction of George Clark, who has five men working. During 1917 good trails were constructed to the property, and cabins built near the mine, having accommodation for about twenty men.

Previously the only work of any importance on the property consisted of a 20-foot shaft sunk on the ledge, and from which a small quantity of high-grade ore was extracted. An assay in possession of the owners gave: Gold, 0.01 oz.; silver, 70.20 oz.; lead, 80.61 per cent.; zinc, 3.92 per cent. Oxidized ledge-matter, consisting principally of angular fragments of altered country-rock, calcite, and spathic iron, and having a width of about 15 feet, outcrops for a short distance near the shaft. In this material small bunches of galena and zinc-blende occur on the surface, while from the bottom of the shaft I am informed 60 tons was shipped some years ago. Although there is not much ore in sight, indications are sufficiently good to encourage further development-work being done, especially as the showing occurs in a well-mineralized and proven district.

Ruth.—Development carried on during the season was confined to the driving of a long crosscut to tap the vein at a greater depth.

Soho.—J. C. Ryan is carrying on development-work at this property.

Goodenough.—This is one of the old properties upon which extensive development has been done. During the year four men were working.


NELSON MINING DIVISION.
BAYONNE DISTRICT.
to accompany report
of
A.G. Langley
Resident Engineer.
Scale
2 Miles
N
Wharf site.
KOOTENAY
LAKE
Kuskinook
H.W. 1765.
L.W. 1760.
Kootenay Lag.
Sidar Jim.
DUCK LAKE
Iva Fern.
6000'
Foot Trail
3758 Creek
6558
HORSE TRAIL
2000
Cultus
5000
Burnett Mt. 7500'
Foot Trail
3408
Creek
3803 Canyon
Steeple Mt. 8050
Creek
2000
3000
Shaw
4000
Trail Wagon Road Location
North Fork
Forks
South Fork
Wall Mt. 7830
7000
6000
7640
7100
5000
2000
3000
Shamrock mine
6000
Summer Horse Trail
Arkansas Lake
Diamond Dick
Arkansas Ridge
Bayonne Mines
6800
John Bull Mt. 7450
Echo
Meggie Aikens 5885
Montana 6900
North Fork
4000
Summit Creek
Trail
2000
3000
5000
West Fork
Old Dewdney
6590
6540
6000
4000
South Fork
6625
Corn Creek
2000
3000

The following is a list of shippers from this part of the district, giving the approximate amount of ore or concentrates shipped during 1917:—

	Tons.
Surprise Mining Co., lead concentrates	2,228
Surprise Mining Co., zinc concentrates	4,470
Lucky Jim, zinc concentrates	3,000
Slocan Star, silver-lead-zinc concentrates	1,440
Rambler-Cariboo, silver-lead-zinc concentrates	1,300
Queen Bess, silver-lead ore	2,200
Ivanhoe, silver-lead-zinc concentrates	54
Ruth	283
Wonderful, silver-lead ore	250
Sovereign, silver-lead ore	169
Idaho-Alamo, silver-lead ore	164
Freddy Lee, silver-lead ore	69
Goodenough	62
Noonday, silver-lead ore	63
Number One	50
Reco	30
Daniel, silver-lead ore	18
Grey Copper, silver-lead ore	37
Payne, silver-lead ore	21
Black Grouse, silver-lead ore	10
Gem, silver-lead ore	10
Lone Batchelor, silver-lead ore	7
Bon Ton	7

SLOCAN CITY MINING DIVISION.

Although there has not been any pronounced activity in this district during the year, the production compares favourably with that of the previous year.

The following shipments were made to Trail during the year: *Ottawa* group, 182 tons; *Black Prince*, 17 tons; *Meteor*, 14 tons; *Enterprise*, 112 tons.

Lily B. W. A. Buchanan, manager for the property, reports that development-work during the year consisted of completing a 300-foot crosscut to the vein. Drifting is now being done, and they expect to ship in the near future. The values are principally in native silver and tetrahedite. Five men are working.

Evening Star. Work was started on this property under lease and bond in July. M. Maurer is in charge of the work. Shipments are expected to be made shortly.

TROUT LAKE MINING DIVISION.

Elsmere Group. The Circle City Mines, Limited, of which George Brown is president and Norman Ross secretary, owns a group of fourteen claims near the headwaters of Ferguson creek, the names of which are as follows: *Elsmere Nos. 1, 2, 3,* and *4, Pass, Cadle, Alberta Nos. 1* and *2, Victor, Helensburg, Little Robert No. 1,* and *Big Five Nos. 1* and *2*. During the year development-work has been confined to the *Elsmere* group, the workings on which are situated at a distance of approximately ten miles from Trout Lake, the nearest shipping-point. The elevation of the main tunnel is 5,850 feet.

The mine is situated in what is known as the Lime Dyke Belt, which traverses the Trout Lake Division in a south-easterly direction, and which is fully described by Newton W. Emmens in Bulletin No. 2, published by the Department of Mines at Victoria. The ore occurrence is along the contact of a chloritic schist and limestone. Along the line of contact the limestone is metamorphosed, being white in colour and having a finely crystalline structure. The ore is galena carrying silver in varying quantities, a low percentage of zinc, with a small amount of iron pyrites. In the lower tunnel the ore occurs in streaks and irregular-shaped patches, replacing or, rather, impregnating the limestone.

Although some fairly high silver values have been obtained, generally speaking the ore is low in silver contents, and to produce a shipping product concentration will be necessary. An excellent mill-site is available at Circle City, some 2,000 feet below the mine. There is abundant timber in close proximity to the mine. During 1917 eight to ten men were employed, new camp buildings were erected, and a trail built from the mine to Circle City. A small compressor plant was purchased and is on the ground.

The development-work done, as on August 22nd, consisted of two adit-tunnels, the upper of which was driven for a distance of 50 feet along the contact, and near the surface exposes a width of from 2 to 3 feet of medium-grade ore along the bottom of the tunnel between well-defined walls of schist on the south and limestone on the north. The lower tunnel is being driven in limestone, at a vertical distance of 350 feet below the upper, to strike the vein at a point below the exposure in the upper tunnel. This tunnel was in 175 feet, but a considerable distance has yet to be driven to reach the objective point. At a distance of 42 feet from the portal, ore was encountered, and this occurrence, consisting of irregular bunches and streaks in the roof and sides of the drift, was continuous up to the fact. Evidence here of any well-defined boundaries of the ore is lacking, no crosscutting having been done. The strike of the vein is N. 75° W. and conforms with that of the formation; the apparent dip is 56 degrees to the north.

On the surface the contact is well defined, and well-mineralized ledge-matter can be traced for well over 1,000 feet. The property is still in the development stage, and although not enough work has been done to form a definite opinion of the character of the deposit from an economical standpoint, it would appear to be a prospect which has possibilities and on which further work should be done, with a view of developing sufficient ore to justify the erection of a concentrator, which, I understand, is the intention of the company.

Old Gold Group.

This property is owned by Conaway & Birch and is being managed by J. M. Miller. For a number of years work has been done on these claims and ore extracted from time to time. The workings are on the Duncan River side of the divide, which separates the Trout Lake from the Ainsworth Mining Division. The natural outlet is by way of the Duncan River valley, but at present the only trail open to this part of the district is from Circle City townsite, over the divide at an altitude of 7,200 feet, and down the other side for about one mile to the camp, the elevation of which is 5,700 feet. The total distance over which the ore has to be packed is thirteen miles to Ferguson; thence by wagon to Trout Lake, a distance of four miles. Hence, in order to ship at a profit, the ore has to be high grade, as the freight charges alone amount to about $25 a ton. The country surrounding the mine is of an extremely rugged nature, the mountain-sides being precipitous and devoid of timber.

The present development-work principally consists of two crosscuts to tap the ore-body and about 139 feet of drifting along the vein, the total amount of tunnelling being about 300 feet. In the upper workings approximately 3 feet of ore is exposed along the drift for a distance of 40 feet, and at the bottom of the 10-foot winze 3 to 4 feet of ore is exposed. Not much drifting has been done in the lower tunnel, but there is a nice showing of ore about 9 inches wide at the end of the crosscut and approximately under the ore exposed in the winze in the upper level. The ore is a massive galena carrying high silver values, fairly free from gangue-matter, and judging by its appearance it is low in zinc and iron. The formation consists of slates and graphitic schists, with intermittent narrow bands of limestone.

The strata have a dip of 50 degrees and a strike of N. 57° W. The ore apparently occurs along the contact of the schists and limestone, and it would appear to replace the limestone. Eight to ten men were steadily employed during the season. Some 28 tons of ore was packed out last fall.

Among other properties which have been operated during 1917 are the following:—

Triune.—Operated by the Minnesota Gold and Silver Mining and Manufacturing Company; R. H. Batty, manager. During the year development-work was carried on and a number of men employed. A trial shipment of 28 tons was sent to Trail.

Towser.—Five men have been employed steadily. Shipment to Trail, 25 tons.

Nettie L.—The property is being worked under lease by McLaren, White & Cameron. Shipment to Trail, 25 tons.

Ethel.—Three men were engaged during the year. Ore is being rawhided down this winter. Shipment to Trail, 9 tons.

Florence.—Development-work is being carried on by the Minnesota Gold and Silver Mining and Manufacturing Company.

Foggy Day.—Shipped 26 tons.

Black Eagle.—J. Livingstone is doing some work on this property.

Crescent.—The Mansfield Mining Company had four men working during the year.

Fidelity Group.—Two men were working during the summer; ore is being rawhided down this winter. Shipment to Trail, 5 tons.

Copper Chief. A considerable amount of work was done on this property during the year under the direction of R. D. Fetherstonhaugh, M.E. Two trial shipments were made to Trail. The first one of about 5 tons gave the following result: Silver, 241.4 oz.; lead, 12.8 per cent.; zinc, 23 per cent. A second shipment of 6 tons was made in the nature of an experiment to see how much ledge-matter could be included to do away with hand-sorting. The following results were obtained: Silver, 63.8 oz.; lead, 7.1 per cent.; zinc, 6.7 per cent.

Molybdenite is reported to occur on the property, but not enough work has been done to demonstrate the value of the showing. Owing to lack of funds for the continuance of the development-work the property closed down in the fall.

NELSON MINING DIVISION.

BAYONNE DISTRICT.

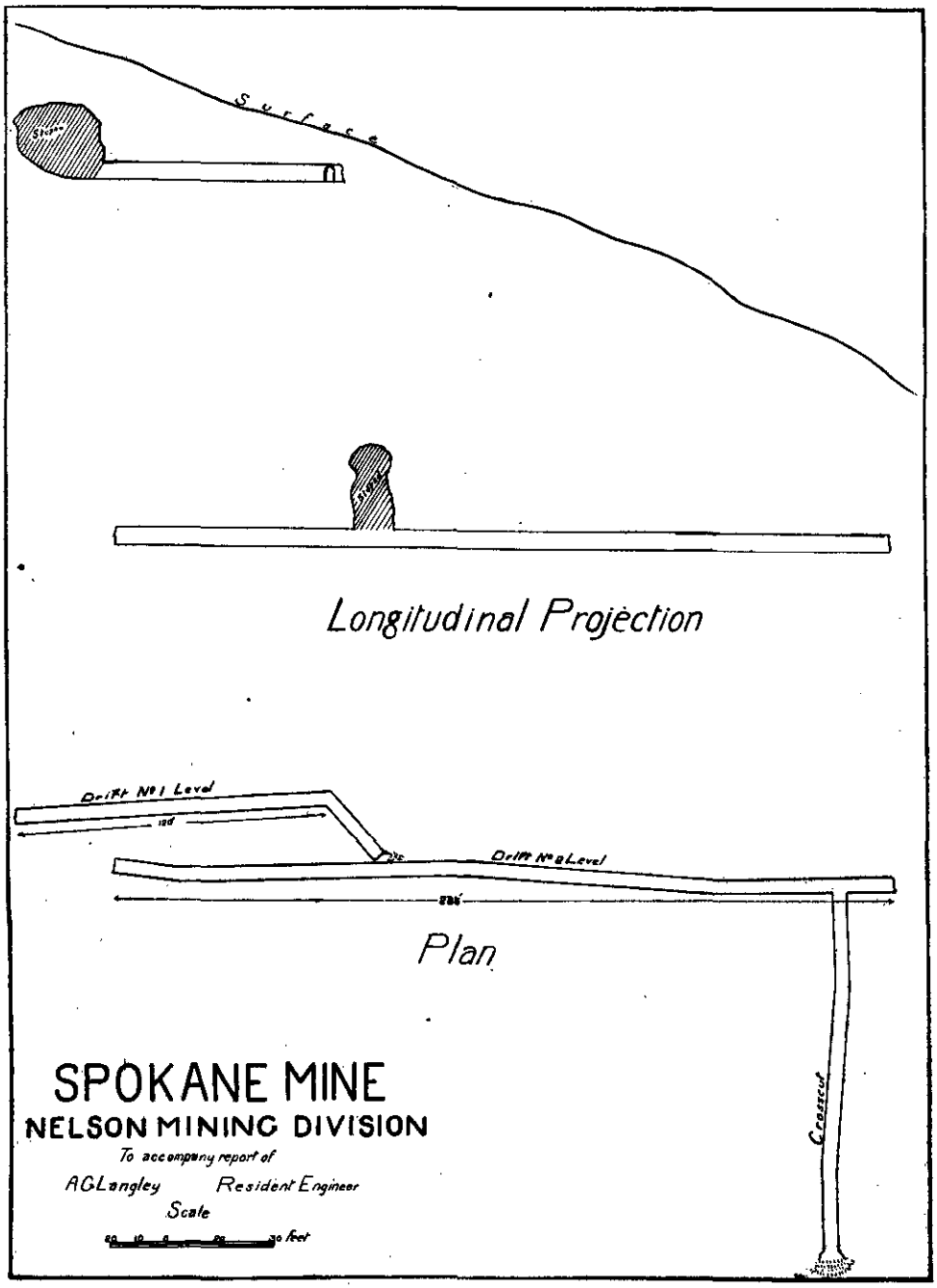
Spokane Group. This property, consisting of six claims—*Granite*, *Spokane No. 1*, *Spokane*, *Continental*, *International*, and *Timberline*—is owned by the Laib Bros., of Salmo, who staked it in 1911. The elevation of the mine-workings is 6,100 feet. The present means of access is by wagon-road up Sheep creek from Salmo for a distance of eleven miles, and then by trail over the divide at the head of Sheep creek for a distance of about eight miles. Between the end of the wagon-road and the summit the trail, which zigzags up the mountain-side, climbs to an altitude of 6,500 feet. Down the other side of the summit the trail is steep and rocky for a short distance, but for the balance of the way to the *Spokane* group it is of good grade and in good condition.

The mountains forming the sides of the wide U-shaped valley which is drained by Canyon creek present an even sky-line, and few high peaks are conspicuous. The slopes have an angle of about 30 degrees, and are well timbered and covered with overburden, on which there is a thick growth of underbrush.

The formation, which is granodiorite, covers an area of some hundred square miles, and large angular boulders which have been eroded from the summits of the ridges have formed numerous rock-slides, which are characteristic of the scenery around the *Spokane* and *Bayonne* groups.

The vein on the Spokane group, which has been systematically and well developed by the Laib Bros., may be classified as a fissure-vein in granodiorite, which would appear to be partly formed by replacement along a joint fracture. The vein, which has an average width of 2.5 feet, strikes east and west and dips at 80 degrees to the south. The underground workings show the vein between well-defined and clean-cut walls to be composed of oxidized and leached country-rock, with ribboned and shattered quartz running through it. Occasional inclusions of altered granite are noticeable in the vein, as are also several small micaceous dykes which cut the vein, but do not otherwise have any effect on its continuity or mineralization. The metallic contents are gold, silver, lead, and zinc, the gold values predominating. The ore is a mixture of argentiferous galena, iron pyrites, quartz carrying free gold, and a little zinc-blende and carbonates.

As the property has been thoroughly sampled by competent engineers, only a few check samples were taken. In the upper tunnel three samples were taken at intervals of 40 feet, and gave an average value of: Gold, 1.50 oz.; silver, 18.78 oz. The average width across which these samples were taken is 2.3 feet. In the lower tunnel five samples were taken at intervals of 60 feet, and gave an average value of: Gold, 0.206 oz.; silver, 3.15 oz., across an average width of 3 feet. The lead and zinc assays were not made, but the ore carries, besides the gold and silver values, 7 to 11 per cent. lead and 2 to 2.5 per cent. zinc, and the mine-run has a value at present market prices of from $22 to $24 a ton.


Surface
Longitudinal Projection
Drift No 1 Level
Drift No 2 Level
Plan
SPOKANE MINE
NELSON MINING DIVISION
To accompany report of
A.G. Langley Resident Engineer
Scale
Crosscut

Wall Mountain. Arkansas Lake in Foreground.

Old Gold Mine, looking down Valley.

The development-work has been carried out by means of two adit-tunnels. There is 120 feet of drifting along the vein in the upper tunnel and 285 feet in the lower. The vertical distance between the two tunnels is 135 feet.

Presuming that the vein carries its width between the two tunnels, it is reasonable to assume that there are between 4,000 and 5,000 tons in this section of the vein, while there is the possibility of winning 3,000 to 5,000 tons from that section of the vein which lies between the lower tunnel and the surface. The vein can be traced by means of small open-cuts on the surface for a considerable distance, but, except for showing the strike to be persistent, the work done has not been sufficient to enable one to attach any economic importance to the surface showings. It would indicate that further underground development might be done to advantage by continuing the present drifts.

In order to handle the output of this mine to the best advantage it will be necessary to install a mill, an excellent site for which is available on Canyon creek at a short distance from and 900 feet below the mine-workings. Laib Bros. are continuing with the development of the property this winter.

Transportation facilities are a serious handicap to the property at present. The packing charges over the divide to the Sheep Creek road are prohibitive. The only feasible route from the mine to transportation facilities is down Canyon creek for a distance of about six miles, then over Low pass and down the valley of Cultus creek to Kootenay lake, a total distance of seventeen miles, over which a good uniform grade is obtainable.

Harris. This property adjoins the *Spokane* group on the west. An open-cut exposes a small quartz vein having a width of about 6 inches, the strike of which is N. 77° W. It is slightly mineralized with galena and iron pyrites. This is probably the continuation of the *Spokane* vein.

Diamond Dick. This property, belonging to Alex. Stuart and McDonald, is situated on the ridge of Arkansas mountain, at an elevation of 6,900 feet. Numerous open-cuts and a small tunnel expose a small though persistent quartz vein in granite, with a width varying from a few inches to 15 inches. The quartz-filling of the vein is stained with oxide of iron and in places is honeycombed.

Bayonne. No work has been done since J. D. Galloway reported on the property in 1915. It is undoubtedly a property which has great merit, and it seems extraordinary that it should have remained idle for long. A sample taken across a width of 4.5 feet in the *Ohio* tunnel assayed: Gold, 1.96 oz.; silver, 4.60 oz. A sample of 125 tons of dump at *Ohio* tunnel: Gold, 1.42 oz.; silver, 2 oz. A sample of 50 tons of dump at *Bayonne* tunnel: Gold, 0.60 oz.; silver, 2.6 oz.

Montana. This claim is located at the head of the North fork of Summit creek and at a distance of about a mile in a north-easterly direction from the *Bayonne* mine. The elevation of the property is 6,600 feet. The surface of the claim is covered with large granite boulders. Numerous open-cuts expose the vein at intervals for a distance of about 500 feet; the width is 10 inches, the strike N. 80° W., and the dip 58 degrees. The vein-filling is quartz, with small quantities of galena and iron pyrites. A sample taken across an 8-inch width in a small shaft gave the following returns: Gold, 0.16 oz.; silver, 0.54 oz. A sample of selected ore on the dump ran: Gold, 0.10 oz.; silver, 4.40 oz.; lead, 24.5 per cent.

Maggie Aitkens, Summit Bell, and Michigan.—These claims are situated about one mile down the North fork from the *Montana*. The elevation of the tunnel on this property is 5,885 feet. The ore occurs as galena, iron pyrites, and probably free gold in a quartz vein. The country-rock is granite, which is altered in the vicinity of the vein and is stained red with oxide of iron. There has been a considerable amount of movement along the line of fracture, and the vein appears to be faulted and broken. The width of the vein varies from a few inches to 2.5 feet. A sample across a width of 2.3 feet at the face of the tunnel gave no values. A sample of selected ore on the dump ran: Gold, 2.94 oz.; silver, 1.9 oz. The principal work done consists of 120 feet of drifting along the vein. This property was examined under the disadvantages of having little time on the ground, and not having any one with me who was thoroughly familiar with what had been done.

Iya Fern Group. This group, consisting of seven claims, is situated on the north side of Cultus creek, at a distance of about seven miles from Kootenay lake. The property is owned by J. Mullholland, of Sirdar, B.C. In the vicinity of the

workings the hillside has a fairly uniform slope which is covered with overburden, and on which there is ample timber for all requirements. The workings are situated near the top of the hill at an elevation of 5,735 feet, or 1,870 feet above Cultus creek, where there is abundant water-power available.

The formation is of sedimentary origin, composed of shales and schists, and is cut by intrusive dykes which are said to run parallel to the formation, but the short time that the writer had on the property did not allow a surface reconnaissance to be made in order to trace the geology or to identify the various surface showings of ore with the vein system.

The work done consisted of a number of open-cuts, which in every case showed a width of ore from 1 to 6 feet, but on account of the heavy covering of overburden it was difficult to definitely determine the nature of the walls and the dip and strike of the strata, which latter, as far as could be ascertained, was approximately north and south. However, with only the cursory examination that was made, it was quite evident that the surface showings and general conditions were encouraging and fully warranted the further exploitation of the property.

At the lowest exposure the ore consisted of a mixture of galena, a little chalcopyrite, and iron pyrites occurring in oxidized ledge-matter; at the upper workings the ore was principally galena. A sample taken at the lowest showing, across a width of 6 feet, gave the following returns: Gold, trace; silver, 3.50 oz.; lead, 5 per cent. Farther up the hill a sample across a width of 2.5 feet gave: Gold, 0.02 oz.; silver, 3.40 oz.; lead, 22 per cent.; while at a short distance from this, on the summit of the hill, a sample across a width of 2 feet gave: Gold, trace; silver, 1.80 oz.; lead, 10 per cent.

During the summer development-work was carried on, and according to recent reports the property has now been bonded by the Consolidated Mining and Smelting Company.

In connection with the occurrence of sedimentary rocks in this section, it may be of interest to note that this belt of schists and slates, bounded by the granite formation on the east and west, extends southward across Cultus creek and apparently forms the saddle of the Low Pass divide; and, further, it has been reported that the same character of ore has been found in the vicinity of the Low pass on a group of claims owned by C. O. Woodward, R. J. Elliot, and others, of Nelson.

YMIR CAMP.

Yankee Girl.

The Hobson Silver Lead Company, of which W. T. McDowell is manager, has been actively engaged in the mining and development of this property during the year, with results that apparently are highly satisfactory. The work done during the year consists of approximately 450 feet of drifting on the vein and 185 feet of crosscutting.

The manager reports that an ore-body consisting of lenses of heavy sulphides was developed near the end of the drift, and stoping was commenced on this at a distance of 35 feet from the face. The stope at present extends 65 feet above the drift and is 55 feet long. The ore, which is reported to have a width of 6 feet, runs about 8 per cent. zinc, 25 per cent. pyrite, and pyrrhotite carrying gold and silver values, which show average returns of $17.50 a ton. Since September 18th fifty-five cars having a total dry weight of 2,300 tons have been shipped to the Canada Copper Corporation at Greenwood.

Pat, Carthage, Wildhorse, and X-Ray Claims.

This group of claims, which is situated along the east side of the gulch formed by the North fork of Wildhorse creek, is at about the same elevation as the *Ymir* mine, and covers the hillside where an easterly extension of the *Ymir* vein would be expected to occur. The remains of a wagon-road from the *Ymir* mill up the North fork as far as the *Pat* claim are in evidence, but the greater portion of this road has been washed out.

At the *Ymir* mine the ore occurred as a large lenticular shoot in a strong and well-defined quartz vein. Although the workings extend down to the 1,000-foot level, on which a lot of drifting has been done on the vein, the values were found to decrease with depth, and no ore of any economic importance was discovered below the 700-foot level. The management, after prospecting without success for another vein higher up the hill, the presence of which was indicated by the discovery of rich float, closed down the mine in 1908.

From the intersection of the adit-tunnel and the vein on the 1,000-foot level drifting has been done along the vein for nearly 1,000 feet. The vein exposed in this drift is 9 feet wide

Old Gold Mine, Pack-train, Nelson M.D.

Spokane Mine, Pack-train at Camp, Nelson M.D.

and is composed of a massive bluish quartz. As the easterly face is approached the vein gradually gets smaller, splits, and pinches out. The ore at the *Ymir* consisted essentially of an auriferous galena associated with iron pyrites and zinc-blende.

Pat. This claim is located on the North fork of Wildhorse creek. The prospecting-work done here consists of 140 feet of tunnelling and a few shallow open-cuts. There is no evidence of the existence of a vein on this property, either in the tunnel or on the surface. Across the creek and almost opposite the tunnel on the *Pat* a tunnel has been driven for a distance of 72 feet in a crushed and slickensided slate; with the exception of a little quartz near the portal, no vein-matter was encountered. A sample taken of this quartz gave: Gold, 0.14 oz.; silver, 0.2 oz. The hillside above the *Pat* is covered with thick underbrush, which made it somewhat difficult to find the old workings of the *Carthage*, which are located higher up the hill.

Carthage. The lower tunnel is at an elevation of 900 feet above the *Ymir* mill. The length of the tunnel is 150 feet and is timbered within 30 feet of the face. The last 30 feet is in waste. The upper tunnel is 1,350 feet above the *Ymir* mill and is said to be 250 feet long. Unfortunately it has caved, and I was unable to examine it.

The following is an extract from C. W. Drysdale's report, referring to the geology at the *Carthage:* "The country-rock is Pend d'Oreille schist, much of it andalusite schist due to the contact metamorphism caused by the near-by Nelson batholith. Spotted porphyry dykes are also found intrusive in the schists. The veins, many of which are parallel and strike with the schists, contain slightly mineralized blue quartz. They penetrate the crumpled schist and end in sharp tongue-like terminations."

A sample taken across a small exposure of the ledge immediately above the portal of the tunnel gave no values. Going down and around the hillside in the direction of the *Wildhorse* claim, a small open-cut was noticed. This was driven for about 8 feet and exposed 18 inches of quartz on the foot-wall and about 2 feet on the hanging, separated by about 6 feet of crushed slate. The vein consisted of bluish quartz carrying iron pyrites. A sample taken here gave 0.04 oz. gold.

The *Wildhorse* claim is located in the zone of contact of the Nelson batholith and the Pend d'Oreille formation. The zone is characterized by tongues of granite cutting the sedimentaries, which are greatly metamorphosed near the contact. Some of the most important mineral discoveries in this and the Sheep Creek district have been made along the line of this contact. From the vicinity of these claims the zone of contact can be traced in a south-westerly direction to the *Yankee Girl* and *Dundee* groups. In these deposits the ore occurs in the granite at its intersection with the fissure-vein.

The workings on the *Wildhorse*, which consist of a few small open-cuts and a short tunnel, expose a quartz similar to that found in this locality—namely, bluish in colour, carrying a little iron pyrite and zinc-blende; no galena was noticed. At the entrance to the tunnel there is a strong blow-out of quartz carrying iron pyrite and zinc-blende; a sample was taken across a 6-foot width of vein here which gave 0.02 oz. gold. Another sample was taken of the quartz at one of the open-cuts which gave 0.06 oz. gold.

Ovid Poulin, who showed me over the properties, is very familiar with the district, but did not know of any workings on the *X-ray* claim. Upon going over the claim we found it densely covered with underbrush, and the only sign of a trail was that leading to the cabin from the *Wildhorse* claim, and from the cabin to the creek. The only cabin left standing on any of these claims is that on the *X-ray*, which is in fairly good condition.

Summary.

The *Ymir* vein is exposed along a uniform dip and strike for over 1,000 feet by underground workings. The ore was found in one large lenticular shoot, the rest of the vein being very low in values. The richest ore occurred near the surface. Should the vein have been faulted, the throw was probably to the east; hence it would be reasonable to look for an extension in an easterly direction across the creek.

Indications on the *Wildhorse* claim are more encouraging than those on the *Pat* or the *Carthage*, and the formation here is more favourable for the finding of mineral, but as to whether another shoot such as that found in the *Ymir* exists in this direction is highly problematical,

for, even if an extension of the *Ymir* vein is discovered, it does not follow that it will be highly mineralized. The assay returns of the few samples taken are not encouraging.

SHEEP CREEK CAMP.

Emerald. This property has been a steady producer during 1917 and has shipped more ore than any other mine in the district. Development-work during the year has opened up a large body of ore on the lower level. With the result that there is sufficient ore in sight to ensure steady shipments being made for some time to come, providing market conditions are favourable. The mine-run averages about: Lead, 27 per cent.; zinc, 5 to 6 per cent.; silver, 1½ oz.

Other development-work includes the building of one mile and a half of road from the *Emerald* camp to the *Jersey Lily* group, on which recent development-work has been done. About forty-five men were steadily employed during the season. Shipments to Trail total for the year. 4,448 tons.

Southern Bell Group.—C. E. Wilson, of Salmo, has done a considerable amount of work on this property and is reported to have a good showing. The ore is argentiferous galena.

Relief. This mine is situated at Erie. A. D. Westby, the manager, reports that mining and development work have been carried on during the year. The cyanide plant has been closed during 1917 owing to the inability of being able to secure cyanide, zinc shavings, and other chemicals. New equipment, including a concentrating and sliming table, an amalgamator, and a 45-horse-power gas-engine, has been recently purchased, with the idea of saving the free gold and shipping the concentrates until such time as they can again operate their cyanide plant.

H.B. During the year 1,500 tons of zinc ore was shipped, having an average value of 32.7 per cent. zinc. The ore occurs principally as a zinc carbonate. The mine was temporarily closed down during the latter part of the year.

Aspen. This property was examined with a view to ascertaining the justification of Government assistance for the widening of the present trail. The property is situated near the headwaters of Deer creek, in the Nelson Mining Division, and at an elevation of 5,200 feet. It consists of eight claims and is owned by P. F. Horton, of Salmo; E. W. Rawson, of Vancouver; and Mrs. W. H. Billings, of Salmo.

Shoots of ore occur in a vein in the Pend d'Oreille limestones. The strike of the vein is S. 20° E., with an apparent dip of 50 degrees to the east. The vein shows continuity and the walls are well defined. The ore occurrence is found to exist in the limestones near the contact of the granitic batholith. The formation is somewhat similar to that at the *Emerald* mine.

From discoveries that have been made there appears to be a mineralized zone extending in a south-westerly direction from near the *Aspen* group to the International Boundary. This zone is characterized by the occurrence of the Pend d'Oreille limestones along or near a granite contact, and in my opinion is likely to prove one of the most economically important mineral-bearing zones in this district.

Recent development-work has been confined to open-cuts. A shoot of ore having an apparent length of 60 feet has been crosscut by open-cuts. Owing to the short time I had at my disposal for the examination of this property, I will not attempt to write a detailed description of the workings or of the character of the ore-bodies, upon which not enough work has been done to enable one to form any accurate idea of the exact nature of the deposit or of the definite boundaries of the ore without spending some time on the property. There is, however, a considerable tonnage of ore available for shipment which can be extracted at small mining cost, but will have to be hand-sorted. The ore is said to average about as follows: Gold, 0.04 oz.; silver, 26.4 oz.; zinc, 5 per cent. A sample taken across 6 feet assayed: Gold, 0.04 oz.; silver, 19.5 oz.; zinc, 10.5 per cent. Another from a small pile of sorted ore gave: Gold, 0.68 oz.; silver, 123.4 oz.; zinc, 6 per cent. The gangue is high in silica and lime and therefore suitable for fluxing. It is claimed that the zinc can be eliminated by careful sorting, and trouble from this source is not anticipated.

Ore Hill. The *Ore Hill* mine is situated on Coon creek at an elevation of 5,200 feet, or 2,100 feet above Sheep creek. There are five claims in the group—*Ore Hill, Ore Hill No. 3, Dixie, Standard,* and *Last Dollar Fraction.* The property is

principally owned by Dr. Ittel, of Minneapolis, and is leased by C. H. Cassell, of Oranda, Wash.; Mr. Dewitt is managing the property.

A nice showing of ore is exposed in two open-cuts along the strike of the vein. At the No. 1 open-cut I was unable to examine the face at close quarters on account of danger from caving, but noticed good ore along the wall and in the bottom of the cut. At the No. 2 open-cut, which is some 50 feet below the No. 1, there was a width of 4 feet of ore in the face, and it also showed in the walls. A sample taken here from a dump of ore selected for shipment assayed: Gold, 0.20 oz.; silver, 8 oz.; lead, 22 per cent.; zinc, 27 per cent. Not sufficient work has been done at the surface working to enable one to determine the definite boundaries or character of this deposit.

Proceeding down the hill the vein is well defined in another open-cut along a length of 40 feet. The width of the pay-streak here is 20 inches. The lowest assay taken at this place was said to run $73, the values being in gold, silver, and lead. A sample taken from a dump of selected ore for shipment gave: Gold, 0.06 oz.; silver, 10.2 oz.; lead, 37 per cent.; zinc, 12.7 per cent. Below this outcrop a crosscut has been driven, which cuts the vein along which some drifting has been done. The ore occurs in a vein in crystalline limestone. The vein shows continuity and has a strike of N. 25° E. and a dip of 65 degrees to the west, which, however, does not appear to be uniform. The ore consists of galena, iron pyrites, and sphalerite. There are between 100 and 125 tons of milling and shipping ore on the dumps. Six men are employed on the property.

A small 7-ton mill has been installed. This plant consists of a small crusher, a 2-battery stamp-mill, a No. 6 Wilfley table, and a Johnstone Frue vanner. When water is sufficiently plentiful the plant will be operated by Pelton wheels, and in a dry season by a gasolene-engine. At this date (October 10th) they are short of water and are waiting the delivery of their power plant. Six men are employed.

HALL'S SIDING.

SW-27.) **Lost Cabin Group.** This property is under lease and bond to Frank Stoner, of Chokeville, Wyoming. Mining operations have been carried on under the direction of F. H. Shoemaker. Two men have been steadily employed and work will be carried on all winter. Average assays across a 20-foot width of vein on the surface are said to show a value of $50, the principal values being in gold and silver.

SW-27 **Monarch Group.** This group, consisting of seven claims, belongs to J. Fisher and S. E. Coulter, of Rossland. The claims are situated at an elevation of 5,000 feet, near the head of Keno creek, and are accessible by trail from Hall's Siding, a distance of three miles. Recent work has been confined to driving a tunnel and open-cut work near the cabin.

The lowest open-cut reveals the country-rock to be slightly mineralized in patches, with chalcopyrite associated with pyrrhotite, the latter predominating. At a short distance up the hillside another open-cut exhibits similar conditions. A tunnel has been driven for a distance of 79 feet in a hard diorite porphyrite, the idea being to get under the showing at the upper open-cut. The tunnel has been driven too much to the south, and it will be necessary to run a short crosscut from the end of it to reach the objective point.

An old 40-foot shaft sunk years ago on the *Monarch* claim has recently been retimbered. This shaft was sunk on the flat top of the mountain ridge, at about 1,600 feet from and 600 feet above the other workings. The bottom of the shaft is in a very hard igneous rock resembling an altered diabase, in which pyrrhotite and chalcopyrite are disseminated, but apparently not in a sufficient amount to be of economic importance.

A sample taken along the bottom of an open-cut near the shaft gave the following values: Gold, trace; silver, 1.6 oz.; copper, 0.6 per cent. The formation is of volcanic origin and belongs to the Rossland series. The mineralization occurs near the contact of an augite porphyrite and a fine-grain diabase rock.

OTHER PROPERTIES.

Orinoco. M. Egan and partner made a shipment of 66 tons to the Greenwood smelter. The assay values ran as follows: Silver, 0.73 oz.; copper, 2.5 per cent.

California. Development-work, which is being carried on under the direction of W. H. Turner, consists of running a 1,000-foot drift to get under the ore-bodies exposed on the Nos. 1 and 2 levels. The depth gained will be 200 feet. The principal values are in gold, which is associated with lead and zinc.

Eureka. Recent work has been confined to improving the transportation facilities by building a short tramway to connect the mine with a new road to the upper terminal of the *Granite-Poorman* tramway, and extending this tramway across the Kootenay river to connect with the Canadian Pacific Railway. Shipments made to Trail last spring total 1,240 tons.

Granite-Poorman. This property was operating during the summer, but closed down in the fall. The principal values are in gold. The ore was treated by a 20-stamp mill; 84 tons of concentrates was shipped to Trail.

Monarch. This group, consisting of seven claims, is situated at an elevation of 3,800 feet and at a distance of about one mile and a half north of Beasley Station, on the Canadian Pacific Railway; it is being operated by the Spokane Mining and Development Corporation, of Nelson. Previous work done on the property consisted of a 30-foot shaft and a few open-cuts. Prospecting has been confined to a band of buff-coloured garnetite, which occurs near the contact of the granite and sedimentary rocks. The ore occurs as chalcopyrite, associated with pyrrhotite and iron pyrites, impregnating the garnetite in irregular patches, also in small fault fissure-veins in a quartz gangue stained with epidote. The formation bears evidence of contact metamorphism, and general conditions would appear to fully justify more development being done by means of open-cuts and surface trenching in the vicinity of the line of contact, which lies at a short distance to the west of the present workings.

A sample taken from a small dump of ore extracted from near the old shaft ran as follows: Gold, trace; silver, 0.4 oz.; copper, 1.6 per cent. This dump was a miscellaneous mixture of waste and ore, and much better returns could be obtained by sorting. Since visiting the property on October 22nd development-work has been continued, and two or three car-loads of ore have been shipped to Trail.

Silver King. The Consolidated Mining and Smelting Company, which owns this group, has recently placed a diamond-drill on the ground after having done preparatory development-work during the summer.

Molly Gibson. This property was operated during the summer by the Consolidated Mining and Smelting Company. Shipments to Trail, 367 tons ore.

TRAIL CREEK MINING DIVISION.

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. At the town of Trail are situated also the extensive smelting and refining plants of the Consolidated Mining and Smelting Company of Canada. This company is the most important mining company in the southern interior of British Columbia, and the smelting plant also draws custom ore from a large district.

CONSOLIDATED COMPANY.

The following extracts from the report of J. J. Warren, managing director, which appears in the annual report of the company for the fiscal year ended September 30th, 1917, will throw some light on the company's financial affairs, and reveal the magnitude of the company's operations:—

"*Capitalization.*—The authorized capital of the company is $15,000,000, in 600,000 shares of $25 each par value. Of this amount, 419,098 shares have been issued, with a total par value of $10,477,450.

"*Earnings.*—The company earned during the fiscal year ending September 30th, 1917, a net profit of $1,076,828. This includes $150,000 from the West Kootenay Light and Power Company. The earnings in 1916 were $996,496. The percentage of earnings was about the same in each year, which is accounted for by the increase of capitalization in 1917.

"*Value of Plants.*—The value of the mining, smelting, and mining plants was increased by $794,825, which after writing off $648,058 for depreciation represents an investment of $4,867,505.

"*Value of Mines.*—The value of the company's investment in mines, mineral claims, and shares in other companies shows an increase of $338,558, and now represents a total investment of $7,303,443.

"*Total Assets.*—The total assets for 1917 are placed at $16,994,568, which is an increase of $1,980,340 over the preceding year.

"*Ores and Metal on hand.*—Pig lead on hand was worth $29,242, while ore and metals on hand or in transit to the smelter on September 30th represented a value of $2,586,421.

"*Total receipts* were $15,533,076, as compared with $10,032,878 for 1916.

"*Ore and Metal purchased.*—Customs ore, lead, and bullion purchased during the year had a value of $5,899,082.

"*Sales.*—Sales of smelter product, ore, etc., amounted to $12,700,971. Freight paid on the ore from the company's mines during the year was $286,972. Expenditures on the mines amounted to $4,530,599, exclusive of development expenses, which were $380,071. The expenditures on the various properties were as follows: *Sullivan*, $429,204; *Molly Gibson*, $22,562; *Richmond-Eureka*, $777; *Maestro*, $6,537; *Highland*, $72,315; *No. 1*, $813; *St. Eugene*, $33,237; *Le Roi*, $186,361; *Centre Star*, $209,898; *No. 7*, $1,552; *Lucky Thought*, $14,992; *Emma*, $75,324; *Ottawa*, $14,150; *White Bear*, $4,961."

ROSSLAND CAMP.

According to the report of W. M. Archibald, mine manager of the Consolidated Mining and Smelting Company, since 1894 to date the *Centre Star-War Eagle* has produced 2,611,143 tons; *Le Roi*, 2,007,626 tons. Underground development at the *Centre Star-War Eagle* has reached 40.10 miles; *Le Roi*, 17.10 miles.

No material change in Rossland ore reserves occurred during the year, but promising new territory was opened up with good possibilities.

Owing to coke shortage the shipments of gold-copper ores from Rossland mines were irregular and curtailed, amounting to only about one-fourth of the normal output.

It may be of interest to point out that during the previous four years the average annual gold production of the camp is nearly 60 per cent. of that of the whole Province.

The following table gives a comparison of shipments made during the last two years:—

	1916. Tons.	1917. Tons.
Centre Star	163,000	36,890
Le Roi group	130,000	49,827
Josie group	15,800	11,803
Velvet	124	...
White Bear	...	1,506
I.X.L.	...	8
Mountain Chief	...	137
Totals	308,924	100,171

The Mountain Chief Group.—This property is situated at Renata. A considerable amount of prospecting has been done, disclosing irregular ore-bodies in a limestone formation. The average value of the ore is $14 a ton, the values being in copper and silver.

THE TRAIL SMELTER.

The Consolidated Mining and Smelting Company of Canada, Limited, Trail, British Columbia, is now producing on a commercial scale five refined metals—namely, gold, silver, copper, zinc, and lead—as well as bluestone, sulphuric acid, and hydrofluosilicic acid at the Trail plant.

During the last year the zinc plant has been completed, and has a capacity of from 60 to 70 tons a day of spelter, working on high-grade zinc ores. The ores treated, however, are, in the main, very low in zinc, so that the capacity of the plant is thereby reduced, the best tonnage to date being 62 tons a day.

The zinc plant contains: Two driers; three 18- x 5-foot ball-mills; thirteen 7-deck, 25-foot Wedge roasters; a large leaching building where the ores are leached by counter-current continuous process in Pachuca tanks and thickened in Dorr thickeners, purified in Pachuca tanks, and filtered through Kelly & Oliver filters; electrolyzing-tank rooms where the solutions

are electrolyzed in concrete electrolytic tanks; thirteen 1,000-kw. motor-generator sets; the necessary transformer plant to reduce the 60,000-volt current with which the plant is supplied; and a melting plant with two reverberatory furnaces for melting the cathode zinc.

The copper plant is, primarily, a gold-copper plant for the treatment of Rossland ores. The copper tonnage is small.

The copper-smelter consists of the necessary ore-bins; two 35-foot and two 25-foot furnaces; two 12-foot Great Falls type converters.

The refinery was originally built to refine 10 tons of copper a day. It was found necessary during the year to double this capacity.

Owing mainly to increased production of customs lead ore, it has been found necessary to increase the roasting capacity in the lead-smelter. This equipment now consists of three 7-hearth, 25-foot Wedge roasters; five single-hearth Godfrey roasters; thirty-two Huntington-Heberlein converters; and three Dwight & Lloyd sintering-machines.

The lead-smelter consists of the necessary ore and roast bins, four blast-furnaces, drossing-kettles, and an anode casting-machine.

The lead-refinery, which is an electrolytic Betts process plant, has a capacity of approximately 100 tons pig lead a day.

During the year a concentrator with daily capacity of 400 tons has been built. This mill is equipped with a 6- x 6-foot ball-mill; a standard 24-inch, 17-cell Minerals Separation machine; concentrating-tables, filters, thickeners, etc. This mill has been working on the concentration of the low-grade zinc-lead ores from the *Sullivan* mine.

Since the company took over the plant in 1894, 5,179,307 tons of all classes of ores have been treated, with a gross value of $94,315,754 and yielding 1,778,921 oz. gold, 27,500,350 oz. silver, 458,326,524 lb. lead, 75,047,410 lb. copper, and 23,056,996 lb. zinc.

During the fiscal year 10,000 tons zinc was produced, representing a value of $3,000,000, marking an epoch in the metallurgical history of Canada; while the production of lead amounted to 22,000 tons, exceeding that of last year by 2,000 tons.

The year's output of sulphuric acid reached 2,878.7 tons of 100-per-cent. product. The capacity has been doubled and a daily output of 30 tons established.

Hydrofluosilicic acid was produced to the extent of 196 tons, and installation of new retorts designed to double capacity is being made.

ARROW LAKE MINING DIVISION.

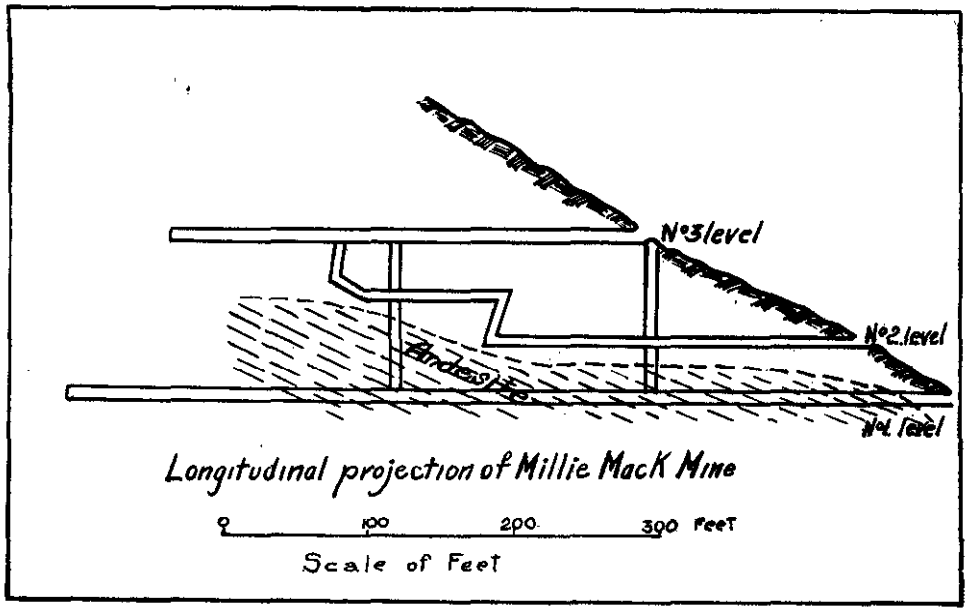
Millie Mack.

The property consists of six claims—*Millie Mack*, *Impregnable*, *Triumph*, *Wolf*, *Gold Ring*, and *Rainbow Quartz*. The mine is situated at an elevation of 6,300 feet and at a distance of twelve miles from Burton City, in the Arrow Lake Mining Division. H. E. Forster, of Wilmer, is the sole owner of the property. The camp consists of two good cabins with sufficient accommodation for eight men. Work was first commenced on this property in 1897, and since 1904 the property has been worked continually. A considerable amount of money has been spent on development-work and on improving the transportation facilities.

The Character of the Deposit.—Fragments of a quartz vein occur irregularly in a sheared and crushed zone of graphitic slates. This zone, lying nearly horizontal on an igneous rock classified as an andesite, is between 60 and 100 feet thick, and apparently marks the line of contact between the igneous and sedimentary rocks. Syenite porphyry dykes cut the formation at various angles. The steep slope of the mountain-side, together with the sheared and crushed nature of the formation in which fragments of the vein occur, would indicate that there has been a break near the surface, accompanied by a sliding movement downwards on the base of andesite, and that the vein may possibly be found to be in-place farther in and at a greater depth under the mountain.

The ore is a complex mixture of galena, zinc-blende, and iron sulphides carrying gold and silver values. The average values of previous shipments ran: Silver, 110 oz.; gold, 1.55 oz.; lead, 11.7 per cent.; zinc, 8 per cent.

No. 1 tunnel has been driven for a distance of about 700 feet in the andesite which forms the foot-wall of the crushed zone. No ore was encountered in this tunnel, but it may be of use at some future time either as a shipping-tunnel or for further development.



No. 2 tunnel has been driven for a distance of 265 feet and is 40 feet above No. 1. In this tunnel ore was encountered in the graphitic slates.

No. 3 tunnel is 70 feet above No. 2 and discloses the same formation. The length of this tunnel is 320 feet.

Sample No. 11651 was taken from a pile of 8 tons of sorted ore for shipment, and sample No. 11652 from a 4-ton pile, which contained more iron than the usual run of the mine; the assay results were:—

Sample No.	Gold.	Silver.	Lead.	Zinc.
	Oz.	Oz.	Per Cent.	Per Cent.
11651	1.74	54.3	11.2	14.5
11652	2.20	50.4	24.0	8.0

Two men are employed at the mine, and rawhiding will be carried on this winter.

Of the other claims in this vicinity, a little work was done during the year on the *Tillicum* claim and on the *Mountain Meadow*, from which latter property a small trial shipment was made to Trail.

NORTH-EAST KOOTENAY DISTRICT.

GOLDEN AND WINDERMERE MINING DIVISIONS.

REPORT BY JOHN BULMAN, GOLD COMMISSIONER.

I have the honour to submit herewith the annual report of the North-east Kootenay District, embracing the Windermere and Golden Mining Divisions.

Mining throughout the district has shown considerable activity during the year 1917, which may be attributed to the general revival in mining throughout the Province, caused by the increase in the price of metals.

I enclose report from the Mining Recorder at Wilmer, which covers nearly all the principal mines in the Windermere Mining Division. The following is my report on the *Monarch* and the *Giant* mines, which are situated in the Golden Mining Division:—

GOLDEN MINING DIVISION.

Monarch. *Situated on Mount Stephen, Field. This mine has been lying idle during* the past year.

SPILLIMACHEEN DISTRICT.

Giant. Situated on the Spillimacheen river. There is quite a large body of low-grade ore, but owing to the absence of Captain Armstrong, one of the owners, being away serving his country on the Tigris river, there has been no development since the war broke out.

Tarheel Co. The Tarheel Copper Company, Limited, is the first mining organization to begin development in the old Bobby Burns-International Basin country since the earlier boom days. During the past summer the company established two camps—one at old Spruce Tree camp, now known as Dixie, and one in the Rainbow basin, located one mile and a half north-west of Dixie.

Work began late in the fall and some 200 feet of development-work has been completed. These workings were driven to determine the strength of two large veins and to prepare for ore-extraction. During the winter a 100-foot tunnel has been driven on the *Rainbow* claim that gives a depth of 145 feet, and as soon as this working is completed stoping of ore will begin.

This property has produced some exceptionally rich ore at surface, and will begin shipping from a 2½-foot shoot of chalcopyrite ore as soon as transportation facilities are completed. This is embraced in a contemplated road extending from the mine to Parson Station, on the Kootenay Central Railroad.

This region abounds in rich surface shoots of copper and gold ores, lying on the north side of the Middle fork of the Spillimacheen, extending along a lime-belt south-westward to Copper creek, and thence onward to Vermont creek and other tributaries to the South fork. To the westward from Dixie the ores are galena and silver, the surface croppings showing exceptionally high grade.

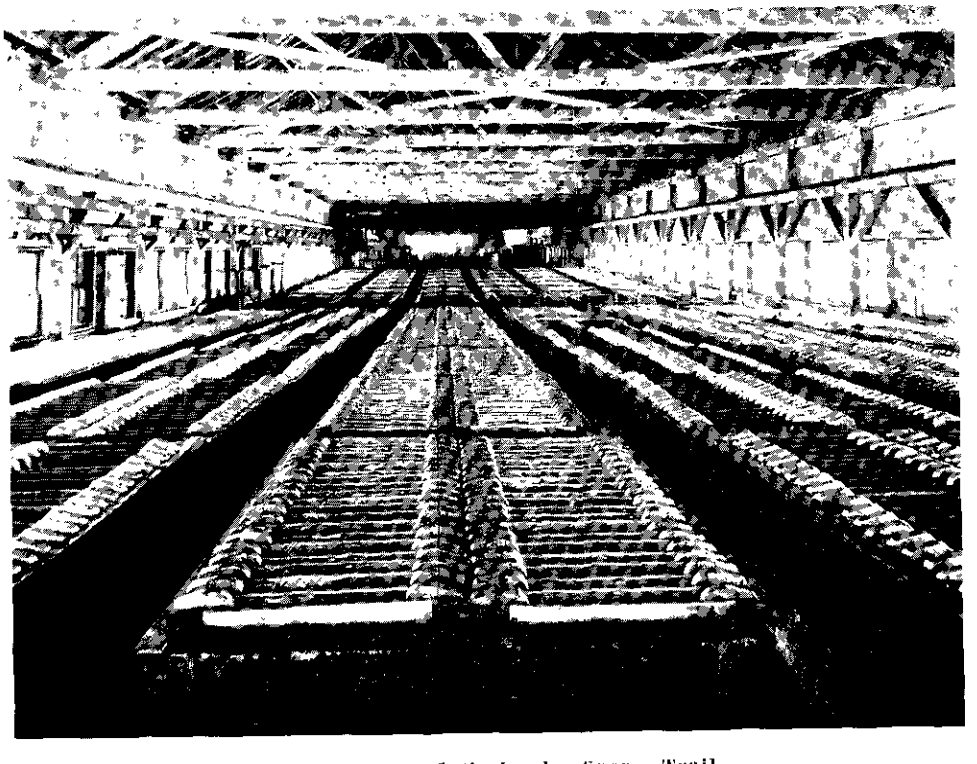
The Tarheel is the first to begin systematic exploration, and upon its success will depend the future of this district. In years gone by a number of shallow workings were run on the veins, which served only to show their continuity laterally, but sufficient depth was not obtained to determine the size of the ore-bodies. This the Tarheel, which is a close corporation, is now endeavouring to do.

Other claim-owners are planning development during the coming summer, and the outlook is for a general revival in the district.

The question of transportation has been a wagon-road twenty-two miles along the Middle fork to Parson Station, and this will be solved by the Tarheel Company during the summer of 1918.

Ore-extraction up to March 1st consisted of some 50 tons of surface ores, and this will be shipped to smelter. Trial shipments from these veins, with 17 per cent. copper, gave returns of $59 a ton.

Interior, Electrolytic Zinc-refinery, Trail.



Interior, Electrolytic Lead-refinery, Trail.

This region has been prospected only in a desultory manner, and further work gives promise of success.

OFFICE STATISTICS—GOLDEN MINING DIVISION.

Revenue.

Free miners' certificates (special) (2)	$ 30 00
Free miners' certificates (ordinary) (130)	580 00
Free miners' certificates (company) (1)	100 00
Mineral claims recorded (79)	197 50
Assessments recorded (25)	62 50
Bills of sale, agreements, etc. (9)	24 00
Notices to group (3)	75
Copies of records (2)	2 00
Mining leases (6)	150 00
Ore-tax	1,605 33
Acreage-tax	318 75
Total	$3,070 83

WINDERMERE MINING DIVISION.

REPORT BY E. M. SANDILANDS, MINING RECORDER.

I have the honour to submit my mining report for the year 1917 on operations in the Windermere Mining Division.

During the year 1917 mining has not been as active as was expected owing to the Trail smelter not being able to handle the ore. This possibility has been the cause of several small properties not being worked which would otherwise have been.

I am glad to say that the office returns have exceeded those of 1916, despite the fact that the valley is more or less depleted of people and money is scarce. The sale of free miners' certificates, number of claims recorded, and certificates of work issued show an increase over the year 1916. As most of the properties, especially the small ones, are at an altitude of from 6,000 to 9,000 feet, the cost of getting down the ores over trails works very much against their operation.

Paradise. During 1917 over 2,000 tons of ore was shipped to the Trail smelter, the nature of the ore being a sand carbonate with an approximate content of 30 oz. in silver to the ton and 30 per cent. lead. During the year considerable improvements have been made at the mine. The tramway has been overhauled and new bunk-houses, bath-rooms, and dry-rooms have been built, and everything done to assist in the comfort and cleanliness of the men. During the summer months a caterpillar tractor was placed on the road, and this was able to haul from 15 to 20 tons a trip to the railway. Also during the summer the new "Cut-off" road has been finished and a bridge made across Toby creek at about the 7-Mile. This new road lessens the distance from the mine to the railway by some four miles. The ore is now hauled straight to Invermere, where new ore-pockets have been built. It is reported that R. R. Bruce has purchased the Hammond Estate's interest in this valuable property. Mr. Bruce is the manager and Robt. McDonald superintendent at the mine. During the year an average of thirty men was employed at the mine and from six to eight 4-horse teams employed. The offices of the company are at Invermere.

Lead Queen. This property is situated on Frances creek and is some twenty miles distant from the railway at Brisco, where the ore is shipped. The owners, Brown & McLeod, have worked the property almost continuously during the past year, averaging about four men a month. During the year about 126 tons of ore was shipped to the Trail smelter, going about 40 oz. silver and 40 per cent. lead. The property is still working and it is expected shipments will be made this winter.

Mabel R. This property is owned by R. R. Bruce & McDonald and has been under lease to Frank Anderson, who has packed down about 15 tons of ore which has been shipped to the Trail smelter. The property is situated on Law creek, a branch of Boulder creek. The distance of packing down the ore to the road at 10-Mile has been very much against it.

Relief. This property is owned by M. Craik and is situated on Boulder Mountain at an elevation of some 9,000 feet. It has been under lease to W. Chamberlain and others, who have shipped about 20 tons of good grade ore which will net the leasers about $100 a ton. It being at so high an altitude, the season for working it is naturally very short.

Isaac. H. E. Forster, the owner of this property, has shipped during 1917 some 125 tons of argentiferous galena and has about two cars more to come down this winter. The ore is fairly good grade, but the distance from the railway is rather against it. This property uses the same road as the *Lead Queen* on which to haul the ore.

Sitting Bull. During the summer this property has been operated by some Seattle people under the management of E. D. Smith, who has done considerable development-work, working an average of six men for about five months. The ore is a fine-grained steel galena and is fairly high grade. The work done so far has been encouraging. A temporary tramway has been installed and a preliminary survey for a wagon-road made. Unfortunately, last December snowslides came down and covered up the buildings, etc., so that work has ceased for the time being. It is expected that work will be resumed when conditions warrant.

Blue Grouse and Bald Eagle. These properties are owned by Mr. Burman and others and are located across the summit from the *Paradise* mine, on Boulder creek. Mr. Burman and partners have built a cabin on the claims and have done considerable dead-work. They are driving a crosscut tunnel to strike the lead, and it was recently reported that they had struck the lead.

Hidden Treasure. Fourteen tons of ore has been shipped from this property, which is situated on the Spillimacheen river, about seven miles from the railway. T. Barry and partners are the owners. The main value of the ore is in copper, with a trace of gold.

C. D. Ellis and associates have done considerable prospecting-work on their claims in the *Paradise* basin during the summer, and, I hear, with very favourable results.

OFFICE STATISTICS—WINDERMERE MINING DIVISION.

Free miners' certificates sold	78
Claims recorded (quartz)	59
Claims recorded (placer)	2
Certificates of work issued	60
Certificates of improvements	4
Bills of sale, agreements, etc.	9

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 1917.

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
1916	353	133	56
1917	367	120	105

In submitting to you my report of mining conditions for the year 1917, it must be admitted that the year was not so progressive as anticipated; this was partly due to lack of transportation in the St. Mary's district and in the want of interest taken in free-milling gold properties on account of the greater demand for lead, copper, etc. However, certain encouraging facts may be noted, the chief being the entry of the Federal Mining and Smelting Company into the district for exploration purposes; the practical success of the *Victor* mine, at Fort Steele; the encouraging report on Alki Creek properties; and the further prospecting of the *St. Eugene* property, at Moyie. Against these favourable indications is the negative results obtained by the development on the *Burton* mine, at Elko.

On the whole, progress has been fairly substantial and interest exhibited in many properties, nearly twice as many claims being recorded as in 1916; the closing-down of the *Sullivan* mine, due to the strike at the Trail smelter, has come to an end, and by now a full force of men are at work. The Consolidated Mining Company has also done considerable prospecting and developing in the lower workings of the *St. Eugene*, at Moyie, an expenditure of over $30,000 being involved, the results of which have not been given publicity. The upper workings are still under lease and about 1,200 tons was shipped by the lessees. It was a stroke of bad fortune that the experimental concentrating plant, erected for the purpose of determining the best method of handling the *Sullivan* ore, and just on the point of completion, was utterly destroyed by fire.

The *North Star* hill is again coming into prominence by reason of the Federal Mining and Smelting Company obtaining control over a large portion of it, and systematic prospecting by diamond-drills has been going on for the past few months. The results will be awaited with interest, as a discovery of ore at depth, combined with the known bodies on the *Stemwinder* group, will give that company an additional incentive to operate in the district on an extensive scale.

The management of the *Victor* mine, at Fort Steele, are so pleased with the results of the development that a small compressor was installed to expedite the work and to ensure, by spring, a sufficient quantity of ore blocked out to warrant steady shipments; two ore-shoots are exposed, the shipping-ore running about 40 per cent. lead, 20 oz. silver, and zinc from 8 to 10 per cent. A wagon-road of over six miles was constructed to the main road to Fort Steele, the nearest point of railway connection, and it is the intention to ship as soon as possible, in a small way, the development to keep pace with the extraction.

The Spokane Syndicate, to which the *Park* group is bonded, has made a further payment and work is being carried on; this is entirely a shaft proposition and will demonstrate the possibilities of the ore-bearing ledges, of which there are many along the west side of St. Mary's prairie.

The St. Mary's district did not come in for much examination this year (although it is apparently chiefly a copper district), with the exception of Alki creek, the properties on which were examined and an offer to bond made; the want of transportation in this district is a serious obstacle to investors.

It seems a great pity that the discovery of bismuth and molybdenum at the forks of St. Mary has not been further investigated; the ores are reported as being in commercial quantities, but evidently the demand is not very great, or the transportation difficulty is the obstacle. Joseph Ryan, one of the owners, reports that after much correspondence no market for this ore has been found; it is evidently a specialty that the ordinary mining investor leaves alone, as very few custom smelters can do anything with it.

The discovery of a large iron-pyrite-covered ledge on Skookumchuck, within half a mile of the Kootenay Central Railway, is interesting, as native copper was found in the druses and crevices; the width of the ledge is stated to be 20 feet, and the owners refused a bond on the property, preferring to do a winter's work before deciding to sell.

Farther up the Skookumchuck is an ore described as carrying 5 per cent. nickel and over 11 per cent. cobalt, with 54 per cent. arsenic; the gold content was given as 10.75 oz. a ton, the analysis being made by the Department of Mines, Ottawa. This property is lying idle at present.

Free-milling gold quartz has not been in demand, and Perry, Weaver, and Nigger creeks—in fact, the whole district—received no attention at all.

The *Sullivan* mine, in spite of the shut-down, created a record for itself in ore shipment by sending 110,000 tons to the smelter; latterly this has been much reduced, zinc ore being shipped chiefly, to allow the smelter to accept lead ores from other properties.

The *Quantrell* shipped several cars of ore, and it is now, I understand, under bond to the Federal Mining and Smelting Company, which has taken control of the *Stemwinder*, *North Star*, and *Mount Sicker* groups, on the *North Star* hill, besides several other individual properties. These properties cover a large area, and it is to be hoped that the results will warrant this company getting down to systematic development on a large scale.

OFFICE STATISTICS—FORT STEELE MINING DIVISION.

Mineral claims recorded ("B")	105
Certificates of work ("E")	120
Certificates of improvement issued ("G")	14
Conveyances and other documents of title (bills of sale)	27
Abandonments	2
Partnership agreements	1
Gold Commissioner's permits	4
Documents filed	7
Affidavits filed	170
Mining leases issued	7
Free miners' certificates (ordinary)	216
Free miners' certificates (company)	3
Free miners' certificates (special)	2
Crown grants issued	14

Revenue.

Free miners' certificates	$1,136 75
Mining receipts	1,199 25

NORTH-WEST KOOTENAY DISTRICT.

REVELSTOKE AND LARDEAU MINING DIVISIONS.

REPORT BY ARTHUR JOHNSTON, GOLD COMMISSIONER.

I have the honour to submit herewith a report on the mining conditions within the Revelstoke and Lardeau Mining Divisions for the year ending December 31st, 1917.

In former years, the fall and winter seasons, mining operations in these Divisions about cease. This winter, however, mining development is progressing somewhat extensively. In fact, never since the early days of mining in the Kootenays has there been such activity shown as during this season of 1917.

BIG BEND DISTRICT.

The Big Bend district, north of Revelstoke, has received a good deal more than passing attention from mining men and investors during this season, being somewhat of a contrast from former years.

An expenditure of $14,000 was authorized by the Hon. Wm. Sloan, Minister of Mines, to extend the wagon-road north from 11-Mile. Five miles and a half of new road was built and a good deal of repairs made on the old road between the Columbia canyon and the 11-Mile. This road is now built to within three miles of 19-Mile, at the mouth of LaForme creek. This three miles no doubt will be built this coming season, and the road-construction carried on until Downie creek is reached, a distance of twenty-five miles, or forty-five miles north of Revelstoke. The eventual completion of this road will bring within reasonable transportation facilities a splendid mineral district that will add to the Revelstoke Division a territory of immense possibilities. It is estimated by men who know that the completed road in use will reduce the cost of transporting supplies by 80 per cent.

The Granby Consolidated Mining Company extended its operations into the Big Bend district this year, having taken a bond on the *Montgomery* group of gold-copper claims on Downie creek. The company employed about a dozen men during the summer in development-work. It is the intention to return during the forthcoming season to continue a more vigorous development of this well-known property. The prospect of the early completion of the wagon-road to Downie creek has encouraged the opening-up of this mineral area, as it means the cheaper transportation of supplies and machinery.

On Carnes creek the McBean property has been developed steadily for many years by the owner, E. McBean, there being upwards of $20,000 worth of work completed, demonstrating the existence of a very extensive gold-copper bearing zone.

Keystone mountain, Standard basin, and the territory lying adjacent in former years attracted considerable attention owing to the knowledge of big ore-bodies being discovered. On the Standard Basin properties alone it has been estimated that all of $100,000 has been expended in the past. But the lack of transportation has occasioned a delay in bringing these fields into activity. During the forthcoming season, however, with the knowledge of the efforts the Department of Mines is making to furnish the transportation needed, the miners are looking forward with much encouragement for the immediate future.

The Mastodon Mining Company, Limited, whose properties are situated on LaForme creek, twenty miles north of Revelstoke, has carried on extensive operations for the past eighteen months. This company has expended to date in excess of $25,000. The company built a first-class pack-trail from the Columbia river to the property, six miles up LaForme creek, and has also completed commodious mine buildings, taking in sufficient supplies to provide for the dozen miners who are actively employed at development-work this winter. The work already completed in the way of shafts and tunnels has exposed extensive ore-bodies of silver-lead-zinc ores. The company has this winter brought out to 19-Mile about 15 tons of ore, which was extracted in the development operations. The company intends to make regular shipments next year after the road reaches the 19-Mile Station, and will install a compressor during the summer with which

to increase the efficiency of the operations at the mines. J. W. Evans, the manager of the company, is in the East arranging with the directors for the coming year's work, in which they are planning for a very active campaign of development.

Placer operations in the Big Bend have been less than usual, and no reports of the success of the few men engaged are to hand. Mr. Remmillard and his associates, who are operating at French creek, are wintering at the mine and will continue work during the coming year on their leases.

ALBERT CANYON-ILLECILLEWAET DISTRICT.

This district has received special attention from mining men this year, and is therefore a very active camp.

The *Lanark* mines, of which W. B. Dornberg, of Spokane, is the manager, in the past was the biggest shipper in the entire North Kootenay country, and it is estimated $800,000 worth of ore has reached the smelters during the early years of its existence in 1897-8-9. After a lapse of some fifteen years Mr. Dornberg acquired the property, and during the past two years he has shipped about 800 tons of ore, netting very handsome returns. The property has been equipped with the latest in mining machinery for economic working. An aerial tram from the mine to the Canadian Pacific Railway tracks has been in operation for the past two years. This tram has one of the largest spans in the West. A new concentrator was built last year and has been successful, and the concentrates from the mill have been shipped to the smelter at intervals. A small crew of men is engaged this winter in opening up new ore-bodies, and the coming year should see everything in full blast at the mine. The *Lanark* is considered a silver-lead mine.

The old *Donald* group of claims, situated on Cariboo creek to the eastward of the *Lanark*, owned by David Woolsey, of Victoria, for the past twenty-five years, and extensively developed by him, was sold last fall to a Spokane Mining Company, which has already arranged for active mining-work on this property during next season. This company proposes putting in an aerial tram system to handle the output.

On Silver creek D. Woolsey is developing a group of claims with a small crew of men this winter, and is reported to be meeting with success. In the spring the crew will be increased and the property put into shape to be a producer.

The Dunvegan Mining Company, Limited, of which R. A. Grimes is the resident manager, is developing the old *Dunvegan* group, situated at the headwaters of the Incomappleux river. This property is reached from the Canadian Pacific Railway main line at Albert Canyon by a new trail, ten miles long, built by the company in the spring of this year. Cabins and mine buildings were built and a 100-foot tunnel was driven on the big ore vein, as well as considerable other work accomplished, which demonstrated the surface extent of the big ore-bodies well known to exist on this property. About twenty years ago the original owners of the *Dunvegan* shipped two car-loads of the ore to Selby smelter, and the returns are reported as 80 oz. silver a ton and 68 per cent. lead. Mr. Grimes has planned for an active summer's work on the property this coming year. Supplies are already on the ground, having been delivered to the mine last fall by pack train.

Many locations were recorded from this district, and at least some of the newer prospects are expected to give a good accounting when more development-work can be done on them.

LARDEAU MINING DIVISION.

As the Mining Recorder, W. A. Strutt, of Beaton, is covering the Lardeau Division in his statement to the Department, it will be unnecessary for me to give an extended report as to conditions in this Division. I might, however, point out that, while actual mining conditions are not up to those of former years, there was at least really more interested demands for information coming in from outside points than in any previous year. The old properties, such as the *Eva, Oyster-Criterion, Beatrice, Mohawk, Eclipse, Del Rey, Silver Dollar, Scout* group, the *Big Showing, Glengarry, Berniere,* and *Nelson* groups, the *Goldfinch,* and many others, all of them with histories of big development in the early days of the Camborne camp, were either inspected by prospective buyers this season or were the topics of much correspondence by men in the South and East who were in touch with the mining situation here and were anxious to be advised of the movements in this camp.

REVELSTOKE MINING DIVISION.

REPORT OF JOHN LEE, 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, 1917.

The Gold Commissioner for the Division is forwarding his report for the year, and, as it covers the conditions appertaining to this district, I feel it will not be necessary for me to touch upon that feature of the situation; but I would like to point out that, while the returns from this office are not as large as last year, the reasons are obvious. Revelstoke is credited with being the third largest recruiting-point in the Province, but in reality it is the largest from the view-point of population, and we are credibly informed that no town or district of its population in Canada has a prouder record than we have in this respect. A very large percentage of our prospectors and miners were among those who enlisted. These men are protected by the Government regulations and are not obliged to carry their annual free miner's certificate, nor to record their assessments, etc., until after the war, which brings our returns less than would otherwise be the case.

OFFICE STATISTICS—REVELSTOKE MINING DIVISION.

Free miners' certificates	182
Claims recorded (mineral)	87
Certificates of work recorded	58
Permissions	2
Powers of attorney recorded	5
Agreements and transfers	27
Placer leases granted	11
Payments in lieu of work	4
Leases of Crown-granted mineral claims	3

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 1917.

Mining operations in this district show a decrease over the last year, and yet work progressed more steadily, but by a smaller force of men.

The *Goldfinch* property, which has been idle for a number of years, changed hands, and three men are working on contract there.

The Multiplex Mining Company during the past year has purchased the controlling interest in the *Excise* and *Duty* minerals claims, which join the *Spider* mineral claim. Approximately 600 feet of drifts, crosscuts, and raises have been driven and a considerable tonnage of good milling grade ore blocked out. New buildings have been erected both on the *Multiplex* and *Excise* groups, with the intention of driving a fourth tunnel to tap the ore-bodies already proven in the upper levels. Contractors are drifting on the vein on the No. 3 level. Ore has come in nearly across the entire face and continues to improve steadily. Drifting will continue during the winter.

On the *Spider* mineral claim a 40-foot shaft has been sunk from the No. 2 level in ore of good milling grade all the way, and an appreciable increase in values at depth attained. Owing to water troubles sinking was discontinued, but a No. 3 level was started to tap the ore-bodies encountered in No. 2 level at a depth of 100 feet below bottom of shaft. Two shipments of 6 tons each were shipped to smelter and concentrator; test results were satisfactory. The company owns eighteen claims and from five to ten men have been employed during the year.

The *Winnipeg* property, under lease by A. Evans, of Beaton, has proved very satisfactory. High-grade ore was encountered in the upper workings and some 26 tons of ore taken out; this ore is now in transit. It is the intention of the lessee to put on a force of men this coming season.

OFFICE STATISTICS—LARDEAU MINING DIVISION.

Free miners' certificates (ordinary)	52
Free miners' certificates (company)	1
Certificates of work	65
Payments in lieu of work	4
Locations recorded	32
Agreements and transfers recorded	20

SLOCAN DISTRICT.

AINSWORTH MINING DIVISION.

REPORT BY R. J. STENSON, GOLD COMMISSIONER.

I have the honour to submit herewith the annual report on mining developments in the Ainsworth Mining Division for the year ending December 31st, 1917.

With the high prices of metals, mining companies, individual operators, and lessees looked forward with confidence for a successful year, and operations were carried on with vigour by the larger operators until about the middle of November, when the smelter at Trail closed down on account of a strike, in consequence of which several of the larger properties laid most of their men off. Towards the end of December the strike was settled and the company entered into a new agreement with the mine operators; as a result several properties resumed work with the usual force; in a few cases full crews will not be employed until spring. Notwithstanding the shut-down of the smelter, the results have been very satisfactory.

A discovery of manganese on a group of claims on Kaslo creek, about seven miles from Kaslo and close to the right-of-way of the Kaslo & Slocan Railway, has been explored sufficiently by the owners to demonstrate they have a large body of shipping-ore. They expect to ship in the spring. A report on this property by A. J. Curle, one of the owners, is herewith appended:—

Manganese Group.

"The mining property under my management during the year ending December 31st, 1917, is a new discovery named the *Manganese* group, and consists of six claims named *Manganese*, *Cantan*, *Manganese No. 1*, *Manganese No. 2*, *Manganese No. 3*, and *Manganese No. 4*. The ore taken from this property to date is a manganese dioxide, assaying 25 to 35 per cent. manganese for the concentrating-ore, and 36 to 50.6 per cent. manganese for the straight shipping-ore. Only a rough estimate of the ore at present in sight, both concentrating and straight shipping ore, has been made, and we think a fair estimate would be about 10,000 tons. During December A. D. Nash, a mining engineer, of Nelson, made a survey of one deposit on the *Manganese* claim, and although he has not yet completed his work, he thinks a fair estimate would be about 5,000 tons of ore in this deposit. No ore has been shipped, but about 30 tons has been mined. This 30 tons was mined from the surface in two days by four men and sacked up; this time included cleaning the surface of debris. This ore is stored. A small frame building has been put up on the *Manganese* claim, which accommodates six men, including cook. Seven men only have been employed for ten days, from November 20th to 30th, taking out ore, cleaning surface, making man-trail, and erecting building. A wagon-road on about an 8-per-cent. grade from the railway to main ore-deposit on the *Manganese* claim, a distance of about three-quarters of a mile, has been made. Six surface outcroppings of ore, other than the one explored on the *Manganese* claim, have been discovered on one and another of the other claims in the group, but these outcroppings have not been sufficiently explored to determine even approximately their extent, although two of them have been traced for a considerable distance."

Cork-Province.

Situated on the South fork of Kaslo creek; operated by the Cork-Province Mines, Limited. Development-work consisted of approximately 700 feet of drifting; 413 tons of silver-lead concentrates was shipped, and extensive improvements made to the mill. Owing to the smelter strike the property practically closed down the latter end of the year, but they expect to resume operations on a large scale in March, when, with improved milling facilities, they expect to produce zinc concentrates in addition to silver-lead product. On an average forty men were employed.

Revenue.

Situated about eighteen miles from Kaslo, on the South fork of Kaslo creek. The work consisted of cleaning out a lower tunnel for about 180 feet and laying track; an upraise 5 x 7 x 36 feet, from which 20 tons of clean ore was extracted; driving a tunnel about 45 feet, from which was taken 1 ton of ore assaying 236 oz. silver and 50 per cent. lead. In addition to the above, a blacksmith-shop, 10 x 12 feet, was erected.

Silver Bell. This claim is on Kaslo creek, about fifteen miles from Kaslo. The work on this property was of a preparatory nature, and consisted of cleaning out the trail; constructing a bridge, and a shed, 16 x 36 feet, at portal of tunnel; cleaning out tunnel and retimbering for a distance of about 145 feet; laying 95 feet of track. The tunnel was extended a short distance.

Index. This property is under lease and bond to J. A. Poyntz, who has erected new cook-house, ore-shed, stables, etc. I am informed the property will be worked continuously next season. Four men were employed. The work did not start until the latter end of the season.

Gibson. This claim, owned by D. K. May, has had from eight to twelve people employed in building and developments since July 1st, and the work has been very satisfactory. Three large buildings have been erected, consisting of a storehouse at the wagon-road, 20 x 42 feet in the clear; a bunk-house, 16 x 30 feet in the clear; also a kitchen and dining-room, 16 x 30 feet in the clear; and a large shed and ore-bin for sorting and storing of ore.

Over 500 feet of drifting and upraises on the silver-lead vein has been done, which exposes an ore-body from 30 to 36 inches wide, and all of a good grade of concentrating-ore. This is the third tunnel or drift on this ore vein and proves the ore goes down to that level, which is 194 feet below the upper tunnel, which is in 449 feet, with a depth of 350 feet.

There is also being driven another tunnel at the foot of the mountain on Cariboo creek which will crosscut all the veins in the property within about 350 feet distance and at about 200 feet greater depth than we now have. This tunnel is now in 50 feet.

There is about 3,000 feet of development on the property and it has been equipped with all the tools necessary for hand-mining. All supplies are in for the winter and development will be carried on continuously.

Bell. Situated in Jackson basin; employed twelve men; the development-work consisted of 325 feet of tunnel. Shipment for season, 605 tons of zinc ore.

Flint. Operated by J. A. Carter for a short time during August and September with satisfactory results, who shipped about 7 tons high-grade ore and expects to open up again in February. Mr. Carter has a nice showing of 1 foot of solid ore averaging 100 oz. silver and 65 per cent. lead.

Helen. Owned by English Bros., Kaslo, and was operated by three men since July; tunnel-work, about 250 feet. Indications, so far, are very promising. This property is in Stanley basin in the vicinity of the Utica mine.

Gold Cure. Is on the South fork of Kaslo Creek, under lease and bond to local parties, who have extended the tunnel 112 feet and erected a new cabin and blacksmith-shop. Three men employed since the latter part of the year.

Utica. An average of twenty men was employed during the year; the development-work accomplished was 2,678 feet, consisting of drifts, crosscuts, raising, etc. In addition to the above, there were erected a new bunk-house to accommodate thirty men, a stable for ten horses, and a power plant of 100 horse-power; 305 tons of lead ore was shipped.

Silver Glance. Work was commenced on this property by J. W. Power, of Vancouver, on September 15th; two crosscuts were extended 50 and 20 feet respectively, with satisfactory results, small showing of dry ore occurring in each place. Three men were employed until November 15th. Expects to resume operations in the spring.

Panama. This promising property was closed down in May owing to the death of J. P. Miller, one of the owners. Work will be carried on, it is understood, as soon as the Miller interest is disposed of. This is a silver property.

St. Patrick. This property is under lease and bond to Saskatchewan capitalists; the first payment under the bond was made in December. Reports are the property is looking well; the values are in silver, lead, and zinc.

Red Elephant. Owned by Power & McKay, who started work on June 1st, resulting in 20 feet of tunnel, in which, I am informed, gold to the value of $10 is found, and also good lead values in a 50-foot open-cut.

Piker. Situated about three miles south of Kaslo; is under lease and bond to D. P. Cosgriff. A shaft was sunk 25 feet, 5 x 7 feet, from which 6 tons of clean ore was obtained.

Sun. This claim is owned by D. H. Nellis and is situated on Woodbury creek; 35 tons of silver-lead-gold ore was shipped from this property.

Eden-Crescent Group. Situated about two miles south of Ainsworth. There has been constructed a comfortable bunk-house, mess-house, office building, a foreman's house, a blacksmith-shop, etc. Two shafts 100 feet apart have been sunk on the Crescent vein—No. 1, 40 feet in depth; No. 2, 27 feet. There has been shipped one car of ore as a sample shipment. As a result of the favourable showing a tunnel was driven down the mountain to cut the ore at 150 feet depth. After driving the tunnel for 100 feet a parallel vein was encountered and drifted upon for 315 feet before it was opposite the No. 1 shaft, when a turn was made to the east and crosscut driven for 205 feet, cutting the ore under the shaft about 145 feet below the surface, which was drifted on in the vein for 107 feet. A raise was started from the drift toward the surface, following the dip of the vein for 32 feet. A small crew is now working here to put through the upraise to the surface on the dip of the vein. The full face of this upraise is in ore, the vein being all in ore 7 feet between the walls. The above work, with seven open-cuts both on the north and south of the shafts to open up the veins, are all in the *Eden* and *Crescent*.

On the *Blizzard* claim a 10-foot tunnel on the vein and a small shaft and two open-cuts were made to prospect the veins, and these make a fine showing. Work was only suspended for the reason that the workings lower down the mountain will open up the vein at greater depth.

A new tunnel was started at the creek-level on another vein on the *Sunnyside* claim, being about 650 feet lower down the mountain, on a showing of galena, and was continued 55 feet. A cribbing was put in at the mouth of the tunnel on both sides of the creek and the first timbers were installed for a bridge to bring machinery across, but, as the Government road was not completed in time to get the machinery in this fall, and owing to the excessive cost of working this hard ground by hand, it was decided to discontinue the work, except to make the upraise in the *Crescent* tunnel through to the surface, which would give ventilation, and when the machinery was installed work could be rushed under most favourable conditions. The tunnels are fully equipped with rails and cars and piped for ventilation and air; the blacksmith-shop with all tools, blower, bellows, three anvils, and plenty of steel, etc.; sufficient timberman's tools. Two cars and a stock of rails are at the end of the new road waiting to come up with the machinery. At the mine there are all necessary furnishings, buildings, dining-room, bunk-houses, etc., for a crew of eight men. The ore shows, as a result of several samples of the car of ore shipped, 35 to 40 per cent. lead, 8 to 35 per cent. zinc, and 6 to 12 oz. silver.

Highland. Is situated in Ainsworth camp and is operated by the Consolidated Mining and Smelting Company; seventy men were employed in mining and milling; 9,465 tons silver-lead ore was mined, 8,896 tons of which produced 746 tons of concentrates, which, together with 569 tons of crude ore, was shipped to the Trail smelter. The surface improvements consisted of a new bunk-house, dry-room, compressor, addition to concentrator, power-line to compressor, and tram-lines.

Banker-Maestro. Is under lease to the above company, which had four men working over the dump and getting out ore for the mill; 250 tons was milled, producing 26 tons concentrates, which, together with 21 tons crude ore, was shipped.

Crow Fledgling. Operated by A. W. McCune. The work consisted of driving a crosscut tunnel 1,200 feet, drifting from this crosscut tunnel about 1,100 feet; 250 feet of this drifting was to the south and 900 feet to the north; and seven other crosscuts totalling 300 feet. Stripping vein for 400 feet on surface, reported as showing good ore-bodies.

Skyline. Work done consisted of 1,500 feet of crosscut tunnel, in addition to which cook and bunk houses, blacksmith-shop, engine-room, and offices were erected. Twenty men were employed; no ore was mined during the operations.

Wolverine Group. A shaft to the 200-foot level was completed. A drift run 80 feet north, encountering an ore-body of unknown width. About 100 tons of ore was hoisted during drifting operations and stored for milling. It is the intention to start a long tunnel for advantageous working and drainage purposes. The operations were conducted under supervision of C. de Lancey with ten men.

Florence. This claim is situated on Woodbury creek and was worked continuously; about 850 tons of ore was shipped.

Little Phil. Was under lease to Nelson & Erickson, who have run several crosscuts and drained the winze. They encountered several ore-streaks, from which they have shipped during the three months' operation 30 tons silver-lead ore and one car is ready for shipment. In addition to the above, there are 50 tons of ore which will require to be milled, and should mill about 4 to 1. The hand-selected ore averages 20 oz. silver and 55 per cent. lead.

Albion. Is under lease to the same parties as the *Little Phil*, who have blocked out 4 x 50 feet of 45-per-cent. zinc, and have shipped 12 tons of the same grade of ore as above mentioned.

Spokane-Trinket. Operations consisted of 1,000 feet of stoping, sinking, upraising, and drifting, and shipping 85 tons of ore. Eight men were employed. Bunk-house, office, and ore-sorting sheds were erected.

Gallagher. Is owned by A. D. Wheeler and was under lease, from which one car of ore was shipped, the gross value of which was a little over $1,000; 200 feet of drifting was done.

Bluebell. This mine is now opened to the fifth (or E) level below the adit. The elevation of adit station is 1,773 feet and of E station 1,403 feet. The ore-bodies have not yet been sufficiently exposed to permit one to say whether or not the lowest level will reveal any change of importance in physical or mineral conditions. There is noticeable, however, a decrease of both zinc and lead tenure and an increase of silver as depth increases. There was 58,620 tons of ore mined. Out of this, 1,030 tons was low-grade oxidized ore, the greater part of which was shipped direct to the smelter; the remainder was concentrated. The mine worked continuously during the year with an average of eighty-two men employed, including the staff.

Lavina-Butte. This property was opened in the summer for the first time since 1900, showing small veins of silver-lead ore of a good grade carrying a little zinc. Operations have produced about 60 tons of ore running 70 per cent. lead and 60 oz. silver. Owing to weather conditions and the difficulty in getting packers the ore has not been shipped.

Whitewater.—Under four leases produced 379 tons of silver-lead ore and 500 tons of silver-zinc ore.

OFFICE STATISTICS—AINSWORTH MINING DIVISION.

Free miners' certificates	106
Claims recorded	150
Assessments recorded	277
Agreements and transfers	59
Certificates of improvements	6

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, 1917.

The operations carried on in this Division during the year have fully met the expectation and the optimistic feeling in all parts of the camp. Most of the old mines that were unworked for years have been taken over by men and companies who are alive to the possibilities of the Slocan for investments in mining properties.

In the Silverton camp the *Van-Roi* and the *Hewitt* groups have been taken over by Clarence Cunningham; there are sixteen claims in the two groups and a first-class concentrating-mill on each of the groups. The *Van-Roi* mill is about one mile above the *Hewitt* mill; the latter is fitted with oil-flotation equipment. At this writing the properties are looking well beyond all expectation. There are about 150 men employed between the two mines and they keep three 4-horse teams busy getting the concentrates away.

The Standard Silver Lead Mining Company, whose properties, the *Standard* and *Emily Edith* groups, are near Silverton, is working the usual number of men and shipping the usual amount of silver-lead and zinc concentrates. Just now they employ 150 miners and labourers.

The *Lucky Thought* group, owned and operated by the Consolidated Mining and Smelting Company, of Trail, is situated about three miles up Four-mile creek from Silverton. On an average thirteen men are employed.

The Echo Mining Company, whose properties are situated directly above the *Standard* group, is doing a considerable amount of development-work and has big bodies of high-grade ore blocked out. Preparations are now being made to build an up-to-date tram down to the lake and concentrator, when it will be very much cheaper to handle the ores.

The *Surprise*, now called the Rosebery Surprise Mining and Milling Company, is another big concern that is going ahead and prospering. It has acquired the *Bosun* properties, near New Denver, together with the large mill situate at Rosebery. Since taking over the property the company has enlarged the mill and put in a flotation plant, and employs at the mine and mill some fifty men. This company is also owner of the *Surprise* and *Elkhorn* mines, at Sandon, where it has another large mill and employs over seventy-five men; P. J. McFadden is Superintendent and manager and F. Murphy is engineer.

The *Queen Bess*, *Idaho-Alamo*, and *Wonderful* groups have also been taken over and operated by Clarence Cunningham; these three groups have been systematically developed and ore blocked out ready to break down. Mr. Cunningham has now about finished a system of trams whereby he can take the ores from at least two of these groups down to the railroad at a very small cost; he also contemplates building a large mill at Alamo on the site of the old *Alamo* mill.

The *Noble Five* group of mines, situated at Cody, about one mile above Sandon, has been developed for some years by James Dunsmuir, of Victoria, with A. Lincoln as manager; they are also making arrangements to replace the old mill with a new and up-to-date mill with a flotation plant attached.

The Galena Mines Company, owning the *Galena Farm* group on Slocan lake, is operated by P. Clark. At present they are only doing development, for the reason that they are short of water to run the mill, but expect to be running full blast in the course of a month.

The *Sovereign*, near Sandon, is another of the Cunningham properties and is looking well under development.

The *Freddy Lee* is owned and operated by M. McCune, of Salt Lake City, he is at present engaged in developing the property with a view to increasing the force and shipping ore, of which he has large bodies blocked out.

The *Rambler*, situated near Three Forks and owned and operated by a Spokane company, has been operated very successfully for the last year and made large profits for the owners; Wilfred Cameron is the superintendent.

Besides these properties I have mentioned, there are a number of smaller properties which may develop into mines when more work is done. Following is a list of mines in this Division that made shipments this last year:—

	Tons.
Black Grouse	10
Daniel	18
Echo group	81
Freddy Lee group	68
Galena Mines group	2,797
Gem	11
Grey Copper	37
Hartney	12
Idaho-Alamo group	164
Ivanhoe group	54
Lone Bachelor	7
Lucky Jim group	3,033
Lucky Thought group	882
Montezuma	2
No. 1 mine	50
Noonday group	62

	Tons.
Payne mine	19
Queen Bess group	2,198
Rambler-Cariboo	1,301
Reco group	30
Ruth group	283
Slocan Star	1,441
Sovereign	158
Standard Silver Lead	15,124
Surprise group	6,728
Van-Roi and Hewitt groups	1,263
Wonderful group	242

OFFICE STATISTICS—SLOCAN MINING DIVISION.

Free miners' certificates	192
Free miners' certificates (companies)	2
Claims recorded	48
Assessments recorded	113
Transfers recorded	9
Notices filed	11
Revenue collected	$5,893.95

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, 1917.

Beyond the keeping-up of the yearly assessment-work on all the promising claims, very little work has been done in this Division during the year 1917. However, the work which has been done has given encouraging results.

The *Ottawa* group, owned by the Consolidated Mining and Smelting Company of Canada, has had a force of men working nearly the whole of the year on development-work, but has only been shipping the ore that has been taken out in the completion of such work, the total amount shipped totalling 178 tons.

The *Black Prince* group, which is under lease to J. T. Tipping, has not been working more than half the year owing to the scarcity of labour and the high cost of mining, only having shipped 17 tons. The property is now looking very promising and Mr. Tipping hopes to work the same the coming year.

The *Alice S.* claim has been closed down for the whole year.

The *Meteor* is under lease and bond to Barber & Taylor and has done extensive development-work, but has not taken out any ore except that encountered in the doing of such development-work, but they have not shipped any this year.

The *Enterprise* has been under lease to Pat McGuire and has shipped a total of about 112 tons of high-grade ore.

The *Empire* mine, owned by Wm. Cottercll, has shipped about 6 tons of ore taken out in development-work, but has been compelled to close down till spring.

OFFICE STATISTICS—SLOCAN CITY MINING DIVISION.

Free miners' certificates issued	66
Locations recorded	34
Notices to group	18
Certificates of work	98
Bills of sale recorded	12
Agreements and certificates recorded	2

TROUT LAKE MINING DIVISION.

REPORT OF OSCAR JACOBSON, 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 1917.

There has been a little improvement in the mining industry during this season as compared with past years, but it was expected in the spring that more properties would have been opened up. A good many mining men and experts were in the camp during the summer looking over prospects here. One drawback is no doubt the transportation problem, but in time that would adjust itself. The Canyon Creek portion of the district is almost deserted now on account of the poor trail, although the Government spent a whole lot of money there some years. As it is now, it is almost impossible to get up there. There are some very promising properties there owned by Bodin & Berg and others.

Ethel. This property, operated by the Silver Crown Mining Company, Limited, of Spokane, Wash., worked three or four men the entire year, and shipped 26 tons of silver-lead ore that gave a return of 140 oz. of silver and 8 per cent. lead. The intention is to keep on working during the winter.

Foggy Day. This claim is owned by Mrs. A. E. Jowett and is under lease and bond to J. S. Lamphere, who worked it during the summer months, and shipped 9 tons of ore that gave a return of 4.29 oz. in gold, 16 oz. in silver, and 4.6 per cent. lead. As soon as it is possible to start in the spring, Mr. Lamphere intends to build quarters to accommodate the men that he is going to employ.

Crescent. This claim is owned in Mansfield, Wash. The owners have driven about 200 feet of a crosscut, but have not as yet struck the lead. The idea in crosscutting is to tap a big surface showing that carries gold and silver.

Gold Bug. This property is situated at Seven-mile, on the South fork of the Lardeau river, and is owned and operated by J. W. Livingston; it is a very promising property, as Mr. Livingston struck a fine body of galena ore this summer.

Copper Chief Group. This property is situated on the west side of Trout creek and consists of four full claims and a fraction. The property was bonded by R. D. Fetherstonhaugh from J. W. Livingston in November last year, and a syndicate composed of Calgary and Edmonton capitalists, known as the Copper Chief Mining Syndicate, was formed to carry on development. Work was started on December 1st, 1916, under the superintendency of Mr. Fetherstonhaugh, and carried on till about November 1st. A trial shipment of some 6 tons was made in the month of June to the Trail smelter, which gave the following returns: Silver, 241 oz.; lead, 12 per cent.; zinc, 23 per cent. Some 258 feet of tunnelling has been driven and a number of open-cuts, showing up the vein for a distance of 1,200 feet. A new tunnel was started 100 feet below No. 1, which is expected to cut a large ore-body. Another trial shipment of some 7 tons was made a short time ago, from which no final return is to hand.

During the season molybdenite was found on the property, following a diorite dyke, cutting obliquely across the formation; this was only found late in the season and has not been developed to any extent; yet, however, several open-cuts were put in, showing a considerable quantity of this valuable mineral. The second payment of the bonding price was made to the owner a few days before closing down the work.

Silver Cup. Not much work has been done on the *Silver Cup* and *Sunshine* this season, as only two men have been employed in putting the property in shape, but I understand that it is intended to start work in the spring with a force of men.

True Fissure. This well-known property has had considerable development-work done on it; work started there over a year ago and has been going on steadily until a short time ago. I have been unable to get any official report in regard to the amount of work done, but I am informed by men that have been employed there that the property is showing up very well, with ore-showings in the tunnels. Two car-loads of ore are now being taken down from the mine for shipment to the smelter.

Great Northern. A few men have been working on this property for some time, and it is the intention of H. Macpherson, one of the owners of the property, to continue the work all winter and to get some ore blocked out.

Nettie L. This mine, owned by the Ferguson Mines, Limited, has been worked throughout the year under lease; one car-load of silver-lead ore was sent to the smelter during the summer that gave a return of 150 oz. in silver, 13 per cent. zinc, and 13 per cent. lead; 25 tons of zinc ore was also shipped which assayed 47 per cent. zinc. Another car-load of silver-lead ore is ready for shipment at the mine. An average of six men has been employed and it is intended to continue work all winter.

York Group. This group of claims is owned by Hillman & Culkeen and is situated on Gainer creek; the owners have erected a cabin, and it is the intention to drive a tunnel to tap a shaft where there is a foot of high-grade shipping-ore.

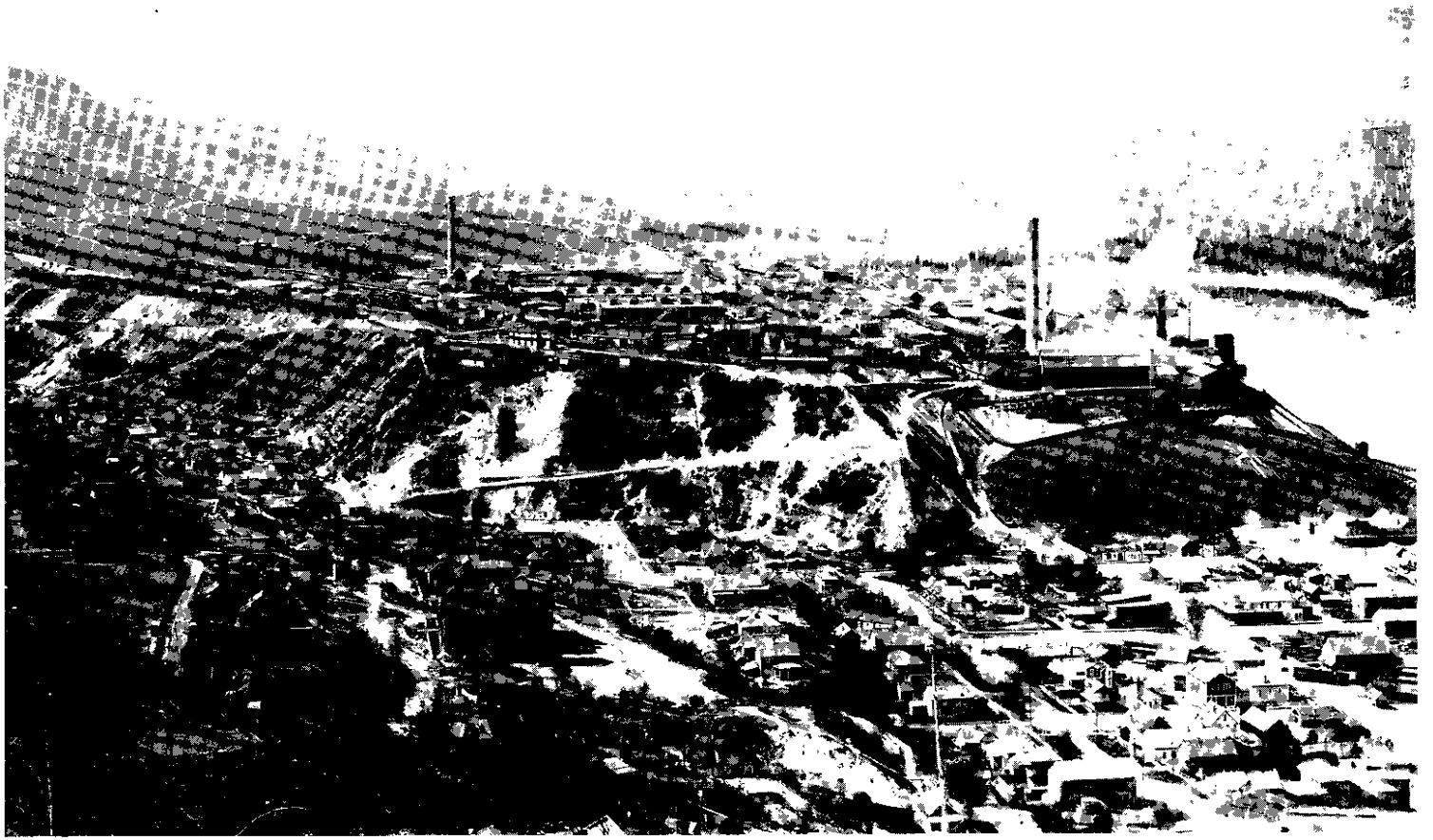
Index Group. This group of claims is situated on Gainer creek and has had considerable development-work done on it; a crosscut tunnel of 150 feet in length has been driven this season and developed about 40 feet of concentrating-ore, and the other wall is not yet struck. As the property is situated in a rather difficult place, the work had to be suspended for the winter, but as soon as the weather will permit in the spring the work will be started up again.

Elesmere Group. This property is owned by the Circle City Mines, Limited; George Brown, president. The property consists of eight claims and is located on the North fork of the Lardeau river, about seven miles from Ferguson. The property has been working all the year with a force of eight men, and the intention is to work all winter. A tunnel of about 217 feet has been driven, beside crosscuts and upraises. Cabins and blacksmith-shop have been built, and there is about 3½ feet of concentrating-ore in the drifts; it is the intention of the company to install a mill as soon as the property warrants it. An air-compressor was bought and brought up as far as Ferguson, but on account of the condition of the trail it was impossible to get it up to the mine.

Triune. This property is owned by the Minnesota Gold and Silver Mining Company. According to information received, the mine is looking as well if not better than it ever did before; and when the men left this fall (on account of snow) there was an ore-showing of 3 feet of good high-grade ore in one of the drifts. All of this ore is not solid mineral, but such does extend to the width of 18 inches, and the rest of the ore is not quite so high grade, although it will stand shipping. Work started on June 1st and a crew of fifteen men was employed until the time of closing down. During the time that working was carried on, one tunnel was extended 40 feet, one upraise 50 feet, one tunnel 20 feet, one crosscut 30 feet, and another drift 50 feet. One car-load of ore was sent to the smelter that netted almost $200 to the ton. Another car-load was ready for shipment when the snow came and stopped operations for the season. The company is very much handicapped in not having a tram-line, but it is the intention to erect one next season. The work at the mine will commence again as soon as the weather will permit in the spring, and it is hoped that after the end of next season the property will be operated steadily.

Reward Group. The *Florence* mine is one of the claims in the *Reward* group and is owned by the Minnesota Gold and Silver Mining Company. The property has been worked since June 1st, and the company proposes to keep right along with a force of eight men. No ore has been shipped, as it is a milling proposition, so all work done is of development character; the work includes crosscutting and drifting; the object of the work is to find out the extent of the ore-body, and to have tests made to find out what kind of a mill will be needed for the treatment of the ore. There are some twenty claims in this group, and all of them are in the same mineral belt as the *Silver Cup*, *Sunshine*, *Nettie L.*, and the *Great Northern* mines, so there can be no doubt the company has good ground to work on. The property is very close to a wagon-road, so it will not require a long tram for the transportation of the ore to the mill.

Towser. This property is situated below the *Sunshine* mine and is operated by J. F. Carey, of Spokane, Wash. I am not in possession of official data of how much work has been done during the season. One car-load of ore was shipped from the mine during the summer, and another one is ready to be shipped. Eight men have been employed and the idea is to keep working right along.



General View, Consolidated M. & S. Co. Smelter, Trail, B.C.

POPLAR CREEK SECTION.

Nothing more than the usual assessment-work has been done on the claims in this part of the Division.

OFFICE STATISTICS—TROUT LAKE MINING DIVISION.

Assessments recorded	158
Locations recorded	78
Agreements and transfers	25
Notices to group	29
Free miners' certificates (ordinary)	73
Free miners' certificates (company)	1

NELSON DISTRICT.

NELSON MINING DIVISION.

REPORT BY S. S. JARVIS, ACTING GOLD COMMISSIONER.

I have the honour to submit the annual report on the Nelson Mining Division for the year ending December 31st, 1917.

NELSON CAMP.

Silver King. Development-work is still being carried on by contract at the *Silver King* mine; 734 feet of drifting was done the past year, and two men were employed pumping and keeping the mine generally in shape so that it can be started up at any time.

California. One car of ore was shipped from the *California* mine to the Trail smelter, the ore being what had been saved during development-work performed in 1916. During 1917 development-work only was carried on, 786 feet of tunnel being driven. Equipment costing $2,168 has been installed. Power is being leased from the *Athabasca* mine for operating air-drills. The average number of men employed was eight.

Granite-Poorman Group. The Kootenay Gold Exploration Company, which has the following Crown-granted claims under lease and bond: *Poorman, Hardscrabble, White, Hardup, Myemer, Electric, Green Horn Fractional, White Swan, Granite, Red Rock Fractional, Tamarac Fractional, Blue Grouse, White Swan Fractional,* and which are known as the *Granite-Poorman* group, has not been operating since August 15th last. The character of ore, gold and silver; method of operating, mining and stamp-milling.

Approximately 98 tons of concentrates was shipped to the Trail smelter last year. Average assay, 2.01 oz. gold, 1.903 oz. silver, and 1.494 per cent. copper. Ore treated at mill, 1,000 tons; average number of employees, 25; new underground development-work, 474 feet crosscut; new surface development-work, sluicing; new mechanical installation, a 200-horse-power electric motor, 20-cubic-foot compressor, 4 Overstroom tables, and electric equipment. In addition to above, bullion was shipped to the Dominion Assay Office, Vancouver, approximately containing 446.67 oz. gold.

Athabasca. About 131 tons of ore went through the *Athabasca* mill the past year, and an average of four men was employed up to November 1st, 1917.

Eureka. Work is being carried on under the direction of J. J. Malone, of Nelson. Shipped to Trail last spring, 1,240 tons; character of ore, gold, copper, and silver; method of operation, hand-mining; average number of employees, 84. New underground development-work, 200 feet crosscutting; open-cuts, 200 feet on surface showing. A new compressor and hoist is now at the mine, but not yet installed. An aerial tramway has been erected, length 1,080 feet. New ore-bins, etc., have been installed.

The Eureka Copper Mines, Limited, is also building another tramway, 3,000 feet, extending from *Granite-Poorman* tramway to railway-track, and on its completion expects to ship about 50 tons a day.

Orinoco Group. This mine is composed of the following claims: *Orinoco, Orinoco Fractional, Queen Victoria Fractional,* and *Rio Tento,* which are owned by M. Egan, of Nelson. Some 144 tons of ore was shipped to the Greenwood smelters. The assay values ran as follows: Silver, 2.5 oz.; copper, 2 per cent. Mr. Churchill, who had a lease on the above property last fall, made a shipment of 56 tons to the Trail smelter.

Perrier Group. Very little development-work was carried on owing to shortage of water. About 25 feet of crosscutting, 50 feet of drifting, and some open-cut work was done. No shipments were made to the smelter. Four men were employed when conditions allowed.

Molly Gibson. This mine was closed till the end of June. Work was started in July at the mine, and at the mill in August. All the development done was for enlargement of stopes. Some 367 tons of crude ore was shipped to the Trail

smelter. The mill put through 1,759 tons of feed and produced 134 tons concentrates, which was not shipped. A new flotation process was installed and a Hardinge ball-mill is now on its road to the mill. The average number of men employed was fifty.

Iva Fern Group. This property is situated on Cultus creek, at a distance of six miles from Kootenay lake. J. Mulholland, the owner, who has been developing the property during the year, has now bonded it to the Consolidated Mining and Smelting Company, of Trail.

YMIR CAMP.

Yankee Girl Group. The Hobson Silver Lead Company, of which W. T. McDowell is manager, has been actively engaged in the mining and development of this property during the year. The group consists of the following claims: *Yukon Fraction*, *Yankee Girl*, and *Canadian Girl*. Character of ore, gold and silver (lead and zinc in small quantities); method of operation, machine-drills for drifting and stopers for stoping. Since September, fifty-five cars having a total dry weight of 2,058 tons have been shipped to the Canada Copper Company at Greenwood. Average number of men employed, 17; new underground development-work, 450 feet of drifting on vein, 185 feet of crosscutting; stope, 60 feet long by 65 above tunnel. One 4-horse-power gasolene-engine has been installed.

The manager reports that an ore-body consisting of lenses of heavy sulphides was developed near the end of drift, and stoping was commenced on this at a distance of 35 feet from the face. The ore, which is reported to have a width of 6 feet, runs about 8 per cent. zinc, 25 per cent. pyrite and pyrrhotite carrying gold and silver values, which shows average returns of $17.50 a ton.

Quite a number of other mines in the Ymir camp have been doing development-work on smaller lines, such as the *Jennie Bell*, *Nevada*, *Imperial*, *Lost Cabin* group, and *Monarch* group.

SHEEP CREEK CAMP.

Ore Hill Group. SW-53 This property is now being operated by C. H. Cassill under the management of W. B. DeWitt, and is composed of five claims: *Ore Hill*, *Ore Hill No. 2*, *Standard*, *Dixie*, and *Last Dollar Fractional*. Character of ore, gold, silver, lead, and zinc; method of operating, hand-mining. One car of ore is ready to ship. Five men have been employed continuously. About 90 feet of underground development-work and 120 feet of surface work has been done during the year. A Wilfley table and crusher have been installed, also a 2-stamp mill near the mine. The old mill has been repaired and several changes have been made. The property has undoubted merit and gives promise of becoming a productive mine.

H.B. and Zincton. This property shipped a considerable tonnage of zinc ore during the year, but latterly has been closed down.

Aspen. P. F. Horton is developing this property and intends shipping during the winter. Assay returns of ore sorted for shipment ran as follows: Gold, 0.68 oz.; silver, 123.4 oz.; zinc, 6 per cent.

Emerald. This property, which is owned by the Iron Mountain, Limited, of which John Waldbeser is manager, has been a steady producer during the year, having shipped 4,334 tons of ore to the Trail smelter. An average of thirty-three men has been employed throughout the year, while at the *Jersey*, the adjoining mine, an average of seven men has been at work since last July.

Development at the *Jersey* consisted of drifting on the vein and open-cutting. Bunk-house, cook-house, ore-bins, etc., were erected, as well as constructing two miles of wagon-road to connect with the *Emerald* mine.

The mill at the *Emerald* has a capacity of 25 tons of ore daily, and the company expects to use part of it to enter into construction of a larger and more modern mill at a later date. A concentrator has been purchased and is now being erected.

SW-48 **Queen.** This property, which was a very active producer in 1915 and 1916, has been closed down during the past year.

Spokane Group. This property is situated on Wall mountain, in what is known as the Bayonne section. Laib Bros., who are the owners, are continuing with development-work, which consists principally of two drifts on the vein.

There is a considerable quantity of ore exposed in the two drifts. The average values at present prices of metals would run about $22 a ton in gold, silver, and lead, the principal values being gold and silver. It is a promising prospect which at present is handicapped by lack of transportation facilities.

Molybdenite Group.

This property is situated about thirteen miles from Salmo, on Lost creek, and is owned by Bennett, Ross & Benson. Considerable development-work has been done on the property during the year. The International Molybdenum Company treated approximately 65 tons at its Flotation Reduction Works at Renfrew, Ontario, and the Department of Mines, Ottawa, approximately 85 tons. The property has merit and no doubt will be a heavy shipper during next year.

ERIE CAMP.

Second Relief.

This mine is situated about ten miles from Erie. A. D. Westby, manager, reports that mining and development work have been carried on during the year. Owing to the inability to secure cyanide, zinc shavings, and other chemicals, the cyanide plant has been closed down during 1917. New equipment, including a concentrating and sliming table, a Senn amalgamator, and a 45-horse-power gas-engine, has been recently purchased, with the idea of saving the free gold and shipping the concentrates until such time as they can again operate the cyanide plant. Nine men are working.

OFFICE STATISTICS—NELSON MINING DIVISION.

Free miners' certificates (individual)	576
Free miners' certificates (company)	4
Free miners' certificates (special)	1
Claims recorded (mineral)	275
Claims recorded (placer)	1
Certificates of work recorded	504
Agreements, transfers, etc.	107

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, 1917.

At the *Millie Mack* a force of men has been working all summer, and has 40 tons of ore ready for shipping to the smelter as soon as roads are in order for hauling.

Meadow Group.—The owners of this property shipped 1½ tons to Trail smelter as a test sample.

Big Ledge.—No extra development-work has been done on this property further than the ordinary assessment-work. This vein shows a very large outcrop of zinc.

OFFICE STATISTICS—ARROW LAKE MINING DIVISION.

Free miners' certificates issued	34
Certificates of work recorded	16
Mineral claims recorded	16

ROSSLAND DISTRICT.

TRAIL CREEK MINING DIVISION.

REPORT BY H. R. TOWNSEND, GOLD COMMISSIONER.

I have the honour to acknowledge receipt of your letter of the 23rd instant, requesting me to forward my report as Gold Commissioner. In reply, I beg to inform you that I requested the proper officials at the mines here to supply me with this information some time ago, and they informed me that they would supply me with the desired information, but they also stated that this information had already been supplied to the Provincial Mineralogist. No new mines have been working in this district during the last twelve months. Below you will find the office statistics, which show an increase in most cases over the year before.

OFFICE STATISTICS—TRAIL CREEK MINING DIVISION.

Mineral claims recorded	79
Certificates of work	68
Bills of sale	10
Partnerships	2
Leases of reverted mineral claims	21
Free miners' certificates (individual)	132
Free miners' certificates (company)	9

SOUTHERN DISTRICT (No. 4).

REPORT BY PHILIP B. FREELAND, RESIDENT ENGINEER.

The Southern Mineral District includes the Grand Forks, Greenwood, Osoyoos, and Similkameen Mining Divisions. The writer regrets that the shortness of the season and the many calls for assistance from the Government in building roads and trails prohibited any time being spent on the study of the geological conditions of the different Divisions. However, some of the most likely mineral-bearing localities have been already reported on by the Geological Survey of Ottawa, and these reports can be had on application to the Geological Survey, Ottawa.

There has been a marked activity throughout the entire district in the prospecting for both metallic and non-metallic minerals, especially those which are necessary for munition-making and for use in the upbuilding of our industries.

Hitherto a great many minerals were imported to this country from Europe. These imports are closed to us during the war, and will probably be for some time after it ceases, owing to the necessary demands for material for the upbuilding of the areas that have been destroyed.

Below is a list of the minerals required for munition-making and other purposes:—

Metallic Minerals.—Manganese, tungsten, molybdenum, antimony, chrome, sulphur ores, platinum, tin, zinc, copper, lead, and iron.

Non-metallic Minerals.—Bauxite, magnesite, fluorite, flake-graphite, strontianite, fireclay, sheet mica, potash, and phosphate.

Although most of the above minerals may not be needed in large quantities, yet the present high price of the products is an incentive for intensive prospecting and development, and may be the means of establishing permanent domestic industries.

In the Grand Forks Mining Division fair showings of chromite have already been discovered, the serpentine being particularly favourable to the occurrence of chrome ore.

Strontianite float was discovered two miles and a half up the Ashnola river, in the Osoyoos Mining Division, late in the fall. Further investigation was impossible owing to the depth of snow.

GRAND FORKS MINING DIVISION.

Emma. Owned by the Consolidated Mining and Smelting Company and situated in Summit camp. This mine has more than doubled its production during the last year, the amount of ore shipped to the Trail smelter being 33,976 tons, as compared with 14,000 tons in 1916.

Union. This property is situated forty-one miles north of Grand Forks, in the Franklin camp, being one-quarter mile west of Burrell creek and approximately 3,000 feet above sea-level, on a good wagon-road. This mine has been shipping at irregular intervals to the Granby smelter at Grand Forks, the total aggregating 751 tons.

Some analysis has been made upon the ore for milling purposes, giving as high as 90 per cent. extraction by flotation. The present owners are endeavouring to obtain enough capital to install a mill and treat the ore at the mine. By this means the heavy transportation charges would be eliminated and the mine put on a paying basis.

The average value of ore shipped to the smelter at Grand Forks is $30. Transportation by motor-truck, $15 a ton; transportation by railway, $1.50 a ton; smelter treatment, $6.75 a ton. These costs plus mining charges leave practically no margin for the operators.

The mine is well situated for operation, having plenty of water for milling purposes within a quarter of a mile, and by going up the river for half a mile sufficient fall could be obtained for the generation of power.

At present the ore has to be hauled twenty-seven miles over a wagon-road to Lynch creek, where the Kettle Valley line terminates; from thence by rail to Grand Forks, a distance of seventeen miles. It is to be hoped that the owners will be successful in their endeavour to interest capital sufficiently so that proper machinery may be installed and the mine put on a running basis.

The geology of the district has been reported on by C. W. Drysdale, Geological Survey of Canada, 1911; also a report by A. G. Larson, M.E., and C. S. Verrill, M.E., appears in the Annual Report for 1914, which deals with the property in detail.

Further ore-bodies were developed during the year by a crosscut tunnel driven north.

Mastodon. This claim is situated close to the International Boundary-line and about 4,000 feet from the Canadian Pacific Railway near Cascade, at an elevation of 3,200 feet. A general report on the district is given by R. A. Daly in "The Geology of the 49th Parallel," Memoir No. 38, 1912, Geological Survey, Ottawa.

The above claim was staked for some years, the presence of chromite being undetected until the summer of 1917, when The Stewart-Calvert Company, of Oroville, Wash., U.S.A., obtained a lease for $5,000 for a period of one year and a half.

Very little development has been done on the property up to the present, the ore-body being stripped for 75 feet and a shaft sunk alongside the ore 10 feet deep. The ore seems to be in lenses varying in width and length, carrying values from 30 to 50 per cent. chromium. The surrounding rock (serpentine) carries from 3 to 10 per cent. chromium. Very little can be said as to the extent of the ore-body at the present time, but its transportation facilities and the high price of the metal make it a property worthy of further attention. The writer visited this property in December, the snow on the ground making a thorough investigation impossible.

Original. This claim, situated on Granby river (North fork of Kettle) has shipped 38 tons of ore.

Berlin. This property, owned by the Inland Mining Company and situated four miles east of Paulson, adjoins the old *Inland Empire* claim, now called the *Inland*. A shaft has been sunk 25 feet on a quartz lead, developing a fairly high-grade ore-shoot. Drifts have been driven both ways from the shaft on the lead, and a car-load of picked ore shipped to the Grand Forks smelter, assaying between $90 and $100 to the ton in gold and silver.

The lead averages from 6 inches to 2 feet 6 inches in width and dips nearly vertical. Development-work is being carried on by machines, and since January 1st another car-load has been shipped. The total tonnage shipped in 1917 was 59 tons.

Molly Gibson. A few feet of crosscut tunnelling was done under contract with the idea of tapping an inclined shaft showing some ore at the bottom. The contractors, however, threw up the contract before the shaft had been reached. No further work has been done since.

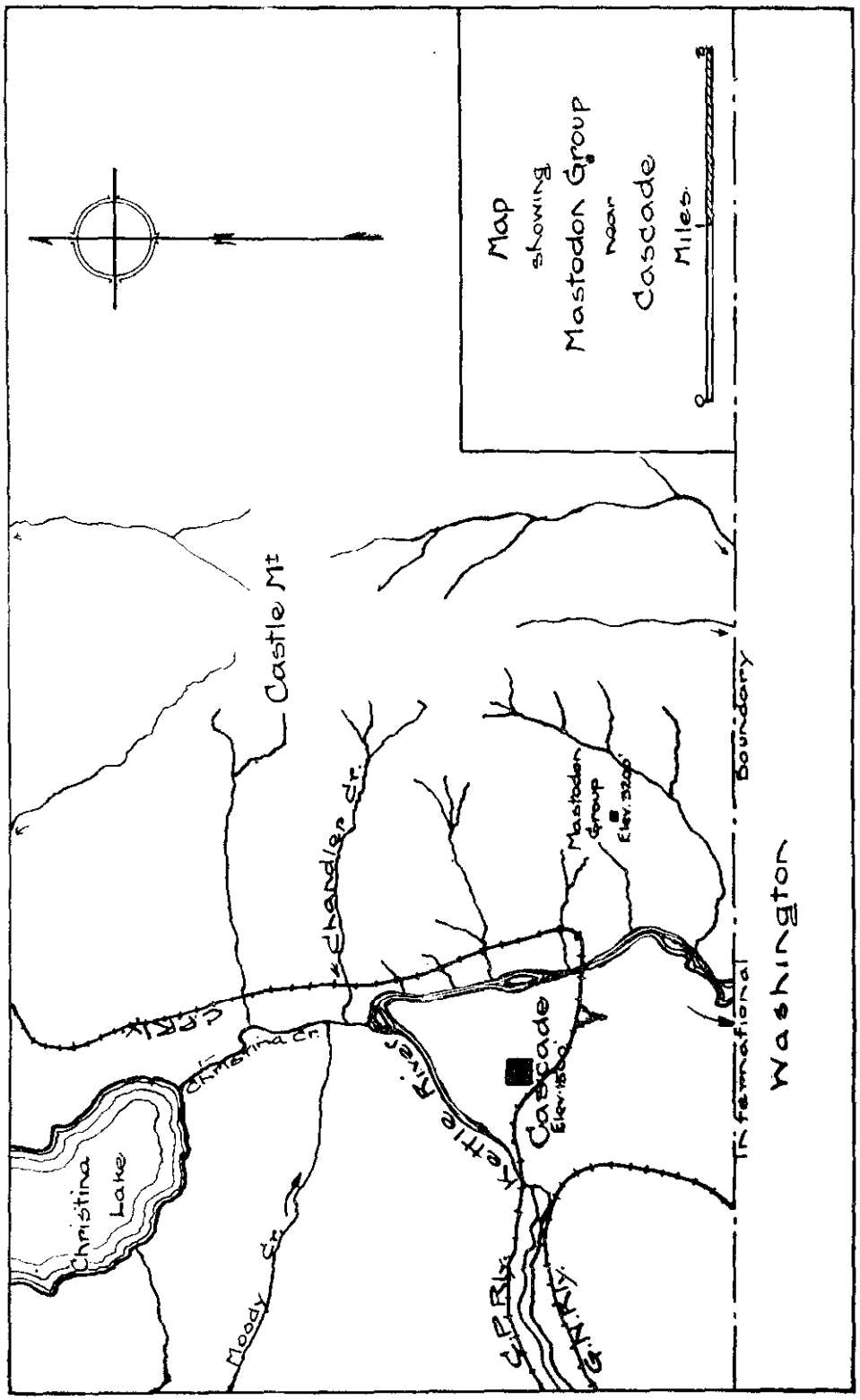
Waterloo. Situated thirty-three miles from Edgewood (Arrow lake), on Lightning peak. Elevation 5,460 feet above sea-level. Lead about 4 feet wide, striking east and west, carrying gold and silver. Samples from ore sacked assayed high in silver. Development-work consists of open-cuts and tunnels. The lead has not been developed at any great depth up to the present.

This is a promising prospect and worthy of further exploration. The chief difficulty is transportation, which will be facilitated by the building of a snow-trail around Gallopin mountain to join the Edgewood-Vernon road. This trail was commenced late in the fall of 1917, but snow-storms prevented its completion. Assistance was given by the Government towards building this trail.

Equinox. This group, consisting of four claims—*West Fork*, *First Chance*, *Jim Hill*, and *St. Paul*—is situated thirty miles north-west of Edgewood (Arrow lake), at an elevation of approximately 5,825 feet above sea-level. The lead averages 1 foot in width, carrying silver, lead, and iron. Samples of ore shipped assayed 180 oz. silver and 18 per cent. lead; and samples of ore on dump assayed 0.02 oz. gold, 37.5 oz. silver, and 41 per cent. lead.

Transportation forms the chief difficulty at the present time, all the ore having to be packed out over a bad trail on horses. The trail to be built to the *Waterloo* claim will pass close to the workings of the *West Fork* claim and thereby make shipping possible.

Oro Denoro. This mine has shipped 243 tons of low-grade ore carrying gold, silver, and copper values.


Map
showing
Mastodon Group
near
Cascade
Miles
Castle Mt
Chandler Cr.
Christina Cr.
Christina Lake
Moody Cr.
Kettle River
Cascade
Elev. 1850'
Mastodon Group
Elev. 3300'
C.P.R.Ry.
G.N.Ry.
Trifurmational Boundary
Washington

B.C. This old property has been leased by the Canada Copper Corporation to A. Luciani, of Phoenix. The lessee took out some ore from the old open pits adjoining the shaft, and also sorted over the dumps, with the result that 675 tons of second-class copper ore was shipped to the Greenwood smelter.

Maple Leaf. This claim adjoins the *Union Fraction* on the north. A new ore-body has been stripped over an area of 200 feet during the past year, containing values in native copper and copper carbonates on the surface. A tunnel has been driven approximately 25 feet under this showing and some chalcopyrite found intermingled with the rock. At present the ore is too low grade to permit transportation to Grand Forks smelter, but further development the owners hope will encounter richer bodies.

Rock Candy Group. Situated on Kennedy creek, four miles in a westerly direction from Lynch creek, a tributary of Granby river. The writer was unable to visit this property, but a report by the agents of The Stewart-Calvert Company, of Oroville, intimate that there is a considerable quantity of fluorspar, stripped, 300 feet in length and approximately 20 feet wide. An analysis of this deposit has not come to hand up to the present.

Mother Lode. Owned by the Contact Consolidated Gold Mines, Limited (Henry Jackson, manager, Paulson, B.C.), and situated in Burnt basin. In the Summary Report of the Geological Survey of Canada, 1901, prospectors were advised to be on the look-out for platinum in the Boundary Creek district of British Columbia. The special reasons for suspecting the occurrence of platinum in West Kootenay and the Boundary Creek districts were:—

First: The general resemblance in many essential particulars between the rocks and ores of these districts and those of the Similkameen.

Second: The presence of masses of basic eruptive rocks now frequently altered to serpentines, rocks in which platinum has been most frequently found in-place, and which seem to be the chief source of the platinum in the Similkameen.

Third: The fact that the chalcopyrite-pyrrhotite ore-bodies of these districts, sometimes slightly nickeliferous, bear a marked resemblance to the platinum-bearing copper-nickel deposits of Sudbury, Ontario.

The subsequent discovery of platinum in the copper ore of the *Rambler* mine, Wyoming, in the same form (sperrylite) as in the Sudbury copper ores, further emphasized this possibility.

Development on the *Mother Lode* claim consists approximately of the following: Tunnels, 300 feet; shaft, 65 feet; open-cuts, 70 feet. The veins occur in disturbed areas where porphyry dykes are most numerous, and vary from 1 foot to 2 feet 2 inches, being chiefly auriferous quartz. The strike is approximately N. 70° W. (mag.).

The quartz has small amounts of metallic sulphides scattered through it; pyrite, galena, and zinc are the most common, the occurrence of chalcopyrite and molybdenite also being noticeable. Quantitative tests showed values in platinum from 0.25 oz. a ton to 0.05 oz. a ton and in other samples *nil*. It is evident that the platinum is unevenly distributed through the vein.

GREENWOOD MINING DIVISION.

GRANBY CONSOLIDATED MINING, SMELTING, AND POWER COMPANY.

The following constitutes the report of the operations at the Granby mines at Phoenix for the fiscal year ended June 30th, 1917, by C. M. Campbell, superintendent:—

"Operations for the year ending June 30th, 1917, were seriously curtailed by coke shortage. The Crowsnest coalfields, from which the supply of coke comes, has been the centre of more far-reaching labour troubles than have occurred in all the other coalfields and metal-mines in British Columbia combined.

"Time after time the industries of the whole country which depend on coke, almost from Winnipeg to the West Coast, have had to curtail operations until the men and operators settled their disputes. During the period covering this report their troubles seem to have been unending, and the result from our standpoint was that our shipments were reduced one-half during the months of December, January, February, and April, while the property was shut down entirely as far as shipments were concerned during May and June. This state of affairs is not only responsible for higher costs, but the efficiency of the organization has been noticeably impaired by the loss of many capable employees.

"*Shipments.*—Total shipments from all sources amounted to 677,292 tons. The following table shows the distribution of this tonnage and the ore shipments to date:—

	Tunnel Ore.	Shaft Ore.	Gold Drop.	Ore Totals.
	Tons.	Tons.	Tons.	Tons.
Prior to July 31st, 1916	6,075,674	4,560,450	1,512,000	12,148,134
Year ending June 30th, 1917	74,365	479,173	123,754	677,292
Total to date	6,150,039	5,039,633	1,635,754	12,825,426

"*Recovery.*—From the year's shipments the smelter reports a recovery per ton of 13.52 lb. copper, 0.177 oz. silver, and 0.027 oz. gold.

"*Development-work.*—Development amounted to 8,900 feet, averaging 16 cents per ton of ore, and cost 12.2 cents per foot.

"Diamond-drilling for the year amounted to 6,502 feet and the total to date is 119,122 feet.

"*Costs.*—Cost per ton of total output, crushed, on cars, including all development and removal of 233,785 tons of waste, was $1.175. Wage bonuses amounted to 15.7 cents per ton. Increase cost of supplies over pre-war prices amounted to 11.2 cents per ton; Workmen's Compensation Fund, 1.5 cents per ton. The reduction in freight rates due to the completion and operation of the Kettle Valley Railway lowered the cost 0.7 cents per ton. These particular items aggregated 27.7 cents per ton over normal pre-war conditions.

"The expense incurred in handling waste cannot be considered as so much waste, as we have been able to use the waste in many places as stope-filling, and thus hold up ground directly underneath buildings and railroad-tracks, which otherwise would have to be supported by extra pillars of ore.

"Costs were also increased due to the fact that the ore-bodies now mined are smaller, flatter, and farther away than heretofore. The intermittent nature of the shipments, due to reasons already referred to, also worked against a low tonnage cost.

"It is important to note that the mining of the low-grade ore is not curtailing the production of the regular grade of ore. If the higher price of copper did not allow the low-grade ore to be shipped, the tonnage would have been reduced by one-half. Not only that, but the cost would have gone up, as a certain amount of low-grade ore has to be mined, anyway, it being sorted out as waste, except under present conditions.

"*Ore remaining and Grade.*—As in previous years, due to the high price of copper, we were able to increase our shipments by mining a considerable tonnage of low-grade ore not hitherto considered an asset.

"This low-grade ore amounted to 294,622 tons, and the total of ore developed has been increased to this extent. Further development, chiefly by the extension of the *Gold Drop* stopes, added 46,670 tons, and the total increase is therefore 341,292 tons. The present condition of the ore reserve is therefore as follows:—

	Gold Drop.	Ironsides.	Totals.
	Tons.	Tons.	Tons.
Ore developed	1,685,754	14,414,668	16,100,422
Mines have produced	1,635,754	11,189,672	12,825,426
Ore remaining	50,000	3,224,996	3,274,996

"From this we estimate that a recovery of 17 lb. copper and 75 cents in gold and silver can be maintained. There is a considerable amount of low-grade ore of which a reliable estimate is impossible, but which will approximate 300,000 tons. This will give a recovery of 9 lb. copper and 60 cents in gold and silver. In addition to this ore there is also the *Grey Eagle* ore-body, containing 50,000 tons of iron flux. This will run 0.20 per cent. copper; trace in silver; 0.02 oz. gold; 18 per cent. silica; 30 per cent. iron; 10 per cent. lime; 5 per cent. sulphur."

GREENWOOD.

Big Copper. This mine has been under lease and bond to J. Poggi, who shipped 683 tons of copper ore, some to Grand Forks and some to Greenwood smelter. The *King Solomon* mine, which adjoins the *Big Copper*, shipped 267 tons of high-grade copper ore to the Greenwood smelter.

Surprise No. 3. This mine, situated about two miles south-west of Phoenix, in the Skylark camp, is under lease and bond to Mike Kane, Joe Cunningham, and Axel Gustafson, of Phoenix, B.C. Development-work consists of one shaft 40 feet deep, one drift 30 feet, and 20 feet of trenching. The shaft is sunk on the lead, which is nearly vertical and about 4 feet wide. The lead in the tunnel is continuous, averaging about 2 feet and containing about 1 foot of chalcopyrite and copper carbonates. The same amount of ore is apparent in the bottom of the shaft. Samples from across the ledge at the bottom of the shaft assayed a trace in gold, 1.0 oz. in silver, and 7.4 per cent. copper.

The entire claim and vicinity is covered with a heavy gravel-wash from 6 to 10 feet deep, which makes the prospecting for the continuance of the lead a difficult matter. A trench 50 feet east of the main workings uncovered the lead and showed values in chalcopyrite and copper carbonates. A good road, branching from the highway between Phoenix and Greenwood, a quarter of a mile below the former, runs up to within 200 feet of the workings. The wall-rock seems to be a siliceous limestone, slightly impregnated with iron pyrite.

Elkhorn. This property, which is near Greenwood, has been under lease to Rowe & Mathews. A few tons of silver ore was shipped to the Trail smelter.

Prince Henry. This claim was leased to Johnson, Sorturne, Nelson & Christensen, of Phoenix, for a few months. Seven tons of silver ore was shipped to the Trail smelter.

Tip Top. Twenty-five tons of gold and copper ore was shipped to the Greenwood smelter.

CAMP MCKINNEY.

A revival of interest was shown in this locality during the year, when a number of claims were restaked and bought in and around the old camp. It is generally understood that the high-power electric line from Greenwood will pass through this camp in the near future, which may offer better facilities for power for operating purposes.

The Great Northern Railway passes through Bridesville, a distance of approximately seven miles from Camp McKinney. In the past, wood was used for fuel and all supplies were brought in from Midway by wagons, a distance of approximately twenty-five miles. It will be readily understood that the improved fuel and transport conditions of the future will make a vast difference in the cost of operating the mines in this camp.

CANADA COPPER CORPORATION.

The *Mother Lode* mine has been running steadily throughout the year, with the exception of a few weeks on account of coke shortage at the smelter at Greenwood. Total tonnage shipped amounted to 176,392 mine-run and sulphides. The *Sunset* mine shipped 2,155 tons.

BEAVERDELL.

Revenge. This claim and the *Sunset Fraction* and *Bell Fraction* are owned by G. Barrett, of Carmi. Work was commenced in the summer of 1917 on a new surface showing and some 25 feet of open-cut work had been accomplished, also 30 feet of stripping. No appreciable amount of ore had been blocked out in October, 1917, although the surface showings carried good values in silver and lead. A letter from the owner in January stated that a tunnel started from the lower open-cut had developed satisfactorily and that he hoped to ship some ore in 1918.

Kokomo. This claim is also owned by G. Barrett, Carmi. Twenty-four tons of silver-lead ore was stoped and shipped from the old workings to the Trail smelter.

The *Bounty Fraction* shipped 17 tons to Grand Forks.

Sally. This mine is located on the eastern face of Wallace mountain. The property was operated until the beginning of 1910 by the Vancouver and Boundary Creek Development Mining Company, Limited. During 1910 and 1911 the mine was shut down. Since that time work has been carried on, by lease, periodically.

In 1917, 117 tons was shipped to Trail and Grand Forks smelters. The main development has been carried on by tunnels and crosscuts along the fault-planes cutting the veins, also by open-cuts, and amounts to approximately 2,500 feet. The ore was shipped by wagon, a distance of approximately two miles and a half, to Beaverdell Station, on the Kettle Valley Railway, and from thence to the smelter.

The ore occurs in shear-zones in an acid-quartz diorite. The shear-zone dips generally about 60 degrees to the south. These zones are displaced by numerous faults striking in a northerly direction and dipping west.

The ores in the *Sally* tunnel consist of galena, pyrite, sphalerite, tetrahedrite, and pyrargyrite in a gangue of sericite, quartz, and altered rock. Native silver is found in the fault-planes and occurs in a gangue of chlorite, calcite, etc. Surface alteration has probably caused the formation of native silver.

Rambler. This claim, lying on the southern slope of Wallace mountain, is owned by W. H. Rambo, and is mentioned in the report of the Provincial Mineralogist in 1901. Since then some work has been done in the tunnels and on the surface, but no great amount of ore has been discovered. The country-rock is quartz diorite accompanied by aplite dykes. Forty-one tons of ore was shipped.

Black Diamond. This claim and the *Standard Fraction*, situated on Dry creek, have been operated by P. Kennedy, of Beaverdell. There are three inclined shafts, which are part of the old workings. Latterly some 150 feet of open-cuts and drifts have been driven under an iron-capping. No large quantity of ore has been encountered up to the present.

Beaver. Owned by Jas. Sutherland. Work commenced late in the summer. A tunnel 50 feet has been driven and open-cuts 10 x 10 feet. A small lead has been discovered carrying lead, silver, and some iron. In October, 1917, no ore had been shipped.

Bell. This claim is at present under lease and bond for one year to Oliver & McIntosh on a royalty basis. Several hundred feet of tunnel-work has been done below the old workings and ore has been taken out and shipped, amounting to 206 tons of silver and lead ore, to the Trail and Granby smelter. The grade of the ore shipped is generally lower than when the mine was worked in 1910 and 1911, the better facilities for transportation making this possible. Freighting from the mine to Beaverdell Station amounted to $3.50 a ton; railway and treatment to Trail smelter, $15 a ton.

The ores occur in shear-zones in an acid-quartz diorite. As in the *Sally* mine, the shear-zones are displaced by numerous faults, which make proper development difficult. In October the lessees were driving a tunnel in below the present workings in hopes of striking the lead at a greater depth.

Nepanee Group. This property consists of the *Nepanee*, *Nepanee Frac.*, *Nevada*, *Nevada Frac.*, and *Cobalt Frac.* claims. These claims lie towards the south-eastern part of Wallace mountain and are owned by M. J. Cummings *et al.*, of Beaverdell. The upper workings consist of an incline shaft 70 feet deep; 300 feet to the north-west is a 30-foot shaft, two open-cuts, and some drifting. Assays from the incline shaft averaged $14 in gold and silver and carried about 3 per cent. copper.

The shaft is in a zone of hornblende diorite porphyry of the Wallace group; the hanging-wall is well defined, but not the foot-wall. The strike of the lead seems to be south-east and dips about 42 degrees to the north. The ores consist of pyrite and arsenopyrite.

Lower down the hill, approximately 50 feet, a tunnel has been driven, since the above work was accomplished, a distance of 105 feet without striking the lead. At the mouth of this tunnel some float was discovered carrying good values in silver and lead. From this a small lead was uncovered, and the present owners have started an open-cut to try and develop the ore.

KETTLE RIVER.

Scandia. This claim, lying about three miles and a half south-east of Beaverdell, is owned by Mark Smith and leased by Eric Jackson. Considerable work has been done by the lessee to improve the property. Development consists of one tunnel 40 feet, one winze 12 feet, and some open-cuts and stripping. A good log cabin has also been built. The lead, carrying silver, gold, lead, and zinc, averages about 8 inches in width and strikes in an easterly and westerly direction, dipping about 60 degrees to the north.

O.K. Group. This group, consisting of the *Oro Fino*, *O.K.*, *Ivanhoe*, *Liberty*, and *Tip Top Frac.*, was located in 1897. The group is situated in the Triple Lakes region, on the summit of Kloof ridge, and approximately six miles from the Kettle river. The ore in the *O.K.* consists of pyrrhotite and pyrite disseminated through a fine-grained igneous rock. Owing to the dense growth of pine it was very difficult to see the country. The claims have not been worked for many years. Selected samples from some of the prospect-shafts gave an average of $5 a ton of gold. This property was reported on by W. F. Robertson in the Minister of Mines' Report, 1901.

Mogul. This claim lies on Lake Ridge, about one-half mile east of Triple lakes, on the eastern brow of Horseshoe mountain. Reported on by W. F. Robertson in the Minister of Mines' Report, 1901. General samples taken from the dump out of the shaft assayed $20.40 in gold and 1 oz. in silver to the ton. J. D. Galloway also reported upon this claim in 1913, getting assays as high as 3.85 oz. in gold and 0.6 oz. in silver to the ton.

The workings are at present in a dilapidated condition and unsafe. These constitute a shaft about 50 feet deep and an open-cut 10 feet long. The vein is quartz in a quartz diorite cut by basic volcanic dykes, and on the surface appears to average 1.6 feet in width.

Since the above work was done a wagon-road has been built up the Kettle river to within two miles of the claim. This claim was originally owned by R. Roberts *et al.*, of Greenwood, B.C. The present owners are unknown.

Barnato. This claim lies to the east of the *Mogul* and nearer the Kettle river. This claim is owned by Sam Larsen, of Rock Creek, B.C. No work has been done on this claim for some time and the workings had caved to some extent in October, 1917, making a thorough investigation impossible. The shaft is supposed to be 40 feet deep, and one open-cut is 5 feet wide and 12 feet long, the other being 25 feet long and 10 feet wide. The lead on the surface averages 2.6 feet of quartz carrying some pyrite and arsenopyrite. General assays gave 0.5 oz. in gold and 0.1 oz. in silver to the ton.

Silver Dollar. This claim lies on the northern end of Lake Ridge, about one-half mile south of the divide between Deer creek and the Triple Lake valley, Horseshoe mountain. The owners are Spankey & McMynn, of Greenwood, B.C. The workings consist of a shaft about 40 feet deep, with a crosscut tunnel driven into it 20 feet below the surface. The ore is pyrite, pyrrhotite, and arsenopyrite surrounded by a dense metamorphosed igneous rock, probably a tuff, cut by light-coloured granitic dykes. Only traces of gold and silver were obtained from general samples taken from the dump. This claim was reported on by the Provincial Mineralogist in 1901, when values were obtained from the quartz in the dump assaying $16.40 in gold and 0.6 oz. in silver.

OSOYOOS MINING DIVISION.

Oregon Group. This group of claims is situated four miles south-west of Hedley, B.C., on the east side of the Similkameen river and approximately 4,000 feet from the Great Northern Railway. These claims can be reached by wagon-road and trail from Hedley—i.e., road four miles and trail one mile and a half. The group includes the following mineral claims: *Oregon*, *St. Bernard*, *Savage*, *Winchester*, *Two Sisters*, *Oregon Fraction*, and *Winchester Fraction*, comprising an area of 211 acres.

A good deal of development-work has been done upon the *Oregon* claim to try and prove the extent of the ore-body. The upper tunnel has been driven 35 feet, mostly in ore, and one crosscut tunnel, 8 feet long, from this tunnel, all in ore (August 2nd, 1917).

There are two lower tunnels about 70 feet down the hillside, driven in, apparently, below the ore-body, for no values were discovered. At present there is well over 100 tons of ore piled

outside the upper tunnel. An open-cut above the upper tunnel shows plenty of mineralization. The lowest-grade sample, cut along the side of the upper tunnel, assayed 1 per cent. copper, 0.9 oz. silver, and 0.06 oz. gold; the highest assayed 3.90 per cent. copper, 3.40 oz. silver, and 0.12 oz. gold.

Transportation at present is carried out over a steep trail. Should the mine develop, any ore taken out could be cheaply handled by cable to the flat below.

This deposit seems to be of the contact-metamorphic class, being an intrusion of diorite gabbro into the sedimentary limestone, principally a garnet and epidote.

The chief minerals in evidence are bornite, chalcopyrite, arsenopyrite, and pyrrhotite. The ore strikes north-east and south-west. Up to the present the continuance of the ore-body has not been discovered; the tunnels below the outcrop have not been driven far enough to ascertain the possibility of the ore dipping nearly flat into the hill.

Claremont Group.

This group, which is situated on Siwash creek, can be reached by trail from Jellicoe Siding, Kettle Valley Railway, a distance of approximately fifteen miles. A considerable amount of development-work has been done to try and locate the continuance of the ore body, as follows: No. 1 upper tunnel, 198 feet; No. 1 crosscut, 33 feet; No. 2 tunnel, 61 feet; No. 2 crosscut, 27 feet; No. 3 tunnel, 180 feet; total, 499 feet; and also some open-cuts in the gravel-wash approximately 10 feet long. Samples taken across the lead in the upper tunnel assayed 269.8 oz. silver and 0.1 oz. gold to the ton. The principal ore is galena, carrying some iron.

The vein seems to strike in a northerly direction and dips 45 degrees to the east, varying in width from a few inches to a foot, and continues as fas as development has gone in the upper tunnels. The distance from the mine to the railway forms one of the chief difficulties at the present time. Should the mine develop, however, easy grades could be obtained for a wagon-road. The owners are to be congratulated upon the systematic way they are developing the property.

SPOTTED LAKE.

This lake lies approximately one-half mile north of the southern entrance to Richter's pass and has been purchased by the Stewart-Calvert Company, of Oroville, Wash. About twenty men have been employed during the dry period of the season, digging out the magnesium salts from the surface of the lake and transporting them by auto-truck to the Oroville plant for treatment. A large tonnage of these salts is shipped to the Eastern States, where they are used in the preparation of leather. The amount shipped from the lake to the plant in 1917 was 900 tons.

KEREMEOS.

Copper King.

This group consists of the following claims: *Copper King*, *Copper Hill*, *Mountain Lion*, and *Copper King Extension*. The group lies closely to Olalla, on the west side of the valley, at an elevation of approximately 3,400 feet above sea-level, and four miles north of Keremeos, on the Great Northern Railway. There are some good surface showings of chalcopyrite and magnetite lying close to the contact of lime and granodiorite, the lime being well altered and mineralized.

A shaft 30 feet deep sunk through the magnetite-capping develops some chalcopyrite in the bottom; also a tunnel 20 feet long and 30 feet below has been driven with the intention of tapping the bottom of the shaft, but not finished; also two crosscut tunnels 25 feet and 65 feet respectively have been driven across the lime towards the contact, but also not carried far enough to prove any depth on the ore-body.

Four tons was shipped to the Grand Forks smelter for trial in November. This shipment averaged about $24 a ton in silver and copper. This ore was taken from the upper tunnel.

The property has been under lease to A. Hagelberg, Olalla; owner, R. W. Northern, Olalla, Keremeos. Transportation charges to the smelters make it very difficult for the mining men in this district to develop their properties.

Golconda.

This property adjoins the *Copper King* on the north-west and is owned by Dan and Archie McEachern, of Olalla. Over 100 feet of tunnel has been run on the lead, and 4,390 lb. of molybdenite, containing 751 lb. of MoS_2, was shipped to Ottawa. Two tons of copper ore was also shipped, assaying about 19 per cent. copper. The molybdenite lies in small lenses and can easily be extracted.

Dolphin. This claim is situated on the east side of the Olalla Valley and is owned by Jordan & Brown, Olalla. Three car-loads, amounting to 72 tons, of gold and copper ore was shipped during the year.

Horn Silver. This group is situated on the east side of the Similkameen river and approximately seven miles in a southerly direction from Similkameen Station, on the Great Northern Railway. The group includes the following claims: *Horn Silver*, *Golden Horn*, *Silver Plate*, *Cornia Copia*, and *Ally*. The *Horn Silver* has been Crown-granted for three years. The present owners are Mrs. Powell, Victoria; Jones & Rant, Victoria; and B. Powell and Condit Bros., Similkameen.

Development consists of several hundred feet of tunnel on the vein, also incline shafts and upraises. A 30-ton bunker was installed, and a ½-inch cable, 3,000 feet long, supported by wooden towers and carrying wooden buckets having a capacity of 150 lb. each. A Winton Four engine is at present used to drive a Canadian Rand compressor, which supplies air for two small pneumatic drills.

There are two veins varying in width from 1 to 5 feet and striking in a northerly and easterly direction respectively. The north vein has been stripped for several hundred feet, but does not, as far as development has gone, contain as high values as the east vein. One of the chief difficulties encountered in mining the ore is the present extreme flatness of the dip of the vein, which makes it impossible to stope the ore into the chutes on the levels.

There has been a considerable amount of faulting, chiefly to the south-east. Up to the present these faults vary, the biggest displacement being only 7 feet, whilst the smallest is about 1 foot. The best values, mostly in native silver, are found along the fault-planes.

The principal ores are native silver and argentite, some iron and small quantities of galena also being present. The vein, which is of the fissure type, is quartz, and cuts a medium coarse-grained granite formation.

The main workings are on the east vein, where a considerable amount of stoping has been done and about 18 cars of ore shipped to the Grand Forks smelter. Samples from car-load lots assayed as high as 393.4 oz. in silver and 1.02 oz. in gold, the lowest being 28.8 oz. in silver and 0.02 oz. in gold.

The cost of transportation, etc., is as follows: Shipping by motor-truck to Similkameen Station, $2.50 a ton; freight by Great Northern Railway to Grand Forks, $4 a ton; treatment at smelter, $5 a ton. This is a promising property.

HEDLEY.

Nickel Plate. This mine has been running steadily throughout the year and is the main producer of this Division. During the year the tonnage of ore mined and milled amounted to 71,207 tons. The treatment of the ore entirely by cyanide has been in operation during the year. The method used for agitation in the cyanide-tanks is well worthy of notice.

RIORDAN MOUNTAIN.

Billy Goat Group. This group is owned by J. Riordan and Morris, of Keremeos; it was mentioned by W. Fleet Robertson in the Minister of Mines' Annual Report for 1901. A considerable amount of surface development has been accomplished on the property, consisting of trenching and open-cuts, but none of the work has gone deep enough to prove the extent of the ore-deposits. The pyrrhotite-showings, which are mainly in evidence, carry values in gold and copper and are worthy of proper development.

SIMILKAMEEN MINING DIVISION.

Copper Mountain Group. Owners, Canada Copper Corporation, Limited. This group of claims is situated about ten miles in a direct line, a little west of south of Princeton, B.C., and at an elevation of approximately 4,200 feet above sea-level. Copper mountain was reported upon by W. F. Robertson, the Provincial Mineralogist, in August, 1901, and this report appears in the Annual Report of the Minister of Mines, 1901; also a general report of the district was made in 1906 by Chas. Camsell, of the Geological Survey of Canada. Since then development-work has been carried on extensively, especially on the *Sunset* and *Helen H. Gardner*. About $1,250,000 has been expended, including diamond-drilling,

118,000 feet; tunnelling, 90 per cent. of which is 9- x 10-foot tunnels, 12,800 feet; upraising, 3,000 feet; sinking, 936 feet; surface trenching, 32,000 feet. All this development-work has been done to ascertain, as nearly as possible, the size of the ore-bodies, the grade of ore, and the best possible means of handling a large tonnage in the cheapest manner.

A main working-tunnel is being driven below the ore-bodies. From this tunnel an upraise will be put in to tap the levels above, and the ore dumped into this upraise will be hauled to the concentration plant for treatment. The rate that this tunnel is being driven averages about 20 feet a day.

New bunk-houses, with steam heat and shower-baths for the men, have been built. A concentration plant and sawmill are also being constructed.

In connection with this company, the old cement plant near Princeton has been put into use for experimental purposes in ascertaining the possibilities of nodulizing the concentrates from the company's flotation plant. It is understood that these experiments were satisfactory, coal-dust being used instead of oil for fuel.

SUMMIT CAMP.

The following claims are located in this camp: *Lambert*, *Bluebell Frac. No. 1*, *Bluebell Frac. No. 2*, *Indiana*, *Morning Star*, *Sultie Chief*, and *Silver Chief*, all on and near Treasure mountain. Reports upon these claims will be found in the Annual Report of the Minister of Mines for 1913 and 1915.

The condition of the *Silver Chief* underground workings in 1917 was unsatisfactory. The timbers at the mouth of the lower tunnel having fallen in had allowed a considerable amount of debris to collect, thereby causing a flood of water 3½ feet deep for a distance of 300 feet back in the drift. Beyond this an upraise had been driven to the surface. The ground around the opening had caved, nearly filling the tunnel.

The vein seemed to be persistent in these drifts, having well-defined walls and carrying good values in silver and lead. With the present high price of metals it seems a great pity that a good showing of this kind should not be developed and some tonnage blocked out.

Red Star. Reported upon by W. Fleet Robertson, Provincial Mineralogist, in the Annual Report for 1900. Since the above report was made a crosscut tunnel has been driven in 300 feet at the foot of the hill. No ore has been encountered as yet in this tunnel.

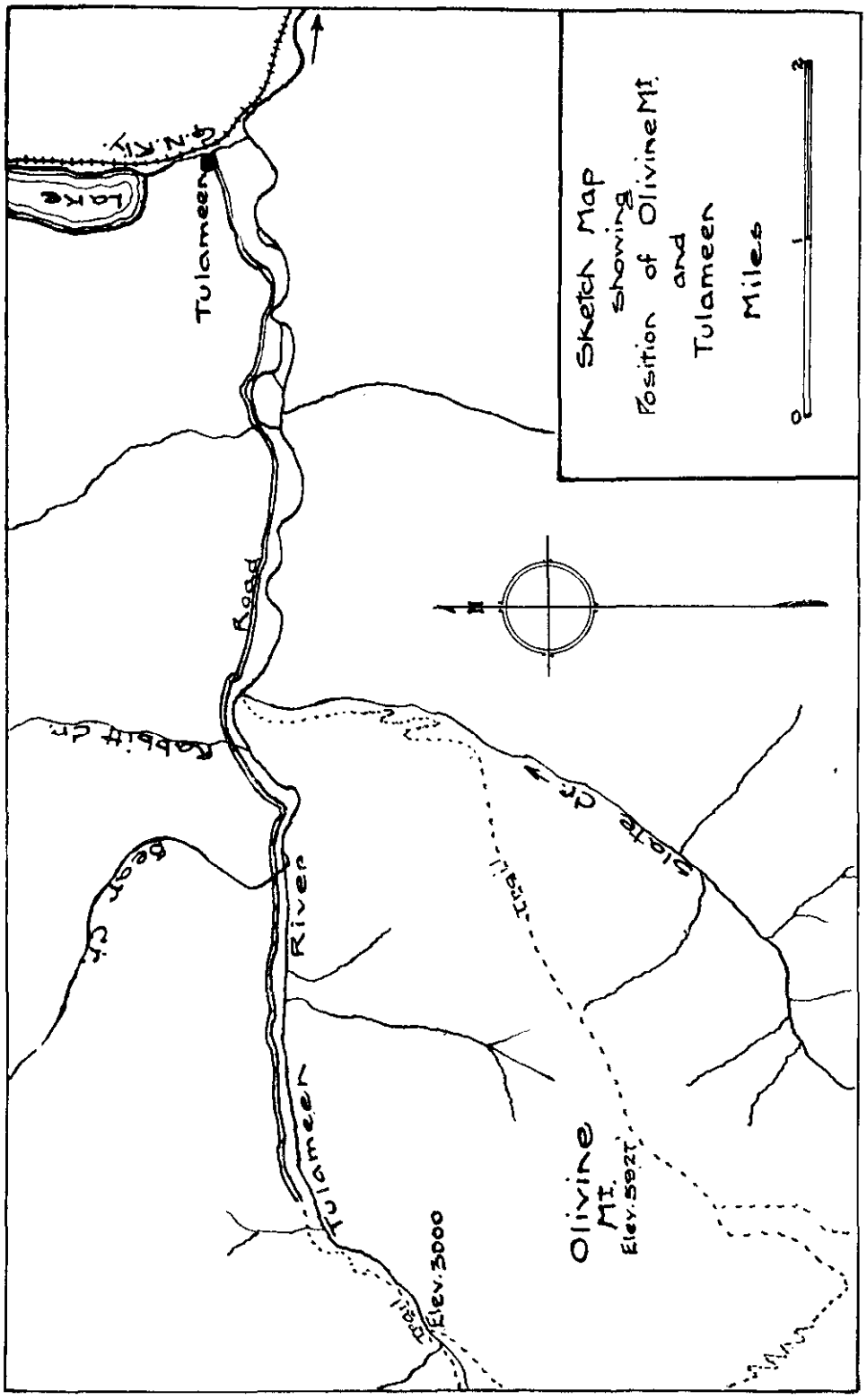
Britton Mountain. The group of mineral claims located on the mountain are owned by Mr. Britton, of Tulameen, and have been prospected by him for the last eighteen years. A great deal of development-work has been done in different directions without any large-sized ore-bodies being encountered up to the present. This mountain was mentioned in Chas. Camsell's Geological Survey Report in 1911, also by J. D. Galloway in the 1913 Annual report.

OLIVINE MOUNTAIN.

The copper-deposits on Olivine mountain lie to the south of the main peak and on the eastern slope at an elevation of approximately 5,500 feet above sea-level. The distance by road and trail from the Great Northern Railway at Tulameen is approximately eight miles and a half up the Tulameen river, and thence one mile and a half in a south-easterly direction. A short visit was paid to these in the fall of 1917, with the idea of reporting on them as possible copper-producing properties.

The claims visited are owned by A. Jensen, of Tulameen. Some development-work had been done by open-cuts and trenching, but no depth had been attained to prove the size of the ore-bodies or whether the values improved at depth.

The copper-deposits seem to lie wholly in the pyroxenite rock, which constitutes the larger portion of Olivine mountain. The pyroxenite is in places sheared and rendered schistose, and in these zones quartz veins have been formed, carrying a small amount of pyrite and chalcopyrite. The latter mineral is not generally disseminated throughout the pyroxenite, but only occurs, as far as could be seen, in small areas. General samples taken across these open-cuts gave traces in gold and silver and 0.5 per cent. copper. Samples taken by the Geological Survey of Ottawa in 1911 assayed as high as 3 per cent. in copper, but it is stated that the average grade of ore will probably not exceed that figure.


Sketch Map
showing
Position of Olivine Mt.
and
Tulameen
Miles
0
1
2
C.N. Ry.
Lake
Tulameen
Road
Tulameen
River
Olivine
Mt.
Elev. 5927
Elev. 3000
Trail

A good deal of interest has been created over Olivine mountain during the latter part of the year on account of the high price of platinum and the demand for chromite, both of which metals have been discovered in variable quantities on different parts of the mountain. Whether or not the deposits contain a sufficient quantity of copper, gold, platinum, and chrome to be of economic value as producers remains to be seen.

A memoir on the geology and mineral deposits of the Tulameen district by Chas. Camsell can be obtained from the Geological Survey Branch, Ottawa.

BOUNDARY DISTRICT.

GREENWOOD MINING DIVISION.

REPORT BY 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 1917.

Canada Copper Corporation, Ltd.—

Tons of ore treated at smelter	196,856	
Production of smelter—		
Blister-copper	4,247,316	lb.
Gold	9,582	oz.
Silver	46,355	oz.
Average number of men employed—		
Smelter	60	
Mother Lode	70	
Lone Star	20	
Principal ore shipments—		
Mother Lode Mine	176,392	tons.
Lone Star mine (Washington)	5,704	„
Napoleon (Washington)	466	„
Queen Victoria mine	32	„
Sunset mine	2,155	„
Oro Denoro mine	243	„
B.C. mine	675	„
Big Copper	398	„
Other custom ores	10,791	„
Total wages paid—		
Smelter	$ 81,753 25	
Mother Lode	108,577 75	
Lone Star	8,686 10	

The Granby Consolidated Mining, Smelting, and Power Co., Ltd.—

Tonnage shipped	492,051	
Development—		
Drifting	1,459	feet.
Raising	4,509	„
Diamond-drilling	3,962	„
Average number of men employed	318	
Amount paid out in wages	$405,000	

The mine was closed down during the months of May and June on account of labour trouble at Fernie. There were no new additions to plant equipment of consequence.

Consolidated Mining and Smelting Co. of Canada, Ltd.—During the year 1917 there was 33,976 tons of ore shipped from the *Emma* mine. Thirty-six men were employed underground and fifteen on the surface. There was no special construction outside of the new school-house for the benefit of the men employed.

The following development was done during the year:—

Drifting and crosscutting	1,302	feet.
Raising	573	„
Sinking main shaft	34	„
Diamond-drilling	3,056	„

WALLACE MOUNTAIN, NEAR BEAVERDELL.

The *Bell* mine, leased to Oliver & McIntosh, has been worked during the whole of the year, and the following is a summary of ore shipped and values received:—

To the Granby Consolidated Mining, Smelting, and Power Co., Ltd., Grand Forks—	
Dry weight	71 tons.
Silver	2,837.06 oz.
Net smelter returns	$1,809.69
To the Consolidated Mining and Smelting Co. of Canada, Ltd., Trail—	
Dry weight	164 tons.
Silver	35,378.79 oz.
Lead	26,400 lb.
Net smelter returns	$28,534.53

The total wages paid out, not including the management, was $4,320.26. The average number of men employed was four.

Sally.—The following is the result of the operations of this mine for the year: Shipped to the Granby and Trail smelters, 117 tons, containing 3 oz. gold, 10,808 oz. silver, and 3,296 lb. lead.

I am indebted to Eric E. Jackson, of Beaverdell, for information regarding the claims surrounding Beaverdell and Carmi, as follows:—

Revenge.—Adjoins the *Bell* and is owned and operated by George Barrett, of Carmi. The group consists of the *Revenge*, *Bell Fractional*, and the *Sunset Fractional*. About 140 feet of drifting and crosscutting has been done and considerable open-cut work. Six tons of ore has already been taken out and the stope has been opened up ready to start stoping. The pay-shoot will average 5 inches of first-class ore. A good trail, 3,000 feet long, has been built from the main wagon-road to the camp, and 1,500 feet still has to be built to reach the tunnel. Two men are at present employed on the property.

Kokomo.—Owned by G. M. Barrett. Twenty-four tons of first-class ore was shipped during 1917 and about 60 feet of drifting accomplished.

Napanee Group.—Development consisted of 75 feet of cross-tunnel work and considerable surface work. Owned by E. G. Cummings and M. D. Schenck.

Standard Fractional.—This claim is now under lease to Nordman & Sons and is owned by W. H. Rambo. Development: Three tunnels on the *Buster* lead—No. 1 tunnel, 12 feet; No. 2 tunnel, 30 feet; and No. 3 tunnel, 30 feet. "A" tunnel is on the *Standard Fractional* lead. No. 1 raise put up 30 feet and No. 2 raise put up 30 feet; these raises are on ore and are of the nature of "raise and stope." Built a blacksmith-shop and ore-house and 1,200 feet of wagon-road. Sixteen tons of ore has been taken out and it is expected a shipment will be made before spring. Work has been continuous during the past five months and three men are at present employed.

Standard and Black Diamond.—Owned by Kennedy & Steeves. Development was 100 feet of tunnel, also 1,300 feet of wagon-road. One man employed at present.

Rambler Fractional.—The owner, W. H. Rambo, is working on this property and has 6 tons of ore ready for shipment.

Scandia.—Owned by M. Smith and leased to parties in Phoenix. A tunnel was driven 50 feet and considerable surface work done, also winze 20 feet deep. One man employed.

CARMI CAMP.

Askwith.—This claim, owned by Kinzett *et al.*, has been leased to Hennessey & Thadich. Development is by shaft 40 feet and tunnel 60 feet.

Nipper Group.—The owners are Dale, Morton & Sheridan. The ledge has been stripped and a 70-foot tunnel driven.

ARLINGTON CAMP.

Saunier & Gachain are working the *Lake Vale* and have taken out 10 tons of ore. The ore is quartz galena. The development consisted of sinking and drifting.

GREENWOOD.

Argo.—Ola Lofstad, manager of the Argo Mining and Tunnel Company, Limited, was kind enough to give me the following report on the *Argo* mine, situated near Greenwood:—

"When work was stopped temporarily in July last the tunnel had been driven a distance of 1,800 feet at a depth of about 600 feet from the surface. Mr. Freeland, the Resident Engineer for the district, inspected the tunnel in August, 1917, and gave it as his opinion that the quartz-bodies apparent on the surface would be found at the contact of the granite with the lower formations. He thought we were too low to do this, and by making an upraise at the face, of about 100 feet, we would be likely to encounter the quartz. Following his advice, we put on three men to start the upraise at a point 40 feet from the face, and are making good progress with the same. Owing to the slope of the hill we should reach our objective in considerably less than the 100 feet estimated as required if started at the face."

Providence.—This mine is leased to J. A. Morrison and is owned by the Providence Mining Company, Limited. The property lies close to the City of Greenwood and has lain idle for the past ten years owing to the difficulty in obtaining a lease on the mine from the owners. The drift from the main shaft is now in 100 feet and high-grade ore has been encountered; seven men employed.

Freemont.—Situated near the *Providence*, in Greenwood camp, and owned by Dr. Kingston *et al.*, of Grand Forks, has been leased to Joseph H. Duhamel. A lead 3 inches wide has been struck; the ore is silver, gold, and copper. Two men are at present employed. One ton of ore is ready to ship.

King Solomon.—This mine, situated in Copper camp, near Greenwood, and owned by D. C. Corbin, of Spokane, Wash., has been worked steadily during the year. Reports indicate that this property is quite profitable to the owner. I am unable to obtain particulars as to quantity of ore shipped or values received.

Big Copper.—Adjoins the *King Solomon*. This mine is under lease to James Poggi, who shipped 683 tons of copper ore to the Grand Forks and Greenwood smelters.

Surprise No. 3.—Situated near the City of Phoenix and is under lease to Joseph Cunningham *et al.* A shaft has been sunk 50 feet. Ten tons of ore has been shipped to the Grand Forks smelter; the ore carries silver and copper values.

CAMP MCKINNEY.

Fifty-five mineral claims were staked in Camp McKinney during the year and six were leased under the "Taxation Act, 1916." Twenty-nine of these claims were transferred to the Consolidated Mining and Smelting Company of Canada, Limited.

OFFICE STATISTICS—GREENWOOD MINING DIVISION.

Locations (quartz)	108
Rerecords (placer)	4
Certificates of work	137
Free miners' certificates	161
Free miners' certificates (special)	3
Bills of sale	42
Abandonment	1
Agreement	1
Options	2
Miscellaneous	1
Filings	17

GRAND FORKS MINING DIVISION.

REPORT BY 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 1917.

In presenting this report, I would like to point out that, although there was more or less inquiry after mining property in the district, very little new work was commenced; some properties were bonded in the Burnt Basin camp and one or two on Castle mountain, near Cascade. The announcement that the *Little Bertha* and the *Pathfinder*, both situated on Granby river, near Brown's camp, are to start work again has been made; a new company having been formed for that purpose.

The *Union* mine, in Franklin camp, on Burrell creek, through the summer shipped 751 dry tons of ore, which averaged $31.80 a ton; during the same period 150 feet of drifts and crosscuts was made and 40 feet of incline shaft on the lead. The mine has closed down for the winter on account of the difficulty of hauling the ore in the winter-time to the rail-head, which latter is twenty miles from the scene of operations.

The *Emma* mine, at Denoro, in Summit camp, worked by the Consolidated Mining and Smelting Company of Canada, shipped 33,976 tons of ore to the company's smelter at Trail. The men employed on the mine numbered fifty-one, thirty-six of these being employed underground and the balance on the surface. There was little construction-work done on the mine, outside the new school-house. Development-work done during the year 1917 consisted of 1,302 feet of drifting and crosscutting and 573 feet of raising. The main shaft was sunk 34 feet and 3,056 feet of diamond-drilling was done on the property.

The Granby smelter at Grand Forks and the Granby mines at Phoenix were both handicapped by the strikes among the coal-miners in the Crowsnest coalfield; to illustrate this and to better describe the work done at the smelter and the mines, I take the liberty of introducing the reports of the two superintendents, as contained in the report for the year ended June 30th, 1917, of the Granby Consolidated Mining, Smelting, and Power Company, Limited.

Report of W. A. Bishop, superintendent of Grand Forks smelter:—

"The following report covers the local smelting operations for the year ended June 30th, 1917:—

"There were operated in the blast-furnace department the equivalent of 5.30 furnaces for the ten months' period, smelting—

Granby ore	673,742 tons.
Foreign ore	11,308 "
Anyox matte	40,139 "
Converter slag and matte	33,414 "
Flue-dust	2,988 "

"The average percentage of coke used per ton of ore was 13.55 per cent., and the smelting cost in this department was $1.564, as against $1.187 for 1915 and $1.237 for 1916.

"Detailed costs for year ended June 30th, 1917—

	Per Ton.
Smelter expense	$0.033
Sampling and assaying	.058
Shops	.009
Briquette	.005
Furnaces	.181
Slag	.056
Charge	.067
Coke	.987
Converting	.112
Workmen's compensation	.007
Anyox matte	.146
	$1.661

"This department produced 9,038,010 lb. of copper from Phoenix ores, 389,301 lb. of copper from foreign ores, and 8,122,142 lb. of copper from Anyox matte, being a total of 17,549,453 lb. The above copper was obtained from 29,200 tons of 30-per-cent. matte. Total smelting and converting costs for the year were $1.661 and loss of copper in slags 4.2 lb.

"A coke shortage caused by disturbed conditions at the coke-ovens seriously hampered operations during August and December, 1916, and January, February, March, and April, 1917. This finally culminated in a complete shut-down of the plant in May and June owing to an entire lack of supply.

"There has been no new construction during the year. Mention is made with pleasure of the continuous keen interest in the company's welfare as shown by all members of the organization."

Note by the Provincial Mineralogist.—The report of C. M. Campbell, superintendent of Phoenix mines, is quoted by the Resident Engineer (*see* page 201), and it is therefore unnecessary to reprint it here.

OFFICE STATISTICS—GRAND FORKS MINING DIVISION.

Free miners' certificates	130
Locations	86
Certificates of work	122
Filings	31
Certificates of improvements	4
Crown grants	1
Transfers and bonds	23
Leases of reverted Crown-granted mineral claims	2

OSOYOOS MINING DIVISION.

REPORT BY J. R. BROWN, GOLD COMMISSIONER, FAIRVIEW, B.C.

I have the honour to submit the annual report on mining operations in the Osoyoos Mining Division for the year 1917.

In the district as a whole very little increased production of ore has been accomplished, but considerable inquiries for possible mining propositions have been made.

At Camp Hedley the Hedley Gold Mining Company has been steadily at work, and with about the same results as formerly.

The *Dividend* and *Gold Dust* groups of claims on Kruger mountain have not shipped any ore during this year.

The *Horn Silver* mine, near Cawston, Similkameen, has shipped about 320 tons of ore at a gross value of $39 a ton.

The *Dolphin* group, near Olalla, has shipped about 80 tons at a gross value of $35 a ton.

The Stewart-Calvert Company, of Seattle, working the *Spotted Lake* properties, has taken out more sulphate of magnesia than in the year 1916; all this goes into the United States and is sold there.

The West Kootenay Power and Light Company is contemplating running a power-line from Trail to Copper mountain and passing through Camp Fairview. In consequence the company located a considerable number of mineral claims and leased several Crown-granted claims that had been forfeited to the Crown. These were taken up with a view to diamond-drilling, and no doubt, in the spring, some activity may be looked for.

OFFICE STATISTICS—OSOYOOS MINING DIVISION.

Free miners' certificates	65
Claims recorded	132
Certificates of work	93
Conveyances	22
Leases of Crown-granted claims	12
Total mining receipts	$3,010.06

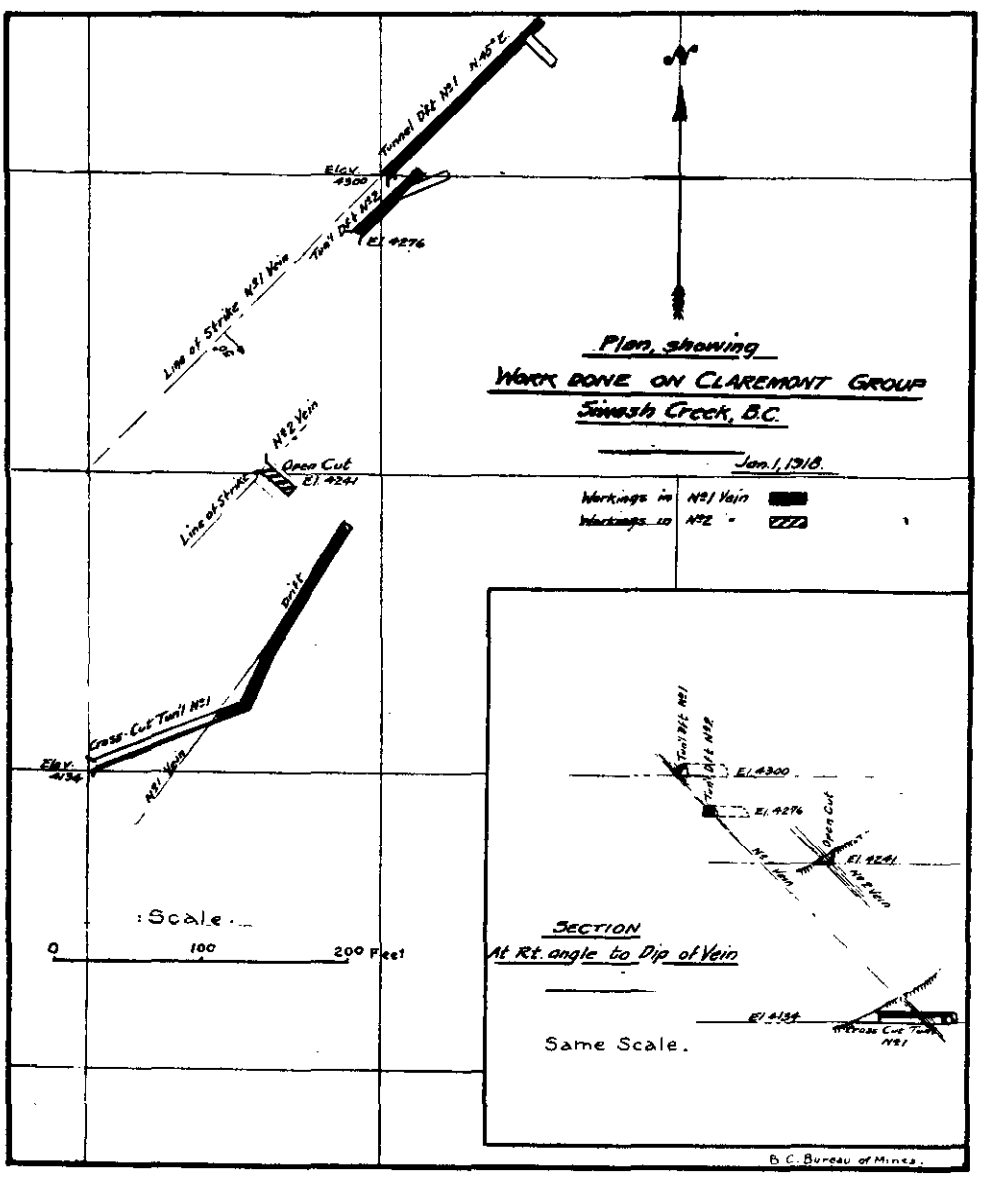
SIMILKAMEEN MINING DIVISION.

REPORT BY HUGH HUNTER, GOLD COMMISSIONER.

I have the honour to forward the annual mining report on the Similkameen Mining Division for the year 1917.

On the Tulameen river a number of men have been placer-mining in a desultory manner, and in most cases good wages have been obtained, the price of platinum having nearly doubled since last year. The Efanjay Syndicate is about to transfer its leases to a new company of Seattle, they not having sufficient funds to carry on the work. Mr. Schubert, of Tulameen, was unable to do much work on his claims, as the water gave out early in the season; he reports a clean-up of 3 oz. of platinum and 3 oz. of gold.

On Copper mountain the Canada Copper Corporation, Limited, is developing its property; a new tunnel is being driven to tap the lower ore-body. A site for the mill was purchased, which



is about four miles south of Princeton, and the proposed branch railway as at present surveyed goes through the property. Experiments were made at the cement plant on nodulizing concentrates, coal-dust being used instead of oil, and these experiments are reported a success. The company has entered into a contract with the West Kootenay Power and Light Company, pursuant to which it will extend its line from Greenwood so as to supply the necessary power for the operation of the properties on Copper mountain.

The Princeton Coal and Land Company mined 52,000 tons of coal during the year 1917.

Work has been resumed on the properties of the Columbia Coal and Coke Company at Coalmont by a Vancouver syndicate under management of Alexander Sharpe, and preparations made for shipping coal on large scale.

The yield of platinum for 1917 was approximately 57 oz. at $70 an oz.

The following report has been received on the *Claremont* group from the owners, the Claremont Syndicate:—

"All the work during 1917 was concentrated on the crosscut tunnel mentioned in last year's report, and a drift following the course of a vein intersected by this crosscut. This vein, we believe, is the same one followed by tunnel drifts Nos. 1 and 2. Wooden rails and ties hewn out of timber on the property were laid in the tunnel and drift. The rails were shod with strap-iron, and a small car is now used to transport material from the face of the drift. Both the car and the iron were packed in to the claims on horses at considerable expense. The total amount of work done in 1917 was about 250 feet of combined crosscutting and drifting. A blacksmith-shop and powder-magazine were built at the portal of the crosscut tunnel.

"As shown in the accompanying sketch, a vertical depth of 166 feet below the outcrop of vein No. 1 is attained at the intersection of this vein in the crosscut. This will give a very satisfactory section of stoping-ground if values corresponding to those at the surface are encountered on this level. Owing to winter conditions it is difficult to get to the claims, so at this writing it is impossible to state results and values obtained during the last three months, but work has been carried on steadily."

OFFICE STATISTICS—SIMILKAMEEN MINING DIVISION.

Free miners' certificates	196
Special	1
Location records	205
Certificates of work	286
Bills of sale (mineral claims)	39
Records of placer claims	12
Leases (placer claims)	3
Bill of sale (placer)	1
Powers of attorney	7
Certificates of improvements	4

CENTRAL DISTRICT (No. 3).

REPORT BY R. W. THOMSON, RESIDENT ENGINEER.

This district, with headquarters at Kamloops, includes the following Mining Divisions: Clinton, Lillooet, Kamloops, Ashcroft, Yale, Nicola, and Vernon.

LILLOOET MINING DIVISION.

Copper mountain lies approximately twenty-five miles almost due west from the junction of Gun creek with Bridge river. It is reached by taking the Bridge River wagon-road, which starts from the north shore of Seton lake at Mission, for a distance of thirty-five miles to the junction of Gun creek and Bridge river. From this point an old trail which has been used for many years for the purpose of taking hunting-parties into the Interior winds over two mountain-summits of approximately 6,700 and 7,300 feet altitude, again connecting with Gun creek (after traversing a distance of thirty miles) at a point about twenty miles from its mouth. Crossing to the south side of the creek and following it for a distance of four miles, then one mile up the south slope from an elevation of approximately 5,000 feet at Gun creek, to about 6,800 feet, which is the altitude of the floor of a sub-valley at the base of Copper mountain.

This elevated valley, which has probably been the bed of a mountain glacier, ranges in width from one half to three-quarters of a mile and is enclosed on three sides—the east, south, and west—by mountains; Copper mountain being on the east side. On the north it slopes at a steep gradient to a small lake, an expansion of Gun creek, the altitude of which is approximately 5,200 feet. Three small lakes or ponds at the head of the valley form the source of a mountain brook which would provide an ample supply of water for a camp of considerable magnitude.

Opposite page 80 of the Summary Report of the Geological Survey, 1915, is a geological diagram of the Bridge River area, accompanying a report on the area by Dr. C. W. Drysdale. Although the boundary of the ground covered by the report and map area does not reach within twenty miles of Copper mountain, the general physical features, flora, etc., as described in the report may be applied to the country in its vicinity.

Copper mountain is one of several peaks of a mountain range which runs in a general north-and-south direction, and is not more than approximately 1,200 feet above the level of the valley at its base; its peak altitude being about 8,000 feet. Geologically it probably belongs to and is contemporaneous with the Bendor Mountain formation, described by Dr. Drysdale, in the report referred to above, as Bendor granodiorite of the Coast Range batholith, Upper Jurassic period. A small cupola rising from the valley-floor at the foot of Copper mountain shows in miniature what the structure of the mountain is in a larger way. At one time quite a number of these small cupolas had apparently been scattered over the valley at the base of the mountain, but erosion and weathering has worn them away, so that there is little left now but the ragged bases and detritus. The orbicular structure of the granodiorite is a feature of Copper mountain, but on a much larger scale, the curved cleavage faces of the orbicular structure in some cases having a radius of curvature of 5 to 6 feet. There are several large dykes cutting through the country, but there was no time for a detailed investigation of these.

From the photograph of Copper mountain it will be seen that the foot is hidden by the talus broken down from the higher part of the mountain. Above the upper fringe of this talus, which has an average altitude of about 7,200 feet, the rock in-place is exposed along a horizontal distance of several hundred feet. At several areas along and above this line are fractured zones impregnated with the carbonates and sulphides of copper; similar occurrences could also be seen farther up towards the summit. No defined line of fracture or vein walls could be distinguished. A sample taken across 6 feet of one of these mineralized areas gave, on assay: Gold, trace; silver, trace; copper, 0.5 per cent.

The *Copper Mountain* group comprises twelve mineral claims covering considerable ground outside of and including Copper mountain. J. M. MacKinnon, of Vancouver, at present has an option on the group.

There are other mineral occurrences in the vicinity of Copper mountain; cinnabar has been found and also copper-glance (chalcocite). Over forty mineral claims have been staked in the immediate district. There was no opportunity, however, to investigate these.

A trail is being constructed up Gun Creek valley for the purpose of avoiding the long detour over the two mountain-range summits referred to in the first part of these notes.

KAMLOOPS MINING DIVISION.

Windpass Group.

This group consists of three mineral claims recorded as follows: *Windpass No. 1:* Owner, Olie Johnson; located June 7th, 1916. *Windpass No. 2:* Owner, T. H. Campbell; located June 7th, 1916. *Windpass No. 3:* Owner, Oscar Horgen; located June 7th, 1916. This group lies easterly from Dunn lake, a distance of approximately two miles on the crown of a small mountain, the altitude of which is by aneroid 5,150 feet.

The claims are reached by starting northerly from Chu Chua, a station on the Canadian Northern Pacific Railway, and taking the main highway on the east side of the North Thompson river for a distance of five miles, then a trail for a distance of three miles, the trail rising from an approximate elevation of 1,500 feet at the wagon-road to 5,150 at the mine-workings. The country-rock in the vicinity of the claims appears to be of a basaltic nature and probably belongs to the Kamloops volcanic group of the Lower Miocene period.

Although the claims are at an altitude of 5,000 feet, the rock generally is covered with considerable surface drift, on which is growing scattered patches of timber varying from scrub to fir a foot in diameter. There is a good two-roomed log house on the property.

Near the centre of *Windpass No. 1* is an outcropping of quartz containing magnetite, the sulphides of copper, and carrying some bismuth. This vein strikes in an east-west (mag.) direction and dips slightly to the north; it has been stripped for a distance of approximately 200 feet and two shipments of ore taken from along the surface, the smelter returns from which are given below. The average width of the vein is about 18 inches. It appears to be of primary origin.

Running north and south (mag.) across the claims, *Windpass No. 1* and *Windpass No. 3*, and continuing southerly through the adjoining claims, is a large dyke apparently of an aplitic nature. This cuts across the *Windpass No. 1* about 100 feet, to the west of the workings on the quartz vein, the intersection of which with the dyke has not yet been demonstrated. The easterly contact of the dyke has been traced for fully 3,000 feet; the westerly side has not yet been exposed, but the occurrence is of some considerable width.

The following are the smelter returns from the shipments referred to above:—

The Consolidated Mining and Smelting Co. of Canada, Ltd.

December 16th, 1916—

Dry weight of ore, 63,042 lb.

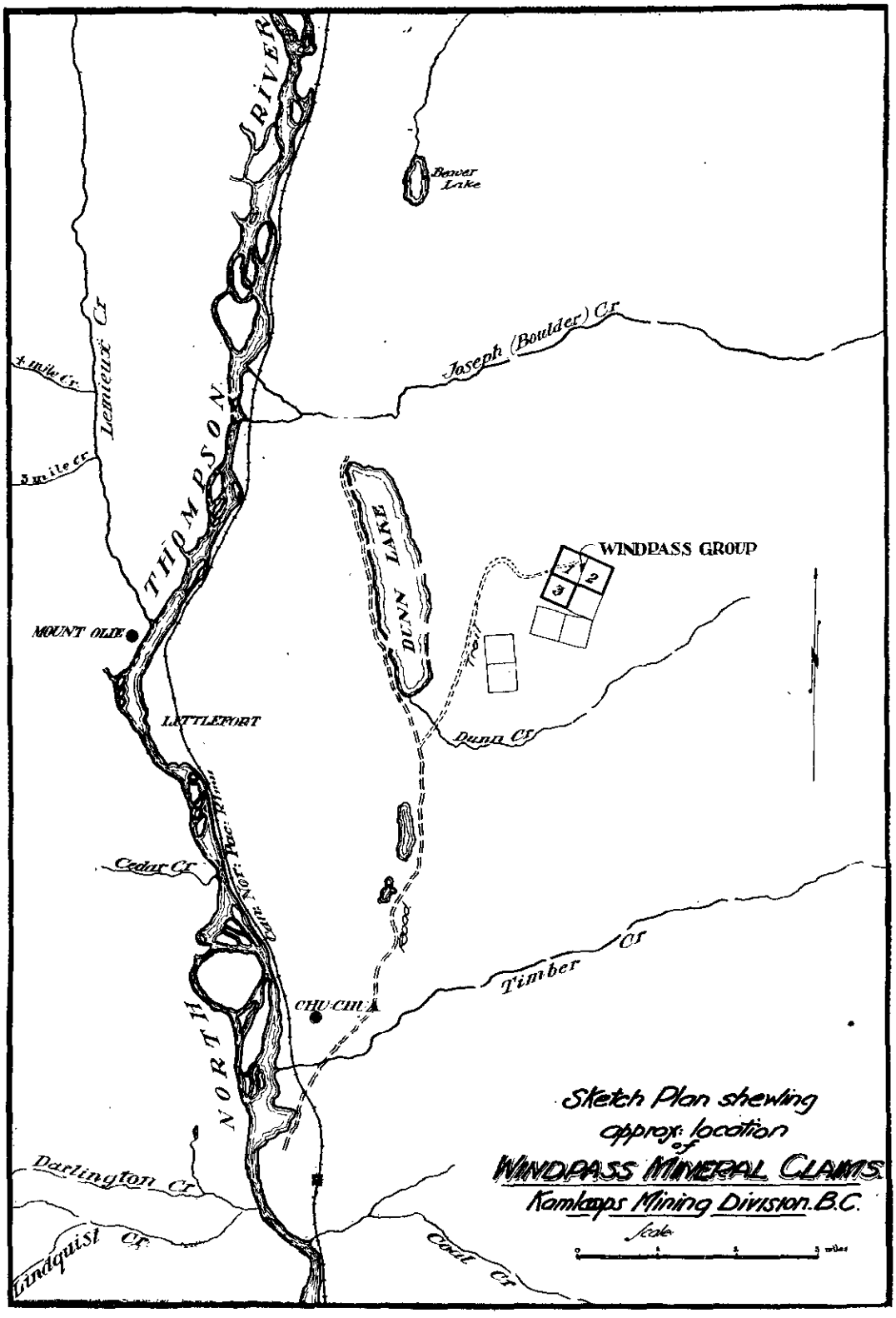
Assay values—

Gold, 2.40 oz. a ton.

Silver, 0.90 oz. a ton.

Copper, 1.46 per cent.

Gross value		$1,648 62
Treatment at $4	$126 08	
Freight from Kamloops	147 38	
Freight to Kamloops from Chu Chua	78 00	
Transfer costs	16 00	
		267 46
		$1,381 16


THOMPSON RIVER
Beaver Lake
Joseph (Boulder) Cr
4 mile Cr
Lemieux Cr
3 mile Cr
LAKE DUNN
WINDPASS GROUP
1
2
3
4
Road
MOUNT OLIE
LYTTLETON
Dunn Cr
Cedar Cr
South Thompson River
Timber Cr
CHU-CHUA
NORTH
Darlington Cr
Lindquist Cr
Coal Cr
Sketch Plan shewing
approx. location
of
WINDPASS MINERAL CLAIMS
Kamloops Mining Division. B.C.
Scale
0
1
2
3 miles

March 5th, 1917—

Dry weight of ore, 58,392 lb.

Assay values—

Gold, 2.14 oz. a ton.

Silver, 1.40 oz. a ton.

Copper, 0.58 per cent.

Gross value		$1,244 68
Treatment at $4	$116 78	
Freight from Chu Chua	224 04	
		340 80
		$ 900 88

The cost of transportation from the mine to the wagon-road by pack-horses and then by wagon to Chu Chua was $17 a ton. The mine was visited again on November 21st, 1917, when it was found that a shaft had been sunk to a depth of 30 feet from the surface, showing the vein dipping to the north at about 45 degrees. There was some water in the shaft, but it was stated that the vein showed a width of 2 feet at the bottom, with mineralization as good as that contained in the shipment. Appearances indicated that this statement could be accepted as reliable.

There are several other claims in the neighbourhood on which prospecting-work has been done, but no developments of particular interest have occurred.

Homestake.

The *Homestake* silver-mine is situated on the northern slope of Pass Creek valley, at a distance of approximately three miles westerly from Adams lake and eighteen miles from Louis Creek Station, on the Canadian Northern Pacific Railway, which is on the east bank of the North Thompson river, thirty-six miles north from Kamloops. A wagon-road runs from Louis Creek Station to Adams lake, passing within about three-quarters of a mile by trail of the workings on the property. The approximate elevation of the tunnel is 2,600 feet, which is about 700 feet above the level of the wagon-road where it passes through the lower claims of the property.

Holdings.—The mine holdings consist of four Crown-granted mineral claims, making a total, according to survey, of 191.44 acres. There are no buildings, those that were erected some years ago having been destroyed by fire. In the immediate vicinity of the workings there is very little timber, but on the lower claims of the property there is sufficient for mining requirements for some years to come.

Geology.—In the Annual Report of the Geological Survey of Canada, 1894, page 22A, Mr. McEvoy, in his report on the *Homestake* mine at that time, says: "The country-rock is a talcose schist." On page 349B of the same publication, Dr. Ferrier describes more technically a specimen from two miles up Louis creek, north side, as a "feldspathic actinolite schist." These two are probably contemporaneous in origin and development.

The Adams lake formation in which the *Homestake* mine is situated is regarded by Dawson as of Cambrian age. On page 24 of No. 59, Geological Series (Memoir 68), Geological Survey of Canada, 1915, Daly regards this formation as of Pre-Beltian (Pre-Cambrian) age, and farther on, in discussing the origin of these schists, states that there is not sufficient evidence to hand to warrant a definite statement as to whether they are a metamorphosed Pre-Cambrian sediment or an altered igneous rock, but that there is no doubt about the schistosity having been produced by the tremendous pressure of the at one time overlying formations, accompanied by high temperatures and probable permeation by aqueous gases. In the immediate vicinity of the *Homestake* mine the schist is extremely fissile in structure, and therefore will make very insecure walls for mining operations. The valuable metal is silver, which appears to be associated with galena and copper sulphide in a baryte gangue.

Workings.—The workings so far have been confined to the *Homestake* claim, on which the principal showing occurs. These consist of a tunnel 190 feet in length, running about due north (mag.) and cutting the formation at about right angles to the strike. The dip of the formation and the dip of the vein appear to coincide very closely. At the end of the tunnel the vein has been crosscut, showing it 8 feet in thickness on the west side of the tunnel. A drift has been run to the west on the foot-wall for a distance of 15 feet, where a fault was encountered cutting off the vein. On the east side of the tunnel a drift was started on the foot-wall of the vein in

a north-easterly direction, which at a distance of 32 feet from the tunnel has cut through to the hanging-wall, indicating considerable distortion in the ore-body. From the last-mentioned drift and at a distance of about 20 feet from the tunnel a raise has been put through to the surface, a distance of 130 feet on the foot-wall. Forty feet up this raise a drift has been run to the west, which at 18 feet encounters a fault cutting off the vein at this level. From this latter drift a crosscut raise has been put through to the hanging-wall, showing the vein at this point to be 16 feet in thickness. Underlying the vein throughout there appears to be an occurrence of quartz varying in thickness from a few inches to several feet.

There is a baryte bluff outcropping about 400 feet westerly from and at a level of approximately 300 feet above the main tunnel. Between these two there is a fault-zone which has a dip to the east, and it is the opinion of the writer that these two occurrences were originally in one body, and that their present relative positions are the result of normal displacement along the fault-zone referred to. This opinion, which is founded on observations taken underground and casually observed surface indications, may, however, on development-work being proceeded with prove erroneous. In this baryte bluff a crosscut tunnel has been driven a distance of 10 feet, giving an exposure in the face of 3 feet above the foot-wall.

Ore in Sight.—There is such a very small amount of ore which can be classified as "blocked out" that I shall make only a rough estimate of what might be classified as "ore in sight."

Taking the ore from the lowest level exposed, up to the drift west from the main raise, there is an area approximately of 53 feet in width by 70 feet on the dip, or 3,710 square feet. Assuming the average thickness as 12 feet (the mean between the thickness on west side of tunnel and the thickness in the crosscut raise) gives a cubic content of 12 feet by 3,710 square feet, or 44,520 cubic feet.

From the holing of the main raise at the surface the outcrop runs north-east a distance of 80 feet, where it dips under Falls creek, and at this point is 9 feet in thickness. Westward from the raise it outcrops for a distance of 100 feet, at which point it is 5 feet in thickness. Sketching this area out on the plan down to the upper boundary of the first-considered area, it will be found to assume the shape of a parallelogram having two parallel sides of 100 feet in length, with a perpendicular distance between of 70 feet measured along the dip as shown in the main raise, or an area of 100 x 70 feet, or 7,000 square feet.

Taking the average thickness of this area as the mean of 16, 9, and 5 or 10 feet, we get for its cubic contents 7,000 square feet by 10 feet, or 70,000 cubic feet. This gives as the total cubic contents of "ore in sight" in the vicinity of the workings 44,520 cubic feet plus 70,000 cubic feet, or 114,520, say 115,000 cubic feet.

This estimate does not take into consideration the ore extracted from the drifts and raise, the continuation in depth which has not been taken into account being assumed to compensate for this. G. S. Eldridge, of Vancouver, who made the assays for this report, determined the specific gravity of the ore from an average of eleven samples, and found it to be 4.14 or 7.73 cubic feet of ore a ton of 2,000 lb. On this basis the "ore in sight" from the above method of calculation amounts to 14,877 tons.

Values.—The results of sampling are as follows:—

Across 8 feet of vein at end of tunnel: Silver, 7.78 oz. a ton; copper, 0.22 per cent.; gold, negligible.

Across 16 feet in crosscut raise: Silver, 11.18 oz. a ton; copper, 0.25 per cent.; gold, 0.03 oz. a ton.

Across 9 feet face of outcrop at creek: Silver, 8.96 oz. a ton; copper, 0.15 per cent.; gold, 0.02 oz. a ton.

Referring to the sketch-plan, it will be seen that these sections lie roughly in a line across the centre of the ore-body estimated as "ore in sight." Taking the values found as representing the average at the respective sections and weighting them in proportion to the thickness of the vein at these sections, the general average will be found to be: Silver, 9.75 oz. a ton; copper, 0.22 per cent.; gold, 0.02 oz. a ton.

Treatment.—On account of the high specific gravity of the gangue, concentration by the ordinary methods, of jigs or tables, does not give satisfactory results, neither is the ore amenable commercially to the cyanide treatment. This leaves the "flotation process" as the only one from which to expect favourable economic results.

G. S. Eldridge, of Vancouver, as the result of some experiments on this ore, makes the following statement: "In regard to the question of flotation, I consider that ore going 10 oz. to the ton in silver could be concentrated to 100 oz. a ton; that is, a ratio of 10 to 1 would be obtained, and that a saving of at least 92 per cent., and probably up to 95 per cent., of the values would be recovered by means of a modified form of the flotation process, which would cost possibly 25 cents a ton more than the ordinary Minerals Separation method. It is possible that the Callow method might work on this ore. I have not tried it, but I could not get better than 65 per cent. with the Minerals Separation process on this particular ore."

Additional General Information.—Baryte bluff outcropping as shown on plan approximately 30 feet in thickness and 80 feet in length, 10 feet crosscut tunnel on foot-wall. Sample from face of tunnel across 3 feet from foot-wall up gave: Silver, 1.68 oz. a ton; copper, 0.20 per cent.; gold, trace.

Sample from surface across 6 feet running from 3 feet above foot-wall to 9 feet above foot-wall gave: Silver, 1.18 oz. a ton; copper, 0.10 per cent.; gold, trace.

Sample from 18 inches baryte outcrop in faulted zone 175 feet west from main tunnel gave: Silver, 11.66 oz. a ton; copper, 0.07 per cent.; gold, trace.

Sample of 1 foot of talcose parting between baryte vein and underlying quartz near creek gave: Silver, 3.72 oz. a ton; copper, 0.12 per cent.; gold, 0.02 oz. a ton.

Sample across 2 feet of quartz, which is several feet in thickness at this point, underlying last sample gave: Silver, 1.02 oz. a ton; copper, 0.19 per cent.; gold, trace.

During the years 1893-94 there was shipped from the workings 20 tons of high-grade ore, from which the smelter at Everett gave the returns as follows: Silver, 79.20 oz. a ton; gold, 0.18 oz. a ton; lead, 4 per cent. (approximate).

There is a streak of high-grade ore showing in the main raise running up to about 8 inches in thickness. This was not taken in with the general average as it did not show in the sections sampled.

There is a small creek running through the claims which has a fall within their limits of over 1,000 feet. This is large enough to supply all mining requirements and probably could be utilized to supply a certain amount of power.

In case of resumption of operations on this property, the logical procedure would be to continue development and at the same time operate a small experimental concentration plant of the nature suggested in Mr. Eldridge's statement, previously quoted, until such time as the quantity of ore developed and the demonstrated efficiency of the method of concentration would warrant the installation of works on a scale commensurate with these results.

ASHCROFT MINING DIVISION.

Snowstorm Group.

In the Annual Report of the Minister of Mines, 1915, there is a full and comprehensive report on the *Snowstorm* group of mineral claims by W. M. Brewer, M.E.; this also includes a summary of a report made by the Provincial Mineralogist in 1907. Mr. Brewer in his report describes fully the geology, ore occurrences, work accomplished at the time, and also gives plans of the workings and a map showing the location of the claims in relation to the railroads, wagon-roads, and physical features of the country generally. On page 87 of the Summary Report of the Geological Survey of Canada, 1915, there is a description of the *Snowstorm* group by the late Dr. C. W. Drysdale, followed by a statement on the geology and theory of mineralization of this neighbourhood.

At the time of the above-mentioned reports there had been shipped from the *Snowstorm* main workings slightly over 90 tons of ore, which from smelter returns averaged 30.06 per cent. copper, with small values in gold and silver. In this is included ½ ton of high-grade ore from a 3½- x 7-foot shaft situated about 275 feet in a S. 22° W. (mag.) direction from the main workings and apparently in the same line of strike, and which at the time of Mr. Brewer's visit was 15 feet deep. In June, 1916, this shaft had been sunk to a depth of 58 feet and a shipment of 40.5 tons of ore obtained from it and sent to the Trail smelter, the returns from which, as given by Stuart Henderson, were: Gold, *nil;* silver, 4.52 oz. a ton; copper, 23.71 per cent. At the time of the writer's visit this shaft was full of water to within 20 feet of the surface.

For the purposes of the following notes the *Snowstorm*, the *Channel* group, the *Guernsey-Jersey*, and the *Great Britain* group shall be considered as one.

At the time of the writer's visit in October, 1917, no work had been done on these claims for over a year, and the main workings on the *Snowstorm* were inaccessible, excepting the main crosscut or working tunnel. Samples were obtained from this where it crosscuts the vein and extended into the foot-wall rock, the assays from which gave:—Across 4 feet of main fissure: Gold, trace; silver, 1.30 oz. a ton; copper, 6.40 per cent. Next 5 feet of foot-wall rock (basaltic): Gold, trace; silver, trace; copper, 1.20 per cent.

The open-cuts mentioned in Mr. Brewer's report were caved to a considerable extent and the shafts inaccessible. However, a casual reconnaissance of the claims was made under the guidance of Stuart Henderson and samples taken where mineralized outcrops were exposed.

On the *Jersey* (old *Handball*) an open-cut showing mineralized disintegrated granite in a fissure striking approximately north-east and south-west (mag.) was sampled, and gave across 3 feet: Gold, trace; silver, trace; copper, 2.10 per cent. A similar showing 350 feet southerly from above and apparently in the same line of strike occurs.

Continuing in a southerly direction on to the *Guernsey* (old *Last Chance*, also *Football*) claim for a distance of 230 feet, an old shaft said to be 88 feet in depth is encountered. The vein at the bottom is said to be 3 feet 6 inches in width, and to assay: Gold, 20 cents a ton; silver, 1 oz. a ton; copper, 6.50 per cent. A grab sample taken from the dump, which did not appear to have been sorted, gave: Gold, trace; silver, 1.50 oz. a ton; copper, 5.50 per cent. Following along the same line of strike for a distance of 500 feet more, a small shaft 20 feet deep is met with, showing a fissure 4 feet in width, well mineralized, but as the shaft was inaccessible and the dump not defined no sample was taken.

Summing up the above, it would appear that there is extending through the *Jersey-Guernsey* claims a fissure or fissure-zone in the granitic country-rock at least 1,100 feet in length, well mineralized and probably of some considerable depth.

On the Channel claim is an old open-cut showing indications of a 4-foot fissure with strike approximately parallel to that running through the Jersey-Guernsey claims, and well mineralized with the carbonates of copper.

On the *Shetland* claim is an open-cut 150 feet in length, striking east and west (mag.), showing mineralization similar to that on the *Channel* claim.

On the *England* claim, in a narrow mineralized fissure in the granitic country-rock, there is a small outcropping of iron pyrites which gave on assay: Gold, trace; silver, trace; copper, 9.1 per cent.

On the *Iona* claim, on the crest of a rounded knoll, is an occurrence of a quartz-porphyry nature, stained with the carbonates of copper. This outcrops through the surface drift at different points over an area of at least 60 feet in diameter. A sample taken across 4 feet of surface exposure gave: Gold, trace; silver, trace; copper, 1.30 per cent. Stuart Henderson in his report states that an average sample taken over the different exposures gave: Gold, 40 cents a ton; silver, 3 oz. a ton; copper, 3.90 per cent.

TRANSVAAL, HIGHLAND, CONSOLIDATED, AND KEYSTONE GROUPS.

These groups of mineral claims are at an elevation of approximately 5,500 feet. Again referring to the map accompanying Mr. Brewer's report on this district as published in the 1915 Annual Report, it will be seen that these groups of claims lie about five miles in a north-westerly direction from the *Snowstorm* group.

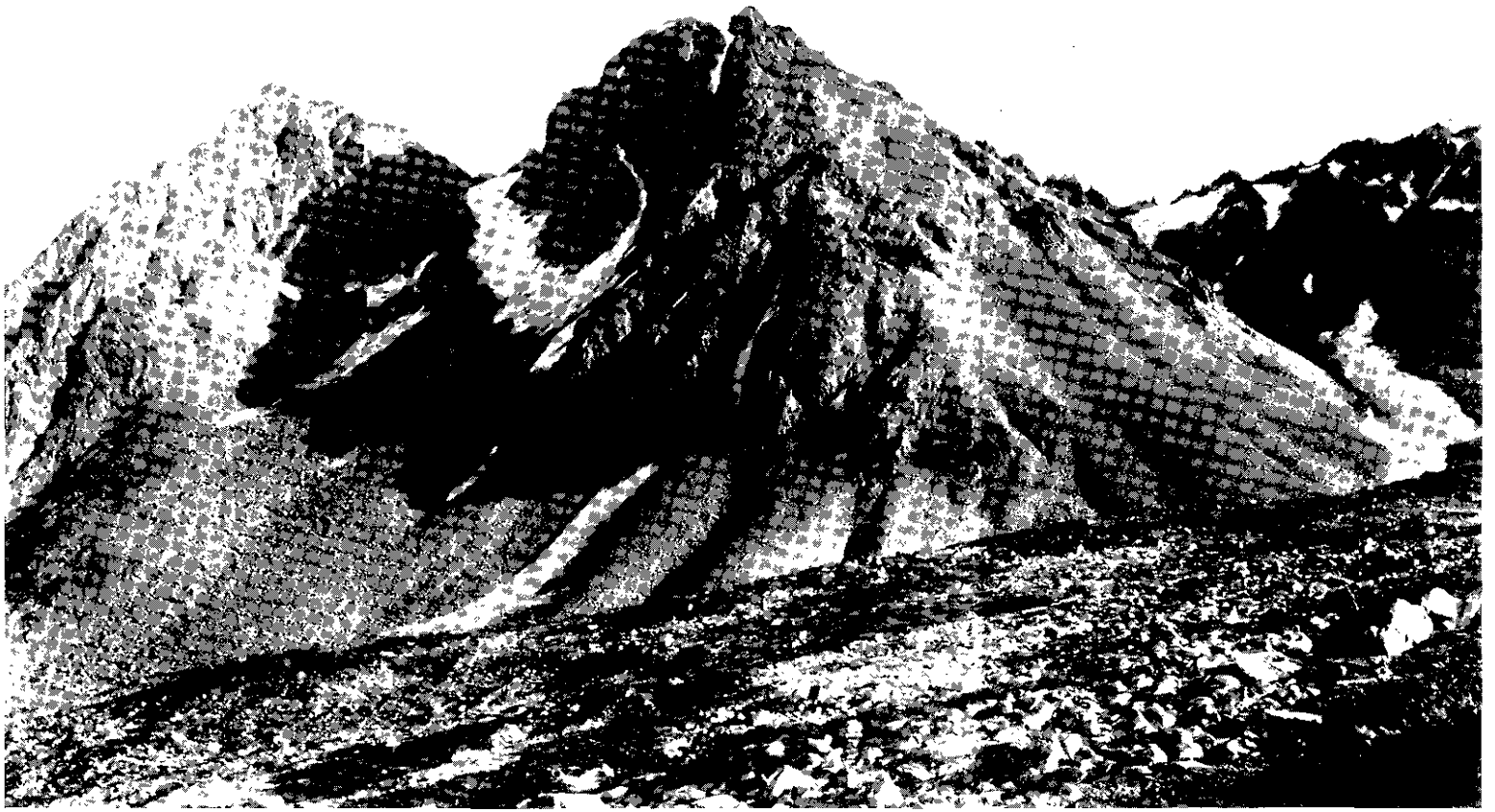
The names of some of the claims have been changed. The following are the alterations:—

Keystone Group.—Douglas Pine, altered to *Keystone; Waverly*, altered to *Calumet; St. Boniface*, altered to *Hercules; Snowdon*, altered to *Granite.*

Consolidated Group.—Ajax, altered to *Hecla; Leptento*, altered to *Copper Cliff; Copper Queen*, altered to *Consolidated.*

The position of the *Keystone* group as shown on the sketch-plan is incorrect, it having been moved over so as to adjoin the *Transvaal* and *Consolidated* groups, the intervening claims having been allowed to lapse; the workings as shown on the *Keystone* claim being now on the *Calumet.*

Transvaal Group. This group is in the same condition, as far as the main workings are concerned, as at the time of the Provincial Mineralogist's report as given in the 1907 Report. A grab sample taken by the writer from the dump at the main shaft on *Imperial* claim gave on assay: Gold, trace; silver, trace; copper, 1 per cent. During the past two years there has been considerable trenching done on the *Transvaal* group, the result of which has been the exposing of two parallel fissures on the *Chamberlain* claim and



Copper Mountain, Gun Creek, Lillooet M.D.

two on the *Transvaal* claim. The two on the *Chamberlain* have been traced for a distance of approximately 2,000 feet, running south into the *Ladysmith* claim and north into the *Imperial*. The vein-filling is similar to that described by the Provincial Mineralogist in the report above referred, being a black trap-rock showing carbonates of copper and low grade in value. The fissures run from 3 to 7 feet in width where exposed, and are approximately 100 feet apart. The country-rock is granitic.

Of the two on the *Transvaal* claim, No. 1 has been traced for a distance of 400 feet, striking in a north-south direction. From an open cut a sample was taken across 4 feet, neither wall being exposed. Assay results were: Gold, trace; silver, trace; copper, 1.30 per cent. No. 2 runs parallel at a distance of 100 feet, and has been traced for 700 feet. Both are in granitic country-rock and have the same appearance in regard to mineralization as those on the *Chamberlain* claim.

Highland Group. There have been no developments on this group since it was examined by Mr. Brewer, the report on which appears in the Annual Report for 1915, excepting that the shaft on the *Highland No. 2* mineral claim has been continued to a depth of 75 feet and a crosscut at the 55-foot level put in for a distance of 23 feet. This crosscut was run for the purpose of tapping a vein appearing on the surface, but had not reached it at the time work was stopped.

Consolidated Group. On the *Copper Cliff* claim a fissure has been exposed striking in a north-west (mag.) direction and extending in to the *Pretoria* claim, said to have been traced for a distance of 3,000 feet. Mineralization, dark-coloured trap-rock carrying carbonates. Country-rock granitic. A sample taken across 4 feet of vein-matter exposed in an open-cut gave on assay: Gold, trace; silver, trace; copper, 1 per cent.

On the *Hecla* claim are several open-cuts showing strong copper mineralization.

Keystone Group. On the *Calumet* claim of this group there is a rather remarkable showing of copper carbonates. The contact between the granite and overlying Kamloops volcanics runs roughly east and west (mag.) through this claim. The granite has been subjected to a very considerable degree of contact metamorphism and the effect of metasomatic replacement influences. It now has the appearance of a very minutely fissured rock uniformly impregnated with the carbonates of copper to such an extent as to conceal its real structure.

In this altered granite, at a short distance from the contact and roughly parallel to it, a tunnel has been driven for a distance of 78 feet. The first 13 feet from the portal is in loose surface drift. The remaining 65 feet is in the green-coloured altered granite. The mineralization appears to be uniform throughout the tunnel and no alteration is evident in the face. A sample was taken along 15 feet of the tunnel, which was fairly representative of the whole, and gave on assay: Gold, trace; silver, trace; copper, 1.60 per cent. The face of the tunnel is approximately 40 feet vertically below the surface. Some 140 feet to the south of the above is a parallel tunnel 25 feet in rock, to which the same description applies. This was not sampled.

Glossie Group. This group was visited by the writer in company with J. W. Burr, the owner, in October, 1917. No work has been done on the property for some time, and the shafts were inaccessible. W. M. Brewer's report on this property, given in the 1915 Annual Report, is from more reliable and fuller data than could be obtained at the time of the writer's visit.

Before closing these notes on a few of the properties visited in the Highland valley, it is fitting to add an extract from the report of the late Dr. C. W. Drysdale, as given on page 91 of the Summary Report of the Geological Survey of Canada, 1915, which is as follows: "The work that has already been done in Highland valley demonstrates the presence of copper veins within comparatively easy reach of the main line of the Canadian Pacific Railway. The veins occur in an area covering at least twenty square miles, are of high grade, although narrow, and are of deep-seated origin. With further careful prospecting and systematic development, it may be expected that sufficient quantity of copper ore will be blocked out to warrant the construction of a spur line to connect the Highland Valley camp with the Canadian Pacific Railway at Spatzum. Until such transportation facilities are afforded, it will be practically impossible to operate the mines successfully."

The above quotation refers to the country in which the *O.K.* mine of the Highland Valley Mining and Development Company is operating, as well as that covered by the preceding notes.

YALE MINING DIVISION.

Emigrant Group.

This group consists of six claims and one fraction situated on the South fork of Siwash creek, about seven miles from the town of Yale and five miles east from the Fraser river. In the sketch-plan attached it will be seen that they are tied on to the Roddick claim, which is the *Discovery* claim of the district and is Crown-granted.

In 1911 a geological reconnaissance of the Siwash Creek area was made by A. M. Bateman, of the Geological Survey. The following extracts are from his report:—

"The rocks underlying the area consist of a metamorphosed sedimentary series represented by slates, garnet-schists, mica-schists, siliceous schists, and thin bands of crystalline limestone.

"This series is intruded by the Coast Range granitic batholith and its accompanying acid and basic dykes. A small remnant of volcanic tuff overlying the granitic rocks is exposed in one locality. Glacial deposits are found along the borders of the stream.

"The gold without exception is associated with porphyry dykes and occurs in the porphyry itself, or in quartz veins along or adjoining the contact of the porphyry with slate. The gold is thus seen to be genetically dependent on the dykes, and the great number and wide distribution of these dykes makes it a promising field for prospecting."

Mr. Bateman tentatively refers the Siwash Creek series to the lower Cache Creek formation of the Carboniferous period.

Placer-mining on Siwash creek has been carried on intermittently for more than fifty years. In 1902 the Mount Baker and Yale Mining Company erected a 10-stamp mill on the west side of the forks; this was operated for only a short time. In 1911 the Martel Mining Company was operating a 6-stamp mill on the *Ward* claims, erected between the Middle fork and the North fork. This was operated for a short time only.

Both of these companies were organized with the expectation of being able to operate in a commercially successful way on the mineralized gold-bearing porphyritic dykes described by Mr. Bateman in the previously quoted extract.

During the past two years the Fagan Bros. have been working steadily on the *Emigrant* group of claims. The country-rock in the vicinity of the workings is the slate or argillite of the Siwash Creek series, very fissile in structure and dipping at a high angle. Attention was first drawn to this particular vicinity by the finding of "float" carrying gold values on the top of the west slope of the South fork of Siwash creek. This was traced in a north-west and south-east direction, but on account of the considerable thickness of surface covering the outcrop could not be located.

Coming down the north slope of the stream a short distance on the *Gold Road* claim, a tunnel (No. 1) was started in a north-westerly direction, and at 72 feet intersected a quartz vein 14 inches in width at about 15 feet vertically below the surface; this is said to contain good gold values; at the time of the writer's visit it was inaccessible. Next a tunnel (No. 2) was started about 90 feet vertically below No. 1, running in a north-westerly direction, which at 410 feet struck the foot-wall of the vein, and also a rush of water which washed out the timbering at the portal of the tunnel and prevented further progress for the time being. No. 3 tunnel was then started from the same portal as No. 2, but at an angle to the west. At 430 feet the vein was struck, and as this had drained the water from No. 2, work was resumed on the latter. The horizontal distance along the strike between the No. 2 and No. 3 tunnel-faces is estimated to be 80 feet; aneroid reading at portal of tunnel 2,000 feet. Work was resumed on No. 2 tunnel; an upraise of 14 feet was put in a short distance back from the face, and from this a crosscut was run through the vein, which at this point was said to be in the neighbourhood of 20 feet wide. It appears to be dipping north-west at a rather low angle, not more than 25 degrees. The vein-matter is a white quartz intercalated with bands and stringers of slate.

At the time of the writer's visit to the mine, October 30th, the vein and walls in No. 2 tunnel had caved to such an extent that it was impossible to secure a satisfactory sampling. Learning from the owners that Glen L. Thompson, M.E., of Prince Rupert, had sampled the vein a short time previous, when it was more accessible, he decided to ask Mr. Thompson for his results, with permission to use the same; this was kindly granted. The following is from Mr. Thompson's letter:—

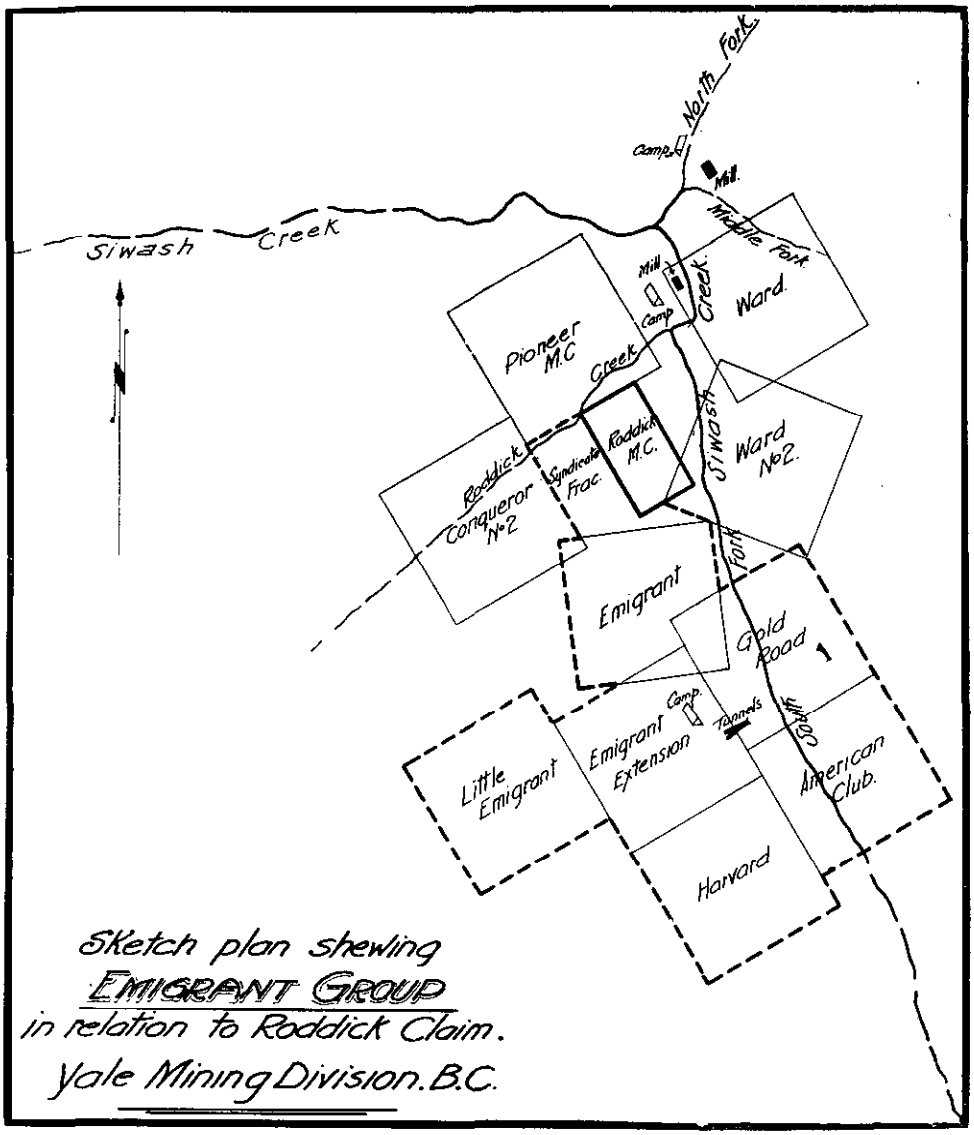
"My assays were taken across a face as exposed by the crosscut for a distance of about 12 feet from the foot-wall.

	Au, Oz.	Value.
12 feet south side of crosscut	0.48	$9 60
12 feet south side of crosscut	0.36	7 20
Section No. 3, 3 feet slate and quartz on foot-wall	0.19	3 80
Section No. 2, next 3 feet	0.08	1 60
Section No. 1, next 4 feet	0.12	2 40

"The above samples from the *Emigrant* mine, on the South fork of Siwash creek, Yale, B.C. Assay by C. S. Eldridge & Co., Vancouver, under date April 14th, 1917."

The above results would indicate that the values are on the hanging-wall side of the vein.

During the latter part of the year the owners were engaged in repairing the trail from the Fraser river up to the mine preparatory to getting in supplies, intending to erect during the winter a 3-stamp battery which had been secured. While this latter work was in progress the



storm which devastated the Fraser valley to such an extent early in January, 1918, destroyed the bridges up the trail, and the breaking of log-jams cleared the mill-construction away completely.

The latest news from the owners is that they are running a drift to connect the two tunnels along the hanging-wall of the vein, finding good values, and it is their intention to erect a 25-ton ball-mill on the property in the spring.

McIntyre Group.

This group of mineral claims is owned by Murdock McIntyre, of Merritt, B.C., and comprises a block of ten claims, staked two in width by five in length, or a rectangular block approximately 3,000 feet in width by 7,500 feet in length; the longer axis running east and west (mag.). The easterly and higher end of the block, where the mineralized exposures are the better defined, is approximately two miles and a half in a northerly (mag.) direction from Canford, a station on the Spences Bridge branch of the Kettle Valley Railway. This part of the group has an elevation of 4,000 feet and is reached by a two-mile trail running from the Nicola Valley main highway.

Striking north-south (mag.) across the easterly end of the block of claims runs a limestone occurrence, outcroppings of which can be traced for some considerable distance; on account of surface drift, however, the contact on neither side could be traced, but it appears to dip slightly to the west. This limestone has been subjected to great torsional strain as well as high pressures, which have resulted in imparting to it a comb-line appearance along the outcrop and an asbestiform structure. On the west side of this limestone the country-rock generally appears to be of a diabasic nature, probably one of the volcanics of the Nicola formation.

In a line at right angles to the general strike of the limestone-outcropping, and running westerly from it over a distance of several hundred feet, a number of open-cuts have been made in the country-rock. In these open-cuts the rock has a fractured structure, but in none of them is there any evidence of a vein or indications of vein-walls. They are all fairly well mineralized with the carbonates and sulphides of copper. From one of these open-cuts near the contact with the limestone, but which did not appear to be more highly mineralized than any of the others, a sample was taken across a 5-foot face, which gave on assay: Gold, trace; copper, 2.50 per cent. At the lower end of the property and approximately 3,000 feet westerly from the open-cuts mentioned some surface trenching has been done, but nothing of particular interest exposed.

Donohoe Mines.

Situated in Stump Lake vicinity. In the Annual Report (New Series) for 1887-88 of the Geological Survey of Canada, on page 69R, there is a report on the Stump Lake mines by Dr. G. M. Dawson, from which the following extracts are taken: "In the year 1887, 200 claims were recorded in the vicinity of Stump lake, and during the summer of 1888 I had the opportunity of examining a number of these, comprising all those upon which any considerable amount of work has yet been done. Some locations were originally taken up in this neighbourhood about six years ago, but prospecting-work appears first to have been undertaken in 1885. The principal developments are comprised within an area of about five miles in length, with a variable breadth, lying nearly north and south on the east side of the lake. The claims included in the property of the Nicola Mining Company and in the adjoining property of the Star Mining Company are those upon which the most extensive operations have been undertaken, confined, in the case of the first-named property, to development by means of several shafts and prospecting on the surface. In the case of the second, a small crushing and concentrating plant has also been established. Development and prospecting has also occurred to a considerable extent by the Mary Reynolds Company on the *Hepburn* group of claims, on the opposite side of the valley and farther south than those above mentioned, and from these, some of the richest ore, of which very satisfactory trial shipments have been made, has been obtained.

"The metalliferous veins which have been found within the limited district above defined are very numerous. They vary from about 10 inches to 5 or 6 feet in width, and some of them have been traced for a length of several hundred feet. Though it is probable, from the great number of veins which exist, that no single one will be found to be continuous for a very great distance, a large supply of ore is already assured. Most of the veins run with very considerable uniformity in a bearing a few degress west of true north, or from N. 10° W. to N. 30° W. (mag.). There are, however, a few which diverge widely from this direction, and two or three which run nearly

at right angles to it. The gangue is generally white quartz, and the principal metalliferous minerals present include iron and copper pyrites, galena, blende, and tetrahedrite. Assays made in the laboratory of the Survey run from 15 to 406.5 oz. of silver, with 0 to 6 oz. of gold a ton of 2,000 lb., according to the relative amounts of the various mineral constituents. The country-rock consists of altered volcanic materials of Palæozoic or Triassic age, and may be generally characterized as a diabase porphyrite, the most characteristic material in this place being a rock of green and green-grey colour with coarse porphyritic crystals of plagioclase and pyroxene."

In the Annual Report of the Minister of Mines, B.C., 1889, Mr. Hussey, the Gold Commissioner for the district, reports:—

"The *Mary Reynolds* claim, owned by John Hepburn & Company, has now three shafts—one 100 feet, one 75 feet, and one 35 feet—all on the same vein. Several drifts are also run from the 100-foot shaft a distance of 90 feet. From this claim 3,500 lb. of ore has been shipped to San Francisco, and the encouraging result of $168 per ton has been obtained. There are said to be $10,000 worth of ore on the dump averaging from $50 to $60 to the ton.

"On the *Jenny Long*, *Silver King*, *Silver Queen*, and the Star Company's claims nothing more than assessment-work has been done during the past season. The principal development-work done has been on the *Joshua*, *Tubal Cain*, and *King William* ledges, owned by the Nicola Milling and Mining Company, Limited (foreign), which run through Mineral hill, Stump lake.

"Work done on the *Joshua*—

	Feet.
Main double-compartment shaft	400
Air-shaft connecting with 100-foot level	85
Drifts on 100-foot level	175
Drifts on 200-foot level	220
Drifts on 300-foot level	350
Total	1,230

"Work done on the *Tubal Cain*—

Main double-compartment shaft	220
Air-shaft connecting with 50-foot level	40
Drifts on 50-foot level	160
Drifts on 116-foot level	300
Drifts on 220-foot level	200
Tunnel connecting with 116-foot drift	290
Tunnel to connect with 220-foot drift	400
Total	1,610

"Work done on the *King William*—

Main double-compartment shaft	175
Air and other shafts	75
Drifts on 100-foot level	180
Drifts on 175-foot level	102
Total	532"

From the above reports it will be seen that during the years 1887-90 there was quite an excitement around and considerable justifiable work done in the vicinity of Stump lake.

Referring now to a report by Dr. Dawson which is given in the 1894 Annual Report (N.S.) of the Geological Survey of Canada, page 334B, Dr. Dawson gives the assay results of several samples taken by his staff in the Stump Lake vicinity, which is followed by the statement: "Though scarcely any work has been done upon these deposits since 1890, partly in consequence of the general depression in mining matters, but in this instance also because of special difficulties of other kinds which have affected some of the companies chiefly concerned, there can, I believe, be no doubt that this district will ultimately become a mining centre of some little importance."

From the above extracts the general history of the Stump Lake vicinity in a mining way can be deduced up until 1894. Also the geology and mineralization is described and an opinion by so eminent an authority as Dr. Dawson is given in regard to its future as a mining camp.

Since 1890 until quite recently practically no work has been done in this camp.

In March, 1916, according to the Mining Recorder's report, eight Crown-granted claims were acquired by the Donohoe Mines Corporation; these included most of those mentioned in Mr. Hussey's report, the most important being the *Joshua*, *Tubal Cain*, and *King William*.

There is a good hoisting-engine at the *Joshua* shaft which was installed several years ago. A small concentrating plant consisting of a jaw-crusher, a tubular-steel-bar pulverizer, and two concentrating-tables was erected, and some ore from the old dump as well as some extracted from the workings on the *Joshua* claim was run through. At the time of the writer's visit the work was closed down and the mine full of water to the 100-foot level. A grab sample was taken from a portion of the dump, from which, according to the foreman's statement, the high-grade ore had been removed for concentrating purposes. This sample from the discarded ore gave on assay: Gold, 0.08 oz. a ton; silver, 20 oz. a ton.

The following is from a letter recently received from Frank M. Hawkes, secretary and treasurer of the Donohoe Mines Corporation:—

"SEATTLE, WASH., U.S.A., January 28th, 1918.

"The facts are that no machinery has been scrapped and we have no intention of discarding any of our equipment. We do intend, however, to add to our grinding units in order to increase the capacity of our concentrating plant.

"We shipped three car-loads to Trail smelter during 1917. The returns in gold values ranged from 3.04 oz. to 0.48 oz. a ton; in silver, 36.6 oz. to 24.8 oz.; in lead, 12.1 to 6 per cent. in copper, 1.17 to 2.59 per cent."

LILLOOET DISTRICT.

LILLOOET MINING DIVISION.

REPORT OF JOHN DUNLOP, GOLD COMMISSIONER.

I have the honour to submit the annual report on the progress of mining in Lillooet Mining Division during the year 1917.

MINERAL CLAIMS.

Bridge River.—The development-work done during the past season has been limited in character and confined to the few Crown-granted mineral claims on Cadwallader creek—viz., *Lorne*, *Pioneer*, and *Ida May* group.

Lorne Mine.—Length of tunnels driven, 532 feet; surface work, 120 feet of open-cuts averaging 4 feet wide by 6 feet in height, exposing seven different ledges; also 620 feet of gravity-tram line built to convey ore to stamp-mill. The manager of this property reports 1,500 tons of ore taken from tunnels driven on ledges, and milling same; no stoping was done. The tailings of such ore milled are reserved for further treatment. Gross value of ore milled, $22,500; after deducting cost of transportation and milling, a net return of $12,750, on which amount the tax of 2 per cent. is levied.

Pioneer Mine.—No particulars from the manager of this property have been given this office in respect to mining operations or amount of ore milled. I understand the owners have had a most successful season.

Ida May Group.—Operations on this property were resumed and work commenced early in May and continued until the month of October. The work consisted in driving and crosscutting several veins, disclosing in course some fine ore. It is the intention of this syndicate to erect a milling plant in the near future.

Wayside Mine.—Situated on Sucker creek, Bridge river. Development-work during the season was confined to No. 4 tunnel. This tunnel was extended into the hill to a depth of 510 feet. Several lenses of milling-ore from 30 to 40 feet long were encountered; one lens at its widest filling the fissures. The walls of this fissure remain constantly from 5 to 6 feet apart, with talc on both walls; but on the whole, so far, the filling met with has been heavily crushed wall-rock. No work was done on the other ledges this season, where good ore has already been disclosed in course of previous operations. The small mill was run a few times to test the machinery, but no collection of values was made.

Upper Gun Creek.—About forty miles from intersection with Bridge river, on Copper mountain, some promising locations owned by local parties, staked three years ago, attracted the attention of Eastern capital. These claims, with but little development-work, show fairly good values in copper, and further explorations in the same neighbourhood prove the extensive area of this newly discovered mineral belt. Examinations made by mining engineers, early, and late in the fall, I understand were favourable. Considering the location and difficulties encountered in reaching Copper mountain, the fact that capital can be attracted to outlying sections heretofore considered inaccessible should encourage the intelligent prospector in his search for hidden treasures. Many of the claims in this new field are held under bond, and I am informed that considerable development-work will be proceeded with during the coming season. In this connection a trail leading to the new camp was commenced and extended about 20 miles.

Pemberton Meadows.—In this section I include Owl creek and that northern portion of Lillooet lake lying in this Mining Division. Beyond the annual assessment-work done by the several owners there is nothing special to report. A small plant was introduced on Owl creek by the Copper Queen Mining and Milling Company; I have no information, however, as to the character of work done or results obtained. This latter remark may likewise apply to the properties situate on Seton and Anderson lakes. The molybdenite properties on Texas creek kept a small force of men, and development-work was proceeded with for about two months.

PLACER-MINING.

Golden Dream Mining Co.—This company, operating on the South fork of Bridge river, being unable to obtain delivery of the necessary machinery to handle the heavy ground, the leases were practically untouched during the season, and the Lillooet (B.C.) Mining Company did not resume work, nearly all the shareholders being with the Allied Forces at the Front.

Operations of the individual miner were confined to Cayoosh creek, Bridge river, and Fraser river. The recovery of placer gold, so far as I can account, is $2,979.18, showing an increase of $79.18 over 1916.

OFFICE STATISTICS—LILLOOET MINING DIVISION.

Free miners' certificates issued	213
Mineral claims recorded	308
Certificates of work recorded	213
Placer claims recorded and rerecorded	8
Mining and dredging leases in force	35
Conveyances, etc., recorded	69

Revenue.

Free miners' certificates	$1,529.00
Mining receipts, general	2,384.80
Tax, Crown-granted mineral claims	305.00
	$4,218.80

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, 1917.

As will be noted from the office statistics, the mining industry for the year 1917 showed no marked activity, the business transactions being very little more than last year.

The soda-deposits mentioned in last year's report have received considerable attention in the way of investigation during the past year and several new claims have been staked. The holders of the mineral claims at Chilko lake have been steadily continuing development-work, and now report finding molybdenite in considerable quantities. These claim-holders state that with a small amount of road-construction they can easily transport ore to salt water. There has been very little placer-work during this season. Since the close of the year and prior to the present date a number of claims have been staked in the vicinity of Clinton. These claims are stated to contain valuable chemical deposits largely used in the manufacture of steel. If these locations prove satisfactory it will make considerable activity in this division.

OFFICE STATISTICS—CLINTON MINING DIVISION.

Free miners' certificates (individual)	51
Mineral claims recorded	41
Placer claims recorded	22
Conveyances, etc.	15
Certificates of work	10

YALE DISTRICT.

NICOLA MINING DIVISION.

REPORT OF J. A. MURCHISON, 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, 1917.

Last year active development on two groups of mines was reported—the *Aberdeen* and the *Donohoe*. In the early months of 1917 the promise seemed good for continuous and profitable operation, but unfortunately the promise has not made good.

Aberdeen. This mine has shipped in the past two years a fair tonnage of ore of excellent grade. I learn that certain difficulties compelled the cessation of operations in the early fall.

Donohoe. This group of eight claims was operated by the Donohoe Mines Corporation, which confined its attention chiefly to the *Joshua*. Having on the surface a large tonnage of ore mined some thirty years ago, in addition to that mined by the corporation from the upper levels of the mine, it was decided to install a flotation plant to concentrate this. This plant was in operation for a short time during the summer. As a result of this, three car-loads were shipped to the smelter at Trail, giving returns as follows: 0.48 oz. to 3.04 oz. gold a ton, 24.8 oz. to 36.6 oz. silver a ton, 6 to 12.1 per cent. lead, and 1.17 to 2.59 per cent. copper.

It was found, however, that the grinding-machinery was unsuitable and inadequate and the property was closed down. During October, the mine having been unwatered below the 300-foot level, this was thoroughly sampled, and the management expresses itself as well pleased with the results. A directors' meeting was held in Seattle on the last day of the year, and it was decided to remedy the defects of the mill. Active work is anticipated in 1918.

The Donohoe mines are situated at Stump lake. Other interests in that camp are held by Dr. Bridgeman, of Vancouver, who spent his vacation in his customary manner, prospecting his holdings, with some encouragement; by Mansfield & Gardiner, of Victoria, who let a contract for some work toward the close of the year; and by Thomas Corwin, of Vancouver, who made an examination in December.

Aspen Grove. The Aspen Grove Mining Company, of Vancouver, operating under options of purchase of some forty-odd claims in the northern camp, began operations in hope of developing concentrations of ore that would permit of shipping with profit. In this they were disappointed. The manager informs me that he was not authorized to follow up low-grade ore, and is therefore unable to make authoritative statements as to quantity and quality; but he is of the opinion that in this camp very large bodies of commercial ore will be found, and that with modern metallurgical practice—i.e., flotation—a very profitable industry will eventuate.

About the end of the year H. H. Schmidt signed a lease on the *Big Sioux* for a term of five years. The lessee is R. R. Hedley, of Vancouver.

Lucky Mike. This undeveloped prospect, owned by Oscar Schmidt *et al.*, of Nicola, is said to have excellent surface promise. An opening was made by incline, and from this a car-load of ore was shipped, which carried 4.6 per cent. copper. The Granby Consolidated Mining, Smelting, and Power Company did a very limited amount of drilling on this, but results and conclusions were not made known. In November a Spokane company, the Northwestern Mines, Limited, took option of purchase on this property and let a contract in December for a 50-foot shaft which is in progress.

OFFICE STATISTICS—NICOLA MINING DIVISION.

Locations recorded	133
Free miners' certificates	145
Certificates of work	138
Bills of sale	17

VERNON MINING DIVISION.

REPORT OF 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, 1917.

I regret to say that very little was accomplished during the year 1917 in mining in this district, and there is nothing of importance or of moment to report.

The conditions brought about by the war—the absence of capital seeking investment in mines that are not at present producing anything, the scarcity of labour and the absence at the war of so many men who were formerly engaged in mining—have brought the prospecting and development work, that was going on at one time, to practically a standstill.

OFFICE STATISTICS—VERNON MINING DIVISION.

Free miners' certificates issued	69
Mineral claims recorded	16
Certificates of work recorded	20
Rerecord of placer claim	1
Lay-over	1

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, 1916.

PLACER-MINING.

Beyond an attempt by W. E. Adams and partners to sink a shaft on their Siwash Creek leaseholds nothing has been done in placer-mining. The banks and bars of the Fraser river have been abandoned by the Chinese in favour of steady employment at high wages in other industries. I am informed that the River Gold Recovery, Limited, is putting a gold-saving machine on a bar just below Hope.

QUARTZ-MINING.

Quiet development and assessment work has been carried on throughout the Division generally. A great number of properties have been idle owing to their owners having enlisted.

The *Emancipation* group, owned by Merrick, Thomson & Beech, situated some fifteen miles from Hope, in the Coquihalla valley, shipped 61 tons of gold ore to the Tacoma smelter, which netted slightly over $21,000. Development-work is being continued and a small mill has been purchased which will be installed as soon as weather conditions permit, there being large quantities of ore on the dump which would not pay to ship without previous treatment.

On the Pittsburgh group, which adjoins the *Emancipation*, a tunnel is now being driven by John O'Connell. Assessment-work has been done on nearly all the neighbouring claims and a great deal of the vacant ground has been located and recorded. What is stated to be a continuation of the *Emancipation* lead was found across the Coquihalla river on the divide between Pierre and Dewdney creeks, but the discovery was made too late in the season to allow of any development.

In the 23-Mile district (Hope-Princeton trail) work was continued by Frank Fritz and partners on the *Diamond* group, and on the *Defiance* group by Pennie, Robinson & Bears. C. H. Brown also had considerable work done on his claims. On other claims in this area assessment-work was done and a number of new locations made. This district can only be properly handled by large capital, as it is too far from present transportation to permit the prospector to bring his claims into a productive state.

Quite a blow was administered the Division when it was discovered that most of the Jones Lake area claims were found to lie in the New Westminster Mining Division. Some of the claims are, however, still on record here, particularly those whose owners have enlisted.

On the *Emigrant* group, on Siwash creek, Fagan Bros. have been continuously at work all season, from three to six men being employed throughout the year. The property was visited in October by R. W. Thomson, Resident Engineer for the Central Mineral Survey District. After considerable work in putting the trail and bridges in shape so as to carry pack-horses, the recent severe storms have done a great deal of damage. This will have to be repaired before any ore can be brought out or any heavy equipment taken in. A small mill, which fortunately is above the trouble on the trail, is at present being installed.

On Gold creek, opposite Spuzzum, MacDonald and the Miller Mining Partnership have had a small crew at work all season and intend continuing until they cut their lead on the *Admiral* group. This they hope to do about the first of April.

OFFICE STATISTICS—YALE MINING DIVISION.

Free miners' certificates issued	220
Special certificates issued	2
Locations recorded	179
Certificates of work issued	114
Bills of sale, powers of attorney, options, etc., recorded	55
Filings	18

Revenue.

Free miners' certificates	$1,117.75
Mining receipts, general	1,609.70
Revenue, other sources	400.40
	$3,127.85

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 1917.

There is practically no change in the situation since last year. The Highland Valley Mining and Development Company has been steadily working its mine and concentrator with good results.

OFFICE STATISTICS—ASHCROFT MINING DIVISION.

Free miners' certificates issued	112
Certificates of work recorded	113
New locations recorded	117
Conveyances, etc., recorded	15

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, 1917.

During the early part of the season a considerable amount of placer prospecting was done on the North Thompson river and tributary creeks, which resulted in several leases being applied for, but the applicants failed to complete their applications, which consequently lapsed. Outside of these operations there was practically nothing done in the way of placer-mining.

The interest and development in quartz-mining has been well sustained during the past year, which has resulted in the shipment of over 3,000 tons of ore, which would have been considerably more but for the closing-down for a time of the Trail smelter. The principal shipper has been the *Iron Mask* mine, which has employed a large force of men steadily throughout the year. This company is sparing no effort to make its property a large producer, as, in addition to the

ordinary development-work, a considerable amount of diamond-drill work has been done with satisfactory results; also a new oil-flotation plant has been installed, which it is expected will shortly double the output of the mine.

Trial shipments have also been made from the following properties: *Foghorn*, silver and lead; *Margaret*, silver and lead; *Maxime* group, copper; *Queen Bess*, silver and lead; *Windpass* group, gold. All these shipments have proved highly satisfactory to the various owners of the properties and will no doubt induce them to continue development-work.

The Granby Consolidated Mining, Smelting, and Power Company, Limited, has done some 180 feet of tunnelling on the *Copper King* and *McLeod* groups at Seymour arm, on which they have taken working options, which I understand have resulted in showing up a large body of copper ore. Work has been stopped for the winter, but is to be resumed in the spring.

A Seattle syndicate has taken an option on the silver-lead properties known as the *Queen Bess* group, at Black Pool, on which they have already commenced work, and it is their intention to erect a concentrating plant during the coming year.

The *Lydia* group of copper claims, owned by G. Fennell and associates at Chu Chua, has been bonded to W. H. Aldridge, of New York; the conditions of the bond called for immediate and continued development of the properties, and a large amount of supplies and equipment have already been taken into the claims and active work is now in progress, which will probably result in some shipments being made during the coming year.

On the *Fortuna* group, situated near Louis creek, a force of men are at work under W. J. Smith, who has a contract for the shipment of ore from this property, which he claims carries high values in platinum. It is also his intention to erect a mill near the property, for the site of which he is now making application.

The *Homestake* group, situated near Adams lake, has been bonded to Smith Curtis, who is making arrangements to commence development-work early in the coming year.

On the *Shamrock*, near Vavenby, Mr. Montgomery is driving a tunnel for a contact between porphyry and schist and is already in 135 feet. In this vicinity McDonald & Morrison have done considerable work on the *Last Chance*, *Fumarole*, and other claims, but no ore has yet been shipped. Mr. Morrison is at present negotiating with an American syndicate for the taking-over and working of these claims.

The outlook for this Division for the coming year is very good and should see a large amount of development-work accomplished and a considerable increase in the shipment of ore.

OFFICE STATISTICS—KAMLOOPS MINING DIVISION.

Free miners' certificates issued	297
Mineral claims recorded	254
Certificates of work issued	181
Bills of sale recorded	27
Mining receipts	$2,797.50
Mineral Acts	966.79

WESTERN DISTRICT (No. 6).

REPORT BY W. M. BREWER, RESIDENT ENGINEER.

OUTLINE OF THE REPORT.

The Western Mineral Survey District includes all that portion of the Province contained within the following Mining Divisions, that is to say: Nanaimo, Alberni, Clayoquot, Quatsino, Victoria, Vancouver, and New Westminster. This Survey District, and also five others, was created under the provisions of the "Mineral Survey and Development Act," an Act passed by the Legislative Assembly during the session of 1917.

Measured roughly, the Western Mineral Survey District has a maximum length of approximately 300 miles from north-west to south-east by 175 miles from north-east to south-west, including the area of the various islands between the mainland and the easterly side of Vancouver island, and contains approximately 48,000 square miles, including the area covered by the Gulf of Georgia, and the straits between the mainland and eastern coast of Vancouver island, approximating 3,000 square miles.

In the following report a detailed description of all the properties examined during the season of 1917 is given under the head of the Mining Division in which the properties are located, where either development was being carried on, or the prospects are sufficiently promising to warrant a description of them in the Annual Report.

The progress of the mining industry in the Western Mineral Survey District in 1917 has been characterized by more advancement, more prospecting, and greater production than in any year in the past. Of course, the increased production at the *Britannia* mine is responsible to a very marked extent for the improvement in the Vancouver Mining Division; as many prospectors were searching through the mountain, in the neighbourhood of that company's properties, for ore-bodies occurring under similar geological conditions. Another reason why prospecting was more popular in the district was the number of mining engineers who visited the various camps to make examinations of promising prospects in the interests of such large corporations as the following: The Consolidated Mining and Smelting Company, of Trail, B.C.; the Britannia Mining and Smelting Company, Limited, of Britannia Beach, B.C.; the Granby Consolidated Mining, Smelting, and Power Company, with headquarters at Vancouver, B.C.; the B. L. Thane Exploration Company, of Seattle, Wash.; as well as engineers who represented such important copper magnates as the Guggenheims, the Lewisohns, and the Dunn-Thompsons, of New York. In fact, there has been a more pronounced interest shown in the mineral industry generally throughout the entire Western Mineral Survey District during 1917 than has been the case for several years past.

The most popular sections for prospecting, so far as can be determined by the number of new mineral claims located during the past year, are: The Indian River district, Seymour creek, Jervis inlet, and Lynn creek, in the Vancouver Mining Division; the Alberni canal and Barkley sound, in the Alberni Mining Division; and the West arm of Quatsino sound, as well as in the vicinity of the *Old Sport* group, near Elk lake, reached from June Landing, on the South-east arm of Quatsino sound.

A very great portion of the season of 1917 was occupied by the writer in making examinations of properties for which applications for Government assistance for either wagon-roads or trails had been made. As these were scattered throughout the large district, where transportation was dependent on lines of steamers with infrequent schedules, considerable time was often unavoidably occupied by the writer in travelling from place to place.

During the coming season of 1918 it is hoped to so systematize the work as will permit examination of portions of the district of which at present practically little is known, except from the reports of a few prospectors and timber-cruisers who visited the sections some years back.

No attempt at any serious development of mineral prospects was made because of lack of transportation facilities and the comparatively low grade of the ore discovered. Some of these discoveries are reported as large bodies of low-grade ore, and if such reports are confirmed the discoveries are liable to prove of value. The "flotation" method of concentrating is found to be well adapted to nearly any one or all of the varieties of copper ore that occur in this district, and further water-power is very abundant and can usually be economically developed along the mainland coast or on Vancouver island. The transportation difficulties are not insurmountable, as while it is difficult to construct graded highways, owing to the swampy nature of much of the surface, there is as a rule an excellent supply of timber easily accessible for corduroy or planks, which make a good road-bed.

The most inaccessible portion of the Western Mineral Survey District is the interior of Vancouver island north of the Alberni canal, parts of which have even to-day been only partially explored. The mountains are high and precipitous, the underbrush has an almost tropical growth, and the fallen timber lies so thickly on the ground that the work of the prospector is seriously impeded; but with all of these difficulties to contend with, there are men who each year travel farther back into the bush in search for minerals.

The mineral resources of the Western Mineral Survey District include deposits valuable, or possibly valuable, for gold, copper, iron, coal, lime, clay, sand, gravel, and building-stone; but up to the present time the production on a commercial basis has been principally confined to coal, copper, clay, sand, and gravel, with coal and copper by far the most important.

The occurrence of coal-seams of commercial importance is confined to the eastern part of Vancouver island, although the coal-measures also occur on the western side of the island, where they outcrop at several places, the most important being at Port Alberni, also on Coal and Winter harbours, in Quatsino sound; but there has been no systematic development at either of those points, although large areas of land are held under coal licences in the Quatsino Mining Division.

The Nanaimo coalfield is the only one that has been examined in detail by the Canadian Geological Survey. This examination was made by Charles H. Clapp in 1911, and his report, which was published in 1914 as Memoir No. 51, Geological Series, will be referred to more fully in this report under the heading of the Nanaimo Mining Division.

Occurrences of copper ores are found in each of the Mining Divisions included in the Western Mineral Survey District, but by far the most important occurrence is on the property owned by the Britannia Mining and Smelting Company, on Howe sound, in the Vancouver Mining Division, which was examined by the writer during the past autumn and is described later in this report.

Several of the occurrences of copper ore on Vancouver and adjacent islands were examined during the season of 1916 and described in the Minister of Mines' Report for that year. Nearly all of these were re-examined during the past summer in order to enable the writer to note the progress in development.

The magnetite-deposits found on Vancouver and adjacent islands were all fully described by the writer in Bulletin No. 3, 1917, and as there has been practically no change in the development of these occurrences since that time, it is not deemed necessary to repeat the descriptions in this report.

That part of Vancouver island lying north-west of Campbell river near the north-east coast-line has received but little attention in the past from prospectors for metallic minerals, except by some who were searching for placer gold in black sand; but during 1917 several placer-mining leases were granted on the Nahwitte river and tributaries, which empties into Queen Charlotte sound nearly opposite to Hope island, and it is reported that considerable prospecting-work was done in the neighbourhood of Hardy bay owing to reports of the discovery of deposits of native copper in that vicinity. The usual amount of prospecting for placer gold in black sand along the north-easterly coast of Vancouver island was done during 1917, chiefly by settlers in the neighbourhood of Cape Scott, who report that comparatively small amounts of gold were recovered in sluice-boxes.

The coal-mines at Suquash, near Port McNeill, on the north-eastern coast of Vancouver island, were idle during the past year; these are owned by the Pacific Coast Coal Mines, Limited, of Victoria, B.C.

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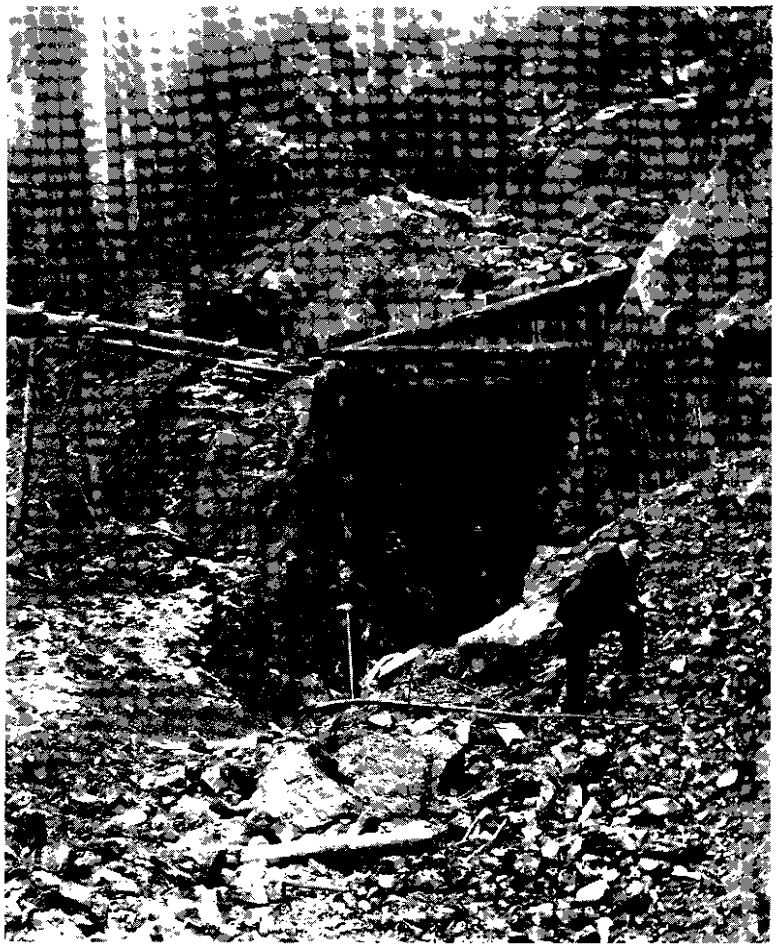

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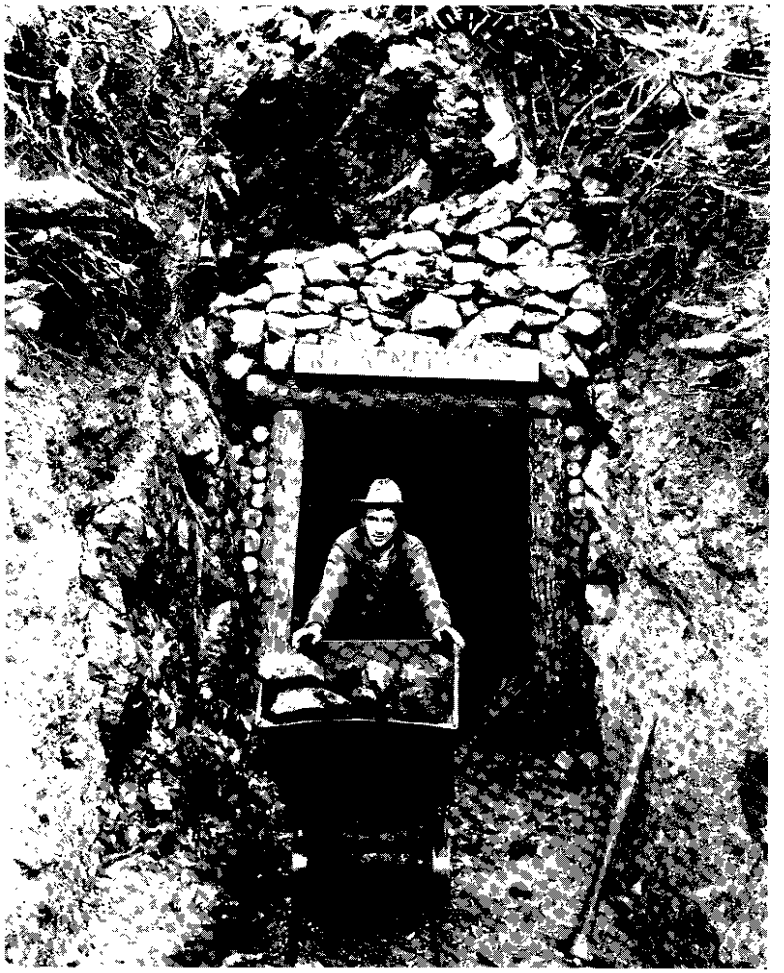

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It will be noticed from the foregoing list of publications that there are none, except the "History of the Britannia Mine" by A. E. Haggen, Bancroft's Memoir No. 23 on the geology of the coast and islands, and Le Roy's preliminary report on a portion of the mainland coast and adjacent islands, which describe the geology and mineralogy of the southern mainland coast or interior which are included in the Vancouver and New Westminster Mining Divisions. This is accounted for to some extent by the fact that Vancouver island and the adjacent islands were prospected at a much earlier date than the portion of the mainland referred to, and attracted the attention of the Geological Survey as early as 1871. Dr. A. C. Selwyn and James Richardson did the first geological work of any importance, when they explored the eastern coast of Vancouver island, and Mr. Richardson continued work on the coal areas of the island for four years afterwards. A final summary of his work is given in the Report of Progress, Geological Survey, 1876-77, pages 160-192, and is accompanied by a map.

In April, 1876, Dr. G. M. Dawson made a reconnaissance of Leech river and vicinity, paying especial attention to the origin and extent of the placer deposits. The result of his work in the southern part of the island is given in the Report of Progress, Geological Survey, 1876-77, pages 95-102, and in several papers published on the physical, glacial, and general geology of British Columbia.

In 1885 Dr. Dawson made an examination of the northern part of Vancouver island, and in the 1886 report of the Geological Survey, pages 1B-107B, made the most valuable of the published contributions to the geology of the island.

In the summer of 1902 Webster and Haycock made a cursory examination of the west coast of the island. Their report is published in the Summary Report of the Geological Survey for 1902, pages 54-92.

In 1905 Dr. H. S. Poole visited Vancouver island to collect data on the coal-deposits of the eastern coast. A summary of his work, chiefly of commercial interest, is given in the Summary Report of the Geological Survey of 1905, pages 55-59.

The palæontology of the Cretaceous rocks has been very fully described by Dr. J. F. Whiteaves in Volume I., Mesozoic Fossils, published by the Geological Survey, Part II. in 1879, and Part V. in 1903, and in other papers. Meek, White, and Woodward have also published

papers concerning the palæontology of the Cretaceous rocks. Professor J. C. Merriam has described fossils collected from the Tertiary formations of the west coast of Vancouver island, and has published his conclusions in the bulletin of the University of California, Department of Geology, Vol. 2, 1896, pages 101-108, and in two others papers.

Detailed notes of value on certain mineral claims, mining districts, and mineral industries have been made by the Provincial Mineralogist, W. F. Robertson, and by the Provincial Assayer.

INTRODUCTION.

The writer's previous work, done at various times since 1898 in the several mining camps in each of the Mining Divisions that are included in the Western Mineral Survey District, proved of very distinct advantage, and his general acquaintance with the owners of the several mineral claims gave him a personal knowledge of the conditions in the district which was of inestimable assistance to him in carrying out his work.

The writer is under obligations to so many persons for favours extended to him during the field-work season that it would require more space to mention each case individually than is permissible, so that he is compelled to make this general acknowledgment with sincere thanks.

The southern main coast only commenced to assume importance and attract the attention of prospectors about 1898, the year of the stampede to the Yukon, about which time the *Britannia* group of mineral claims was located, and when the mineral claims known as the *Dorotha Morton*, on Phillips arm, and *Douglas Pine*, near Shoal bay, were being developed.

Previous to that time, however, in 1892 the *Elsie* mineral claim had been located on West Redonda island for iron ore, and in 1893 626 tons was mined and shipped to the Oswego Iron and Steel Company's furnace in Oregon. In 1895 this mineral claim was Crown-granted to DeWolf & Munroe, of Vancouver.

So far as the writer can ascertain, the first mineral located on or near the southern mainland coast was at the southern end of Sechelt peninsula, where some development-work was done at a very high elevation by a Victoria syndicate as early as about 1875. Later, owing principally to lack of transportation, as the writer was informed by one of the locators, work was abandoned on the original discoveries, and has never been resumed. The claims were Crown-granted and are still held by some of the original discoverers or their heirs. Some mineral claims were located in the vicinity of and adjoining this old Crown-granted property about 1906 and some development-work performed, but this was suspended about one year later, and so far as known has never been resumed.

The following extracts are made from Bancroft's report in Memoir No. 23, Geological Survey of Canada, relative to the conditions on the mainland coast in the neighbourhood of Phillips and Frederick arms, about ten miles west of the entrance to Bute inlet:—

"Previous to the year 1896 very little prospecting had been done, but in that year the district about Phillips and Frederick arms and adjacent portions of East Thurlow and North Valdes islands came into prominence. A shipment was made to the Tacoma smelter which gave returns of $31.20 a ton. During the following year the absorbing attractions offered by the discovery of gold in the Klondike caused the development of these claims to be postponed. Many prospectors passed by on their way northwards to the Yukon, while some of the late arrivals stopped to investigate the mineral resources of more accessible areas along the coast. The years 1898 and 1899 were marked by great mining activity in the Phillips Arm district, and a stimulus was given to prospecting throughout the whole area. Many claims were staked and actual mining operations were begun upon some of them. The *Dorotha Morton*, situated west of Fanny bay, on Phillips arm, received the most thorough development. Extensive preparations were made for treating the ore. A Bleichert tramway, one mile and a quarter long, was built to carry the ore from the mine to a Blake crusher, 10-stamp Morison high-speed mill, and cyanide plant, which were erected on the shore of Fanny bay. From December, 1898, to October, 1899, 12,000 to 15,000 tons of ore was crushed and treated by the cyanide process, which yielded $90,000 in gold and silver bullion. The mine was then closed, the unfortunate reason being that the operators had exhausted all the ore they could find, and in doing so found that the nature of the deposit was such as to preclude the possibility of its turning out a mine in the true sense of the word.

"Extensive work was done upon other claims, small shipments being made from some of them; but when the *Dorotha Morton* shut down, operations were soon suspended upon the larger

number of the properties in the district. Work progressed on the *Blue Bells*, which is situated on Frederick arm, and on the *Colossus* group of claims, on Estero basin. On the former a tramway to the shore was constructed, and in 1902 a trial shipment of ore was sent to Tacoma, which returned $13.50 a ton in gold and silver. When the writer visited this district in 1907 all mining operations had ceased. The extensive equipment of the *Dorotha Morton* and the tramway of the *Blue Bells* were in a sadly dilapidated state, shafts were full of water, and some of the tunnels were impassable because of fallen rock.

"In 1906 development-work began on a number of copper claims on South Valdes (Quadra) island; in the summer of 1907 this island was the centre of the only mining activity within the whole area. Rapid progress was being made upon properties at Copper cliff, Gowland harbour, and in the vicinity of Granite bay. From the *Copper Cliff* mineral claim several small shipments had been made which gave satisfactory returns."

The history of mining operations in the vicinity of North Vancouver on Lynn and Seymour creeks, as well as in the mountains adjacent to Howe sound, dates back to about 1898, when the *Britannia*, *Goldsmith*, *Empress*, and other groups of mineral claims were staked. Since then active operations have been carried on continuously only on the *Britannia*. During recent years the Britannia Mining and Smelting Company, Limited, acquired by purchase the *Goldsmith* and *Empress* groups, as well as many other mineral claims in the neighbourhood of the original holdings of the company, which to-day places that company in the ranks of the big copper-mining companies in the world.

The history of mining on Vancouver and Texada islands was quite fully discussed by the writer in his report on the copper-gold-silver ore deposits on Vancouver and adjacent islands, published in the Report of the Minister of Mines for 1916, pages 304-360, so that it is not necessary to repeat the details in this report, but, as no reference to the coal-mining industry was made, the following brief synopsis is taken from the report of Dr. G. M. Dawson in the "Mineral Wealth of British Columbia," Annual Report, Vol. III., 1887-88, page 80B, 1889:—

"The discovery of coal in British Columbia antedated that of gold by more than twenty years, but did not at first produce any effect comparable with that of gold upon the history of the country. Dr. W. F. Tolmie was the first to make known the existence of coal on the coast of the Province in 1835. He was then stationed at the Hudson's Bay Company's post, known as Fort McLaughlin, on Millbank sound, and specimens of coal were brought to him by Indians from the north-east coast of Vancouver island, doubtless from Suquash. The steamer "Beaver," belonging to the company, arrived on the west coast in 1836, and thereafter small quantities of coal were obtained for her, as well as for blacksmiths' use, from this place, being derived from natural outcrops on the beach. In the year 1849 a coal-miner was brought out by the company from Scotland to more fully test the character of the coal on this part of the coast, and in 1851 a further number of miners and necessary machinery were imported. Exploratory work by sinking and boring was prosecuted along the coast of Vancouver island, between Port McNeill and Beaver harbour, till 1853, but without resulting in any notable discoveries.

"Meanwhile, in 1850, the existence of coal at Nanaimo had been ascertained by J. W. McKay, and in the following year it appears that most of the miners above referred to were transferred from the northern end of the island to that place. Work began in earnest at Nanaimo in 1852, and before the close of 1853, 2,000 tons was reported to have been shipped, chiefly to San Francisco. The price of coal at Nanaimo was at this time $11 and at San Francisco $28 a ton. The Hudson's Bay Company, under the name of the Nanaimo Coal Company, continued to work the mines thus opened until 1861, when these were sold to the Vancouver Coal Mining and Land Company."

Charles H. Clapp, in Memoir No. 51, entitled "Geology of the Nanaimo Map Area," published by the Canada Department of Mines in 1914, gives the following further account of the history of coal-mining in the Nanaimo district:—

"Most of the mining by the Hudson's Bay Company was probably carried on from the old shaft, now situated in the city of Nanaimo, west of Nicol street, although mining was done also on Newcastle island and on the shore of Commercial inlet (probably near the causeway on Commercial street), where coal, the upper (Douglas) seam, was first discovered. Under the Vancouver Coal and Land Company, which was reorganized in 1889 and called the New Vancouver Coal Company, most of the large collieries in the immediate vicinity of Nanaimo were opened up. In 1902 the properties of the company were taken over by the Western Fuel

Company, under whose management the collieries have been operated to the present time. The Western Fuel Company opened up the new Northfield Colliery, or, as it is better known, the Brechin mine, in 1905, and has recently completed two new shafts, 1,064 feet in depth, called the Reserve mine, and a slope, the Douglas mine, which was abandoned, it is said temporarily, during 1912.

"In 1869 or 1870 Robert Dunsmuir discovered coal about five miles to the north-west of Nanaimo, at Wellington, although it is reported that he first located the Harewood mine, which was, however, sold to the Vancouver Coal and Land Company and was first worked by them during 1864 and 1865. The Wellington Collieries Company, of which Mr. Dunsmuir was the first president and chief owner, was organized and began to produce coal from the Wellington mines in 1871, the coal being shipped for long-distance transportation from Departure Bay. The Wellington Colliery was a large producer for several years, but finally shut down in 1900. Meanwhile the same company had developed the Union Collieries in the Comox district in 1888, the Alexandria Colliery at South Wellington in the Nanaimo coalfield in 1895, and the Extension Collieries in the same field in 1899. The Alexandria Colliery was shut down in 1902, but the other two collieries have been important producers to the present time. In 1910 all of the property of the Wellington Collieries Company was taken over by the Canadian Collieries (Dunsmuir), Limited."

During 1917 there has been considerable history made in the coal-mining industry on Vancouver island, which has affected not only the two pioneer collieries, but also the smaller operators.

About a year ago a controlling interest in the Western Fuel Company changed and a reorganization of the company took place, when Thomas Stockett resigned as general manager, being succeeded by G. W. Bowen.

Under the new management the output of the mines has been very considerably increased, especially at the Reserve mine, which produced 86,805 long tons in 1916, but increased to 156,943 long tons in 1917. The Harewood mine was reopened on July 15th, 1917, from which a steadily increasing output has been maintained, reaching 700 long tons a day.

The company has been doing a great deal of diamond-drilling during 1917 with the view of opening at least two new mines during 1918. The location of these is not yet decided upon, but the probabilities are that one will be on the Company's farm westerly from and adjoining the city of Nanaimo, and another on the old Douglas mine, while a third new mine may be opened near the mouth of the Chase river.

The management of the Canadian Collieries (Dunsmuir), Limited, has been changed during the past year. The former general manager has been succeeded by J. M. Savage, of Victoria, with Thomas Graham, formerly Chief Inspector of Mines for British Columbia, as general superintendent. This company opened a new mine recently at South Wellington, about six miles southerly from Nanaimo, where a slope known as No. 5 mine is being driven. The company is also boring with diamond-drills near Craig's Station, on the Alberni extension of the Esquimalt & Nanaimo Railway.

The Granby Consolidated Mining, Smelting, and Power Company, Limited, after having bored several diamond-drill holes, has decided on the approximate location of the new mine-workings proposed on the coal lands that company acquired in 1917 near Cassidy Siding, about eight miles southerly from Nanaimo. A spur track three-quarters of a mile in length to connect the workings with the Esquimalt & Nanaimo Railway track is being built, also a large acreage is being cleared for the permanent mining camp, and it is expected that during the spring of 1918 this company will begin producing coal for manufacturing into coke at its copper-smelting plant at Anyox.

ALBERNI MINING DIVISION.

The chief centres of activity in the Alberni Mining Division during 1917 have been along the Alberni canal and on Copper island, in Barkley sound. As the various mineral claims in the Division were described in the Report of the Minister of Mines for 1916, the present report will be confined to descriptions of those properties only on which serious development-work has been carried on during the past year.

Monitor Group. This group of mineral claims was described on page 321 of the Report of the Minister of Mines for 1916, but since then new ore-bodies have been discovered on the *Monitor No. 1 Fraction* claim, close to the shore of the canal.

Following the partial development of the new discoveries, Samuel Ryder, of St. Albans, England, concluded negotiations through J. A. Skene, the mine manager, to purchase for cash the *Monitor* and adjoining *Happy John* groups of mineral claims, and authorized the construction of a wharf, bunkers, and power-house near the portal of the main adit driven on the newly discovered ore-body, which is about 40 feet above high tide; also the installation of a compressor plant, so that ore shipments can be made regularly to a Coast smelter.

The discovery of the ore-body mentioned, called the *Leonard* showing, was made early in 1917, when a contract was made to drive 150 feet along the strike and to make crosscuts to determine the width of the body at several points. This contract was later extended to continue the drift to 300 feet in length, at which point the face of the adit was when last examined on December 21st.

A survey of the workings determined that the new discovery is apparently an extension towards the south-east of the mineral-bearing zone, on which are the workings known as the Hedley open-cuts and shaft, from which a shipment of ore was made in the spring of 1917 that carried 8.65 per cent. copper.

Characteristics of the Ore-body.—The ore-body just mentioned occurs filling a lenticular fissure in a shear-zone in an igneous rock, probably gabbro, at some distance from the contact between the gabbro and a wide belt of crystalline limestone. The ore-body is a typical contact-metamorphic deposit, and the contact-zone is well defined and filled with such minerals as epidote, hornblende, and garnetite, which form the gangue material in which occurs the mineralization, made up of chalcopyrite, iron pyrite, magnetite, and occasionally some pyrrhotite. The outcropping, on which a drift-adit is driven, occurs as the face of a bold bluff about 50 feet from the water in a small bay about half a mile up Alberni canal from the mining camp. The full width of the mineralization had not been determined in August, 1917. Later, when grading was being done for a foundation for the compressor plant, it was found that the mineralized zone on the beach was about 15 feet wider than where it outcropped at the portal of the adit.

Apparently there is a zone of mineralization of possibly 30 or 40 feet in width, with its strike N. 60° W. and dipping vertically. The mineralization develops on both sides of a well-defined cleavage-plane that is probably a fault-plane, which has been followed in driving the drift-adit and forms one wall of the adit. Sometimes this plane is also a wall of the ore-body, but often the mineralization occurs a few feet on either side of the plane, and the permanent walls or boundaries are found several feet either to the right or left of the plane, where they are exposed by a systematic series of crosscuts made at right angles to the main adit.

Although quite a considerable tonnage of shipping-ore, averaging about 8 per cent. in copper with low gold and silver values, is practically assured and may be classed as "actual ore," yet it appears as though the ultimate value of the property will be found in the lower-grade ore, the extent of which, while yet undetermined, is apparently quite great, which should be treated by concentration by the flotation process.

Development-work.—The development-work done during 1917 has been confined to the *Leonard* showing, and consists of an adit about 300 feet long, with crosscuts in both directions made at right angles to the adit at intervals of about 50 feet. In addition to this underground development-work, there has been constructed a wharf, bunkers, and buildings for boiler and compressor-plants, blacksmith-shop, and powder-magazine.

Marble Cove Group.

This group contains five mineral claims called the *Marble Cove Nos. 1, 2, 3, 4, 5*, situated on the west side of Copper island, in Barkley sound, and owned by George and Andrew Smith and Carl Ulstrup, of Alberni. This group of mineral claims was examined on August 21st and 22nd, 1917, in company with the owners.

Characteristics of the Ore-bodies.—The main showing of mineral on the claims is about 900 feet in a south-easterly direction from a small bay on the westerly side of Copper island, where there is an occurrence of chalcopyrite typical of the contact-metamorphic replacement type of ore-deposits, but developed in crystalline limestone which has been partially replaced by ore some distance from the actual contact between the limestone and granite. The outcropping is lenticular in shape, and an open-cut made into it shows a width of ore of about 30 feet and a length of about 60 feet. A grab sample taken from the dump assayed: Gold, trace; silver, 0.1 oz.; copper, 2.3 per cent. The apparent strike of the ore-body is north (mag.), and as there

are no well-defined walls it is not possible to determine the dip, as the ore grades from a fairly solid body of chalcopyrite to small grains of chalcopyrite and iron pyrite disseminated through a siliceous gangue made up of some quartz associated with a greenish-coloured lime silicate.

About 600 feet in a southerly direction from the occurrence of ore referred to there is a wide occurrence of pyrrhotite and impure iron ore, that has a structure resembling a dyke, which strikes towards the south-east, or nearly at right angles to the general strike of the mineralized zone, and dips northerly at an angle of 70 degrees. On the southerly side of the pyrrhotite, about 100 feet distant, there are outcroppings of copper ore of fairly high grade, similar in their general characteristics to the occurrence in the open-cut first mentioned.

Since the examination the *Marble Cove* group of mineral claims has been bonded to James M. Russell, of Oak Bay, Victoria, who since has had a crew of miners at work on the property, but with what results is unknown.

Sudbury Pacific Group.

This group of mineral claims contains the *Ecole*, *Hoge*, and *Seddal* claims, situated on a point near the Ecole fishing-station, on Barkley sound, in a northerly direction from Copper island, and owned by George and Andrew Smith and Carl Ulstrup, of Alberni. The writer made an examination of this group of mineral claims on December 22nd, 1917.

The fact that samples of ore carrying nickel had been sent to the Bureau of Mines about that time, which were said to have been taken from this property, naturally gave the property especial interest, so that considerable disappointment was experienced in finding that the only showing of ore found up to that time occurred below mean-tide level and could only be examined at extreme low tide; fortunately, samples were secured which assayed:—No. 1: Gold, trace; silver, trace; copper, trace; nickel, 0.35 per cent. No. 2: Gold, trace; silver, trace; copper, trace; nickel, 1.9 per cent.

Geology.—The prevailing rock formation in the vicinity of the group of claims is diorite, or possibly granodiorite, and this rock on which the claims are located forms a bold point that stretches into the sea, and is fissured and fractured along a zone about 4 or 5 feet wide. The fissuring apparently forms a depression along the top of the ridge which can be followed, although no work is done, for quite a distance in a north-easterly direction. The fissure is filled chiefly with breccia having a banded structure, and containing small lenses of mineral made up mostly of pyrrhotite, with some arsenical iron associated with it. So far as the writer could see, the ore does not occur above mean-tide level, but, as no work had been done except on the extreme point, there was little from which to form an opinion. The samples taken represented in each sample 8 inches in width of mineral occurring in the banded breccia gangue material. The interesting feature about the prospect is that the ore carries some percentage of nickel, and is the first pyrrhotite ore found on the Coast that carries such values.

Canadian.

This property, situated on the Alberni canal at Murdock's Landing, about fourteen miles below the town of Port Alberni, was described in the Report of the Minister of Mines for 1916. At the time that examination was made the claims had only been staked a few weeks by George Dickson, in partnership with Wm. Hutton. Dickson left for service with the C.E.F. overseas soon after staking the claim, but Hutton, being physically unfit for that service, has since been working on the claim almost continuously. For that reason the writer made a second examination on August 14th, 1917, when he found that an adit had been driven 30 feet to come under an outcropping of high-grade chalcopyrite about 20 feet higher above. This adit would require to be driven about 5 feet farther in order to attain its purpose, provided the ore maintained the vertical dip shown in the open-cut.

The open-cut referred to is 28 feet long, 14 feet wide, and 14 feet deep at the deepest point. The ore mined from this cut has been sorted and occupies two dumps, on which there are about 50 or 75 tons of shipping-ore awaiting transportation to the beach, a distance of about one mile, preparatory to shipment to a smelter for treatment. The strike of the ore-body is N. 10° E. and dip vertical.

The ore outcrops on the right-of-way of the Canadian Northern Pacific Railway, and is exposed in a cut made for the grade of that railway, occupying a fissure in a shear-zone of contact-metamorphic rock some little distance from the actual contact, between it and limestone.

Samples taken from the dumps assayed:—Sample from closely sorted dump: Gold, trace; silver, 0.4 oz.; copper, 10 per cent. Sample from dump not so closely sorted: Gold, trace; silver, trace; copper, 6.9 per cent.

Victoria.

This group of mineral claims contains five claims known as the *Vancouver Island*, *Copper*, *Black Bess*, *Robin*, and *Blue Bird*, located about one mile and a half easterly from Murdock's Landing on Alberni canal. The grade of the Canadian Northern Pacific Railway crosses the *Blue Bird* and *Copper* mineral claims. The property is owned by W. H. Philpot, Levy Dendorf, and Gertrude Dendorf, of Nanaimo, and was examined by the writer on August 15th, 1918.

Geology.—The prevailing country-rock in the vicinity of these claims is granodiorite, which has been very much sheared and fissured. The extent of the shear-zone is not determined either along its strike or across its width. The strike is north and the dip of the cleavage-planes of the fissuring is practically vertical.

Characteristics of the Ore-bodies.—Chalcopyrite ore occurs filling some of the fissures in the shear-zone. The occurrences are lenticular in shape and average about 2 feet in width on the surface. At one point two main lenses of ore are exposed in an open-cut 85 feet long and about 20 feet deep, each lens being about 30 feet in length. Towards the bottom of the open-cut the ore-bodies are narrower than near the surface, and, although they appear to have wedged out at the bottom of the cut, it seems as though, if work is continued deeper, other lenticular deposits might be found.

All of the ore had been mined from the open-cut and carried in a wheelbarrow to a dump beside the railway-grade, a distance of 365 feet. A grab sample taken from the dump assayed: Gold, trace; silver, 0.2 oz.; copper, 4 per cent.

Development-work.—The development-work consists of the open-cut already referred to, as well as several other open-cuts along the strike of the shear-zone, and at one point the miners working on the property had faced up one of the open-cuts to start an adit to drift along the strike of the fissuring.

Bank Group.

This group of mineral claims contains the *Ghylbank*, *Hazel*, *Green*, and *Ore* claims, located on Mount Douglas, about thirteen miles easterly from Port Alberni and about one mile and a half by trail from the old hotel and road-house built about twenty years ago by Robert de Baux when the work was in progress on the *Golden Eagle* and *Consolidated Alberni* mines. The group, which is owned by James Dryden and I. B. Atkinson, of Port Alberni, was examined by the writer on August 20th, 1918.

Geology.—The prevailing country-rock in the vicinity of the *Bank* group of mineral claims is a much-altered metamorphic rock considerably fractured and sheared, in which occur quartz veins mineralized with iron pyrite, chalcopyrite, and a little galena. The strike of the main mineralized zone is S. 20° W. and dip of the fissuring varies from 20 to 40 degrees towards the north-west. The occurrence of the ore-bodies is at an elevation of about 1,950 feet above sea-level.

Development-work.—The development-work consists of a series of open-cuts on the *Ghylbank* claim and a shaft sunk below the floor of the largest of the open-cuts. The shaft is said to be 25 feet deep, but, being full of water at the time, could not be examined. There is also an open-cut and an adit on the *Hazel* claim, but these were caved so much that no examination could be made.

A grab sample taken from the dump at the mouth of the open-cut on the *Ghylbank* claim assayed: Gold, trace; silver, 1 oz.; copper, 3.2 per cent.

The extent of the mineralized zone is undetermined, but along the apparent line of strike it can be traced for several hundred feet, while the width of the mineralization is shown in the largest open-cut to be at least 10 feet.

The lack of transportation is a severe handicap to this property, as at present all supplies have to be hauled about thirteen miles by wagon-road, then packed about a mile and a half over a mountain trail.

CLAYOQUOT MINING DIVISION.

There was but little activity in mining operations in the Clayoquot Mining Division during 1917, except on the *Indian Chief* group of mineral claims on Sidney inlet, where the Tidewater Copper Company operated during the entire year in constructing a concentrating-mill to treat ore by the flotation process and in development-work on the ore-bodies. The following report on the property is made in detail because this is the first attempt to be made on the west coast of Vancouver island to adopt this method of concentration.

Indian Chief Group.

This group of mineral claims originally contained four full-sized claims and three fractional claims, all of which are now Crown-granted, but since the property was acquired through purchase by the Tidewater Copper Company in 1916 there have been added fifteen claims, some full-sized and others fractions, contiguous to the original group. The original group was staked in 1897 by two prospectors named Jones and Laidlaw, who located the claims up the mountain-side in a westerly direction from the beach on Sidney inlet in the following order: *Mephistopheles Fr.; Brutus No. 2; Scotlet Fr.; Victor;* the *Tinnecanum*, adjoining the *Scotlet Fr.* on the south-west; the *Victor Fr.*, lying to the south-west and south-east of the *Victor*, and occupying an irregularly shaped area on the summit of the mountain between the *Victor* and the *Scotlet Fr.* and *Tinnecanum;* and the *Leschi*, which adjoins the *Victor* on the south-east corner and the *Victor Fr.* on the north-east. The claims located more recently are grouped around and contiguous to those named, with four claims, in addition to the *Mephistopheles Fr.*, facing on the beach, thereby affording the property approximately 6,000 feet of water-front and occupying about the same width, extending westerly for about 7,200 feet.

Between 1897 and the present time the original property has changed ownership twice—first from the original locators to the Dewdney Syndicate, represented by the late ex-Governor Dewdney, of Victoria, and from the successors of the Dewdney Syndicate, prior to the death of Mr. Dewdney, to the present owners. In addition to the actual change of ownership, the property has been held under option of purchase by Barclay Bonthrone, of Vancouver, in 1898, who optioned it from the original locators, but failed to exercise the option after driving a drift-adit about 250 feet on the *Tinnecanum* claim.

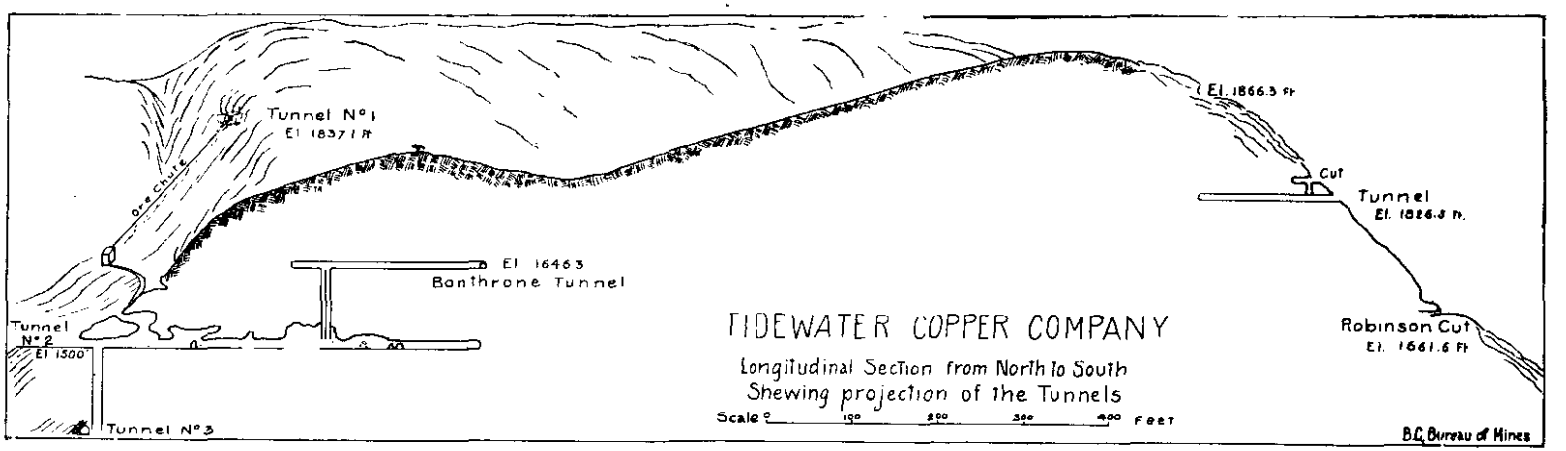
After reverting to the original locators the group of mineral claims was acquired by purchase by the late ex-Governor Dewdney for the Dewdney Syndicate, which performed some development-work on the *Victor* mineral claim near the north-westerly boundary of the group, and made a shipment of copper ore carrying about 18 per cent. copper, together with low gold and silver values. This was packed by horses from the mine-workings to the beach.

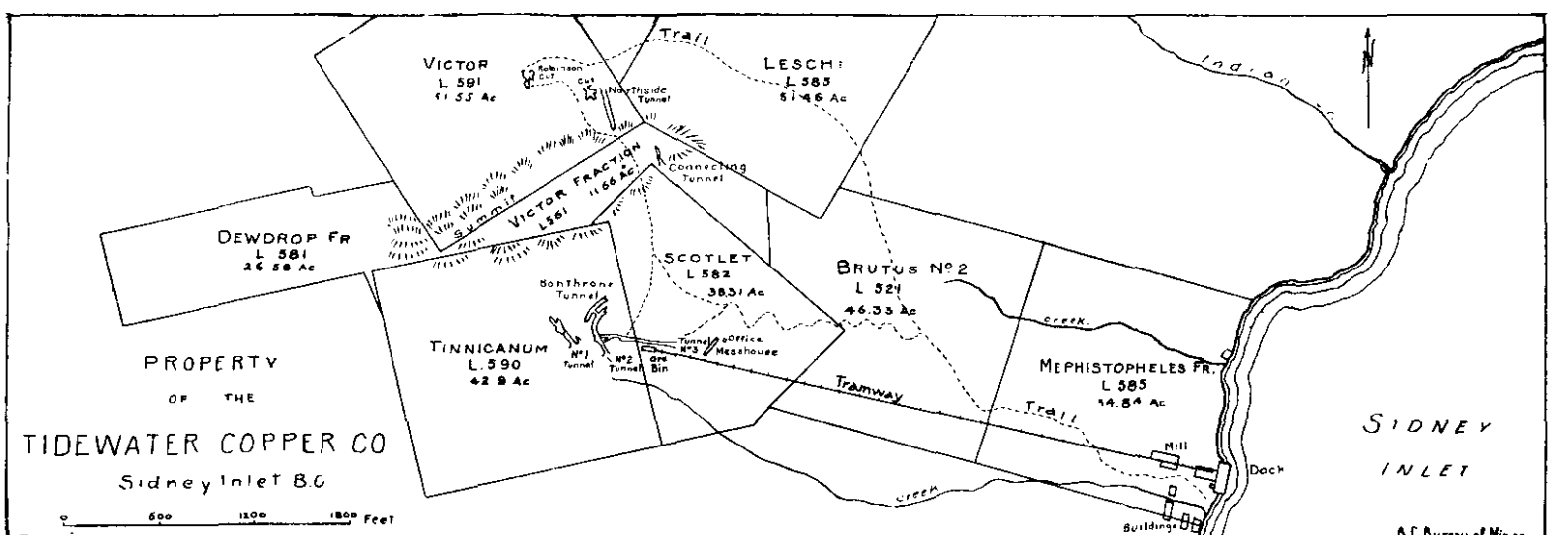
Early in 1907 the property was optioned by the Northern Exploration Company, of Seattle, which performed work on the *Tinnecanum* and *Scotlet* claims, also built a wharf, bunkers, and aerial tramway to connect the mine-workings with the beach. The length of the tramway is 2,500 feet and difference in altitude between terminals 1,550 feet. This company mined and shipped ore, as the development-work progressed, from pockets or lenses of bornite which outcropped on a steep bluff near the upper terminal of the aerial tramway, at elevations above sea-level of from 1,550 to 1,750 feet. The company performed only a limited amount of systematic development-work or prospecting-work, and sold out the option in 1908 to the Tyee Copper Company, which continued to mine and ship such ore as could be easily found without systematically prospecting or doing any dead-work, until 1909, when the management allowed their option to be cancelled, and the property reverted to Dewdney & Springett, successors to the Dewdney Syndicate. From that time the property remained idle until 1916, when an option was taken by Eden & Tanner, of Seattle, who disposed of it to the present owners, the Tidewater Copper Company, of which Sam I. Silverman, of Seattle and New York, is managing director.

An examination and further development showed that, while former operators had gouged out practically all the shipping-ore that could be found without doing systematic development-work, yet there was still some ore of shipping grade remaining near the old workings, but that the value of the property was represented by a "probable" and "possible" tonnage of low-grade copper ore well adapted to treatment by concentration by the flotation method. About 1,000 tons of shipping-ore was mined and shipped to the Tacoma smelter. Later construction of a concentrating plant to treat about 100 tons of ore a day was commenced in the spring of 1917 and completed in November of that year. The plant was first operated in December of that year, and was seen in operation by the writer during the first week of January, 1918.

INTRODUCTION.

The examination of the *Indian Chief* group of mineral claims was made between December 23rd, 1917, and January 6th, 1918, during which time an unusually heavy rainfall was experienced, but the absence of snow enabled as thorough an examination to be made of the surface as was possible, when the heavy growth of underbrush and quantity of fallen timber that covers the surface is considered.


Tunnel N°1
El 1837.1 ft
El. 1866.3 ft
Ore Chute
Cut
Tunnel
El. 1826.3 ft.
El 1646.3
Bonthrone Tunnel
Tunnel N°2
El 1500'
Robinson Cut
El. 1661.6 ft
Tunnel N°3
TIDEWATER COPPER COMPANY
Longitudinal Section from North to South
Shewing projection of the Tunnels
Scale 0 100 200 300 400 Feet
B.C. Bureau of Mines


VICTOR
L 591
41.55 Ac
Robinson Cut
Cut
Northside Tunnel
Trail
LESCHI
L 583
51.46 Ac
Indian
VICTOR FRACTION
11.66 Ac
Summit
L 581
Connecting Tunnel
DEWDROP FR
L 581
26.58 Ac
SCOTLET
L 582
38.31 Ac
BRUTUS N°2
L 524
46.33 Ac
creek
Bonthrone Tunnel
TINNICANUM
L 590
42.9 Ac
N°1 Tunnel
N°2 Tunnel
ore Bin
Tunnel N°3
Office
Mess house
Tramway
MEPHISTOPHELES FR.
L 585
14.84 Ac
Trail
Mill
Dock
Buildings
creek
PROPERTY
OF THE
TIDEWATER COPPER CO
Sidney Inlet B.C.
0 600 1200 1800 Feet
SIDNEY
INLET
B.C. Bureau of Mines.

The writer desires to convey his appreciation and thanks for many favours received to Sam I. Silverman, managing director of the Tidewater Copper Company; Peter E. Peterson, superintendent of the mill; Wesley Warren, general superintendent; and Lee Green, mine foreman; also to Leighton Stewart, M.E., of New York, for valuable assistance in working out the geology and general conditions surrounding the ore-bodies.

Owing to the fact that no previous geological work had been done in this section of Vancouver island the co-operation of Mr. Stewart was especially valuable.

GEOGRAPHY.

The *Indian Chief* group is situated on the west coast of Vancouver island in the mountains bordering the West arm of Sidney inlet. Sidney inlet is about twelve miles long and is a land-locked arm of Clayoquot sound, with its entrance from the open ocean between the west side of Flores island and Sharp point, on Vancouver island.

The only means of transportation is afforded by the Canadian Pacific Railway steamer, which makes a weekly schedule from Victoria during the summer months and a ten days' schedule during the winter.

The mountains in which the *Indian Chief* group is located rise very abruptly from the shore-line to an elevation of about 2,000 feet within a distance of about 4,500 feet. The main mountain range is cut by two torrential streams within the boundaries of the property, the largest being known as Indian creek. This creek carried apparently a sufficient volume of water and has fall enough to furnish power to drive the machinery in the mill as well as the compressor and electric-light plants, but this water-power has not yet been developed.

GEOLOGY.

The prevailing rock formations in this vicinity are limestone, grey granite, granodiorite, and another igneous rock resembling gabbro. The two last-named rocks are found to occur as dykes cutting through the limestone, which is considerably metamorphosed, but not sufficiently so to have obliterated the original bedding-planes.

The limestone is bluish in colour, usually very hard and considerably silicified, so much so that pebbles of it are used in the tube-mill in the concentrating plant.

There appears to be a main contact between the grey granite and limestone, but the actual line of contact is not well defined. Apparently the line of main contact is exposed only at one point, which is at an elevation of about 1,300 feet above sea-level, where it was exposed by grading-work done on the trail from the beach to the mine-workings.

There are apparently two main igneous dykes lying nearly parallel to each other and about 800 feet apart, which appear to mark the boundaries of the mineralization along a general north-easterly strike. These dykes dip nearly vertical and appear to have intruded into the limestone before the mineralization occurred, but what, if any, influence they have exerted with regard to the formation of the ore-bodies is very difficult to determine. In addition to these so-called main dykes, there are others which occur as intrusions in the ore-bodies.

The limestone within the boundaries of mineralization is very much more metamorphosed than it is outside of those boundaries, where the original bedding-planes are quite well defined and dip at varying angles from 5 to about 40 degrees. There is evidence of considerable shearing action having occurred within the boundaries of mineralization, the dip of the shear-planes being generally nearly vertical. The limestone has been replaced to a very great extent by such contact-metamorphic minerals as garnet and epidote, with which are associated magnetite, bornite, chalcopyrite, and pyrite.

From the shores of Sidney inlet the prevailing rock formation exposed along the trail up the easterly slope of the mountain is grey granite. At an elevation of about 600 feet above sea-level there occurs an exposure of hard, bluish-coloured, metamorphosed, silicified limestone, but the exposure is hardly of sufficient extent to determine whether it is "in-place" or only a bed of immense boulders which have been carried down the mountain-side from the near summit. Above this exposure the grey granite again occurs, and there is no change until a point on the trail is reached at an elevation of about 1,300 feet, where a fairly well-defined contact is exposed between the granite and limestone, much of which is replaced by garnetite and epidote, with some magnetite, bornite, chalcopyrite, and pyrite. This character of rock formation is continuous to the summit of a steep bluff at an elevation of nearly 1,900 feet above sea-level, and forms the most prominent outcropping of an ore-body on the property.

The southerly side of this bluff apparently forms the boundary of mineralization in that direction. A torrential stream has washed out a deep gorge under that side of the bluff, through which the water rushes to the beach, where it flows into the West arm of Sidney inlet at the beach camp of the Tidewater Copper Company. Apparently the watercourse marks the plane of an important fault which has cut off all sign of mineralization to the south of it, but no detailed examination could be made because of the quantity of water in the gorge and slide-rock on the side.

ORE-DEPOSITS.

The general character of the ore-deposits in the *Indian Chief* group is that of replacement of the limestone in a contact-metamorphic zone, but where the ore-bodies have been formed at some distance from the actual line of main contact between grey granite and limestone.

The ore-deposits are unique, in a measure, as while they belong to the contact-metamorphic type, they also occur filling fissures in shear-zones in the metamorphosed limestone. There are at present developed two prominent deposits of low-grade copper ore known as the south and north ore-bodies. The outcroppings of these occurrences of ore are separated from each other by the summit of the mountain range and a distance of about 1,500 feet, but if the underground workings on the south ore-body are extended about 800 feet and an upraise made to the adit on the north ore-body, a connection would be established and the relationship between the two ore-bodies be determined.

The outcroppings on the south ore-body occur as a prominent bluff, the entire face of which for a distance of about 500 feet in a westerly direction and for about 250 feet in a northerly direction is an almost continuous outcropping of limestone, much of which has been altered to garnetite, associated with which occur magnetite, bornite, chalcopyrite, and pyrite.

The mineralized rock at the surface strikes in a north-westerly direction and dips at an angle of about 40 degrees towards the north-east. At one point an igneous dyke has been intruded into the ore-body, which strikes north-westerly and on the surface is about 4 feet wide. In the underground workings this dyke forms a so-called foot-wall dipping at about 40 degrees in conformity with the general dip of the metamorphosed limestone in the bluff. On the surface ore outcrops on both sides of this dyke, but in the workings no crosscut has been made through it to determine whether or not the same conditions found on the surface prevail underground. The strike of the dyke underground is N. 55° W. It has been followed in the No. 2 adit for about 240 feet to a point called by the miners "the junction," where a cross system of fissuring occurs carrying ore having a northerly strike. The course of the adit is changed at that point, and the last-mentioned fissuring has been followed by the drift-adit along the northerly strike to the present face of the No. 2 adit, about 300 feet beyond the point called "the junction."

At a point about 500 feet westerly from the portal of the No. 2 adit there is a big open-cut, from which evidently a considerable tonnage of ore has been quarried. There is also an adit known as No. 1 adit or tunnel which was driven about 170 feet in a north-westerly direction in country-rock along a joint-plane, which may be a fault-plane and connected with the fault already referred to, and appears to be the south-westerly boundary of the mineralization in the south ore-body. This joint-plane strikes north-west, stands vertical, and cuts the bedding-planes of the limestone, which is less metamorphosed on the south-westerly side of the fault or joint plane than on the north-west side.

The foot-wall of the zone of mineralization is well defined in the vicinity of the No. 1 adit, which has been driven in country-rock under ore, but the hanging-wall appears to have been carried off by erosion at that point, as the outcroppings of mineralization show on the surface at the summit of the garnetite bluff, which extends from the No. 1 adit to about the No. 2, a distance of about 500 feet.

At a level 100 feet below the No. 2 adit there is the No. 3 adit, which has been driven in country-rock its entire length, evidently in the foot-wall of the ore-body exposed in the No. 2 adit, as is shown by the dip of the ore-body in the winze which connects the two adits.

Towards the north from the portal of No. 2 adit the mineralized outcroppings show for a distance of about 500 feet around the slope of the main bluff referred to, and as far as the portal of the adit known as the "Bonthrone" adit, driven at an elevation of 96 feet above the No. 2 adit. The "Bonthrone" adit exposes magnetite with some chalcopyrite in a garnetite gangue for nearly its entire length, about 250 feet.

The ore-body exposed by the No. 2 adit has been proven to maintain continuity to the level of the "Bonthrone" adit, as an upraise has been made from the No. 2, which is all in low-grade copper ore. The continuity of the same ore-body has been proven below the No. 2 adit for 80 feet by a winze sunk connecting that adit with the No. 3 adit at 100 feet lower elevation, in which ore is continuous for a depth of 80 feet, where the body apparently dips away from the winze and has not been followed.

On the surface at the summit, between the south and north mine-workings, there are several outcroppings of copper minerals associated with garnetite and epidote. No systematic development or prospecting work has been done either on the surface or underground to determine the occurrence of ore-bodies related to these outcroppings, except at the extreme north-western boundary of mineralization, on the *Victor* claim, where an occurrence of chalcopyrite in altered limestone and garnetite occurs next to an intrusive igneous dyke. The dyke strikes N. 60° E. and dips very nearly vertical, but the mineralized material strikes N. 60° E. and dips about 5 degrees towards the south-east. The dyke and mineralized material are exposed on the surface at several points for a distance of nearly 100 feet below the level of an adit driven about 150 feet in length in low-grade copper ore, and apparently crosscutting the mineralized zone diagonally.

In addition to the crosscut adit, there have been several large open-cuts made in the face of the bluff in which the adit is driven, from which high-grade chalcopyrite has been mined, several tons of it which was packed to the beach on horses about fifteen years ago and shipped yielding about 17 per cent. in copper in addition to low gold and silver values.

The south ore-body at the time of the inspection was exposed in the No. 2 adit for a length of about 480 feet, with a maximum width of 40 feet at the No. 3 or junction stope to a minimum width of about 5 feet in some other parts of the adit, also to a height of about 100 feet to the "Bonthrone" adit and a depth of 80 feet down the winze that connects the Nos. 2 and 3 adits.

Unfortunately, the development-work underground has not been sufficient in extent to determine further continuity of the ore-body in length, width, or to a deeper level. There are possibilities that the mineralized zone may occupy an area having its dimensions reaching from the igneous dyke on the *Victor* claim to the igneous dyke near the entrance of the No. 2 adit, or a distance of about 1,400 feet from north-west to south-east by about 500 feet from south-west to north-east, and that within that zone there occur bodies of copper minerals which occupy fissures in shear-zones in the altered limestone of sufficiently high grade to yield commercial values after treatment by concentration by flotation.

Until such further development-work is done it is impossible to estimate with any degree of accuracy the tonnage of available ore occurring on the property. There do not appear to be any well-defined walls, but merely a verging from vein material carrying low values in copper, gold, and silver to barren rock similar to the gangue material associated with the ore, and this change is usually erratic and irregular.

DEVELOPMENT-WORK.

The development-work on the *Indian Chief* group consists of several open-cuts, a series of adits, winzes, upraises, and slopes, as follows:—

On the *Tinnecanum* claim, at an elevation of 1,737 feet above sea-level, the No. 1 adit is driven 170 feet in a north-westerly direction, with a branch to right at a point 40 feet from the face, 20 feet long, and an upraise at a point 80 feet from the portal about 45 feet high. Several large open-cuts have been made at points near the portal of the adit in a north-easterly direction from it.

On the *Scotlet* claim, which adjoins the *Tinnecanum* on the east, at an elevation of 1,610 feet above sea-level, the bluff adit has been driven 20 feet in a northerly direction at an elevation of 1,550 feet; the powder adit has been driven 15 feet at the same elevation; at a point 160 feet east of the powder adit the old No. 2 adit has been driven 50 feet in a northerly direction, where it is intersected by the main No. 2 adit, the portal of which is at the same elevation and 100 feet farther to the east. The main No. 2 adit is 575 feet in length, with a winze sunk 88 feet deep to the No. 3 adit at a point 90 feet from the portal. There are four stopes opened off the No. 2 adit of the following dimensions: No. 1 stope is 35 feet long, of an average width of about 20 feet; No. 2 stope is about 40 feet long, of an average width of about 20 feet; No. 3 stope is about 65 feet long, of an average width of about 40 feet; and No. 4 stope is about 65 feet long, of an

average width of about 20 feet. About 100 feet north of the portal of the No. 2 adit, at the same elevation, there is an intermediate adit which has been driven 30 feet in a westerly direction; the No. 3 adit is 290 feet long, at an elevation of 1,462 feet above sea-level, with its portal 200 feet north-easterly from the portal of the main No. 2 adit and driven in a westerly direction; the "Bonthrone" adit is 245 feet long in a general south-westerly direction, at an elevation of 1,650 feet, with its portal 440 feet in a north-westerly direction from the portal of No. 3 adit. This adit is connected with the No. 2 adit by a raise on the foot-wall of the ore-body from that adit about 100 feet high, made at a point about 150 feet from the face of the No. 2, and making the connection at a point about 160 feet from the portal of the "Bonthrone" adit.

On the *Victor Fraction* claim, which adjoins the *Scotlet* claim on the north, an adit has been driven 140 feet in a north-westerly direction, at an elevation of about 1,650 feet, and construction of a surface tramway started to connect the portal of this adit with the upper terminal of the aerial tramway at the portal of the No. 2 adit. The adit on the *Victor Fraction* claim is driven in country-rock on the southerly slope of the mountain, with the intention of making a connection with the workings on the *Victor* claim on the northerly slope of the same mountain.

On the *Victor* mineral claim, adjoining the *Victor Fraction* claim on the north, there is an adit 160 feet long, at an elevation of about 1,730 feet and about 140 feet below the summit of the mountain. This adit is driven in a south-easterly direction. At about the same elevation and a few feet to the west of the adit there are large open-cuts and two short adits—one about 50 feet long, the other about 20 feet long. About 90 feet lower down the mountain-side and a short distance west of the adits there is an open-cut known as the "Robinson" cut, a short adit, and a shaft; the shaft being full of water could not be examined.

EQUIPMENT AT THE MINE.

The mine-workings are connected with the concentrating-mill at the beach by an aerial tramway 2,500 feet in length, with a capacity to transport about 28 tons of ore each hour. The upper terminal of the tramway is at an elevation of 1,460 feet above sea-level, while the top of the ore-bin is about 100 feet higher, or on the same level as the No. 2 adit, which is the main haulage-way and connected with the bin by a surface tramway.

A well-equipped blacksmith-shop is located at the entrance to the No. 2 adit. Air-drills are used in the mine, the air being delivered through a 4-inch pipe from the compressor, which is installed in the concentrating-mill on the beach.

The mining camp consists of substantially built bunk and cook houses, each two stories high, capable of accommodating about sixty men. There is a station on the aerial tramway on a level with the mining camp for the purpose of unloading supplies.

EQUIPMENT AT THE BEACH.

As the concentrating-mill of the Tidewater Copper Company at Sidney inlet is the first mill erected on Vancouver island for treating low-grade copper ores by the "flotation" process, the writer deems it advisable to describe the plant fully, so as to give an intelligent idea of it.

The concentrating-mill is operated under the superintendence of Peter E. Peterson, who was formerly with the Butte and Superior Mining Company, of Butte, Montana.

Starting at the lower aerial tramway terminal from which the ore is delivered into the ore-bin at the top of the mill, the equipment on each floor as the descent is made is as follows: The ore, which carries an average of about 1.5 per cent. copper and low-grade gold and silver values, is delivered on to a 1-inch grizzly, the oversize from which passes into a 10- x 20-inch crusher of the Blake type, and the undersize directly into a bin which is subdivided into two compartments, so that the undersize is fed directly into the tube-mill. The ore that passes through the crusher, where it is crushed small enough to pass through a 1½-inch ring, is stored in a compartment of the bin that feeds directly into the ball-mill. The total capacity of the ore-bin is about 500 tons. The ball and tube mills are on a floor about 20 feet lower than the grizzly floor.

The ball-mill is of the Morse Bros. pattern, 5 x 4 feet in dimension, and the tube-mill is of the Colorado Iron Works pattern, 5 x 22 feet in dimension. The ore contains many cherty pebbles of sufficient hardness for use for grinding in the tube-mill, instead of using imported flint pebbles, and there are so many of these that there are about 800 lb. in excess every hour

that pass through a trommel from the tube-mill. The trommel is fixed on to the discharge of the tube-mill and works automatically. The pebbles are valueless, as assays show, and consequently those that pass over the trommel are discarded as waste.

The discharge from the ball-mill passes into the tube-mill, and is added to the fine ore that is fed direct into the tube-mill after passing through the grizzly as undersize.

The undersize that passes through a 4-mesh screen in the trommel at the discharge end of the tube-mill passes into a home-made screw classifier, from which the oversize is returned to the feed end of the tube-mill, and the undersize, which will pass through an 80-mesh screen, passes into two flotation-machines, each having six cells, with a capacity of about 100 tons a day.

The concentrates from the cells are carried through launders into a Dorr thickener-tank 14 feet in diameter by 8 feet deep, in which the moisture is reduced to 60 per cent. From the thickener the concentrates pass on to a Portland filter, where the excess of water is removed, and it is expected to produce a concentrate carrying only 12 per cent. of moisture.

The oil for flotation is fed into the tube-mill with the ore. The oil used is a mixture of coal-tar and creosote, and about 3 lb. of oil is used to 1 ton of feed.

The concentrates from the cells carry about 20 per cent. of copper, while the tails carry about 0.25 per cent. of copper, but with good practice can be brought down to almost a trace.

The power at present employed in the mill is steam, which is supplied by a 300-horse-power boiler to a 180-horse-power engine which runs the ball and tube mills, and a 100-horse-power engine which runs the flotation-machines, thickener, filter, vacuum-pump, and dynamo for electric lights. There is also a separate boiler and 80-horse-power engine to run the compressor plant for the mine.

The concentrating-mill was first started up the beginning of December, 1917, and operated for twenty days previous to Christmas, when it was closed down because of lack of fuel, but started up again on January 1st.

It is the intention of the management to develop water-power in the near future from Indian creek, which empties into Sidney inlet about half a mile north of the mill, as well as from a smaller stream which empties into Sidney inlet at the beach camp. It is expected that 500 horse-power can be developed from the two sources. Indian creek will furnish water with about 320 feet of head, and the small creek with about 200 feet of head. The pipe-line from the Indian Creek head will be about 4,600 feet long to the mill, but that from the smaller creek will be considerably shorter.

The first shipment of concentrates was made about the middle of January to the Tacoma Smelting Company, with which Mr. Silverman has made a contract for the treatment.

The concentrating-mill has a present capacity to handle about 100 tons of ore a day, but by the addition of another flotation-machine with larger cells the capacity can be increased to over 200 tons of ore a day. The installation of water-power will decrease the costs of operating about $100 a day.

QUATSINO MINING DIVISION.

Early in 1917 it appeared as though there was to be phenomenal activity in the mining industry in the Quatsino Mining Division, because the development-work done by S. I. Silverman and N. S. Clark, who had a bond on the *Yreka* group of mineral claims in the fall of 1916, had resulted so satisfactorily that a new wharf, bunkers, and aerial tramway were erected in the spring of 1917 and a shipment of about 900 tons of copper ore was made. This ore proved to be of too low grade to warrant making regular shipments of the run-of-mine ore, and demonstrated that a concentrating plant was necessary to produce satisfactory results. Later, because the payments on the bond were not made when due, the owners of the property, Andrew J. Davis, of Butte, and James Breen, of Spokane, cancelled the bond, took possession of the property, and closed down operations.

Active operations were carried on during the past year on the *Old Sport* group of mineral claims, on Elk lake, by the Coast Copper Company, and prospecting with diamond-drills was carried on for most of the year on the Teta river, on the *Quatsino King* group of mineral claims, by the Granby Consolidated Mining, Smelting, and Power Company. In addition to these operations, the usual assessment-work was done on several mineral claims in the Quatsino Mining Division, but none were sufficiently developed to become producers.

Quatsino King Group.

This group of mineral claims contains the *Quatsino King*, *Paramount*, *Hillside*, *Alexander*, and *Eros* Crown-granted mineral claims, owned by the Teta River Mining Company, of Quatsino, but bonded to the Granby Consolidated Mining, Smelting, and Power Company. The group is on the Teta river, which flows into the South-east arm of Quatsino sound on the west side. There is on this group of claims an occurrence of an extensive body of highly siliceous agglomerate, made up mostly of quartz and angular pieces of a bluish rock, apparently a metamorphosed rock. The mass is cemented together, very much iron-stained, and occasionally carries impregnations of iron pyrites and a little chalcopyrite. As there are no walls defined, it is only possible to conjecture as to the strike of the mass, which appears to be towards the north-west, and the dip of the cleavage-planes in the body seems to be at an angle of about 70 degrees to the north-east. The property was originally located as a free-gold proposition, and was bonded by the Granby Company as a source of siliceous flux for the smelters at Anyox.

Development-work.—In addition to three diamond-drill holes which had been bored up to the time of the examination on October 15th, 1917, the original locators have driven four adits into the siliceous mass. The longest of these is about 250 feet and the shortest is about 20 feet. All of the adits except the last mentioned appear to be drifting along the strike of the body of siliceous material, while the shortest is crosscutting it. No samples were taken as it was not practicable to make a systematic sampling, and any other sampling would be misleading.

Old Sport Group.

This group was very fully described in the Report of the Minister of Mines for 1916, and it is not necessary to repeat that report here, so the description will be confined to the development-work done since the Coast Copper Company acquired the property in September, 1916.

Development-work.—On the main adit level the drift towards the north had been continued 100 feet beyond the face on September 1st, 1916. A short distance beyond the face of the drift at that date a diorite dyke occurs which was driven through to ore, and the ore, which varied in value from 1.5 to 4 per cent. in copper, was crosscut for 35 feet to the west. From there the drift was continued for 80 feet, and near the face a crosscut is made to the east in ore averaging about 1.3 per cent. This crosscut is about 10 feet long and there is no foot-wall yet exposed.

An incline winze is sunk to a depth of about 525 feet from the level of the main adit at the point where the ore-body was intersected by the adit about 400 feet from the portal, and 90 feet from the bottom of the winze a station is cut, and drifting in both directions from the station was in progress when the writer saw the work.

The winze is sunk at an angle of about 30 degrees, and for 60 feet from the adit level the vein was followed on the foot-wall, and the ore averaged between 2 and 3 per cent. in copper, with from 80 cents to $1 a ton in gold and traces of silver. Below 60 feet a dyke occurs 20 feet wide, through which the winze is sunk into low-grade ore which continued down to 260 feet, where a fault is exposed that threw the foot-wall of the vein down an undetermined distance. The winze is sunk through the fault, and at 286 feet depth mineral is exposed, but no foot-wall is exposed until 300 feet in depth is reached, where the regular diorite foot-wall occurs. From this point the vein is regular, carrying magnetite and chalcopyrite in a garnetite gangue, and continues fairly regular to the bottom of the winze.

At 353 feet below the adit level a band of limestone is exposed in the roof of the winze, associated with garnetite and crushed diorite and carrying impregnations of chalcopyrite. At 373 feet below the adit level the vein dips at a much steeper angle, and the roof of the winze is still in limestone, so that it would appear as though the vein is a typical contact-metamorphic replacement deposit at depth, while on the surface it appears to be filling a fissure in a shear-zone in diorite, and there is no limestone in evidence for a considerable distance from the ore-body.

Since the writer's visit in 1916 a water-power plant has been developed from Canyon creek, which furnishes at present, with a 350-foot head, 50 horse-power, but can be developed to furnish about 425 horse-power at low water. The flume is 8,000 feet long to a pipe-line 900 feet long.

A compressor plant for two drills is installed at the camp on Elk lake, and the air carried to the mine-workings through a pipe-line; also an electric-light plant, the dynamo of which is run by a 6-inch Pelton motor. At the mine there is a 7- x 9-inch double-cylinder friction-hoist run by compressed air which hoists a 1-ton skip. Also a Cameron sinking-pump, capacity 65 gallons a minute, and an Allis Chalmers feed-pump, capacity about 35 gallons a minute.

A survey has been made for a railway to connect the mine with the South-east arm of Quatsino sound, a distance of sixteen miles.

NANAIMO MINING DIVISION.

Metalliferous mining in the Nanaimo Mining Division at the present time is chiefly confined to Texada and Quadra islands, but there was also considerable activity in prospecting and development during 1917 in the vicinity of Powell lake and Fanny bay, on the mainland; also on the Little Campbell river, Hardy Bay, and Adams river, on Vancouver island. The metalliferous minerals found in the Nanaimo Mining Division include copper, silver, gold, lead, zinc, and iron, and the most extensively developed section of this Mining Division is the northern part of Texada island. Several years ago it appeared as though the mountains bordering Knight and Loughborough inlets and Phillips and Frederick arms, on the mainland, would develop into the most productive portion of the Mining Division, but since the closing-down of the *Dorotha Morton*, *Blue Bell*, *Douglas Pine*, and other promising properties that section has become practically depopulated so far as prospectors and mining operators are concerned.

In the Report of the Minister of Mines for 1916 the writer described most of the metalliferous-mining prospects in the Nanaimo Mining Division, consequently does not deem it necessary to repeat those descriptions in the present report, except in cases where new development-work has been carried on.

Florence. This mineral claim is located about three-quarters of a mile from the shore of Malaspina strait, at a point locally called "Dinner rock," but shown on the map as "Hurtedo point," about five miles south-east of the settlement of Lund, a port of call for several of the steamers that ply along the mainland coast. The mineral claim is owned by McNaughton Bros., of 2104 Semlin drive, Vancouver.

Geology.—The prevailing rock formations in the vicinity are an altered greenish metamorphic rock with porphyritic structure, granite, and limestone. There is a well-defined contact between the granite and limestone, with a zone of varying width lying between those rocks, from a few feet to 60 feet wide, made up of such contact-metamorphic minerals as epidote, garnetite, hornblende, calcite, and quartz, through which are disseminated particles of iron pyrite, chalcopyrite, zinc-blende, and some copper carbonates. The strike of the contact-metamorphic zone is north-westerly, but the dip is not determined, because there has not been sufficient work done at any one point, nor are there any natural exposures from which the angle can be measured.

Characteristics of Ore-body.—The ore-body on the *Florence* mineral claim occurs in a contact-metamorphic zone, with limestone on the south-west side and granite on the north-east. The zone appears to be quite extensive and in some places is about 60 feet wide, and can be traced along its strike by several outcroppings for a distance of about 300 feet to the south-east from an open-cut about three-quarters of a mile from the shore, and at an elevation of about 300 feet above sea-level. Apparently the zone is continuous towards the north-west (mag.) on to the *Zone* mineral claim, which adjoins the *Florence* on the north-west side, but the continuity is not proven, as no work has been done and the surface is covered by fallen timber and brush.

The open-cut on the *Florence* claim referred to exposes an occurrence of epidote, with which is mixed some copper carbonates and grains of chalcopyrite. At this point the contact-metamorphic zone is about 60 feet wide as exposed by the open-cut. No samples were taken from this cut because it was not deep enough to reach solid material and exposed merely decomposed epidote, with apparently not sufficient copper minerals mixed with the epidote to warrant the material being considered as of commercial value.

About 250 feet south-east from the open-cut just mentioned there is another open-cut in which is exposed an outcropping, about 20 feet wide, of epidote and garnetite mineralized with iron pyrite, zinc-blende, and some impregnations of chalcopyrite, with the blende occurring fairly solid for a width of about 18 inches in the floor of the open-cut. A sample representing about an average across 18 inches of the solid ore at one point in the floor of the open cut assayed: Gold, trace; silver, trace; copper, 0.6 per cent.; zinc, 33.7 per cent.

At a third point about 75 feet south-east (mag.) from the second open-cut referred to there is a prospect-pit about 6 feet deep by about 8 feet square, in which is exposed some chalcopyrite occurring as impregnations in epidote and garnetite across the full width of the pit. A grab sample from the dump beside the pit assayed: Gold, trace; silver, 0.8 oz.; copper, 3.1 per cent. This sample was not assayed for zinc because little, if any, blende showed in the ore.

Sproat Lake, Vancouver Island.

Mount Arrowsmith, Vancouver Island.

There is a shaft on the *Florence* claim near the other workings described in this report, but as it was full of water it was not examined.

As neither of the McNaughton Bros. could be reached by the writer, who was informed at their home in Vancouver that both were in a logging camp on Jervis inlet, he secured the services of Sam Wade, a pioneer prospector and owner of the *Zone* mineral claim, to guide him to the workings on the *Florence* mineral claim, which adjoins the *Zone* on the south-east.

Zone. This mineral claim is about one mile from the shore of Malaspina strait and adjoins the *Florence* (just described) on the north-west. The claim is owned by Sam Wade, post-office address Lund, who resides on the property.

Geology.—Apparently the contact-metamorphic zone which occurs on the *Florence* mineral claim extends through a portion of the *Zone* claim, but the limestone is cut off near the south-east end line of that claim by a greenish metamorphic rock with porphyritic structure which continues in contact with granite towards the north-west. The greenish-coloured rock which is called greenstone, is impregnated with grains of iron pyrite, a little chalcopyrite, very much epidote, some garnetite, and hornblende.

Characteristics of Ore-body.—At the contact between the greenstone, which is very quartzose and badly altered, and granite a body of mineralized material is exposed in an open-cut made across the formation about 75 feet long by about 6 feet deep at the deepest part, also a pit at the north-easterly end of the open-cut 12 feet long by 8 feet wide by 4 feet deep. The mineralization is made up of iron pyrite, much epidote, some garnetite, and hornblende.

A grab sample of the mineralized rock was taken, but an assay failed to show any values beyond traces of gold, silver, and copper. Although these results are disappointing, there are sufficient indications on the mineral claim to warrant some more prospecting.

Vanbert. This mineral claim is on Copper creek, which empties into Powell lake on the northerly side about four or five miles from the outlet, and was examined on July 12th, 1917. The property is owned by John Shearman and A. Lambert, post-office address Powell River.

Geology.—The prevailing rock formation resembles diorite belonging to the Coast Range intrusive, which has been somewhat sheared and fissured. One prominent fissure shows a maximum width of about 20 feet, filled with quartz and breccia in which occur impregnations of galena, chalcopyrite, and iron pyrite.

Characteristics of Ore-body.—The quartz vein, on which some development-work has been done, strikes south-westerly and dips at an angle of 75 degrees to the north-west. The length of the fissure is undetermined, but its maximum width is about 20 feet, with no well-defined hanging-wall yet exposed in the workings. The foot-wall is well defined near the face of a short adit driven in the steep hillside overlooking Copper creek. The ore-body is apparently a typical concentrating proposition, and there is ample water for such treatment in Copper creek, providing the creek is dammed and a reservoir thus formed. The development-work consists of a wide open-cut 9 feet long which forms the approach to a short adit which partly crosscuts the quartz vein.

Two samples were taken by the writer. No. 1, a grab from the dump at the portal of the adit, assayed: Gold, 0.02 oz.; silver, 1.8 oz.; copper, 1.1 per cent. No. 2, a grab from a dump of sorted ore ready for shipment, assayed: Gold, 0.2 oz.; silver, 9.8 oz.; copper, 1.9 per cent.

Ophir. This mineral claim is on the opposite side of Copper creek from the *Vanbert* mineral claim, at a somewhat higher elevation, and is owned by John Shearman, of Powell River.

Geology.—The rock formation on the *Ophir* claim is very similar to that on the *Vanbert* claim, but the country-rock is somewhat more sheared and fissured, with the line of strike of the fissuring nearly parallel with the strike on the *Vanbert* claim, but the dip is at a much flatter angle and towards the south-east instead of towards the north-west, as is the case on the *Vanbert* claim. There appears to have been considerable disturbance of the country-rock on a part of the *Ophir* claim, which has changed the course of the fissuring near the face of the main workings to south-easterly instead of south-west, as on the *Vanbert* mineral claim, while at the face of the same workings the direction of the strike of the fissuring is south-westerly or parallel with that on the *Vanbert* claim.

Characteristics of the Ore-body.—The ore on the *Ophir* claim occurs in a quartz vein, filling a wide fissure. The mineralization consists of impregnations of grains of galena, chalcopyrite,

and iron pyrite in a gangue composed of quartz and brecciated rock. The ore-body has been exposed in an open-cut about 20 feet long which crosscuts the quartz vein, and is made for an approach to a proposed adit which will drift on the vein. The width of ledge material is not fully exposed, but there is about 15 feet in width of mineralized ledge material shown by the open-cut. A grab sample taken from a dump of sorted ore assayed: Gold, 0.02 oz.; silver, 1.6 oz.; copper, 1.8 per cent.

The occurrence of ore on the *Ophir* claim appears to be a typical concentrating proposition similar to the occurrences on the *Vanbert* mineral claim.

TEXADA ISLAND.

Marble Bay. This mine was very fully described by the writer in the Report of the Minister of Mines for 1916, pages 351 and 352, so that it is unnecessary to repeat that description. The development-work carried on by the owners, the Tacoma Steel Company, during the past year has been confined chiefly to diamond-drilling below the 1,500-foot level, to determine the extent at depth of the ore-body which is being stoped between the 1,400- and 1,500-foot levels, and called the "1,503" stope, from which about 12,000 tons of copper-gold ore has been shipped during 1917.

The workings on the 1,500-foot level in the *Marble Bay* mine are the deepest mine-workings reached by a shaft in the Western Mineral Survey District, and it is very gratifying to the owners, as well as interesting and important to those interested in the mineral industry in the Province, to realize that in this mine not only has it been demonstrated that the ore-deposits maintain their continuity to such a depth, and to an undetermined depth below, as is shown by drill-cores, but that the values carried by the ore are also maintained, as is demonstrated by the shipments made in 1917.

The "1,503" stope is 60 feet in diameter and has been carried to an average height of about 30 feet. This stope carries considerable garnetite, which is the gangue material associated with the ore.

Van Anda Co. The property owned by the Van Anda Copper and Gold Company consists of the *Copper Queen*, *Cornell*, *Little Billy*, and *Loyal* mines, situated on the north-east coast of Texada island, which were fully described by the writer in the Report of the Minister of Mines for 1916. During 1917 these mines were practically idle, but in the autumn it is reported that they were leased to a Seattle syndicate, which, under the management of P. Stoess, M.E., installed a compressor plant and boiler on the *Loyal* and renewed the gallows-frame over the old shaft which was sunk several years ago, preparatory to beginning active operations and carrying on further development-work than has heretofore been done.

At the *Cornell* the old hoist is being repaired under the management of J. Watson, of Seattle, and it is understood that preparations are being made to drive a long crosscut from the lowest level on the *Little Billy* to traverse the ground under the *Cornell* and *Copper Queen* mines.

The old dump at the *Cornell* was leased by a Vancouver syndicate during the autumn of 1917, and a Faust jig and concentrator were installed to treat the waste dumps, which have accumulated during the several years that the mine was operated.

Retriever. This mineral claim, which is on Surprise mountain and owned by Wm. H. Lee and Wm. McDonald, of Vananda, was fully described by the writer in the Report of the Minister of Mines for 1916, and during 1917 it was bonded by B. F. Raymond and associates, of Puyallup, Wash., who have been carrying on extensive underground development-work, as well as having built a wharf, bunkers at the beach and at the mine-workings, also an aerial tramway, 1,850 feet in length to connect the bunkers preparatory to shipping.

The development underground is represented by an adit 350 feet in length, which crosscuts the formation and intersects the two fissure-veins that occur on the property. The adit is connected with the shafts that were sunk on the two veins some years since by upraising from the adit level to the bottom of each shaft, a distance of about 25 feet in each case, and a station has been cut at the point where the adit intersects the shaft on the silver-lead vein, preparatory to continuing to sink on that vein.

Good Hope. This mineral claim, which is on the south-side of Raven bay, on the east coast of Texada island, is owned by Harry Wolburn, of Vananda. This claim was examined by the writer on July 8th, 1917. It is about 250 feet from the

coast and 115 feet elevation. The country-rock is porphyrite which has been cut by some quartz diorite dykes.

A lens of magnetite, which apparently occupies a fissure in the porphyrite, is exposed by an open-cut 120 feet long by about 15 feet in average width. There is a small percentage of chalcopyrite and iron pyrite associated with the magnetite, but whether the ore carries sufficient copper content to warrant working the property as a copper proposition by treating the ore by concentration is a problem that requires solution.

McConnell, in his Memoir No. 58 on Texada island, published by the Geological Survey, evidently considered this deposit as valuable for the iron ore, because he says: "The magnetite contains some pyrite and a small percentage of chalcopyrite, but is freer from impurities than most of the lenses in the vicinity."

QUADRA ISLAND, VALDES GROUP OF ISLANDS.

The activity in mining on Quadra island has not been as pronounced during 1917 as was the case during 1916, when prospecting was being carried on by diamond-drilling on the mineral claims owned by the Valdes Island Copper Company, Limited, of Victoria. Early in 1917 a contract was made between that company and Jones & Rant, of Victoria, by which the latter shipped ore from the *Ingersoll* and *Copperopolis* mineral claims, owned by the company, and continued development-work until late in the summer, when the contract expired and the mining company resumed development-work on its own account. A good wagon-road was constructed by Jones & Rant from the beach at Gowland harbour to the mine-workings early in the year, and regular shipments of copper ore were made to the Ladysmith smelter during the period of their contract.

Santa Anna Group.

This group of mineral claims, which was fully described by the writer in the Report of the Minister of Mines for 1916, was bonded late last fall by John McConville and partners to H. E. Carleton, Martin Welch, and H. J. Tetter, of Vancouver, who, it is reported, will continue the development-work that was being done by the owners, and place the property on the list of producers during 1918.

CAMERON LAKE DISTRICT.

In the Report of the Minister of Mines for 1916 the writer described the *Independent* group of mineral claims, situated near the head of Englishman river, about eight miles from the foot of Cameron lake. As there was but little activity in that section during the past year, it was not revisited by the writer when he was in the neighbourhood, but a group of two mineral claims in the mountains near the foot of Cameron lake was examined on January 9th, 1918.

Copper King Group.

This group contains two mineral claims, the *Copper King* and *Cameron*, owned by Thomas Kitchin and L. Shepherd, of Nanaimo. This property is one of the oldest lode locations in the Nanaimo Mining Division, and most of the work was done prior to 1901; but since then but little attention has been paid to the claims until the recent abnormal demand for copper has revived interest in the property, especially owing to its accessibility because of the building of the Alberni extension of the Esquimalt & Nanaimo Railway the track of which at Cameron Lake Station is only about one mile and a half from the portal of the lower adit on the *Copper King* mineral claim, and about 1,000 feet lower elevation, so that an aerial tramway could be easily constructed to connect the mine-workings with the railway.

Geology.—The prevailing rocks in the Cameron Lake district are the Vancouver volcanics, with some schists included representative of the Sicker schists. The volcanics are much metamorphosed and in places considerably sheared and fissured. The fissuring is noticeable in and along the sides of a ravine on the *Copper King* claim, where two adits have been driven with the purpose of intersecting an ore-body which outcrops about 100 feet higher elevation than the level of the upper adit.

Characteristics of the Ore-body.—An occurrence of copper-bearing ore occurs on a steep bluff on the side of a deep ravine, but was too much covered with snow when the writer made his examination to be thoroughly examined. The mineralization is chiefly chalcopyrite associated with iron pyrite in a siliceous gangue. The strike is apparently towards the north-east and the dip is fairly steep to the north-west, but the extent of the mineralization is problematical. Underground in one place it appears to have a maximum width of about 20 feet.

Development-work.—The development-work consists of a shallow shaft on the outcroppings and two crosscut adits. The upper adit is about 100 feet below the outcroppings; it is 80 feet long to the point where ore is exposed on the hanging-wall; there the course of the adit is changed and cuts the ore-body diagonally to the foot-wall, a distance of 56 feet, and is continued for a further distance of 40 feet in lean ground. Where the foot-wall is exposed a drift has been driven back along it towards the main adit, a distance of about 30 feet, and a short crosscut made into the foot-wall. Two shallow winzes are sunk from the main adit, one near the centre of the ore-body, the other at the point where the foot-wall is exposed (both of these were full of water at the time the examination was made by the writer, so could not be examined). The lower adit is about 100 feet lower elevation than the upper one, just referred to, and is about 300 feet long, driven in country-rock except for about 40 feet, where ledge material consisting of quartz stringers in a hard blue gangue rock is exposed.

On the dump at the portal of the upper adit there are several tons of copper ore, mostly chalcopyrite, some of which is evidently of good grade, but no sample was taken because the dump has been sorted over several times, as the writer was informed by T. McBey, of Cameron Lake, who acted as guide. The ore-body exposed in the diagonal crosscut in the adit is a concentrating proposition, unless, because of the siliceous character of the ledge material, it might be found profitable to mine it for flux for copper smelters.

NANAIMO COALFIELD.

Earlier in this report reference is made to the coal-mining industry in the Nanaimo Mining Division, on Vancouver island, and to the history that was made in this industry during 1917. The reports made annually by the Mine Inspectors, which are included in the Report of the Minister of Mines, give full particulars with regard to the operations at the various working collieries, and were it not for the preparatory work that was done in 1917 in what may be termed new fields, no further reference would be made to the industry by the writer in this report, but under the circumstances the following brief description of the preparatory work is warranted:—

Granby Co.

The Granby Consolidated Mining, Smelting, and Power Company entered the Nanaimo coalfield early in 1917 by beginning operations with diamond-drill outfits and boring in the Newcastle formation, which contains the Douglas coal-seam, on Haslam creek, near Cassidy Siding, on the Esquimalt & Nanaimo Railway. The places selected for boreholes are about one mile and a half westerly from the junction of Haslam creek with the Nanaimo river on the west side of the Esquimalt & Nanaimo Railway track, near where, according to Clapp's geological maps, there are coal-outcroppings belonging to the Douglas seam, which is the upper seam in the Nanaimo series.

In Clapp's report, "Geology of the Nanaimo Map Area," in Memoir No. 51, Geological Survey of Canada, he says, with regard to the section of the coalfield where the Granby Company is working: "The Douglas coal-seam occurs in the Newcastle formation about 25 to 100 feet above the Newcastle seam, and from 50 to perhaps 250 feet below the top of the formation. The seam is well developed from northern Newcastle island to south of Nanaimo river, the outcrop of the seam crossing the river near the Esquimalt & Nanaimo Railway bridge at Cassidy."

Up to the present time the Granby Company has been doing preparatory work by clearing about 60 acres of land, including the site selected for the mine-workings. On this land the company is erecting a sawmill, buildings for sleeping and living accommodations of the miners and other employees, offices for the staff, powder-magazine, and several cottages similar to those occupied by miners with families at Anyox, where the company's Hidden Creek copper-mine and smelter are located. A water system has been installed by erecting two tanks, each with a capacity of 50,000 gallons, on the ridge east from the clearing, where the elevation is about 150 feet higher than the cleared land and the pressure is 60 lb. to the square inch. The water to supply this system will be pumped from the Nanaimo river.

A spur railway-track three-quarters of a mile long has been built to connect the mine-workings with the Esquimalt & Nanaimo Railway at Cassidy Siding, and there has also been constructed a new wagon-road from the old road that followed up Haslam creek and passed under the railway-track to connect Bevan's sawmill with the main road to Nanaimo or Ladysmith.

The construction-work so far done has been by contract with the Taylor Engineering Company, of Vancouver, and the diamond-drilling has been by contract with Boyle Bros., of Spokane.

NANOOSE BAY DISTRICT.

Nanoose Co.

The Nanoose Colliery Company, Limited, was promoted and organized by John Grant, of Nanaimo, who was also the organizer of the Vancouver and Nanaimo Coal Mining Company, which opened up the *Jingle Pot* mine some years ago. The colliery of the Nanoose Colliery Company is partly located on some foreshore leases acquired by Mr. Grant near the entrance to Nanoose bay, but the property owned by the company includes the Jack and Hinchman Estates in addition to the leases.

In Clapp's report on the Nanaimo coalfield he has not included this portion of the field, which is situated about ten miles north-westerly from the town of Nanaimo, and is the farthest point in that direction where a workable coal-seam belonging to the Nanaimo series is being mined.

In this part of the Nanaimo coalfield the prevailing rocks are those near the base of the series, and the two upper coal-seams (the Douglas and Newcastle) are lacking, and the Wellington or the lowest of the three Nanaimo seams is the only one remaining. This seam is exposed at a vertical depth of 129 feet below the beach where the shaft is sunk. The dip is quite flat, averaging only about 10 degrees to the N. 23° E. (mag.). The shaft was started in July, 1916, and the mine has been producing a limited quantity of coal since then.

To the south of the shaft the coal has been mined, and the work being carried on at present is driving a slope on the dip of the coal under the water in Nanoose bay. The slope on March 23rd, 1918, when the writer examined the mine, was 630 feet in length, and according to the information given by John Johns, the mine manager, has 143 feet of solid rock above it at that point. No attempt has yet been made to drive entries off from the slope.

The coal in the seam occurs with a variable width of rock as parting between the upper coal, about an average of 10 inches thick, and the lower coal, which averages about 22 inches thick. The maximum thickness of the rock-parting is about 7 feet, the average being about 3 feet, but at the face of the slope when the writer saw it the rock had pinched down to a few inches thick, and is lacking for about 12 feet on the east side of the slope, where the coal had widened out to about 9 feet of clean coal.

The coal in this colliery occurs underlying a conglomerate roof and rests on a sandstone floor, presumably the East Wellington sandstone as classified by Clapp. The roof is especially good and solid.

VICTORIA MINING DIVISION.

There has been considerable activity in the Victoria Mining Division during 1917, but this has been confined to the East Sooke, Jordan River, and Cowichan Lake districts, in each of which continuous operations have been carried on in developing the ore-bodies to determine their extent. Regular shipments of copper ore have been made during the past year from only the *Blue Grouse* and *Sunnyside* groups, on Cowichan lake, but some shipments have been also made from the *Margaret* and *Willow Grouse* groups, at East Sooke.

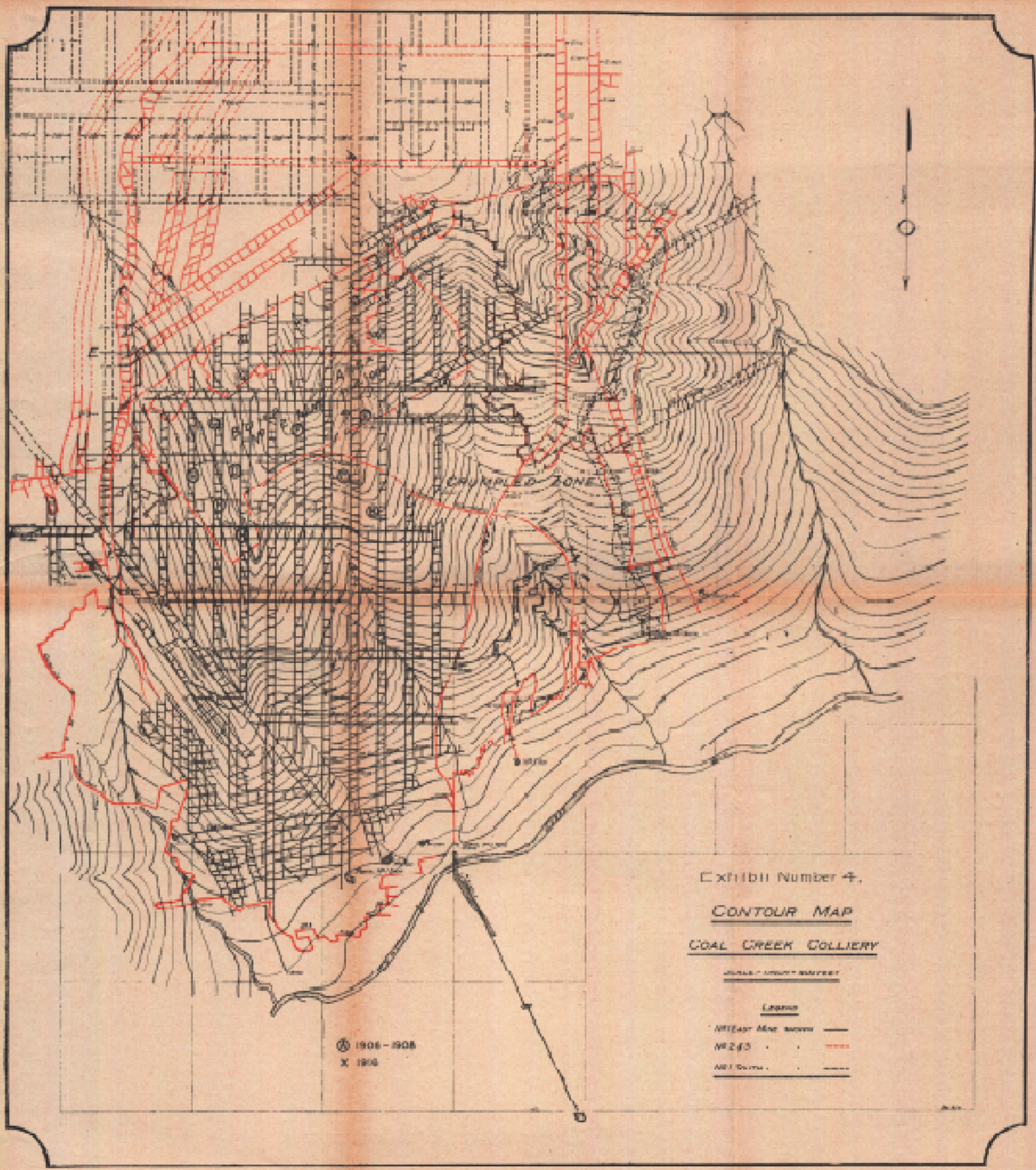
There has been shipped a total tonnage of approximately 2,000 tons of copper ore of good grade from the properties mentioned during the past year. At the same time there has been more prospecting carried on in the Division than has been the case for some years back. The sections that have apparently been the most attractive to the prospectors are the neighbourhood of Duncan, Saltspring island, East Sooke peninsula, the Cowichan Lake district, and the mountains adjacent to the Jordan river.

In the Report of the Minister of Mines for 1916 most of the workings on the mineral claims in the groups were described, but, as there has been so much new work done since that report was made, it is deemed advisable to again describe the properties fully in the present report, especially when the important results that have been obtained from the further development-work is considered.

EAST SOOKE DISTRICT.

Willow Grouse Group.

This group contains the *Golden Thrush*, *Willow Grouse*, *Willow Grouse Fraction*, *Blue Bird*, *Donaldson*, *Jack*, *Sidney*, and *Sidney Fraction* claims, on the north-west slope of Mount Maguire, about twenty-five miles by wagon-road or water from the city of Victoria, and about 3,000 feet from a well-sheltered harbour near the entrance to Sooke harbour. The property is owned by H. B. Thomson and associates, of Victoria, but is at present being worked by the Ladysmith Smelting Corporation,


CRUMPLED ZONE
1906 - 1908
X 1906
Exhibit Number 4.
CONTOUR MAP
COAL CREEK COLLIERY

Limited, under a lease and bond. The writer visited the property on March 13th, 1918, and found a crew of miners working, with A. Macauley as foreman, under the superintendence of Harold Grant, of Victoria.

The occurrence of copper ore on this group of claims occurs in a shear-zone in the Sooke gabbro, as classified by C. H. Clapp in his memoir on the Sooke and Duncan map areas, and is a typical representative of the Sooke type of ore-deposits. The mineralization is chiefly chalcopyrite, usually very pure, but there is often some iron pyrite associated with it. The gangue material is made up almost entirely of hornblende.

The chalcopyrite occurs disseminated through a wide shear-zone, the full width of which has not yet been determined. In the main zone there occur several fissures and subsidiary shear-zones, in some of which are zones of enrichment, varying from 5 to 20 feet in width, in which are found bodies of chalcopyrite carrying copper values averaging about 8 per cent., with the maximum as high as 18 per cent. The most important of these zones of enrichment occurs on the *Willow Grouse* mineral claim where the mine-workings are located, and where the known length of the enriched fissuring is about 150 feet and the width of the high-grade ore-bodies, of which there are three, is 6 feet, 15 feet, and 20 feet. The general strike of these fissures is nearly parallel with the strike of the main shear-zone, or N. 40° E., and the dip is at an angle of about 70 degrees to the north-west; but there is one of the fissures which strikes N. 3° W. and dips 80 degrees west that forms a junction with the others near the southerly end of the mine-workings and apparently carries the richer portion of the ore-bodies.

Until recently no attempt had been made to prospect beyond the limits of the enriched zone where the ore was mined from a deep open-cut, hand-sorted, and the culled material, consisting of low-grade ore and waste, left in the cut. Since the Ladysmith Smelting Corporation has taken over the property the culled material has been again hand-sorted, about 400 tons of ore of a shipping grade selected and shipped, and the waste material trammed out of the cut, so as to enable the miners to extend the development-work farther into the main shear-zone, beyond the joint-plane that has heretofore been considered the north-westerly boundary of the mineralization. This has recently been shown to be merely a joint or possibly a fault-plane in the ore-body, since blasting into the so-called wall exposed another ore-body lying parallel with those that have been mined.

The present operators propose extending their prospecting-work by boring with a diamond-drill to endeavour to determine the extent of the mineralized zone, as well as its continuity to deeper levels.

Margaret Group.

This group consists of three mineral claims—the *Margaret*, *Copper King*, and *Eureka*—at present being operated by O. B. Gerle and associates, of Victoria. This property was fully described in the Report of the Minister of Mines for 1916, but since that report was made there has been much more development-work done which shows important results.

Mineralogy.—The metallic minerals present are chalcopyrite, magnetite, pyrrhotite, pyrite, and native copper. The non-metallic, gangue minerals are amphibole, chlorite, feldspar, and quartz. Chalcopyrite is the only important copper-bearing mineral, and occurs in small disseminated grains, minute veinlets, and in larger veins and masses.

The proportion of massive chalcopyrite occurring in the mineral-bearing zone varies considerably, and is almost always associated with more or less magnetite. Sometimes, however, the chalcopyrite occurs comparatively pure and filling fissures from a foot or so in width up to several feet in width. In other parts of the shear-zone the chalcopyrite occurs in grains and particles as impregnations disseminated through the gabbro in sufficient quantity to so enrich the rock as to make a large proportion of it shipping-ore, while the remainder will be valuable if treated by concentration.

On the *Margaret* group of mineral claims the proportion of massive ore as contrasted with waste exposed in the workings examined by the writer appears to be about 75 per cent. good ore to 25 per cent. waste. The gangue material in which the ore occurs is almost wholly hornblende.

Characteristics of Ore-bodies.—The ore-bodies on the *Margaret* group are typical representatives of the Sooke type. The occurrences of copper ore that have been so far developed occur in a shallow gulch or depression of variable width that appears to extend through the three mineral claims, and appears to have been formed by erosion, which acted on the mineralized

part of the shear-zone, as this rock offered less resistance than that part of the gabbro country-rock in which the shearing action had been less pronounced. At the north-easterly or upper end of the gulch there is a large swamp, in which is exposed a body of almost solid ore opened by a shaft 25 feet deep, and an open-cut for a length of more than 200 feet, a width of about 12 feet in the north-east end of the cut, and to a depth of 25 feet below the level of the surface outcropping at that point. A short distance to the south-west and in the same open-cut the ore-bearing gabbro has been proven to reach a width of 40 feet.

When the open-cut was first made it appeared as though the foot-wall of the ore-body was exposed on the north-westerly side, and in sinking the shallow shaft this so-called wall was made one side of it, but later it was discovered that the wall was only the cleavage-plane of a fracture in the shear-zone, and, when blasted into, that solid ore was exposed beyond it. By a series of open-cuts made towards the north-westerly side of the gulch, and into the rock that had suffered less from erosion, a still greater width of ore-bearing gabbro is exposed, and at the time of the examinations the full width of the ore-body on this portion of the property was undetermined.

In an adit driven to crosscut the ore-body at a point about 250 feet south-westerly from the shallow shaft mentioned, a well-defined hanging-wall occurs near the portal of the adit, dipping at an almost vertical angle and striking in a north-easterly direction, conformable with the strike of the ore-body exposed in the open-cut already referred to. From the hanging-wall the ore-body is crosscut for 10 feet, with the whole face of the crosscut in ore. Drifts are driven in both directions at right angles to the crosscut for a total of about 25 feet in length. These drifts are in solid ore, with the faces of both in ore.

Development-work.—The development-work done since the holders of the lease took the property in the late autumn in 1916 consists of a deep open-cut, a shaft about 25 feet deep below the floor of the cut, and an adit at the south-westerly end of the main ore-body. The open-cut is more than 200 feet long, with a maximum width of about 40 feet, a minimum width of about 12 feet, and a face of about 40 feet in height at the widest part of the open-cut. The adit, including the open-cut approach, is about 50 feet in length, its portal is about 250 feet south-westerly from the shaft, and it is being driven as a drift under the long open-cut referred to above.

There has also been done a considerable amount of prospecting-work, such as stripping and open-cuts, some of which are located about 1,000 feet to the south-westward from the adit, and in these chalcopyrite occurs in a gangue of hornblende similar to the occurrences in the adit, open-cut, and shaft.

About 1,000 feet south-westerly from the adit there are located some old workings, the chief of which is a shaft, said to be 25 feet deep and full of water, so could not be examined. This shaft was sunk in an outcrop of hornblende, through which are disseminated lumps, grains, and small particles of chalcopyrite, and apparently the shaft is sunk in an extension of the shear-zone in which the ore occurs.

In addition to the old workings, there is an open-cut 176 feet long which crosscuts the shear-zone at this point and exposes low-grade concentrating copper minerals, mainly chalcopyrite, disseminated through the hornblendic country-rock the entire length of the crosscut, demonstrating that Clapp's estimate of the width of the shear-zone, in the following paragraph from his report published in 1912, being about 200 feet is well established:—

"On the southern slope of Mount Maguire are three claims—the *Margaret*, *Copper King*, and *Eureka*—located on a wide shear-zone some 200 feet wide, having a strike of N. 43° E., which is traceable for the whole length of the three claims. As a rule, the metallic minerals, chiefly chalcopyrite, are disseminated through the entire shear-zone, with the best values along the north-west wall. Occasionally the chalcopyrite occurs in small lenses and veins. Quartz stringers are very abundant. The deposit is opened only by four or five small pits or shafts."

The workings described in Clapp's report are those referred to by the writer as the "old workings."

The development-work done up to the time of the examination in March, 1918, indicates that the main ore-body has approximately the following dimensions: Length, about 250 feet; minimum depth from the surface to the floor of the adit or tunnel, 25 feet; maximum depth, 50 feet; average width, about 25 feet. The average width may prove to be still greater, as the cleavage-plane that was considered to be the foot-wall proves to be only a false wall, since blasting into it has proven that ore is found to occur beyond it and the definite foot-wall is not yet exposed.

Figuring from the dimensions given above, there is apparently about 20,000 tons of ore above the floor of the adit that can be classed as "probable" ore, meaning such ore as is only partially developed, not sufficiently so to admit of actual measurement, but of the occurrence of which the indications are sufficiently strong to warrant an assumption that such ore probably occurs.

Iron Mine Hill.

Active prospecting has been carried on during the past winter along the coast of Juan de Fuca strait to the south-east of Iron Mine hill and east of Possession point, where A. McVittie, of Victoria, has been unwatering a shaft sunk several years ago on Crown-granted land owned by F. B. Pemberton, of Victoria. The prospects of exposing a body of copper-bearing ore on this property are said to be good, but the work had not progressed far enough at the time the writer visited East Sooke to enable him to make a thorough examination of the old workings.

Caffrey.

In the same neighbourhood as the old workings that McVittie is reopening there is a group of mineral claims owned by Frank Caffrey and associates, of East Sooke, on which, it is reported, there occur very promising outcroppings of copper ore in similar geological conditions to those which surround the occurrences on the *Willow Grouse* and *Margaret* groups. The writer expects to visit these Coast prospects during the coming spring to report on the progress made by the parties engaged in prospecting there.

JORDAN RIVER DISTRICT.

The neighbourhood of the Jordan river which flows into the Juan de Fuca strait appears to have first received attention from prospectors for lode mines in 1915, although placer-miners were prospecting the river bed and bars, as well as the black-sand deposits near the mouth of the river, several years ago, but without commercial success.

George E. Winkler, of Victoria, was the first prospector to discover copper-bearing ore in-place in this part of Vancouver island, and he informed the writer that it was owing to reading the report of Chas. H. Clapp in Memoir No. 13, "Southern Vancouver Island," published in 1912, that he commenced a thoroughly systematic search for copper minerals in the mountains in the vicinity of the river. His search was rewarded by finding occurrences of outcrops of chalcopyrite in a country-rock that resembled very much the country-rock on the East Sooke peninsula. This resulted in his staking a group of mineral claims, on which he performed the assessment-work to give him possessory title, and during the spring of 1917 bonded his claims to R. H. Stewart and associates, of Vancouver, who organized the Sunloch Mining Company, Limited, and has since been developing the property with a crew of miners, of which John Hanna is foreman.

Geography.—As the Jordan River district is a new one so far as lode-mining is concerned, the following short description of that part of Vancouver island with regard to the geography, as well as the geology, is advisable as a part of this report:—

The Jordan river has its source in a series of small lakes and swamps in the vicinity of Jordan meadows, about fifteen miles distant in an air-line from the southerly coast of Vancouver island and Juan de Fuca strait. The distance by following the bends and sinuosities of the river is probably nearer thirty miles than fifteen, since the stream is quite crooked. For some considerable distance above its mouth the river flows between very precipitous banks, so steep as to be better described as the walls of a box canyon. The stream carries a very considerable volume of water and flows with heavy grade, so much so that the Vancouver Island Power Company, a subsidiary to the British Columbia Electric Railway Company, selected this river as a source to furnish water-power to generate electric power to run that company's street-car and electric-light systems in the city of Victoria and its interurban lines.

The company's power-house is located at the mouth of the river, and the water-supply is diverted from the upper reaches of the stream, about seven or eight miles above the mouth, where a concrete dam has been built, from which the ditch-line starts that carries the water to a second reservoir at an elevation of about 1,100 feet, about two miles from the mouth of the river, and from which the water is carried through a pipe-line to the power-house.

Geology.—In Clapp's report on the geology of Southern Vancouver island, he states that the slaty and schistose rocks of the Leech River formation, in which the Jordan river has its source, are the oldest rocks of southern Vancouver island. They form a broad belt with an average width of about five miles, which extends from the east coast of the island to the west

coast, in the vicinity of Port Renfrew. He also states: "Apparently unconformable upon the Leech River formation, although separated from it largely by faults, are rocks of lower Mesozoic age, the Vancouver group. The Vancouver group has been subdivided into the Nitinat formation, the Vancouver volcanics, the Sutton formation, the Sicker series, and the Metchosin volcanics."

The prevailing rock formation in the lower Jordan River district belongs to the Metchosin volcanics, which are composed of ophitic basalt flows, tuffs, and agglomerates, with intrusive diabase dykes. These rocks contact unconformably with those of the Leech River formation, about six miles up the river from its mouth, and the line of contact is represented by an extensive fault, of which Clapp says: "The southern boundary of the Leech River formation, with the Metchosin volcanics, is also an extensive fault. It is approximately parallel to the north boundary fault, but with the apparent upthrow to the north, the Metchosin volcanics being the younger. The character of this fault is also unknown."

Sunloch Group.

This group of mineral claims was examined on November 24th and 25th, 1917. The group is located on the Jordan river, about two miles above the mouth and forty-two miles by auto-road from Victoria. The mine-workings are about two miles from the power-station of the Vancouver Island Power Company, and about 6,000 feet from the end of a spur of a logging-railway built to the beach near the power-station, and which could readily be extended to the present main mine-workings on the *Sunloch No. 6*.

The property known as the *Sunloch* group contains twenty-eight claims in all, but the development-work has been confined almost entirely to the *Sunloch No. 6* claim and to the northern part of the claim which is intersected by the Jordan river. The banks of the river at this point on both sides rise very abruptly, so that, while the elevation of the river-bed is 550 feet above sea-level, the banks on each side reach an elevation of about 1,100 feet. The mining development-work is at elevations from 620 to 865 feet.

On the *Sunloch No. 6* mineral claim there occurs a system of shear-zones in the Metchosin volcanic country-rock which strikes at nearly right angles to the course of the Jordan river and apparently maintains continuity across it, because at one point work on the westerly side has exposed the same character of ore occurring under practically similar conditions, geologically, as occurs on the easterly side.

Six mineralized shear-zones have been exposed, varying in width from about 20 feet to 68 feet, within a width of about 800 feet. These zones are cut by several quartz stringers and are mineralized with iron pyrite and chalcopyrite, with an appreciable quantity of silica in the gangue. The zones are practically parallel to each other and strike about N. 60° W.

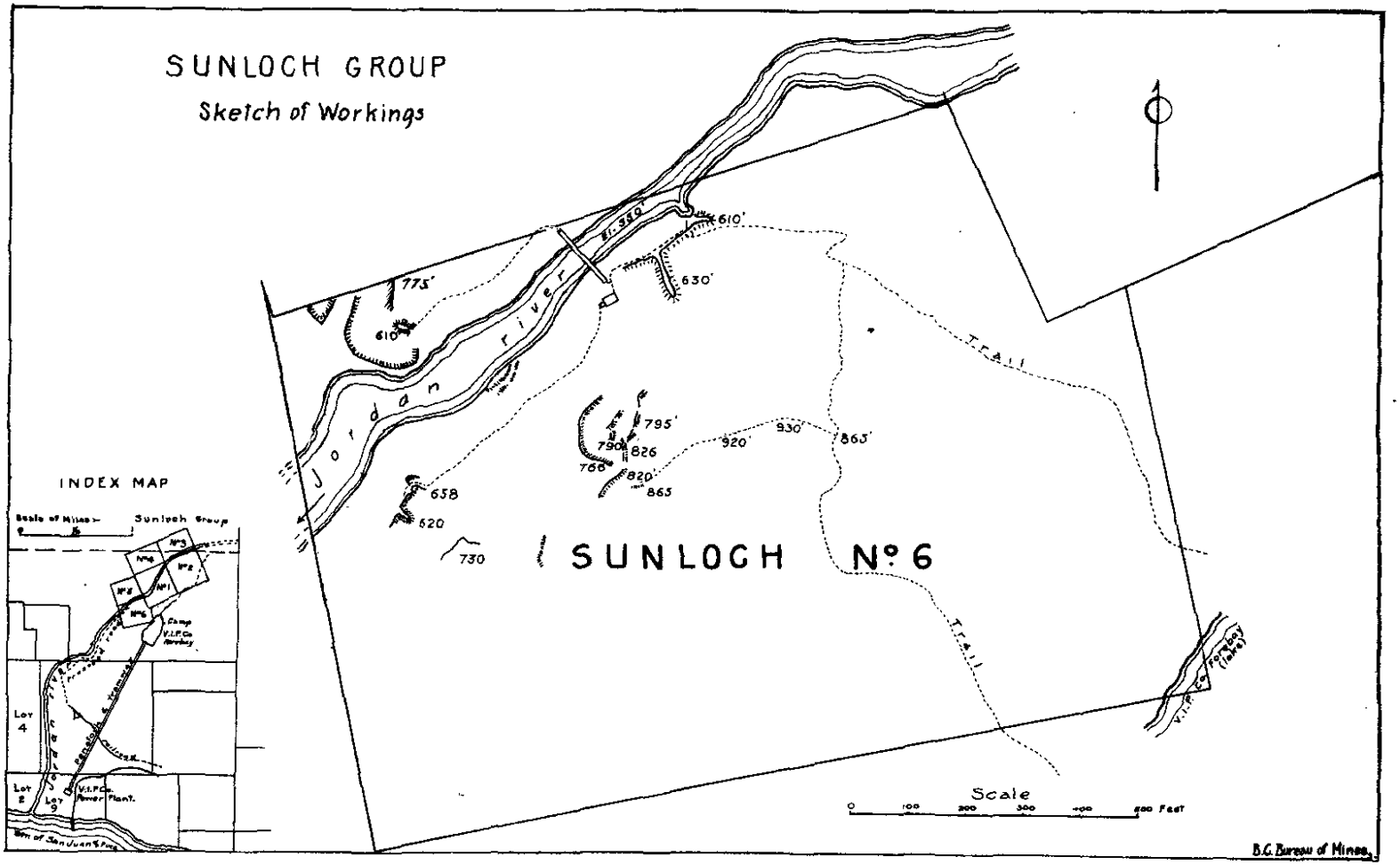
The development-work done consisted of four adits or tunnels exposing three distinct zones, as well as extensive surface stripping across another, known as the "Centre" zone, where three open-cuts have been made on apparently three separate mineralized zones at elevations between 780 and 865 feet. Each cut is about 20 feet long across an ore-body.

Low-grade copper ore also has been exposed on the opposite side of the river in a drift-adit 20 feet in length. This exposure occurs apparently as an extension of the "Centre" zone.

The zone known as the "North" zone, owing to its being the most northerly occurrence of ore opened on the property to date, has been exposed by a crosscut adit, driven 23 feet in length in ore the entire distance. This ore varies in assay values from 2.15 to 2.9 per cent. copper.

The zone known as the "Second North" zone is about 100 feet southerly from the "North" zone. This is being developed by a drift-adit, which was 100 feet in length and exposed an ore-body which assayed from 1.25 to 2.9 per cent. copper, and also carried about 50 cents to the ton in gold and silver values combined. It is purposed to continue driving this drift for a further distance, and then turn its course and crosscut the formation in both directions at right angles to the present course of the drift. The distance between the crosscut adit on the "North" zone and the drift-adit on the "Second North" zone is about 100 feet.

The distance in a south-westerly direction between the drift-adit on the "Second North" zone and, so far as is known at present, the most southerly mineralized zone, known as the "Cave" zone, is about 650 feet. Between these showings or zones the one known as the "Centre" zone occurs. The width of mineralization in the last-mentioned is undetermined, as the three open-cuts are all the development-work yet attempted, and it is not possible to say for certain whether these open-cuts expose three distinct mineralized zones or are all made on one zone, which, in such an event, would be nearly 170 feet wide. It is to determine that question


SUNLOCH GROUP
Sketch of Workings
Jordan river
775'
610'
El. 559
610'
630'
795'
790'
826'
766'
820'
865'
920'
930'
865'
658'
620'
730'
Trail
Trail
SUNLOCH No 6
Scale
0 100 200 300 400 500 Feet
B.C. Bureau of Mines.
INDEX MAP
Scale of Miles
Sunloch Group
Lot 4
Lot 2
Lot 9
Jordan River
V.I.P.Co. Power Plant.
Camp
Bdry. of San Juan S. Para.

that R. H. Stewart, the manager, proposes to drive a long crosscut from the face of the drift-adit on the "Second North" zone, which will cut the formation under the "Centre" zone at a depth of about 200 feet below the highest open-cut.

The work on the "Cave" zone is at an elevation of 620 feet above sea-level, and consists of an open-cut across the face of a steep bluff and a drift-adit driven on the strike of the ore-body exposed by the open-cut. There is a width of ore exposed in the cut of 68 feet that averages 1.2 per cent. copper, while across 35 feet of that width the ore averages 2 per cent. in copper. The drift-adit is 40 feet in length and the ore exposed carries from 2.25 to 2.7 per cent. in copper.

The ore-body exposed in these workings is more siliceous than that exposed in the other workings on the *Sunloch No. 6* mineral claim. This work on the "Cave" zone is located about 150 feet in an easterly direction from the south-westerly boundary of the *Sunloch* group of mineral claims.

No samples were taken by the writer, because he was permitted to see the assays from the sampling done systematically by the management as the work progressed up to November 24th, 1917, the time of his visit, and the values stated in the foregoing report are the results from that sampling.

COWICHAN LAKE DISTRICT.

More attention has been paid to the Cowichan Lake district during 1917 than in previous years, owing to the results of the development-work performed on the *Blue Grouse* group of mineral claims in 1916, which exposed a considerable body of copper ore of shipping grade. The *Sunnyside* group, adjoining the *Blue Grouse* on the north-west, was bonded in the spring by J. D. Grayson, of Victoria, who commenced development-work, and some prospecting was done in other parts of the district. In the Report of the Minister of Mines for 1916 some space was devoted to a description of the *Blue Grouse* group of mineral claims, and about the middle of November last the district was visited and the development-work done examined on the two groups of mineral claims just referred to and which is described in the following pages of this report.

Geography.—Cowichan lake is about twenty miles long; the head of the lake is near the centre of the southern portion of Vancouver island. From there it drains south-easterly into the Cowichan river, which is also about twenty miles long and flows into Cowichan bay at the north end of Saanich inlet. The valley formed by the lake, river, and bay nearly divides the southern part of Vancouver island into two halves.

Geology.—Clapp described the Cowichan valley as being underlain by a closely folded syncline, slightly overturned to the south-west, of conglomerates, sandstones, and shales of the Cowichan group, flanked on either side by resistant volcanic rocks. He says: "The less resistant sedimentary rocks were more easily eroded by the cycle following the uplift of the Tertiary peneplane, and a late mature valley was formed, which during the glacial period was maturely glaciated, being deepened especially in the upper portion where Cowichan lake occurs."

Blue Grouse Group.

This group contains the *Blue Grouse Nos. 1, 2,* and *3* claims, situated about one mile from the shore of Cowichan lake and about six miles westerly from the Riverside townsite, where the lake drains into the Cowichan river. Until recently the property was worked under a lease and bond by H. J. Ketchen and Murray Miller, of Victoria, but these gentlemen have now sold their interests to the Consolidated Mining and Smelting Company, of Trail. G. H. Kilburn, who during the past year has been engaged in field-work on the coast and on Vancouver island for the company, has been appointed manager.

Geology.—The occurrence of copper ores on the *Blue Grouse* group occur as contact-metamorphic deposits developed in contact-metamorphosed limestone at some distance from the intrusive Vancouver volcanics, but so intimately associated with metamorphic and sheared volcanics that the two types of metamorphic rocks cannot always be distinguished.

Characteristics of the Ore-bodies.—There are several outcrops of copper ore exposed on each of the claims in the group, but the most prominent occur on the *Blue Grouse Nos. 2* and *3* claims near the dividing line where most of the development-work has been done. The mineralization is made up of chalcopyrite, iron pyrite, and some magnetite in a gangue made up almost entirely of garnetite, very much decomposed usually at and near the surface. The ore outcroppings are characterized by the heavy gossan which overlays the copper sulphides and usually

form prominent landmarks. The values carried by the ore vary from about 1 to 10 per cent. in copper, with small amounts of gold and silver.

The most extensive of the outcroppings occurs at an elevation of about 1,450 feet above sea-level, where a natural exposure made by erosion is about 30 feet wide and about 50 feet along the strike, N. 23° W. Both hanging and foot walls are well defined, dipping at an angle of 37 degrees to the westward. The width of the ledge material is about 30 feet, as shown in a crosscut adit driven about 50 feet below the apex of the outcrop on the hanging-wall side, but the length has not yet been determined.

Although about 1,500 tons of ore that averaged nearly 7 per cent. copper and about $1.50 in gold and silver to the ton was shipped during 1917, it is the opinion of the writer that the proposition would yield better results if a systematic and extensive system of development was followed with the view of determining whether the ore-bodies were of sufficient extent to warrant the installation of a concentrating-mill, as the cost of hand-sorting as closely as is necessary to produce the grade of ore that has been shipped is a great handicap.

Development-work.—The development-work has been chiefly confined to three points, the most northerly being on the *Blue Grouse No. 3* claim, that for convenience is later referred to as No. 1 workings; the next work is about 200 feet southerly, called No. 2 workings; and the third work is about 300 feet south-westerly from the No. 2 workings and called No. 3 workings.

No. 1 workings consist of a deep open-cut made on an outcrop of gossan and chalcopyrite that occurs on the face of a steep bluff, from which a considerable tonnage of ore was mined and shipped.

No. 2 workings consist of an open-cut approach 15 feet long to a crosscut adit 87 feet long, with a drift driven 28 feet to the south and another driven 52 feet to the north. All of this work is in ore except the open-cut approach and first 29 feet of the crosscut adit. At the time of the examination the ore was being stoped from above the adit level, and a very large proportion of the output of the mine has come from this work. In connection with the No. 2 workings there is a wide outcropping of copper ore exposed in an open-cut about 50 feet southerly from the main adit, but no connection between the two ore-bodies had then been determined.

No. 3 workings consist of a series of open-cuts in which are exposed two apparently parallel ore-bodies occupying fissures in the sheared metamorphosed volcanics; each of these open-cuts exposed ore-bodies about 50 feet in length and about 10 feet wide. The ore in these workings showed fairly solid chalcopyrite that would carry about 6 per cent. copper.

At each of the workings mentioned ore-bins have been constructed, and at the No. 2 workings there is an ore-chute down which the ore is conveyed to the loading-bin on the wagon-road about 100 feet lower elevation.

Sunnyside Group. This group contains two mineral claims, called the *Sunnyside* and *Here-it-is*, situated on the North fork of Sutton creek, which empties into Cowichan lake about six miles north-westerly from the Riverside townsite. The property is being worked by J. D. Grayson, of Victoria, under a lease and bond from the owners.

Geology.—The actual contact between metamorphosed limestone and metamorphosed volcanic rocks is very well defined on the *Here-it-is* claim, which lies westerly from the *Blue Grouse* group, and the copper ore on the former occurs as a contact-metamorphic deposit at the immediate contact and developed in much-altered limestone, hornblende, and garnetite. The contact-metamorphic zone is apparently of very considerable width, possibly about 300 feet, and the ore occurs as lenses, but the boundaries, except on the north-easterly side, are not well defined, as the mineralization gradually fades away or grades into the garnetite gangue.

Characteristics of the Ore-bodies.—Ore-deposits are exposed in three sets of workings: The No. 1 workings expose an ore-body in an open-cut and in the face of an adit 20 feet below the floor of the open-cut; the No. 2 workings expose lenses of ore of irregular shape and extent in a series of open-cuts from which ore is being quarried, scattered over an area of about 2 acres; the No. 3 workings expose a narrow stringer of chalcopyrite in quartz gangue. There has not been sufficient systematic work done to determine what, if any, are the relations between the various lenses or their extent.

A sample representing ore that has been roughly hand-sorted, taken from a width of 6 feet in the floor of the No. 1 open-cut, assayed: Gold, trace; silver, trace; copper, 3 per cent. Judging from the general appearance of the ore-deposits in the other workings, it is the opinion

of the writer that, unless close hand-sorting is adopted, the mine will produce a general product of about the value shown in the sample referred to by rough hand-sorting. There is no doubt but that the future value of this property will depend upon the extent of the ore-bodies and their adaptability for treatment by concentration; consequently a thoroughly systematic plan of prospecting should be adopted to determine whether the extent of the ore-bodies is sufficient to warrant the installation of a concentrating-mill.

DUNCAN DISTRICT.

Cornucopia Group.

This group contains four mineral claims, known as the *Cornucopia*, *Old Gentleman*, *Louise*, and *Rebel*, situated about six miles north-easterly from the town of Duncan near the Duncan-Crofton wagon-road. The group of claims occupies practically the same ground as was occupied by the *Yreka* group, located in 1900, on which two shafts were sunk, said to be 210 feet and 140 feet deep, but the old locations were abandoned after the owners bonded the *Yreka* group of mineral claims on the South-east arm of Quatsino sound in 1902. The *Cornucopia* group is owned by J. Mouatt, Edward Ensel, R. N. Ferguson, and Ernest C. Watson, of Victoria.

Geology.—In the vicinity of this group of mineral claims the prevailing country-rock is a belt of metamorphosed rocks converted into schists and classified by Clapp as the Mount Sicker schists. The belt represents an extension or continuation of the same rocks as occur on Mount Sicker, in which the *Lenora*, *Tyee*, and *Richard III.* mines are located, but in the vicinity of the *Cornucopia* group the belt of schists is much narrower than on Mount Sicker, and is flanked on the north and south sides by the Cowichan group of conglomerate, sandstone, and shale.

Characteristics of the Ore-bodies.—The belt or zone of schists is very much sheared and fissured on the *Cornucopia* group of mineral claims, with some of the fissures filled with quartz carrying some copper minerals of considerable width on the surface, but showing indications of lenticular structure and appearing more like gashes occurring in the shear-zone at irregular intervals. The occurrences of the quartz-filled fissures, provided further prospecting determines that the extent is sufficient, may prove of importance as a source to supply siliceous flux to the smelters, as the quartz apparently carries sufficient copper values to avoid robbing other ore for losses in the slag, or further prospecting may determine that the occurrences are of value as concentrating propositions.

Development-work.—The present owners of the *Cornucopia* group had not performed much development-work up to the time that the writer examined the property on November 14th, 1917, and had confined their work to the *Old Gentleman* mineral claim, a considerable distance west of the old workings, where they had sunk a prospect-hole about 12 feet deep, 10 feet long, and 8 feet wide. A sample taken from the dump at this hole assayed: Gold, trace; silver, 0.8 oz.; copper, 2.1 per cent.

About 200 feet west from the prospect-hole just mentioned there is a short adit driven in schist and quartz a distance of about 15 feet, with about 15 feet of backs at the face, and about 400 feet farther in a westerly direction there is a very extensive outcropping of quartz carrying low values, but no development-work, except a short open-cut, has been done at this point.

The old shafts could not be examined because they were full of water. The dumps near the collars of the shafts were in no condition to sample, but the writer remembers seeing sacked ore on these dumps in 1902.

KOKSILAH RIVER DISTRICT.

The occurrences of copper ore that occur near the Koksilah river within a few miles of Cowichan Station, on the Esquimalt & Nanaimo Railway, were described in the Report of the Minister of Mines for 1916, and, as there has not been any activity in that section during the past year, it is unnecessary to repeat the description in the present report; but on June 28th, 1917, the writer examined for the first time the property known as the "*Robertson* silver-mine," near the headwaters of the Koksilah river, about eleven miles by the old Jordan Meadows trail, westerly from the head of Shawnigan lake.

Robertson.

This mine was located by W. A. Robertson, of Victoria, in 1880, but silver-bearing ore was discovered by Mr. Robertson in 1865 in float found in the bed of the river. At the present time the property is owned by Dr. Helmcken and W. A. Robertson, of Victoria, and has been Crown-granted for several years, but owing to lack of transportation there has been no activity on the ground since it was Crown-granted. The

camp and mine-workings are situated on the steep bank of the Koksilah river, at the base of a mountain, the summit of which reaches an elevation of about 2,000 feet above sea-level.

Geology.—The geological formation in which the *Robertson* mine occurs is that classified as the Vancouver volcanics, made up of metamorphic andesite, amygdaloid, porphyries, tuff, and breccias. The contact between the metamorphosed volcanics and the Wark gneiss, which latter is made up of batholiths of diorite gneiss and intrusive quartz diorite gneiss, occurs in close proximity to the occurrences of ore on the property. Nowhere was the ore observed to occur immediately at the contact, but invariably it was found developed in shear-zones in the volcanics. The mineralization is made up of galena, iron pyrite, sphalerite, a little molybdenite, and some chalcopyrite in a quartz gangue, with which is mixed breccia, garnetite, and calcite.

Characteristics of the Ore-bodies.—The occurrences of ore on the *Robertson* mine occur as lenses in fissures in a contact-metamorphosed shear-zone in the volcanic rocks. The development-work so far done is not sufficient to determine many facts with regard to extent or structure, and no relationship has been established between the various outcroppings that are exposed on the mountain-side, on the river-bank, and in the bed of the river. Two of these exposures of ore have been prospected to some extent. One is an outcropping about 200 feet elevation above the river-bed, where a quartz vein occurs carrying some little galena disseminated through the quartz for a width of about 18 inches. The strike of the quartz veins is north-easterly and dip nearly vertical, with the high angle towards the south-east. Another outcropping of ore occurs in the river-bank, where a vein-like occurrence has been drifted on for a distance of about 30 feet. The exposure shows a quartz vein about 4 feet wide at the portal of the drift. The mineralization of this ore-body is made up of some galena, iron pyrite, sphalerite, and a little chalcopyrite in a quartz gangue. The outcropping is in line with that farther up the mountain-side, and already referred to, but no connection between the two has been established; the strike of the last mentioned is north-easterly and dip about 55 degrees to the south-east. A grab sample taken from the dump at the portal of the drift assayed: Gold, 0.02 oz.; silver, 6 oz.; copper, trace.

Development-work.—The development-work on the property is considerably more than is usually found on an unproductive prospect, especially when located in as inaccessible situation as this is.

There are two adits, an upper and a lower, as well as a large open-cut about 200 feet above the level of the Koksilah river. The upper adit is 125 feet in length, driven in country-rock the whole distance. This adit was projected to expose the ore-body on the adit level, which is exposed in the open-cut about 70 feet higher elevation, but so far no results have been obtained. The lower adit is about 125 feet in length under cover and is approached by an open-cut 30 feet in length; this latter is through very much weathered, decomposed rock, evidently the walls of a vein, where timbering was necessary, to the portal of the adit, which is in solid rock. A quartz vein is exposed at this point with well-defined walls, and the adit is driven as a drift along the vein for 30 feet, where a winze is sunk, said to be about 20 feet deep, but being full of water could not be examined by the writer. The adit is driven about 95 feet beyond the winze in country-rock.

SUTTON LAKE DISTRICT.

The Sutton Lake district is situated south-westerly from the town of Ladysmith, on the Esquimalt & Nanaimo Railway, and is so named because the late William Sutton several years ago constructed a trail from Ladysmith to Nitinat lake, on the west side of Vancouver island, passing en route a fair-sized lake about eight miles from Ladysmith, which has been called Sutton lake ever since by the prospectors, but is called Coronation lake on the geological maps.

At Sutton lake a trail called the Majuba trail branches off towards the south, while the main or Sutton trail continues towards the south-west. The Majuba trail crosses a low divide to the head of Boulder creek, a tributary of the Chemainus river, and follows down that stream, which some years ago was the scene of considerable activity by prospectors who staked several mineral claims. Owing to inaccessibility because of distance from transportation, as well as the low grade of the ore, most of the locations have been allowed to lapse.

On July 2nd, 1917, this section was visited and an examination made of the *Anita* mineral claim, described as follows:—

Anita. This mineral claim is on Boulder creek, about eleven miles south-westerly from Ladysmith. It is owned by Mrs. E. Forcimer, of Nanaimo. The writer was accompanied by R. Kaplansky, the agent for Mrs. Forcimer, when he made

his examination. About five miles of the distance between Ladysmith and Sutton lake is covered by a logging-railway constructed by the Victoria Lumber Company, of Chemainus, which is at present out of use, but could be put into commission without much difficulty if the condition of the mineral claims warranted such action.

Geology.—The prevailing rock formation in the vicinity of the *Anita* mineral claim is schist, probably an extension of the belt of Sicker schist that is crosscut by the Chemainus river between Mounts Sicker and Brenton. The belt of schist is flanked on its northerly side by a batholith of intrusive igneous rock resembling granodiorite.

Characteristics of the Ore-bodies.—The ore occurs in bodies of quartz which appear to be lenses filling fissures in the schist, and which are mineralized in spots by impregnations of chalcopyrite and iron pyrite. A sample of the mineralized quartz assayed: Gold, trace; silver, 0.3 oz.; copper, 3.3 per cent. This sample did not represent an average of the quartz-body, but only such portion of it as showed mineralization, which is a comparatively small proportion of the whole body at the point where the sample was taken.

The quartz vein can be traced by outcroppings which occur at intervals from Boulder creek for a distance of about 200 feet in an easterly direction. In the bed of the creek, but where there was too much water to admit of a close examination, the quartz-outcroppings appear to be about 15 feet wide. Near the creek where some stripping and open-cut work has been done the vein does not appear to be as wide, although it may be, as the body of quartz has not been fully uncovered.

About 100 feet or so from the creek in an easterly direction there is a shaft, said to be 50 feet deep, but because of being about half-full of water and closely timbered this work could not be examined. Apparently the shaft is sunk in mineralized quartz, but no sample was taken from the dump, as it is some years since the shaft was sunk, and the dump, so the writer was informed by Mr. Kaplansky, had been sorted over several times; consequently no sample would represent a fair average of the material taken out of the shaft at the time it was sunk. About 100 feet easterly from the shaft an open-cut has been made. This is 52 feet long, about 3 feet wide, and of an average depth of about 4 feet, with a maximum depth in places of 7 feet. Some quartz occurs in the northerly end of the cut, but the work had not been continued sufficiently far to the north to expose any extensive body of quartz.

Owing to the demand at present by the Coast smelters for siliceous ores for fluxing purposes, the *Anita* mineral claim may be considered to possess sufficient promising possibilities to warrant further prospecting and some development.

If the main Sutton trail is followed for about ten miles from Sutton lake, beyond the forks where the Majuba trail branches off, it leads to a district where several mineral claims were staked some years ago, and it is reported that quite extensive work has been done on some of them, particularly the *Maple Leaf* group of mineral claims, owned by R. Nichols, at present a member of the C.E.F. on overseas service; also on the *Tyee* mineral claim, owned by W. Beattie, of Ladysmith. The writer was unable to examine these properties during the past summer, owing to the difficulty of procuring a guide who was thoroughly conversant with the claims in the absence of Mr. Nichols and the inability of Mr. Beattie to make the trip.

VANCOUVER MINING DIVISION.

Britannia.

The history of the *Britannia* mines, on Howe sound, dates back to 1898, when outcroppings of copper ore were discovered and the first mineral locations were made by trappers on a branch of Britannia creek, named Jane creek, after the name given to one of the mineral claims of the original group staked on Britannia mountain. This group was purchased during the same year from the original locators by Leo Boscowitz, of the fur-buying firm of Boscowitz & Sons, of Victoria, through a fur-buyer named Thomas T. Turner, and some deveolpment-work was commenced. Owing to this transaction a large number of prospectors were attracted into the neighbourhood of the new strike, and within a few months practically all of the ground between the beach and the *Jane* mineral claim, a distance of about four miles, was located, as well as several mineral claims in what was known as South valley, on Furry creek, lying to the south of the earliest locations, about one mile distant.

In the autumn of 1899 seven-tenths of the original *Britannia* group of four mineral claims was bonded by Boscowitz to Howard Walters and Jos. Adams, of Libby, Montana, who organized the Britannia Copper Syndicate with a capitalization of $250,000 divided into 400 shares of the par value of $625 each.

This syndicate performed considerable development-work, and about 1904 sold a control of the capital stock to George Robinson, of Butte, Montana, and Henry Stern, of New York, on a basis of $1,500 a share, who also later purchased the three-tenths interest retained by Boscowitz; organized the Britannia Mining and Smelting Company, Limited; purchased the smelter built by Breen & Bellinger at Crofton, on the east coast of Vancouver Island; erected a concentrating plant, wharf, and bunkers at Britannia Beach, Howe sound; and connected the mine-workings with the concentrating-mill by an aerial tramway about two miles and a half long, built in two sections.

Operations were carried on under the management of George Robinson until his death, but concentration of the ore by water proved unsuccessful. With the then low price of copper, the ore was of too low grade to be profitably smelted direct, and it appeared as though the enterprise would result in failure. About that time the late G. B. Schley, of New York, acquired control of the company, and commenced a policy of systematic development and thorough prospecting of the property. Although the mine was withdrawn from the list of producers from about 1907 until 1910, the results from the development-work showed that there was about 400,000 tons of ore actually available of sufficiently high grade to be smelted direct. Owing to Mr. Schley's perseverance and indomitable courage, as well as his ability to finance the extensive programme for development which he outlined, the enterprise was changed from a possible failure to a success, and since the introduction of the flotation method of concentration, by which the enormous tonnage of low-grade copper ore occurring in the mine can be successfully treated, the *Britannia* mine ranks among the most important copper-mines in the British Empire.

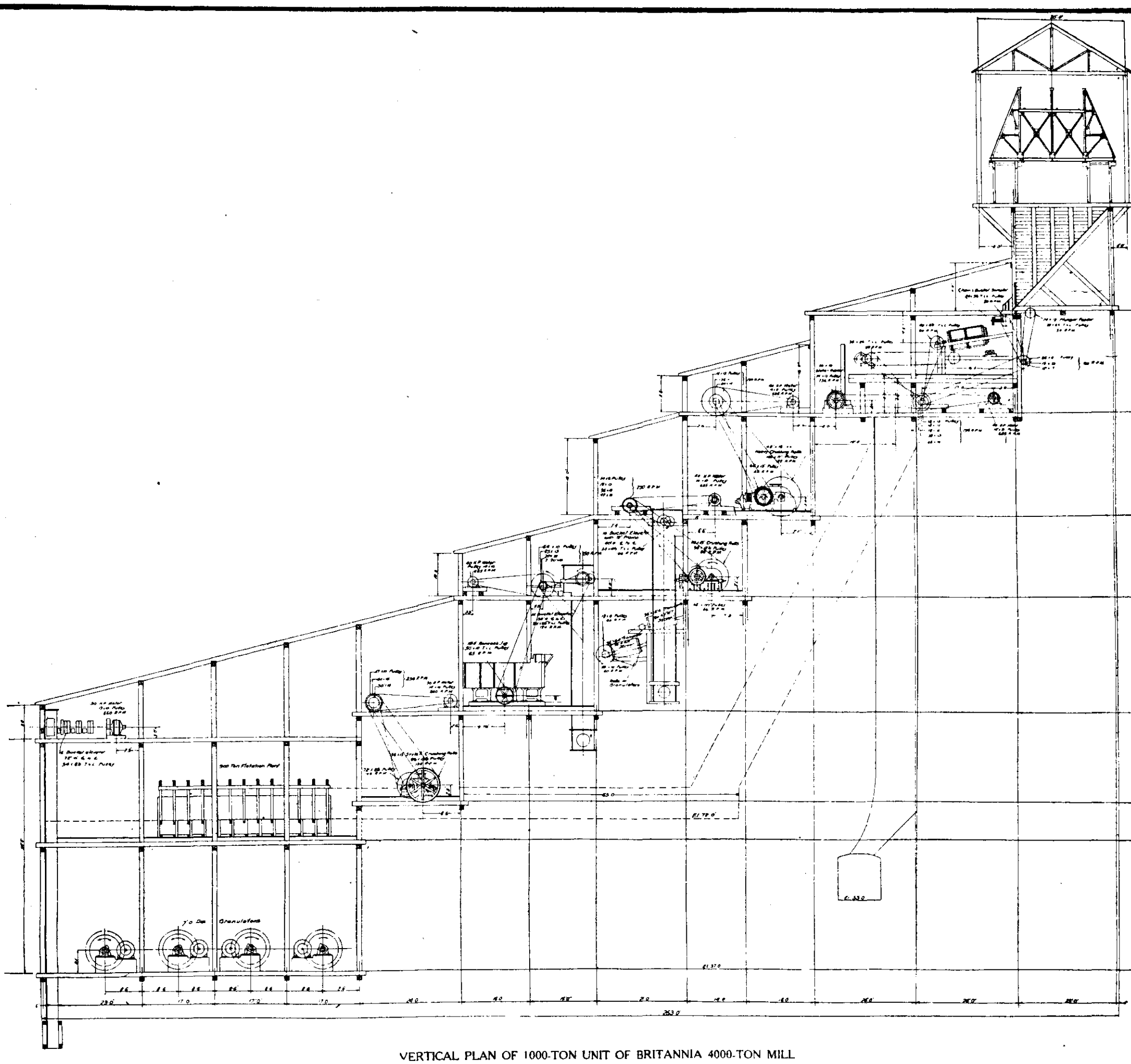
The writer examined the underground workings of the property of the Britannia Mining and Smelting Company, Limited, during the latter part of November, 1917, under the guidance of C. P. Browning, the general superintendent, and was extended many courtesies by E. J. Donohue, secretary-treasurer, who was acting-manager in the absence of J. W. D. Moodie, vice-president and general manager.

Since the late Mr. Schley acquired the control of the company, the original property has been so greatly enlarged by the purchase of adjoining mineral claims that to-day the holdings are represented by about 350 claims covering an area of approximately 18,000 acres in a solid block. For convenience the present productive part of the property, or that portion from which ore is being mined as distinguished from the claims being prospected, is subdivided into four divisions, known as the *Jane*, *Bluff*, *Fairview*, and *Empress* mines, which adjoin each other and are all connected in the workings. The *Jane* is the most westerly, the *Bluff* is east of and adjoining the *Jane*, the *Fairview* is east of and adjoining the *Bluff*, and the *Empress* is southerly of and adjoining the *Fairview*.

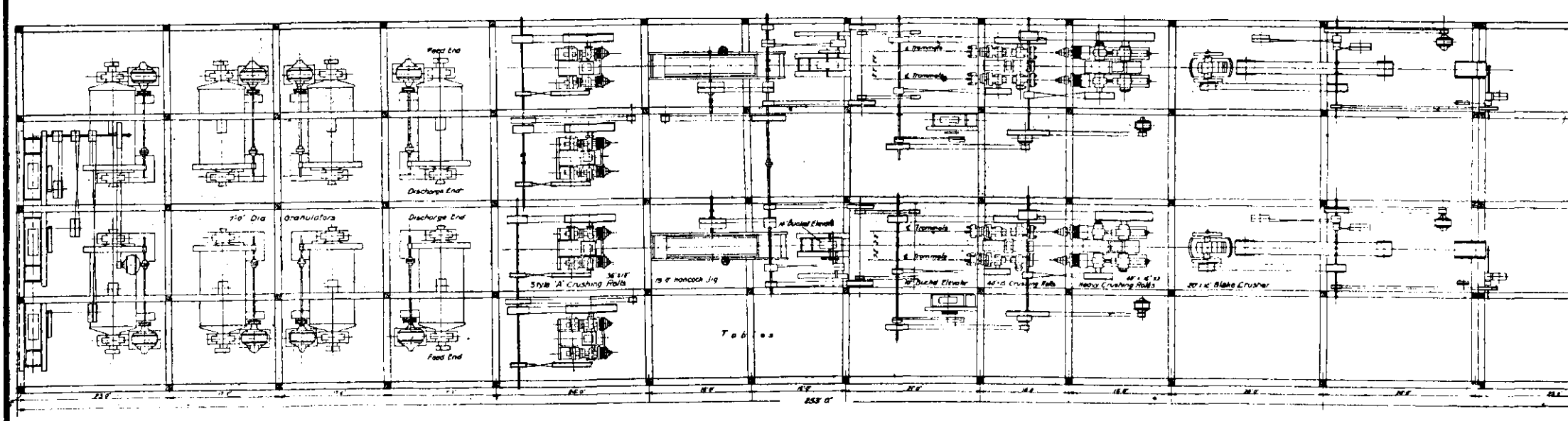
The *Jane* mine is opened underground for a length of 1,000 feet from west to east along the strike of the mineralized zone; the *Bluff* mine extends for 800 feet east from the *Jane;* the *Fairview* mine extends for 2,500 feet east of the *Bluff;* and the *Empress* underground workings extend for 1,200 feet from west to east along the strike of the mineralized zone.

The ore occurrences on the *Britannia* property belong to the replacement type, are very extensive, and occur in what is known as the "Britannia Schist Belt," which extends from the east shore of Howe sound at and near Britannia Beach in a general S. 80° E. direction for a distance of at least about five or six miles. The formation is a silicified greenstone-schist from one to two miles wide, which is very much fissured and occurs between belts of granite. The ore occurs filling fissures in the schist, which have their lines of strike nearly parallel to each other, S. 80° E., conforming with the schistosity, and dip at varying angles from 30 degrees to nearly vertical towards the south. The mineralization in the fissures is chalcopyrite associated with iron pyrite in a siliceous gangue. The fissures are wide but somewhat irregular, and are numbered by the miners for convenience. So far as at present known, there are twelve of these fissures or veins that are numbered from north to south, with the most northerly numbered zero and the most southerly No. 11 vein.

The mine-workings originally were located on and above what is now the 1,000-foot level, at an elevation of about 3,300 feet above sea-level, which was the main haulage-way until the winter of 1915, when the big slide occurred that destroyed the mining camp and terminal of the aerial tramway on that level. Since then a main adit has been driven at the 2,200-foot level, about 2,100 feet above sea-level, which is at present used as the main haulage-way and entrance to the underground workings. This adit is equipped with electric haulage and is 4,712 feet in length,



VERTICAL PLAN OF 1000-TON UNIT OF BRITANNIA 4000-TON MILL



HORIZONTAL PLAN OF 1000-TON UNT OF BRITANNIA 4000-TON MILL

9 feet high by 13 feet wide, driven in a S. 30° E. direction, crosscutting the formation. At a point 3,900 feet from the portal the No. 1 vein is exposed, on which the upraise, known as the No. 1 shaft, is located. This is a vertical upraise to the 1,000-foot level and is the main hoisting-shaft for transporting men, timbers, and supplies to the upper workings.

All of the ore is mined from levels above the 2,200 and transported to the bins on that level by gravity down two rock-raises, the main one known as the No. 68 rock-raise made on the No. 3 vein. This extends from the 850-foot level, at an elevation of 3,500 feet above sea-level, to the 2,200-foot level, and has connections on every level between those two. The other rock-raise is known as the No. 61 or auxiliary, and is made on the No. 1 vein from the 2,200- to the 1,000-foot levels, with connections at every level between.

Above the 850-foot level there are several transfer rock-raises through which ore is transported from the glory-hole and levels between it and the 850, on which electric trains are operated to transfer ore from the bins at the bottom of the raises on that level to the top of the No. 68 or main rock-raise. By this system of transporting ore down to the 2,200-foot main haulage level every economy is exercised and handling of ore is avoided, so that the cost is minimized to the lowest possible figure.

The mine-workings will be described in this report in descending order from their start at the summit of Britannia mountain, at an elevation of 4,350 feet above sea-level, where a glory-hole is opened on veins Nos. 9 and 10, with its dimensions 400 feet in length from west to east by 175 feet maximum width. This glory-hole extends from the surface to the 250-foot level, at an elevation of 4,100 feet above sea-level, and the ore mined in it passes down a rock-raise to the 850-foot level, which is 3,500 feet above sea-level, where the ore is drawn and transferred by electric train to the main rock-raise No. 68, down which the ore passes to the 2,200-foot level, at an elevation of 2,150 feet above sea-level, and which is at present the main haulage-way.

On the 250-foot level there are 2,350 feet of drifts and crosscuts on the veins numbered from 6 to 10, and the workings cover an area of 1,100 feet from east to west by 700 feet from north to south.

On the 250-foot level the tunnel is driven through Britannia mountain, with the northerly portal overlooking the watershed of Britannia creek and the southerly portal overlooking South valley and Furry creek. On the 500- and 1,000-foot levels the mountain has been pierced from side to side by the underground workings, thereby affording easy access from one mine to another, instead of making it necessary to climb over the summit of the mountain by trail to travel from the *Jane*, *Fairview*, or *Bluff* mines to reach the *Empress*, on the opposite side of Britannia mountain.

From the 250-foot level the 500 is reached by way of the *Grandview* hoist, and from the 500-foot level the 1,000 is reached by way of the No. 2 shaft sunk on the northerly side of the workings. Below the 1,000-foot level to the 2,200 access to all levels is by way of the No. 1 or main shaft.

The 500-foot level has up to the present time been one of the most productive levels in the mine. Nine veins carrying commercial ore are exposed on this level, numbered from No. 3 to No. 11, both inclusive, and there are approximately 9,000 feet of drifts and crosscuts.

The 600-foot level, at an elevation of 3,760 feet above sea-level, is opened up with 7,500 feet of drifts and crosscuts.

The 700-foot level, at an elevation of 3,620 feet above sea-level, is opened up with 4,000 feet of drifts and crosscuts.

The 850-foot level, at an elevation of 3,500 feet above sea-level, is opened up with 10,000 feet of crosscuts and drifts. On this level eleven veins, numbered from No. 0 to No. 10, carrying commercial ore, are exposed within a distance of 1,000 feet from north to south, and some of the veins have been drifted on for 1,700 feet from west to east.

The 1,000-foot level, at an elevation of 3,300 feet above sea-level, is opened up with 10,000 feet of drifts and 4,200 feet of crosscuts, without including the old workings done on the *Jane* and *Express* mineral claims by the first operators, amounting to about 1,100 or 1,200 feet. On this level nine veins, numbered from No. 0 to No. 8, carrying commercial ore, are exposed within a distance of 1,000 feet from north to south and a maximum length of 4,000 feet from west to east. This level is the first that enters the ground west of the *Violet* mineral claim, and the lowest level on which connections are made through the *Bluff* mine, on Britannia Creek side of

the mountain, to the *Empress*, overlooking South valley and Furry creek, on the opposite side of the mountain.

The 1,200-foot level, at an elevation of 3,100 feet above sea-level, is opened up with 3,050 feet of drifting and 2,400 feet of crosscuts. On this level five veins, numbered from No. 0 to No. 4, are exposed within a width of 600 feet from north to south and a maximum length from east to west of 2,000 feet. This is the lowest level on which any stoping is done, except the veins numbered No. 3 and No. 1.

The 1,400-foot level, at an elevation of 2,900 feet above sea-level, is opened up with 260 feet of crosscuts and 100 feet of drifting.

The 1,600-foot level, at an elevation of 2,700 feet above sea-level, is opened up with 2,900 feet of drifts and 1,650 feet of crosscuts. On this level four veins, numbered No. 0 to No. 3, carrying commercial ore, are exposed within a width from north to south of about 500 feet.

The 1,800-foot level, at an elevation of about 2,500 feet, is opened up with 800 feet of crosscuts and drifts, in which the No. 3 vein, carrying commercial ore, is exposed. This level is the crusher level, at which all ore mined passes through a crusher and down the rock-raises to the 2,200-foot or main haulage level.

The 2,000-foot level, at an elevation of about 2,300 feet above sea-level, is opened up with about 150 feet of crosscuts and 100 feet of drifting on the No. 2 vein.

The 2,200-foot level, at an elevation of about 2,100 feet above sea-level, is opened up with 4,712 feet of crosscut adit, laid with 45-lb. steel rails and equipped for hauling with electric train by the trolly system. The veins numbered No. 1 and No. 3 are exposed on this level and have been drifted along for about 500 feet on each vein, thereby proving that these two veins at least are persistent to that depth.

On the 2,200-foot level is located the main mining camp, machine-shops, upper terminal of the aerial tramway, and bunkers, from which a part of the ore mined is transferred to the buckets on the aerial tramway, which has a capacity of handling about 700 tons a day. The remainder of the ore mined, or about 1,400 tons a day, is hauled by electric locomotives over three miles and a half of side-hill railroad, which has a maximum grade of 3 per cent. and leads to the head of an incline at an elevation of 1,600 feet above sea-level. This incline is 5,500 feet in length, with an average grade of approximately 30 per cent., and is equipped with standard-gauge double-track railroad, which conveys the ore from bins at the head of the incline to the concentrating-mill bins at the beach.

On the 2,700-foot level, at an elevation of about 1,600 feet, on a level with the head of the incline, an adit is being driven to intersect the main ore-zone at that depth, and when completed will be used as a haulage-way to supplement the electric railroad. This adit is at present about 3,000 feet long, 9 feet high, by 13 feet wide.

On the 4,100-foot level, at the same elevation as the top of the concentrating-mill and about 250 feet from the mill, an adit is being driven into the mountain, and is at present about 3,000 feet long, 9 feet high, by 13 feet wide. It is proposed to continue driving this adit and eventually connect it by upraises with the mine-workings on the upper levels, when it will form an important part of the transportation system between the mine and the concentrating-mill.

The "shrinkage" system of mining is followed throughout the mine, and no timbers are used except in the ore-chutes. By this method about two-thirds of the ore broken in the stopes remains there in reserve to be drawn after the stoping is finished, and in the meantime furnishes a foundation on which to set up the air-drills.

Electrical power is employed throughout the vast system of works operated by the Britannia Company. This power is generated by water-power developed by a system of reservoirs and dams on Britannia creek on the north side of Britannia mountain and Furry creek on the south, from which the water is carried by ditches and pipe-lines to the power plants. These streams drain a very extensive area of mountainous country, and each creek has several tributaries and carries a very large body of water, flowing with a fall of nearly 4,000 feet within the comparatively short distance of about three or four miles.

The water-power system is one of the most perfectly designed and substantially constructed in the Province, and the distribution of the electric current from the power plants to the various units is systematically arranged and works smoothly.

Space in this report will not permit of any attempt to describe the system in detail, but some idea of its immensity can be gathered from the statement that there are electric motors

hauling ore-trains underground as well as in the open on a switchback railway about three miles in length; hoists in the mine operated by electricity in the main shaft from the 2,200-foot level up to the 1,000-foot level or 1,200 feet vertically above the 2,200; also in the shaft from the 1,000-foot level up to the 500; while in the concentrating-mill, machine-shops, and other parts of the works all of the machinery is driven by electricity; and the towns and main mine-workings are also lighted by electricity—in fact, it is the power universally employed throughout the entire year.

The power system has been very much improved and enlarged during the past year since the concrete dam on Furry creek has been built, and the power developed there has been utilized in combination with that developed on Britannia creek.

The Britannia Mining Company was the first company in British Columbia to adopt the Mineral Separation Company's flotation process for concentrating the low-grade copper ore that occurs on the property. This was done after thorough and systematic tests had been made, to ensure that the process would give satisfactory results. The first unit was erected at Britannia Beach with a capacity to treat 1,000 tons of ore a day, and later this increased to about 2,000 tons a day, which is approximately the present capacity. Of this tonnage there is an appreciable quantity of the ore delivered on to the grizzlies at the top of the mill that is sorted out on the picking-tables and shipped to the smelter direct. The remainder is first concentrated by jigs after passing through the crushers and rolls. The product of concentrates made by jigging represents about 40 per cent. of the total product shipped to the smelter. The tailings from the jigs are transferred to the tube-mills, crushed fine, and sent to the flotation cells and the concentrates are shipped to the smelter, while the tailings, after being carried through launders, are deposited on the beach by means of a short tunnel driven from under the side of the mill to low-tide mark, so that when the tide floods the material is carried out to sea.

The mill building is designed so that gravity is employed to the fullest extent possible in handling the ore, which is delivered from the 20-ton skips on the incline railway into the ore-bins at the top of the mill, at an elevation of about 250 feet above sea-level. The ore then passes over the grizzlies, from which the undersize passes direct to the jigs and the oversize to the picking-tables, thence to the rolls and jigs, the tails from which are treated by flotation, and the concentrated product, which represents approximately 60 per cent. of the tonnage, after being dewatered is shipped to the smelter at Tacoma, Washington.

When the concentrating-mill was first erected it was considered necessary to import flint pebbles from Norway for use in the tube-mills, but later it was discovered that there was a sufficient quantity of rock mined with the ore of the necessary hardness for this use; consequently imported pebbles were displaced by the native material, and the milling costs appreciably decreased.

The power used to run all of the machinery is electric, which is generated by water-power and transformed in the power-house built near the mill building on the same level as the picking-table floor; the water, after passing through the turbine-wheels, is piped into the mill, where it is used in the jigs and flotation cells, as well as for protection against fire.

In a short report it is impossible to give a detailed description of the plant, which is as complete in every appointment as mechanical skill can devise. The mill building itself is a model worthy of being copied by any organization; it is much more roomy than such plants usually are, and consequently the ventilation is all that can be desired. Safety appliances have been installed with a consideration for the employees such as is seldom evidenced by large corporations.

The concentrates and sorted ore are transported to the smelter in the company's own steam-freighter, which was originally the lighthouse tender, the S.S. "Quadra," then owned by the Dominion Government, which was purchased some time ago by the Britannia Company, remodelled, and placed under the command of Captain Cutler, one of the veteran skippers on the Pacific Coast.

INDIAN RIVER DISTRICT.

The Indian River district extends from the head of that river, in the Coast range, about twelve miles south-easterly from Squamish, at the head of Howe sound, to its confluence with the North arm of Burrard Inlet, about twenty miles northerly from the city of Vancouver. So far as known at present, the mineralized zone only extends from near the head of Indian river to the *Caledonia* group of mineral claims about eight miles down the river in a south-easterly

direction. Owing to the fact that this section is almost directly on the line of strike of the "Britannia Schist Belt," but about eight miles easterly from the *Britannia* mine-workings, and that the rock formations are somewhat similar to those surrounding the *Britannia* mine, the Indian River district has become very attractive to the prospector. During the past year a larger number of mineral claims have been staked in this section than during previous years. An examination of the more important properties in this district was made in September.

The writer started from the town of Squamish, the terminus of the Pacific Great Eastern Railway, on September 10th, and followed the old Squamish-Seymour Creek trail to the head of Stawamus creek. This trail practically parallels the creek from its mouth, near Squamish, to the forks, about three miles from its source in Stawamus lake. At the forks of Stawamus creek the trail leading down Seymour creek to its mouth, on Burrard inlet, branches towards the south, along the South fork of Stawamus creek, past Stawamus lake and Loch Lomond, in which Seymour creek has its source, while the Indian River trail follows the North fork of Stawamus creek to its source, near the summit of the Coast range, across the summit to the head of Indian river, down that river to its mouth, at the head of the North arm of Burrard inlet.

The trail from Squamish to the head of Indian river was in very bad condition, as no work, other than that done by S. A. Habrich, the owner of the *Belle* group of mineral claims, situated near the head of Indian river, has been done on it for some years past, although the route is used considerably by trappers and prospectors and was laid out by the Government as a highway more than twenty-five years ago. The trail from the summit down Indian river has had a great deal of work done on it during 1916 and 1917, and was found to be in fair condition, with all of the bridges in good shape.

The writer visited this section in 1913, when the *Belle* group of mineral claims was almost the only mineral location on Indian river or in the surrounding country, and his report was published in the Report of the Minister of Mines for that year.

The elevation of the summit where the trail crosses is 2,200 feet above sea-level, and as it is reached within about ten miles of Squamish the grade is much steeper than on the Indian River or southerly side, and the deep snow remains as a covering over the surface to a much later date in the spring of the year than on the Squamish side. In the event of productive mines being developed the ore would be transported to Burrard inlet, a distance of about twenty miles (by trail), rather than the shorter distance to Squamish over the summit.

A.B.C. Group. This group of mineral claims consists of the *A.B.C. No. 1*, *A.B.C. No. 2*, *A.B.C. No. 3*, and *A.B.C. No. 4*, situated at the head of the Indian river, about twenty miles (by trail) from the head of the North arm of Burrard inlet. The country-rock is a greenstone rendered somewhat schistose through shearing. In the west bank of the river there is an outcropping of iron-stained rock in which are visible some grains of iron pyrite and chalcopyrite disseminated through the rock, but no work has been done at that point. On the opposite side of the river an adit has been driven 30 feet in length, 15 feet of which is close timbered, and there is no evidence of any ore in the workings, unless it is behind the timber, out of sight.

There was no one on the property to guide the writer over it, but from the most reliable information he could obtain, no other work had been done on any of the claims contained in the group.

Belle Group. This group of mineral claims consists of five Crown-granted claims, known as the *Ethel*, *Rose*, *Irish Molly*, *Lucky Jack*, and *Jenny*, owned by S. A. Habrich and Peter Herress, of Squamish, B.C. A tributary of Indian river known as Canyon creek flows across the north-westerly end of the *Irish Molly* claim, and another tributary of Indian river known as Copper creek flows across the *Ethel* mineral claim. A good log cabin forms the mining camp, and is located on the *Irish Molly* mineral claim, on which most of the development-work has been done.

At a point 150 feet higher elevation than the cabin, which is 2,150 feet above sea-level, there is an adit 100 feet in length driven in a south-westerly direction through country-rock to intersect an ore-body that outcrops on the surface, about 60 feet higher in elevation than that at the portal of the adit, which apparently has not yet been driven sufficiently far. The outcropping, which the adit is expected to develop at about 60 feet depth, is about 10 feet wide and carries a good grade of chalcopyrite in a schistose gangue. In addition to the outcrop just mentioned, there

are four others on the *Irish Molly* claim to the west of it, as well as several in an easterly direction from it. These outcroppings are found at intervals along a general east-west course for a distance of about 850 feet, and so far as the surface showings indicate are not related to each other, but are apparently outcroppings of separate lenses.

The most important of these outcroppings is one which the writer sampled in 1913. The sample was taken across 25 feet in width and while it is not to be considered as an average of the showing, it represented such ore as could be roughly sorted from the ore-body, and assayed: Gold, trace; silver, 2 oz.; copper, 5.3 per cent. There is an intrusive igneous dyke occurring in this outcrop which is from 12 inches to 3 feet wide, with ore on both sides of the igneous rock. The length of the outcropping exposed by stripping is about 50 feet.

The three other outcrops referred to are exposed by shallow open-cuts. The work done is not sufficient to furnish any data as to the full extent, strike, or dip of the ore-bearing zone.

Grab samples from two of these outcroppings assayed 1.3 and 0.5 per cent. copper, with traces of gold and silver. A grab sample from another outcropping about 60 feet easterly from the outcroppings that occur directly over the adit assayed: Gold, 0.02 oz.; silver, 0.6 oz.; copper, 1.3 per cent.

On the *Ethel* mineral claim, about 400 feet from the south-easterly line of the *Irish Molly* claim, there is a wide outcrop, on the steep bank of a small creek that flows into Copper creek, of iron-stained schistose rock, in which occur particles of iron pyrite and chalcopyrite. This outcropping appears to be a separate lens from the others, but occurs in a general westerly direction from them and under very similar geological conditions.

The *Belle* group appears to be a very promising prospect, but is handicapped by lack of transportation facilities, although, if thoroughly prospected and the work demonstrated that there was an occurrence of ore of sufficient extent to warrant the installation of a concentrating plant, the property is very well located with regard to water-supply for concentrating and power purposes.

Along the bed of Copper creek in a south-easterly direction towards its confluence with the Indian river other outcroppings of iron-stained sheared rock, practically gossan, are found on the *Ethel* mineral claim. These indicate the occurrence of bodies of copper ore underlying the gossan, but apparently have no connection with the outcroppings already referred to, although there is a possibility that there may be some connection; systematic development-work would determine the question.

The bed of Copper creek is for the most part in a deep canyon which crosscuts the formation and exposes several igneous dykes which intrude into light-grey coloured rock similar to a lime silicate, but much altered and sheared. Farther down the creek there appears to have been a *great fault, as the rock formation instead of striking to the east* (mag.) strikes N. 10° W. (mag.). This rock is apparently a sedimentary only partially metamorphosed, as the bedding-planes are well defined, dipping easterly at about 45 degrees.

Bulliondale Group.

This group of mineral claims consists of the *Lady of the Lake* and the *Bulliondale Nos. 1, 2, 3, 4,* and *5* claims, with the *Bulliondale No. 1* adjoining the *Rose* claim of the *Belle* group on the south-easterly side. This property, owned by Robert Mungall, of Vancouver, is situated on the westerly side of the Indian river. The *Bulliondale No 1* claim is crosscut by a torrential stream called Windy creek, and the *Lady of the Lake* claim, which is separated from the *Bulliondale No. 1* by the *Bulliondale No. 2* claim, is crosscut by a smaller stream called Mungall creek. Both of these creeks are tributaries of the Indian river flowing in from the west side. The main trail down the Indian river crosses both of the creeks mentioned about 200 feet higher in elevation than the level of the river.

At an elevation of about 600 feet above the trail on the *Lady of the Lake* mineral claim, and above a rock-slide on the south bank of Mungall creek, there occurs an outcropping of gossan of considerable superficial extent, in which are impregnations of iron pyrite and chalcopyrite. The strike is south-easterly, but the dip is undetermined, and no work has been done. A grab sample assayed: Gold, trace; silver, trace; copper, 0.9 per cent.

At the head of a gulch, a tributary of Mungall creek on the north side of the creek and about 800 feet elevation above the trail, on the *Lady of the Lake* mineral claim there is an adit 100 feet in length, driven in a S. 75° W. (mag.) direction, which crosscuts three bodies of low-grade

copper minerals. The first ore is exposed near the portal of the adit and apparently is crosscut along the top. This body dips into the mountain about 30 feet from the portal of the adit. The second body of ore exposed in the adit is about 60 feet from the portal; it shows for 10 feet in width, and is drifted on to the south-easterly a short distance. A sample taken across 3 feet at the face of the drift assayed: Gold, trace; silver, trace; copper, 0.5 per cent. A third body of low-grade copper mineral is exposed near the face of the adit, where the indications show that the ore is continuing beyond the face and that the full width is not exposed.

The rock formation on the *Bullíondale* group of mineral claims is apparently a continuation of the shear-zone of igneous rock that occurs through the *Belle* group, or possibly a parallel zone. The country-rock is dark green in colour, and so is referred to in this report as greenstone; a microscopic examination would be required to give it a definite name, but in appearance it looks like a diorite.

Roy Group.

This group contains eight mineral claims, known as the *Roy Nos. 1* to *8*, inclusive, located on the east side of the Indian river, about fifteen miles above its mouth. The property is owned by the Copper Exploration and Development Company, of Vancouver, and is reached by a switchback trail constructed up the mountain-side on the east side of Indian river, that branches off from the main trail on the west side of the river, which is crossed on a good log bridge.

At an elevation of about 2,000 feet above sea-level and 1,200 feet above the bridge across Indian river the mountain-side shows evidence of considerable erosion. In this particular vicinity there are mineralized outcroppings made up mostly of chalcopyrite of somewhat marked extent, and portions of which show bodies of high-grade copper ore. The country-rock appears to be diabase, and the ore-bodies are apparently developed on the slope of the hill within a zone that in this particular vicinity has suffered so much from erosion that the hanging-wall has been entirely carried off, as well as much of the ore that underlaid it. Apparently the ore dips at about 25 degrees towards the south-east (mag.) and strikes north-east (mag.).

The development-work consists of a series of open-cuts and shallow prospect-holes made on both sides of an intrusive dyke which has its line of strike almost at right angles to that of the ore-bearing zone. There have also been three diamond-drill holes bored into the country-rock, none of which exposed any ore, but the writer is of the opinion that these holes were bored into the foot-wall below where any ore would likely be found.

Outcroppings of chalcopyrite are uncovered at intervals for a distance of about 300 feet along the apparent strike, and a width varying from a few feet to about 15 feet. The intrusive dyke appears to have exercised but little, if any, influence over the deposition of the ore. It is possible that systematic prospecting lower down the mountain-slope, below where the hanging-wall has been carried on by erosion, may expose an extension of the ore-bearing zone.

At the time of the writer's visit there was possibly about 400 tons of shipping-ore piled in dumps around the various open-cuts, which apparently would equal in grade the sample reported by Robt. Musgrave, M.E., when he examined the same property for the British Columbia Bureau of Mines in the summer of 1916, which assayed as follows: Gold, trace; silver, 1.6 oz.; copper, 12.4 per cent.

There are three other prominent groups of mineral claims on the east side of Indian river which were examined by Robt. Musgrave in 1916, known as the *Caledonia*, *Myrtle*, *Princess*, and *London*. These were not examined in 1917, for the reason that no further work had been done since Musgrave's examination, and there was no one on any of the properties representing the owners to show the locations of the workings or the outcrops. Therefore the writer postponed visiting these groups until some future time when the owners are actively operating them. According to Musgrave's report made to the Provincial Mineralogist, there are promising prospects on some of the mineral claims in these groups, but systematic prospecting is required to determine their possibilities, especially when the lack of transportation is considered.

Although there are altogether about 150 mineral claims staked and recorded in the Indian River district or belt, the writer was unable to find the owners or representatives on any other claims than those he has described; consequently no other examinations were made.

The mineralized zone in the Indian River district apparently extends for about eight miles from north-westerly to south-easterly, following the general course of the river and occupying a position nearly due east of the property of the Britannia Company, about six miles distant.

SEYMOUR CREEK DISTRICT.

The portion of the Vancouver Mining Division included in the Seymour Creek district commences at North Vancouver and extends to the head of Seymour creek, at Loch Lomond, about twenty-five miles northerly from Burrard inlet. Loch Lomond is about seven miles easterly from Britannia Beach, on the eastern slope of the Britannia range of Coast mountains, and near the peak named Ben Lomond, one of the loftiest peaks in that part of the Province. Seymour Creek valley is comparatively quite narrow and the mountains on both sides rise abruptly to considerable altitudes, but the grade of the creek-bed is quite gradual, so that any trails or roadway can be constructed with easy gradients. From North Vancouver there is an automobile-road to the intake, about six miles up the creek, from which the waterworks of the city of Vancouver derives much of its supply of water for domestic use. Above the intake a trail has been constructed up the creek, which is a portion of the old trail to Squamish, at the head of Howe sound, that was used twenty-five years ago by settlers and trappers.

The section of the district that has been the most extensively prospected for minerals commences to the north of the First West fork of Seymour creek, about eighteen miles due north of the city of North Vancouver, and extends to the north of Loch Lomond. There has been, however, some prospecting done in the mountains west of the intake, where several mineral claims were staked some years ago on the divide between Seymour and Lynn creeks.

The writer visited the Seymour Creek district on July 23rd, 1917, for the purpose of examining a group of mineral claims located on the Second West fork of the creek, and but for the fact that from the best information he could obtain there were none of the claim-owners at that time working or living on any of the properties farther north, he would have continued his trip to Loch Lomond.

The Britannia Mining and Smelting Company has for some time past been paying considerable attention to mineral claims located near the head of Seymour creek, and is reported to have purchased some of the most promising prospects.

Travelling along the trail, there is little opportunity to examine the geology, as the rock formations are hidden by overburden of soil, and until the Second West fork is reached there are very few exposures of rock in-place.

Sun Group. This group, consisting of the *Rainy Day*, *Hydro*, *Sunshine*, *Sunrise*, *Sunray*, *Sunlight*, *Sundog*, and *Sunset* claims, is located on the Second West fork of Seymour creek, and is owned by R. D. Watson and Thomas Fry, of 318 Main street, Vancouver. The prospecting and development work has been chiefly confined to the *Hydro*, *Rainy Day*, and *Sunshine* mineral claims.

The creek flows through the *Hydro* and *Rainy Day* claims, with very steep banks, affording a good opportunity to drive along the strike of the mineralized zone and gain considerable backs within a comparatively short distance.

On these claims there is a wide mineralized zone in breccia country-rock, the strike of which is apparently north-westerly. The extent of this zone is at present undetermined, but from the exposures of copper minerals and iron-stained outcroppings it seems as though there is a possibility that the mineralized zone may reach a width of approximately 100 feet. The length is demonstrated to probably exceed 100 feet, as a drift-adit has been driven on the *Hydro* claim for 100 feet in length, through mineralized breccia from a point about 25 feet from the portal to the face, with mineral still showing in the face. The mineralization is a combination of impregnations of iron pyrite and chalcopyrite, of which a grab sample assayed: Gold, trace; silver, trace; copper, 1 per cent.

Open-cuts on the *Rainy Day* and *Sunshine* mineral claims expose the same character of mineralized rock, but the mineralization appears to gradually disappear, for on the *Sunshine*, near what appears to be the north-easterly boundary of mineralization, a grab sample taken from an open-cut assayed only: Gold, trace; silver, trace; copper, 0.1 per cent.

From the samples taken it would appear as though the values carried by the breccia are too low to permit of satisfactory commercial results, unless further prospecting exposes bodies of mineralized material that carry higher values in copper. The apparent considerable extent of the mineralized zone is such that further prospecting is advisable.

The present prohibitive conditions with regard to transportation would undoubtedly be removed should sufficient tonnage of ore of commercial value be developed. The conditions with regard to water-supply for concentrating as well as possibly for power purposes are excellent.

LYNN CREEK DISTRICT.

Lynn creek has its source in Lynn lake, about twelve miles north from the city of North Vancouver. The creek flows southerly to its mouth, in the Second Narrows of Burrard inlet, and roughly almost parallel to the course of Seymour creek, the mouth of which is about one mile east from the mouth of Lynn creek.

About twenty years ago there was considerable prospecting in the mountains adjacent to the creek and near its head, when a group of mineral claims was located for copper ore about three miles above the intake of the Vancouver waterworks, and later several claims were staked farther up the creek and above the forks on a discovery of zinc-blende.

The writer visited the district on August 2nd, 1917, for the purpose of examining the property of the Lynn Creek Zinc Mines, Limited, and to make a general examination of the district, but, as no one was working or living on any of the other mineral claims, the examination was confined to the one group of claims.

In 1913 the same property was examined by the Assistant Mineralogist, Mr. Galloway, and his report was published in the Report of the Minister of Mines for that year.

Lynn Creek Zinc Mines, Ltd.

The group of mineral claims owned by this company contains the following eight claims and a fraction: *Kemptville Extension*, *Evening Star*, *Pretty Bess*, *Fleming*, *Morning Star*, *Cascades*, *Jersey*, *Russell*, and *Lucky Star*. W. C. Woods is president of the company and G. Phillips is secretary, with the head office in Vancouver. The property is located on the West fork of Lynn creek, and is reached by street-car from North Vancouver to the intake, about three miles, and by pack-trail from there to the mining camp. During the past summer a logging company was engaged in constructing a logging-railroad up the creek to the forks, a distance of about four miles from the intake, and the completion of this road will remove to a great extent the transportation difficulties that exist at the present time.

The conditions on the property so far as development is concerned were found to be very similar to those described in Mr. Galloway's report, except that an effort had since been made to intersect the main ore-body with a crosscut adit at a depth of about 150 feet below the outcrop. This adit is known as the Russell tunnel; it is about 162 feet long and at the time of examination there was no ore exposed in it. A survey is necessary to determine whether the adit has been driven sufficiently far to reach the ore-body, if it maintains its continuity to the level of the adit. George Bower, one of the locators of the group, who accompanied the writer over the property, informed him that considerable surface stripping had been done since the visit of the Assistant Mineralogist. The writer does not deem it to be necessary to repeat the details of the development-work, which are fully described in the Report of the Minister of Mines for 1913, pages 307-309, and in the present report is merely giving the assay results from his samples, as well as the assay returns given in the previous report, as follows:—

Assistant Mineralogist's Samples.

Sample No.	Description.	Zinc.	Lead.	Silver.
		Per Cent.	Per Cent.	Oz.
1	No. 1 East working (15 feet)	8.3	....	Trace.
2	West side, A drive (20 feet)	10.8	....	"
3	Face of A drive (3 feet)	5.3	....	"
4	Open-cut, West ore-body (4 feet)	3.2	....	"
5	Cross-fissure (3 feet)	8.1	....	"
6	First-class ore, Pearson drive	18.4	35.0	1.4
7	Second-class ore, Pearson drive	10.3	14.4	2.8
8	Open-cut, Evening Star (4 feet)	13.7	....	Trace.
9	Open-cut, Evening Star (14 feet)	8.4	....	"
	Average	9.4	....	....

Wm. M. Brewer's Samples.

1	Broken across 20 feet from south-east wall towards north-west on East ore-outcrop	14.2	....	Trace.
2	Face of crosscut on East ore-body	5.0	....	"
3	From outcrop about 200 feet north-west from sample No. 2 and 100 feet higher elevation	21.0	....	"

A considerable tonnage of shipping-ore can be mined from the surface workings, but development at deeper levels is essential to determine the advisability or otherwise of investing the amount of capital necessary to install transportation facilities.

JERVIS INLET DISTRICT.

Jervis Inlet district includes all of the western and north-western parts of Vancouver Mining Division west of and including the Sechelt peninsula, as well as the islands in Malaspina strait at the entrance to Jervis inlet, and the mountains on both sides of that inlet; also its West fork, known as Hotham sound, and the South-east fork, known as Sechelt inlet, which forms the eastern boundary of Sechelt peninsula, with Salmon and Narrows arms, which penetrate into the mainland coast towards the north-east from Sechelt inlet.

Jervis inlet penetrates into the mainland about fifty miles in a northerly direction; it is a comparatively narrow fiord, remarkably deep, with the mountains on each side rising very abruptly, and the summits reaching elevations of 5,000 to 6,000 feet within three or four miles from the shores.

Points in this district are reached by steamer or launch from Vancouver to Pender Harbour, on the west side of Sechelt peninsula, from which settlement launches can be secured to make the trip to the various camps on the inlets.

It is interesting to note that Dr. George M. Dawson, in the Reports of Progress published by the Geological Survey of Canada for 1876-77, refers to the fact that copper ore had been discovered in the mountains in this vicinity in the following language: "The most promising locality at present known is situated among the mountains between Howe sound and Jervis inlet, at a height of about 3,000 feet above the sea. Very fine specimens of purple copper ore, associated with quartz, mica, and molybdenite, are brought from this place, which is now in course of development. The country-rock is a granite or diorite of the Cascade crystalline series."

In the Annual Report, Vol. III., Part II., of the Geological Survey for 1887-88, Dr. Dawson again refers to the occurrence of copper ore in this section, as follows: "In the vicinity of the coast the copper-deposit which has received most notice is situated near the head of Salmon arm of Jervis inlet and between that inlet and Howe sound. This is owned by the Howe Copper Mining Company. The ore is chiefly bornite or purple copper ore and the deposit is not far from the coast, but at an elevation of 3,000 feet above sea-level. It was discovered about 1874 and was worked at intervals between the years 1877-83, though rather with the view of developing the property than for the actual extraction of the ore for shipment. Three levels have been driven on veins which are reported to be from 2 feet 6 inches to 3 feet 6 inches in width. Assays have shown 50 oz. of silver to the ton and 58 per cent. copper. An assay of an average specimen in the laboratory of the Geological Survey showed 40 per cent. copper. The veins traverse granitic rocks like those generally met with in the Coast ranges."

About ten days were spent in making examinations of mineral claims in this district during the past summer. No examination was made of the property referred to in the early reports by Dr. Dawson, as no work had been done on it for several years past, and no one could be found who had ever visited the claim to act as guide.

The properties examined were the *Mendella, Norman, Treasure Mountain*, and *Red Jacket* groups, on Jervis inlet, and the *Baramba* and *Jolley* groups, on Hotham sound.

Mendella Group. This group of mineral claims contains the *Mendella, Levinie, Katie, Della, Piney*, and *Ruth* claims, and is owned by Thomas Lillie and associates, of Pender Harbour. The group is located on the north shore of Princess Royal reach, in Jervis inlet, about thirty-five miles from Pender Harbour and three miles above the mouth of the Britain river. The mineral claims are located adjoining each other from south-east to north-east in the order in which they are named above, with the *Mendella* claim commencing

at the beach and extending up the mountain-slope to the southerly line of the *Levinie* claim, on which most of the prospecting-work has been done, at an elevation of about 850 feet above sea-level.

Geology.—The prevailing rocks on both sides of Princess Royal reach are metamorphosed sedimentaries with schistose structure alternating with belts of granite with gneissoid structure. On the *Mendella* group the altered sedimentaries have a width of from 300 to 400 feet in width, and are mineralized to a greater or less extent for the entire width. The mineralization is made up of particles of zinc-blende, galena, iron pyrite, and marcasite disseminated through the banded quartzose country-rock. The strike of the bedding-planes of the country-rock is north-west, with the dip of the planes 85 degrees to the south-west.

Development-work.—The development-work consists of a series of open-cuts, the largest of which is 15 feet long with the strike, 10 feet high at the face, and 10 feet wide. An average sample chipped across the face of the cut assayed: Gold, trace; silver, 0.8 oz.; copper, trace; lead, 2 per cent.; zinc, 6 per cent.

Possibilities.—A close examination of the surface, down the mountain from the work mentioned, also across the zone of altered sedimentaries at the beach, shows that there is a possibility of the zone carrying in places sufficient mineralization to warrant prospecting to ascertain whether or not some parts of the zone carry ore in quantity and quality to be of commercial value.

Norman Group.

This group of mineral claims consists of the *Norman*, *Porcupine*, and *Josie* Crown-granted claims, and the *Haskell*, *Francis*, and *Leslie* not Crown-granted. The group is owned by the Norman Copper Company; James McMurray, of Vancouver, president. At the time of the writer's visit development-work was being carried on by R. J. McLean and associates, of Vancouver, under a bond. The property is located on the west side of Prince of Wales reach, in Jervis inlet, three miles below Britain river, which flows in from the north-west. The south-easterly boundary of the claims is about one mile from the beach and is reached by a fairly good trail.

Geology.—The prevailing rock formations in the vicinity of the group of mineral claims are of an andesitic type, which are much sheared, faulted, and fissured. The north-westerly part of the property extends up a steep mountain-side to a series of red bluffs at an elevation of about 3,500 feet above sea-level. The red stain on these bluffs is so deep a colour that they make a prominent landmark which can be easily seen from the sea. The ore-bodies on the property occur in fissures in shear-zones in the igneous country-rock, which fissures appear to cut the shearing-planes almost at right angles. The strike of the ore-bearing fissure is north-westerly and that of the shearing-planes is north-easterly. The dip of the ore is south-west at a steep angle. There appears to have been much disturbance in the vicinity of the ore occurrences, and a well-defined fault occurs on the east of the main ore-body, where it is exposed at an elevation of 1,500 feet above sea-level, which apparently cuts off the ore-bearing fissure. The mineralization occurs as impregnations of iron pyrite associated with chalcopyrite, magnetite, and a little molybdenite in a breccia gangue which is very quartzose.

Development-work.—The work consists of two adits and several open-cuts on a steep mountain-side at an elevation of about 1,500 feet above sea-level. The lower adit is driven 95 feet in length in a N. 50° W. (mag.) direction. Except where the adit cuts 4 feet of low-grade ore about 60 feet from the portal, there is no mineralization showing along the main adit, but in a short drift to the easterly there is a little copper ore showing in the cleavage-planes and in narrow quartz stringers, not sufficient, however, to establish any commercial value to the property.

In the upper adit, driven about 100 feet higher elevation than the lower one just described, the mineralized zone or fissure appears to be upwards of 20 feet wide, and is partially crosscut by the open-cut approach to the adit, as well as by a few feet of the adit under cover. The total length of the main drive is 20 feet under cover, with 20 feet of open-cut approach, together with a drift about 20 feet long in an easterly direction and a drift about 10 feet long driven in a north-westerly direction. The east drift is in the country-rock, but the other drift appears to be following the strike of the ore-bearing fissure.

Samples were taken across 18 feet in the floor of the open-cut approach and a few feet beyond the portal of the adit, also across the face of the north-west drift, 4 feet wide. The first of these samples assayed: Gold, trace; silver, 1.8 oz.; copper, 1 per cent. The second sample assayed: Gold, trace; silver, trace; copper, 0.2 per cent. Both of these samples were taken

to include all of the gangue material occurring with the ore, in order to determine whether or not the entire body of gangue and mineral in the fissure could be considered of commercial value if treated by concentration.

At a point about 50 feet higher than the upper adit there is an outcropping of gossan 12 feet wide, with impregnations of chalcopyrite, iron pyrite, magnetite, and a little molybdenite in a gangue made up of breccia, very quartzose, and, judging from the surface, as no work had been done, carrying quite low-grade values. Similar outcroppings can be seen at intervals up the mountain for about 500 feet, also in the creek at about 200 feet lower elevation.

Copper Group.

This group contains seven mineral claims, known as the *Eldorado*, *Colorado*, *Portland*, *Columbia*, *Beaver*, *Coon*, and *Otter*, situated on Beaver creek, which empties into Prince of Wales reach in Jervis inlet, on the east side, about five miles south from Vancouver bay. The group is owned by H. W. Treat, of Seattle, Wash. The mineral claims are located on the southern slope of a prominent peak known as Treasure mountain, and the *Eldorado* claim adjoins the *Bonanza* Crown-granted mineral claim, surveyed as Lot No. 1870, on the south-east side.

Geology.—The prevailing rock formation in the vicinity of this group of mineral claims is either an igneous rock very much altered or metamorphosed sedimentaries, the metamorphism having been caused by the intrusion of the Coast granite, but to classify which a petrographic examination is necessary. The rock is sheared, fractured, and fissured to a very marked degree, with some of the fissures apparently of great width, which are filled with extensive bodies of solid pyrrhotite and magnetite carrying low copper values in a gangue of brecciated country-rock. The outcroppings of the mineralization occur along a line of strike apparently nearly east (true), and extend for an undetermined distance in that direction, with the cleavage-planes dipping towards the north nearly vertical.

Development-work.—A force of miners has been working continuously during the past summer, making open-cuts and driving adits to determine the extent of the mineralized zone in width as well as in depth. The occurrence of the outcroppings on the slope of the mountains offers facilities to develop the ore at depth by a series of adits driven one below the other. The highest open-cut is at an elevation of about 2,000 feet above sea-level and forms an approach to an adit driven 30 feet, mostly in gravel, but at the face a body of solid magnetite and pyrrhotite is exposed. A sample from this work assayed: Gold, trace; silver, trace; copper, 0.4 per cent.; iron, 27.5 per cent.

There is another large open-cut on the No. 2 level and two short adits at an elevation of about 70 feet lower than the work just described. This lower open-cut is about 30 x 18 feet, with its face 7 feet high, exposing solid pyrrhotite and magnetite, and in the face in two places short adits are driven, one 18 feet in length, the other 8 feet in length. A grab sample taken from the dump on this level assayed: Gold, 0.02 oz.; silver, 1.2 oz.; copper, 1.1 per cent.; iron, 33.9 per cent.

The No. 3 level is about 40 feet below the No. 2, and the work on that level consists of an open-cut approach to an adit driven about 20 feet in length as a diagonal crosscut, or nearly a drift in the ore-body. A sample taken across 4 feet in the face of the adit assayed: Gold, trace; silver, 0.8 oz.; copper, 1 per cent.; iron, 19.3 per cent. Another sample taken as a grab from the dump at this work assayed: Gold, trace; silver, 0.6 oz.; copper, 1.3 per cent.; iron, 23.4 per cent. On the No. 3 level the work is all in ore, with no rock walls exposed.

Red Jacket Group.

The property known as the *Red Jacket* is made up of two groups of mineral claims and comprises twenty-four claims in all. The groups are called the *Red Jacket* and *Prospector*. The claims are numbered from No. 1 to No. 14 in the *Red Jacket* group and from No. 1 to No. 10 in the *Prospector*. The property is owned by E. Prendergast and associates, of Vancouver, and was examined by the writer on September 22nd, 1917.

The *Red Jacket* group is situated at an elevation of about 3,500 feet above sea-level, at the head of an unnamed creek which flows into Jervis inlet from the south-east near Egmont point, and the claims are reached by following a switchback trail up the mountain from the beach for a distance of about four miles.

The most prominent outcropping of a mineralized zone occurs on the *Red Jacket No. 4* claim, near the boundary between that claim and the *Red Jacket No. 2*, where there is a ledge

or zone of schistose rock that appears to be several hundred feet in width, crosscut by the canyon at the head of the unnamed creek.

Geology.—The prevailing rock formation in the vicinity of the groups of mineral claims is a metamorphic rock that is sheared, fractured, and fissured to such a degree as to be almost a schist. The metamorphosed rock contacts with the granite of the Coast range, which forms the southerly boundary of the mineralized zone that occurs in the schistose metamorphosed rock. There are also some intrusive dykes of igneous rocks which have intruded into the schistose rocks, and will probably be found to have influenced the mineralization. The walls of the canyon, of which the schistose rocks form the bed, are exceedingly precipitous and reach an elevation of about 100 feet higher than the bed. Apparently the walls, which are heavily stained a reddish colour from iron oxides, are made up of the same schistose rock as occurs in the bed of the canyon, which appears to crosscut that formation, in which there occur zones where the fissuring is very pronounced. It is in these zones that mineralization occurs.

Mineralization.—The mineralization is most pronounced along the planes of the schistosity in the rocks, but there are also particles of chalcopyrite, iron pyrite, pyrrhotite, and specks of molybdenite occurring disseminated through the rock itself. Thorough prospecting should be done in order to determine the extent of the mineralization as well as the grade of the ore. It appears as though a very extensive body of mineralized schistose rock occurs on this property that would possibly develop into an important concentrating proposition.

Development-work.—There has been but little development attempted, except prospecting at various places on the surface where the iron-stained rock-outcrops indicated the occurrence of ore. One of such occurrences is located at an elevation of about 3,200 feet above sea-level, another about 400 feet higher elevation, and still others, farther up the canyon. It is practically impossible to sample the mineralized zone unless a great deal of time is occupied and several holes drilled and blasted; consequently the writer only took one grab sample across 6 feet of outcropping at an elevation of about 3,600 feet above sea-level, which assayed: Gold, trace; silver, 0.6 oz.; copper, 0.5 per cent. The above-mentioned sample must not be considered as an average or as representing the values that may be found generally on the property, provided thorough prospecting is carried out. It was merely taken to determine whether the iron-stained outcroppings carried any values.

Baramba Co. The property owned by the Baramba Mining Company, Limited, consists of eight mineral claims, known as the *Evelyn*, *Leonard*, *Mary*, *Copper Princess*, *Third Chance*, *Archie*, *Silver Star*, and *Baramba*, located from the beach on the east side of and near the head of Hotham sound, back into the mountains to an elevation of about 1,500 feet above sea-level. Hotham sound is the West arm of Jervis inlet, with its entrance near the junction of Jervis inlet with Malaspina strait, and is about ten miles long.

Geology.—The rock formation is made up of metamorphosed sedimentaries which have been rendered more or less schistose from shearing movement. The rocks are fractured and fissured; some show much epidote and are feldspathic. Some of the fissures are filled with such minerals as magnetite, iron pyrite, chalcopyrite, and pyrrhotite. The mineral-bearing zone appears to confine itself to a width of about 16 feet, although the shear-zone is apparently very much wider, being estimated by the owners as 800 feet, and there is the possibility of discovering more ore-bodies, as the property has not been thoroughly prospected.

Ore Occurrences.—The main outcropping of magnetite-copper ore so far found on the property occurs on the *Third Chance* mineral claim, at an elevation of about 1,200 feet above sea-level and about one mile and a half from the beach by trail. This outcropping, which strikes about N. 70° E., has been developed by an open-cut about 80 feet long by about 12 feet wide, in which an ore-body is exposed dipping 80 degrees northerly and lenticular in structure. The mineralization in this body is generally made up of magnetite, iron pyrite, pyrrhotite, and a little chalcopyrite, but possibly specimens can be selected that carry a good grade of copper ore.

At the time of examination no samples were taken from the open-cut, because the ore exposed appeared to be of such low grade that concentration would be necessary in order to obtain a commercial product.

Attempts have been made to intersect the ore-body on levels under the outcropping at depths of about 25 feet, 50 feet, and 250 feet by driving adits at those levels. There is ore exposed in only one of the adits, that known as No. 2, in which, at a point about 100 feet from the portal, mineral is exposed for 16 feet in the adit. An average sample taken by the writer across the 16 feet assayed: Gold, trace; silver, trace; copper, 0.3 per cent.

Development-work.—The development-work consists of four adits and a series of open-cuts, as follows: Open-cut about 80 feet long by about 12 feet wide, at an elevation about 1,200 feet above sea-level; No. 1 adit, 54 feet long, at an elevation of about 1,175 feet; No. 2 adit, 152 feet long, at an elevation of about 1,150 feet; No. 3 adit, 220 feet long, at an elevation of about 975 feet; No. 4 adit, 40 feet long, at an elevation of about 100 feet and overlooking the beach.

The adits are all planned with the intention of cutting the ore-body exposed in the open-cut at the various levels, but the No. 2 adit is the only one in which the attempt has succeeded; all of the others are driven in country-rock. The No. 4 adit is a most ambitious project, as it will be necessary to drive more than 3,000 feet to reach a point where it could possibly intersect the ore-body exposed in the open-cut and No. 2 adit, at an elevation of about 1,000 feet above the level of the No. 4 adit.

Jolley Group.

There are six mineral claims in the *Jolley* group, which are known as the *Perfection*, *Don*, *Jolley*, *Copper Prince*, *Hilltop*, and *Hillside*, situated on a tributary of Baramba creek and adjoining the *Baramba* group on the north. The property is owned by Harry and C. Jolley and was being worked at the time the writer examined it (September 23rd, 1917) by Geo. A. McLeod and R. E. Marvin, of Vancouver, under a bond and lease. The property is at an elevation of about 1,900 feet and is reached by following a good switchback trail up the mountain-side from the *Third Chance* claim of the *Baramba* group.

Geology.—There appears to have been very much disturbance of the rock formation on the *Jolley* group, and several wide igneous dykes with porphyritic structure have intruded into a zone of metamorphosed sedimentaries, very much sheared, fractured, and fissured, which have a banded or gneissoid structure. Erosion has caused the formation of deep gorges or gulches in the mountain-side and has left peaks with very precipitous slopes. The occurrences of copper ore are found in close proximity to the igneous dykes, and the mineralized zone appears to be of considerable width, but sufficient work had not been done to permit of reaching any definite conclusions as to the extent of the ore-bodies. Apparently there are two distinct ore-bodies, one occurring on the *Don* claim, the other on the *Perfection* claim, but further work may demonstrate that there is a connection between them. The ore-bodies may be considered as belonging to the shear-zone type.

Mineralization.—The work so far done shows that the mineralization is a combination of magnetite, iron pyrite, chalcopyrite, and a little bornite in a gangue made up of a graphitic metamorphosed rock, with some epidote, calcite, and apparently some feldspar. The average grade of the ore-bodies is low, and suggests that concentration will be necessary in order to obtain a commercial product.

Development-work.—The development-work consists of a short adit driven at an elevation of about 1,900 feet above sea-level at the head of a gulch on the *Don* mineral claim, also another short adit driven at an elevation of about 1,700 feet on the *Perfection* mineral claim.

Samples from both of these workings were taken by the writer. The sample from the *Don* adit is a grab from the dump; this assayed: Gold, trace; silver, 0.5 oz.; copper, 2 per cent.; iron, 22 per cent. The sample from the *Perfection* adit is an average across 3 feet in the face of the adit, and assayed: Gold, trace; silver, trace; copper, 2.6 per cent.

NEW WESTMINSTER MINING DIVISION.

Owing to the demands on the writer's time in other sections of the Western Mineral Survey District, he was unable to devote as much attention to the New Westminster Mining Division during the season of 1917 as he would have liked to have done. The examinations of mineral claims made in the Division were confined to two examinations of the *Empress* group of mineral claims and an examination of the clay-deposits on Blue mountain, near Whonnock Station, on the Canadian Pacific Railway. Late in the season an attempt was made to examine a deposit of molybdenite near Cheam View Station, on the Canadian Northern Pacific Railway, but snow-storms prevented this.

Another discovery of molybdenite was reported by T. B. Hicks, of St. Elmo, on the Canadian Northern Pacific Railway. This is located about seven miles east of Agassiz Station, on the Canadian Pacific Railway, and about one mile and a half from the railway, and would have been examined by the writer at the same time as he proposed to examine the discovery reported near Cheam View Station, but owing to the severe storms at the time he had to abandon both examinations until the coming spring.

Horse Shoe, Anzac, Pay Roll, Monarch, and Steel Trust Groups.—These groups of mineral claims, containing in all twenty-four claims, are owned by Paul Briant and associates, of Vancouver. The groups are situated near the head of Pitt lake, about ten miles from the lake, and were prospected to a considerable extent during 1917 by the owners. The locations were not brought to the attention of the writer until in November, 1917, when it was too late in the season to attempt to make an examination, so it was postponed until 1918 by arrangement with Mr. Briant, who informed the writer that the minerals found on the property consisted of copper, molybdenite, magnetite, and hæmatite ores.

Lucky Four and Lucky Jack Groups.—These two groups contain in all seventeen mineral claims, situated at an elevation of about 4,000 feet above sea-level, near Jones lake, to the east of Cheam View Station, on the Canadian Northern Pacific Railway, and about ten miles from the railway. As the writer found that these groups are recorded in the Yale Mining Division in the Central Mineral Survey District, although it is a question as to whether the locations are in that Division or in the New Westminster Mining Division, he did not visit the property, but is reliably informed that considerable prospecting-work was done with diamond-drills during the past season, with very satisfactory results.

Empress Group. This group of mineral claims is situated about four miles northerly from Agassiz Station, on the Canadian Pacific Railway, which is seventy miles east from Vancouver. There are five claims in the group, four of which are Crown-granted; the fifth one was staked during 1916. The Crown-granted claims, known as *Empress Nos. 1, 2, 3,* and *4,* are amongst the oldest locations in the Mining Division and were partially developed in 1897 and 1898, since which time until last year but very little work had been done. The claim not Crown-granted is called *Empress No. 5.* The property is owned by Barclay and Alex. Bonthrone, of Vancouver.

Geology.—Agassiz is virtually at the head of the Fraser delta, its elevation being only 54 feet above sea-level. The elevation of the highest outcroppings of ore on the *Empress* group of mineral claims is about 800 feet above sea-level. The prevailing rocks are the granites of the Coast Range batholith, but on the *Empress* group there occurs a belt of limestone which contacts with the granite, and the ore-bodies are developed at that contact. The limestone is very erratic in the extent of the tongues or wedges in which it occurs, as well as along its strike and dip, and, as the ore does not appear to occur except at the immediate contact, the extent of the deposits is also very erratic.

Mineralization.—The minerals occurring in the contact deposits are chiefly chalcopyrite, with some bornite, associated with magnetite, iron pyrite, and with variable quantities of molybdenite, in a gangue of garnetite, limestone, and feldspar, the latter being usually decomposed and altered to kaolin.

Under the superintendence of C. M. McDonald the following work has been done since September, 1916: Construction of a jig-back aerial tramway 1,100 feet long connecting the No. 1 adit with the wagon-road; about one mile of wagon-road and trail from the main wagon-road; extension of the No. 2 adit, at an elevation of about 200 feet above the valley; sinking winze 8 feet deep and making drive 18 feet long in the No. 1 adit, at an elevation of 550 feet above the valley; making open-cuts on an outcrop about 50 feet above the No. 3 adit and mining ore from the cuts; building an ore-shoot 3 feet wide, 22 feet long, to connect the open-cuts with the portal of the No. 3 adit; driving the No. 2 adit 60 feet long and connecting it with the east drive in the No. 1 adit by an upraise 30 feet in height.

In the construction of the road and trail it was the intention to build a good wagon-road the whole distance between the main road to Agassiz and the mine-workings, but about an eighth of a mile from the latter point a rocky side-hill that skirted a swamp intervened and work on the road was stopped, but a trail was built across the swamp. This is constructed with corduroy where necessary, but is not sufficiently substantial for hauling heavy loads of ore over, except when sleighing is good.

Two adits or tunnels were driven several years ago, one called No. 3 or Bonthrone adit, at an elevation of about 200 feet above the valley, the other called No. 1 adit, at an elevation of about 350 feet above the No. 3. There is no evidence, so far as the writer could see, to suggest any connection between the ore-outcrops on these two levels. Bunches of chalcopyrite are cut

at each of the portals, but no ore is exposed in either of the adits beyond the portal. In a winze and drive on the easterly side of the No. 1 adit, at a point 30 feet from the portal, a lens of ore is exposed on the south side of the drive. This does not show on the opposite side, but may possibly extend southerly towards the portal. The maximum width is about 4 feet, for 18 feet, the length of the drive, and at the face the width of ore has narrowed to about 15 inches. The mineralization is chiefly chalcopyrite, but with some magnetite and garnetite associated with it. A sample representing about an average of the dump, on which there are several tons, assayed: Gold, trace; silver, 1.4 oz.; copper, 5.2 per cent.

About 30 feet below the No. 1 adit another adit, called the No. 2, is driven 60 feet in length in a north-westerly direction along a well-defined limestone wall. The adit is driven in an ore-body about 4 feet wide, made up of chalcopyrite and some magnetite in a garnetite gangue. An upraise made in ore connects the No. 2 adit with the drive on the easterly side of the No. 1.

At the portal of the No. 3 adit there is a well-defined contact between granite and limestone, with a lens of chalcopyrite in the contact, but this does not extend into the adit, although there are some indications that ore may occur lying parallel to the course of the adit on the easterly side of the portal, but no work has been done to prove it. A sample representing an average of a small dump of ore, apparently mined from the portal, assayed: Gold, trace; silver, 2.8 oz.; copper, 9.3 per cent.

The contact between granite and limestone extends up the face of the mountain for an undetermined height above the No. 3 adit, and at two points above the adit, one about 50 feet, the other about 20 feet higher, there are outcrops of chalcopyrite, with which is associated some bornite. Open-cuts have been made into both of these.

In the face of the upper cut there was a width of about 1 foot of ore, in rotten garnetite, in the contact between granite and limestone. This open-cut at the time of the examination was little more than surface stripping and not sufficiently advanced to furnish much data as to permanency of the ore.

The lower open-cut was about 15 feet square by about 16 feet high at the face, and from it several tons of charcopyrite had been quarried. There was a face of ore in the cut 4 feet wide which the writer sampled by taking an average section across the full width at one point. This assayed: Gold, trace; silver, 2 oz.; copper, 5.5 per cent.

FIRE-CLAY AND SHALES.

The occurrences of fireclay and shales in a portion of the New Westminster Mining Division are of such importance, and the industry built up by the Clayburn Company that has resulted from the development of the extensive deposits has grown to such dimensions, that no report on the mineral industry is complete unless reference is made to these deposits. For that reason the following brief description of the occurrences, taken from the report of Heinrich Ries and Joseph Keele on the "Clay and Shale Deposits of the Western Provinces" in Memoir No. 24E, Canadian Department of Mines, is given:—

"*Clayburn Co., Ltd.*—One of the most interesting series of clay-deposits found in the Western Provinces is that lying in Sumas mountain, east of Clayburn, on the Seattle branch of the Canadian Pacific Railway. About 1,000 feet from the brick-works along the narrow-gauge railway is a bank of blue-grey surface clay, which is dug with a steam-shovel. This is used for common brick and is the same kind of clay that is found and worked at New Westminster.

"The first shale-outcrops are reached about two miles up the railway, in S.E. ¼ Section 31, Township 19, Sumas Municipality. At this point the shale outcrops on both sides of the track and is overlain by a coarse conglomerate composed of fragments of shale, granite, feldspar, etc. The outcrop is not of great length, but from what scant evidence there is we are inclined to believe that the shale-deposit may be of lenticular character.

"The shale is separable into two beds—viz., a lower grey shale of smooth plastic character and an upper purplish one which is harder and grittier. The former is buff-burning and on the south side of the track is at least 6 feet thick, while the upper or grey-burning shale is 4 to 6 feet thick.

"A test made of the buff-burning or lower shale, which is the one most used, showed it to be of good plasticity, and with one exception the most plastic of the Clayburn series tested. It worked up with 17 per cent. of water to a mass whose air-shrinkage was 6.1 per cent. and

average tensile strength 100 lb. a square inch. A full-sized brick cracked slightly in rapid drying. The wet-moulded bricklets behaved as follows in burning:—

Cone.	Fire-shrinkage.	Absorption.	Colour.
	Per Cent.	Per Cent.	
010	0.85	14.32	Pale salmon.
03	2.7	9.20	Buff.
1	5.0	7.0	"
5	6.0	1.43	Brownish.
9	7.0	....	Grey.
12	Thoroughly vitrified.	....	....

"A dry-pressed bricklet was good and hard at cone 05 and pink-buff colour, but in practice it is burned somewhat higher.

"The upper bed of grey-burning shale worked up with 15 per cent. of water to a moderately plastic mass, with much grit, whose air-shrinkage was 3.6 per cent. Following are the fire-tests:—

Cone.	Fire-shrinkage.	Absorption.	Colour.
	Per Cent.	Per Cent.	
010	Slightly swelled....	15.82	Pink-white.
03	0.4	14.28	Grey.
1	1.7	11.0	"
5	3.7	3.06	"

"This is an interesting shale. It burned to a grey brick of low fire-shrinkage and low absorption, and could be used for pressed brick.

"Two miles and a half up the railway, on N.E. ¼ Section 30, Township 19, there is a shale-bank on the right side of the track which shows the following section:—

Red-burning shale ..... 40 feet.
Coal ..... 6 to 8 inches.
Buff-burning shale of ferruginous appearance ..... 12 feet.

"The section extends down to the floor of the pit, which is about 15 feet above the track-level.

"The hill-slope extends upwards beyond the top of the excavation, and more shales occur higher, but these are not at present worked.

"A sample of the 40-foot bed of shale from the pit described above was tested, with the following results: It worked up with 19 per cent. of water to a mass of low plasticity and much fine grit, so that the body is somewhat short. Its air-shrinkage was 5 per cent. and average tensile strength 196 lb. a square inch. A full-sized brick stood fast drying without cracking. In burning, wet-moulded bricklets behaved as follows:—

Cone.	Fire-shrinkage.	Absorption.	Colour.
	Per Cent.	Per Cent.	
010	0.3	16.16	Red.
03	4.0	8.28	"
1	6.0	3.34	"
3	7.0	2.9	"

"The shale burned steel-hard at cone 03. This seems to be a shale of slow vitrifying qualities and is worth trying for a paving-brick, or even sewer-pipe. It would be better to weather it or mix it with more plastic material.

"A test was also made of a sample of shale underlying the above. It took 22 per cent. of water to work it up and gave a mass of good plasticity, whose air-shrinkage was 4.8 per cent. The fire tests of wet-moulded bricklets are given below:—

Cone.	Fire-shrinkage.	Absorption.	Colour.
	Per Cent.	Per Cent.	
010	2.2	15.54	Red.
03	4.0	11.93	"
1	7.0	7.57	"

"At the end of the narrow-gauge road, three miles and a half from the works, in N.W. ¼ Section 29, Township 19, Sumas Municipality, the company obtains its fireclays. The section as near as can be made out shows: —

Sandstone.
Upper fireclay ..... 8 feet.
Coal with flint-clay partings ..... 6 inches to 1 foot.
Lower fireclay ..... 7 feet.
Ferruginous clay ..... 4 feet.
China-clay ..... 10 to 15 feet.

"In mining the material no attempt has been made in the past to keep the two fireclay-beds separate, but this should be done, unless it is known that they are alike. The need of care in mining is well shown by our tests. The first of these was made on an average sample of 75 lb. collected from the stock-pile at the brick-works, and said to represent the run of the mine. This sample worked up with 16 per cent. of water to a very gritty mass of moderate plasticity, whose air-shrinkage was 3 per cent. and average tensile strength 75 lb. a square inch. In burning, the wet-moulded bricklets behaved as follows:—

Cone.	Fire-shrinkage.	Absorption.	Colour.
	Per Cent.	Per Cent.	
010	1.45	15.89	Light pink.
03	2.3	13.63	Buff.
1	3.1	12.30	"
5	3.6	10.96	"
9	4.0	9.75	"

"The clay was unaffected at cone 13, but thoroughly fused at cone 17. At cone 1 numerous small iron specks developed, and it became steel-hard at cone 5.

"At the time this sample was collected it seemed to us that the stock-pile contained a great deal of inferior material, which had been included because of carelessness in mining. In order to corroborate our results, we tested sample of best-grade fireclay taken from a bin at the mine, and found this to have a fusion-point at cone 32. We then tested a sample of firebrick made at these works for delivery at one of the British Columbia smelters, and also a sample of Glenboig brick collected at the same plant. Both of these stood cone 31. Our conclusions are that the mine on Sumas mountain contains some good fireclay, but that in mining the several beds in the deposit should be kept separate until their qualities are thoroughly known.

"The china-clay is a fine-grained, whitish shale, sometimes soft and smooth, at other times hard and porcelain-like, with a conchoidal fracture. It grades upwards into an iron-stained whitish shale. There are numerous small limonite spots scattered through it. When ground to pass through a 20-mesh sieve it worked with 16 per cent. of water to a feebly plastic mass,

whose air-shrinkage was 3.2 per cent. The wet-moulded bricklets gave the following results in burning:—

Cone.	Fire-shrinkage.	Absorption.	Colour.
	Per Cent.	Per Cent.	
010	Slightly swelled	14.57	Pinkish-white.
03	"	13.53	"
1	0.3	12.76	"
5	0.6	11.21	"
9	1.2	9.72	"

"At cone 20 the cone of china-clay was erect, but was glassy and contained many fused iron spots. It probably will not stand much above cone 22. Even at cone 03 the bricklets show many small iron spots, which are fused at cone 9. It is barely steel-hard at cone 9. It is doubtful if this clay would be suitable for anything better than boiler-brick. The iron could not be washed out of it. The clay seems to dry-press if ground fine.

"No analyses of the Clayburn materials were made for this report, but the following two may be quoted from a report on the clay industry of the Coast, published by the Provincial Mineralogist of British Columbia in the Annual Report of the Minister of Mines for 1908. No. 1 corresponds with the bed underlying the coal-parting in the fireclay-mine at the end of the narrow-gauge road, while No. 2 lies above the coal.

Silica (SiO_2)	60.85	58.80
Alumina (Al_2O_3)	35.27	30.55
Ferrie oxide (Fe_2O_3)	2.75	0.65
Lime (CaO)	0.25	None.
Magnesia (MgO)	Trace.	0.5
Alkalies (Na_2OK_2O)	1.88	...
Water and loss	...	9.50"

The report also described other occurrences of clay and shale in the vicinity of the Clayburn Company's property, owned by J. C. Maclure, which description will be found on pages 131 to 138 in the Memoir No. 24E, from which the foregoing quotations are copied.

Blue Mountain Co.

The property owned by this company consists of six mineral claims, known as the *Blue Mountain* group, situated in Section 2, Township 4, Range 4 west of the 7th meridian, about six miles northerly from Whonnock Station, on the Canadian Pacific Railway, at an elevation of about 1,200 feet above sea-level. The claims were located by George H. Turner because of the occurrence of very extensive deposits of clay and shale very similar to the clays and shales occurring in Sumas mountain, already described in this report, but owing to the lack of transportation the development of the deposits has been retarded, and the work done is limited to one adit about 60 feet long and several large open-cuts. Industrially, the owners have demonstrated that the clay and shale are well adapted for the manufacture of several grades of pottery, as well as for vitrified brick.

The extent of the deposits is very considerable, judging from the outcrops exposed by nature on two creeks which flow through portions of the property, and from the fact that above a point on Tunnel creek an adit is driven for 60 feet in length in red shale that underlies a bluish clay underlying sandstone.

There are apparently four distinct varieties of clay and shale, occurring in separate deposits. These are whitish and bluish clay and red and brown shale.

ALBERNI DISTRICT.

ALBERNI MINING DIVISION.

JOHN E. HOOSON, GOLD COMMISSIONER.

I have the honour to submit a brief annual report on mining in the Alberni Mining Division during the year ending December 31st, 1917.

Monitor Group.—Situated on the west side of the Alberni canal. This group has been continuously worked during the year, but no shipments have been made. The work has been performed on what is known as the "New Discovery vein" or "Lower Ore-zone," and consists of approximately 500 feet of drifting and crosscutting; the tunnel enters the mountain 78 feet above salt-water level and gives a vertical depth of 250 feet. This work has proven the existence of a large tonnage of shipping-ore, together with a large tonnage of concentrating-ore.

The installation of a 5-drill compressor and 60-horse-power boiler, also an ore-bunker with a capacity of 700 to 1,000 tons crude ore, is about complete; these are situated at the water's edge, below the portal of the new tunnel, and will enable the ore to be loaded from the bunker to the ship without handling.

It is the intention of the management to push further development with all speed, and to make regular shipments as soon as the preparations for same are complete.

Bunk-house and cook-camp accommodations for twenty-five or thirty men have been provided.

The average number of men employed during the year was twelve.

Marble Cove Group.—Situated on Copper island, Barkley sound. This group has been developed considerably during the year; an expenditure of over $4,000 by J. MacD. Russell, as payment for a half-interest in the group, has been made, with encouraging results. The work consisted of two tunnels of 22 and 44 feet length respectively, with numerous open-cuts, two crosscuts, and one upraise.

Big I. Group.—Situated in the Big Interior basin. The owners of this group have during the year installed a 6½-horse-power engine and erected a diamond-drill building, but have not done actual mining development, other than several open-cuts and general prospecting-work.

OFFICE STATISTICS—ALBERNI MINING DIVISION.

Mineral claims recorded	59
Certificates of work recorded	34
Bills of sale, etc., recorded	19
Free miners' certificates issued	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, 1917.

The outstanding feature for the year has been the steady development of the *Indian Chief* group of claims, situated on Sidney inlet, Clayoquot sound, by the Tidewater Copper Company under the management of Sam I. Silverman. During the latter part of the year the newly erected concentrating plant has been working day and night, and over 400 tons of copper concentrates has been shipped to Tacoma Smelter, and its value placed at over $15,000. Steady employment has been given to an average of over forty men.

Kalappa Group.—Situated on Disappointment inlet. This group consists of the four claims, *Kalappa, Golden Gate, Jack of Clubs,* and *Sninnik Fractional.* Early in the year certificates of improvements were recorded covering these claims; since then Crown grants have been issued to the owner, Mrs. Elizabeth Ann Chesterman. Further details respecting this group will be found in the report of the Minister of Mines for 1916, page 362.

ASSESSMENT-WORK.

Assessment-work has been recorded as follows:—

White Mine.—Situated on Tofino inlet and owned by William Norman Walton (who has since left with the C.E.F. overseas) and Duncan McMillan, of Bamfield, B.C. Thirty feet of open-cut, 8 feet wide; 3 feet of tunnelling, 7 x 5 feet rock; 300 feet of surface work; and about one mile and a quarter of trail. (*See also* Report of the Minister of Mines, 1916, page 362.)

War.—Situated on Kennedy lake and owned by Duncan Grant, of Clayoquot. Twenty-five feet cut rock, and earth 3 x 3 feet; widened tunnel on one side 4 x 2 feet, and other prospecting-work.

Lucky Jim.—Situated on Elk river and owned by William Spittal. Side-cut 10 x 16 feet, rock-work, and 4 feet on the ore-shoot.

Empress.—Situated on Bear river and owned by J. W. McIntosh, of New Westminster, B.C. Uncovering and stripping ore-body for a distance of 200 feet in one place and 20 feet in another.

Ex, Ten. You, and Eight.—Known as the *You* group. Situated at Bear river and owned by J. D. McLeod, of Vancouver, B.C. The work was done in the *You* claim—viz., 50 feet of tunnelling.

Northern Crown.—Situated on Clayoquot river and owned by J. E. Marten. Seven feet of tunnelling, about 3 feet 8 inches by 6 feet, and two days' stripping.

Lucky Jim.—Situated on Bear river and owned by J. D. McLeod, of Vancouver, B.C. Sinking shaft, 4 x 5 feet by 8 inches; also open-cut, 3 x 4 x 3 feet by 15 feet long.

Ivanhoe and Double Standard.—Adjoining mineral claims situated at Camp bay, Nootka, B.C. Twenty feet rock-work, 6 feet high by 6 feet wide; also 25 feet stripping on surface, and open-cut.

OFFICE STATISTICS—CLAYOQUOT MINING DIVISION.

Free miners' certificates (individual)	33
Free miners' certificate (special)	1
Mineral claims recorded	41
Certificates of work recorded	20
Certificates of improvements	4
Payments in lieu of assessment-work	2
Powers of attorney, transfers, etc., recorded	16
Other receipts issued	6

Revenue.

Free miners' certificates	$166 50
Mining receipts, general	431 00
Total	$597 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, 1917.

The *Old Sport* property has been developed continuously during the year, with an average crew of about twenty-five men. The principal work consisted of sinking a winze 400 feet in the main lead and running drifts about 400 feet at that level. The ore-showing is sufficiently good to justify further development. Applications for Crown grants applied for the *Old Sport Nos. 1, 2, 4, 6, 7, 8, 9,* and *11;* the *Shamrock Nos. 1, 2,* and *3;* the *Idaho;* the *Idaho Fraction;* and the *Black Jack Fraction,* all of which belong to the same company.

At the first part of the year the progress of work and showings at the *Yreka* mine was very promising, but on account of financial troubles in the spring and early summer the work was closed down in August.

During the summer and fall a party was working with a diamond-drill on the *Teta River* property. No report of result of the work received.

With the exception of the above-mentioned properties, very little work was done beside the regular assessment-work.

OFFICE STATISTICS—QUATSINO MINING DIVISION.

Mineral claims recorded	103
Certificates of work recorded	140
Powers of attorney, transfers, etc.	20
Free miners' certificates issued	107
Certificates of improvements recorded	2

NANAIMO DISTRICT.

NANAIMO MINING DIVISION.

REPORT OF S. McB. SMITH, 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, 1917.

During the past year the *Marble Bay* group, situated on Texada island, shipped 11,697 tons of gold-silver-copper ore. The company employed throughout the year an average of eighty-eight men in connection with the operations.

Wm. McDonald and W. Lee bonded the *Retriever* group, Texada island, and there was shipped about 400 tons of ore. Considerable development-work has been done, including the building of a tram-line from the beach to the mine, a distance of about three-quarters of a mile, also constructing wharf and bunkers at the beach.

On the property known as the "Iron Mine property," on Texada island, a tram-line was built to the beach, also bunkers and wharf; beyond this very little work was done on the property.

The *Little Billie*, *Copper Queen*, *Cornell*, and *Loyal* (Texada island) have been leased by a Seattle syndicate, which has done some development-work preparatory to shipping.

The Valdes Island Copper Company is developing the *Ingersoll* group, on the south end of Valdes island, near Quathiaski cove.

The Santa Anna group, situated on the south end of Valdes island, near Bold point, had a little development-work done during the year, and will likely have considerable work done during the ensuing year by capitalists who have leased the property.

During the year Wm. Brewer, Resident Engineer for Western Mineral Survey District (No. 6), which includes the whole of the Nanaimo Mining Division, has examined a great many properties in this Mining Division. His report will contain descriptions and details of the important properties in this Mining Division, so I shall not attempt detailed descriptions.

With the exception of the above, very little work has been done, other than the annual assessment-work, which has been recorded on a large number of claims, as shown by the accompanying office statistics.

OFFICE STATISTICS—NANAIMO MINING DIVISION.

Mineral claims recorded	179
Certificates of work	290
Bills of sale, etc.	73
Free miners' certificates	125

Revenue.

Free miners' certificates	$1,311 00
Mining receipts, general	2,225 00
Total	$3,536 00

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, 1917.

LODE-MINING.

There has been considerable activity in mining in this Division during this past year, with already some material shipments, and if one can judge from the success met with by several of the companies in their development-work, there should be within the next few years an output of copper ore which will place this Division in the list of important copper-producing districts.

In the Cowichan Lake district the *Blue Grouse* shipped approximately 1,500 tons of ore averaging nearly 7 per cent. copper, while the *Sunnyside*, in the same locality, also made some small shipments.

The *Blue Grouse* has been bonded by the Consolidated Mining and Smelting Company, of Trail, and is now being worked by that company.

In the Sooke district, the *Margaret*, operated by a Victoria company, shipped some 600 tons of 5-per-cent. copper ore, and the indications are that during the coming year regular shipments will be made.

The *Willow Grouse* did not make any shipments this year, but has been bonded to the Ladysmith Smelting Corporation, under which company systematic operations and development has been instituted, and a programme of prospecting the property on scientific lines is already under way.

Both these properties are sufficiently near the navigable waters of Sooke harbour to permit of shipments being made by scows.

The geological formation upon which both the *Willow Grouse* and *Margaret* are located has been found to extend at least to the Jordan river, where a syndicate known as the Sunloch Mining Company, composed of R. H. Stewart, J. M. Turnbull, etc., has been opening up what promises to be a very extensive low-grade copper property within two miles from the power-station of the British Columbia Electric Company.

As the Victoria Mining Division is included within the Western Mineral Survey District, and the Resident Engineer, W. M. Brewer, is making a very detailed report thereon, it will be unnecessary for me to enter into further particulars.

PLACER-MINING.

I am not aware of any placer-mining having been carried on in the Division this past year, although it is possible some small amount of gold may have been taken out from the Leach, Jordan, and Sooke rivers which has not been reported.

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 Vancouver Portland Cement Company, of Tod inlet (R. P. Butchart, president, Board of Trade Building, Victoria), made an output of Portland cement, of a value of nearly $500,000. This year's output is much larger than that of 1916, as this company also manufactured for the Associated Cement Company, whose works at Bamberton were not operated this past year.

Lime.—The Rosebank Lime Company (W. F. McTavish, manager), Esquimalt, produced burnt lime to a value of about $6,000, which is about the same as last year's output. The Lime Producers, Limited, made almost $5,000 worth of lime.

Of pottery, tile, etc., there was produced, this past year, material valued at about $40,000, 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 $20,000, produced chiefly by the Victoria Brick Company and the Sidney Island Brick Company.

OFFICE STATISTICS—VICTORIA MINING DIVISION.

Free miners' certificates issued	427
Free miners' certificates issued (special)	2
Mineral claims recorded	122
Placer claims recorded	6
Certificates of work recorded	51
Bills of sale recorded	33
Abandonments recorded	1
Certificates of improvements issued	16

Revenue.

Free miners' certificates	$3,771 25
Mining receipts, general	959 70
Total	$4,730 95

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, 1917:—

The following list gives the number and localities of the recorded claims in this Division:—

MINERAL CLAIMS.

Howe sound	54
Gambier island	19
Seymour creek (West branch)	60
Staamus lake and river	8
Furry creek	13
Lynn creek	2
Salmon arm	13
Nelson island	10
Jervis inlet	59
Sechelt peninsula	8
Pacific Great Eastern Railway	22
Indian river	33
Bowen island	5
Princess Royal reach	12
Potlatch creek	2
Capilano	15
Deserted bay, Vancouver bay	5
Daisy lake	3
Cypress creek	7
Bargain harbour	1
Mamquam river	24
Prince of Wales reach	15
Sproat mountain	13
North arm	2
English bay	4
Squaka river	10
Total	419

More prospecting has been done in the Jervis Inlet vicinity than formerly, and according to the reports from the different locators it seems a very promising locality.

The Red Jacket Development Company, Limited, was organized in November last, and intends to start development-work at once on the *Red Jacket* group, situated near Egmont point.

On the *Jolley* group, situated on the northern spur of Mount Calder, about one mile and a quarter from the easterly side of Hotham sound, development-work was carried on during the summer months by MacLeod & Marvin. Mr. Marvin states that the mineralization is very extensive and can be traced for a long distance. It consists of iron pyrite, pyrrhotite, chalcopyrite, and bornite. Two short tunnels—one 17 feet and the other 10 feet long—and several open-cuts were made. About 20 tons of shipping-ore, as well as considerable concentrating-ore, was extracted in the driving of these tunnels, but no drifting or further work was done on the ore exposed.

C. J. West, secretary of the Baramba Mining Company, Limited, states that on its property at Hotham sound, a 60-foot tunnel was run at an elevation of about 50 feet above the beach to crosscut a dyke showing in a bluff, and carrying chalcopyrite and iron pyrite ores in the open-cut. A very encouraging feature in evidence is a well-defined vein, carrying good copper ore, running through the Baramba claims, with a strike of N. 70° W. (mag.). The vein dips southerly, necessitating the location of a further four claims on the southern border of the property. This has been done, and it is the intention of the directors, as soon as the weather permits, to prospect further by open-cuts the north-westerly extensions through the property and the new locations.

Prospecting-work has been carried on by J. M. Carlyle and associates throughout the year on the *Bonanza* group, situated near Elkin's point, Gambier island. Numerous trenches and open-cuts have been made and a tunnel has been driven on the *Winnie* claim. The work done satisfies the owners that there is a large and persistent body of ore, and the assays taken run from 1 to 3 per cent. copper, with a small amount of gold and silver.

C. M. Oliver, secretary of the Bowena Copper Mines, Limited, states that development-work was carried on continuously at the *Bowena* mine, Bowen island, during 1917. A trial shipment of 10 tons of sorted ore was sent to the Ladysmith smelter, and assayed 3.38 per cent. copper, 1.16 oz. silver, and 0.12 oz. ($2.40) in gold to the ton.

G. S. Eldridge, Provincial Assayer and Metallurgist, recently sampled ten dumps on the property for the purpose of making a mill test. He obtained an average of 2.42 per cent. copper from these dumps, and his report of concentration and flotation tests shows that a profit of $2.27 a ton can be made in milling this grade of ore, with copper figured at 17 cents a pound. The company contemplates the erection of a 100-ton mill when sufficient tonnage has been blocked out. A crosscut is now being run from the main tunnel to tap the bottom of the shaft, where there is a good showing of shipping-ore.

Britannia.

The following statement concerning the operations and construction-work at the *Britannia* mines for the year 1917 has been furnished me by Mr. Donohue, secretary-treasurer of the company. The final figures are not yet available owing to delay in receipt of settlement sheets from the smelter, but the approximate results for the year in question are as follows:—

"*Operations*—

Tons mined	669,500
Tons transported to mill	672,000
Tons milled	662,000
Tons mill production shipped to smelter	57,217
Contents of above mill production—	
Lb. copper	16,325,000
Oz. silver	91,125
Oz. gold	974

"*Development.*—Footages of drifts crosscuts, etc., being development-work in the mine during the year—

Drifts	13,000
Crosscuts	7,000
Winzes	110
Chutes	2,200
Raises	10,000
Total	32,310

"The 'glory-hole' system of mining on the surface, reference to which was made in our 1916 report to you, was developed considerably during 1917, and at present we have five distinct 'glory-holes' in operation. Ore from this source is transported with one handling underground through long rock-raises to crushers on our 1,800-foot level, thence direct to the chute for loading on the 2,200-foot level. During the year electric blasting was introduced in our 'glory-hole' work and the results have been most satisfactory.

"Two tunnels through Britannia mountain to South valley, one on the 500 and the other on the 1,000-foot level, were completed prior to January 1st, 1917, and during the past twelve months another was added on the 250-foot level, and work commenced on additional ones on the 600-, 1,600-, and 1,800-foot levels.

"The supplementary rock-raise from the 2,200-foot level to the 1,000-foot level was completed during the year, and connections from the 2,000-, 1,800-, 1,600-, 1,400-, 1,200-, and 1,000-foot levels have been made to it. This raise can be used either for an ore or waste chute.

"A drift has been started west on the 2,200-foot level to connect with the 8- x 10-foot tunnel which was started from a point on Mineral creek above the head of the incline on a level corresponding with the 2,200 of the mine. The latter is known as the Daisy tunnel and has now advanced a total of 340 feet.

"More extensive development of the *Bluff* ore-body was carried on during 1917, principally on the 1,200-foot level, where a series of raises and drifts are blocking out ore for stoping operations.

"A drift has been completed connecting Jane Creek tunnel with the 1,200-foot level, thus affording a portal on this level.

"In the *Empress* mine, adjoining the *Fairview* on the east, ore is being developed by drifts, crosscuts, and raises, the principal work having been done on the 1,000-, 850-, and 700-foot levels.

"The crosscut tunnel driven south from Mineral creek on the 3,100-foot level was not advanced during the year, but a drift to the east from the crosscut progressed 367 feet.

"The 4,100-foot level, the portal of which is situated about 250 feet from the top of the Beach mill, was advanced 807 feet during 1917. This work was not carried on continuously and the face is at present 2,485 feet from the portal.

"Considerable expenditure was made in the way of prospecting on outlying claims, particularly the Queen tunnel, which was driven 326 feet; the Lanz tunnel, 630 feet; Mountain Lake tunnel, 330 feet; and the Harp tunnel, north end 750 feet and south end 420 feet; the two last-mentioned tunnels running through the *Leora*, *Tintic*, and *Mask Fr.* claims, as well as the *Harp*.

"During the last half of 1917 four diamond-drills were working on the property, drilling an aggregate footage of 8,500 feet.

"*Equipment.*—Four additional Westinghouse, oxide-cell type, storage-battery locomotives, each weighing 3½ tons, were placed in service. Additional equipment of this type is now under order, and it is the intention to utilize storage-battery locomotive haulage more extensively in future. In connection with the storage-battery locomotives, sixty 2-ton automatic side-dump cars were put into commission and orders placed for fifty more of the same type.

"The No. 2 shaft was equipped with two larger skips, giving increased hoisting capacity for both men and supplies.

"Several new shops for steel-sharpening have been installed underground to serve the workings close at hand. At present we have one each on the 250-, 500-, 850-, and 1,200-foot levels. The following drill-sharpeners are now in service: Four Sullivans, one Waugh, and eight Leyners.

"A 24 x 36 Buchanan jaw-crusher was placed in service on the 1,800-foot level to serve as an auxiliary to the 7½-K Gates gyratory crusher.

"Two new compressors have been placed in the tunnel power-house—one is a 3,600-cubic-foot Rogler type Rand compressor, a duplicate of the 1916 installation, and the other a 1,500-cubic-foot Rand cross-compound compressor. The former is driven directly by a 550-horse-power Pelton water-wheel and the latter by a synchronous motor, which is brought to speed by a Pelton water-wheel. A synchronous motor was also put in operation in the tunnel power-house to drive the 1,177-cubic-foot Rand compressor, taking the place of the Pelton water-wheel formerly in use.

"A 700-cubic-foot cross-compound Rand compressor has been placed in service at the head of the incline. This compressor is belted to the main drum-shaft of the incline lowering hoist and acts as a brake for the hoist, as well as pumping air into the main line.

"An auxiliary motor-generator set for the operation of the tunnel to incline railroad was built of the 200-k.w., a.c. generator with water-wheel and a new 600-volt, 200-k.w. Westinghouse d.c. generator.

"*New Buildings.*—Two new boarding-houses have been erected on the South Valley side of Britannia mountain—one at the 1,000-foot level, known as the Empress camp, and the other at the portal of the 1,600-foot level, known as the Beta camp. These houses are similar to those erected during the previous year at our Barbara camp, each one having accommodation for forty men and being provided with hot and cold water, heat, electric light, etc.

"At the Beach two five-room dwellings for employees were built, as well as a six-room residence, serving as dwelling and office for the Customs Inspector.

"*Construction.*—The principal construction job at the Beach during 1917 was the completion of the South Valley water project. This necessitated the building of a concrete dam at Furry creek, 207 feet in length and 77 feet in height. The water stored in this reservoir is conveyed to the Beach power-house through: 3,100 feet of tunnel, 5 x 7 feet; 200 feet of 60-inch continuous wood-stave pipe; 2,700 feet of 48-inch continuous wood-stave pipe; 2,480 feet of 42-inch continuous wood-stave pipe; 6,460 feet of 36-inch continuous wood-stave pipe; 3,000 feet of 34-inch continuous wood-stave pipe; 1,410 feet of 32-inch continuous wood-stave pipe; 680 feet of 30-inch steel pipe; 140 feet of 28-inch steel pipe; a total length of 20,170 feet.

"For service in connection with this South Valley line we installed at the Beach power-house two 3,750-horse-power Pelton water-wheels, driving two 2,500-k.w. Canadian Westinghouse Company's generators.

"The completion of this project has eliminated one of the principal sources of interference with continuous operation—namely, shortage of power—which condition formerly prevailed when the high intakes along Britannia valley were unable to serve our requirements."

No placer-mining has been carried on during the past year; but five new leases have been applied for, and the owners intend to work the properties as soon as leases are in order.

As will be seen by the following statistics, the business in this Division is increasing each year; the revenue for 1917 being over 50 per cent. in advance of the preceding year.

There is marked increase in the number of free miners' certificates issued. The numbers of claims recorded, certificates of work issued, and the surveys that have been made and recorded as work shows that a monetary interest is being taken in the mining industry.

OFFICE STATISTICS—VANCOUVER MINING DIVISION.

	1916.	1917.
Free miners' certificates issued	1,382	1,880
Special free miners' certificates issued	17	15
Quartz claims recorded	384	419
Abandonments recorded	10	4
Certificates of work issued	466	617
Surveys recorded as work	38	123
Receipts issued for money in lieu of work	5	28
Notices filed	44	118
Conveyances recorded	225	98
Certificates of improvement recorded	50	36
Powers of attorney recorded	1	5
Placer leases applied for	..	5
Crown grants applied for	74	35

Revenue.

Free miners' certificates	$7,879 50	$10,402 25
Mining receipts	3,538 90	5,954 35

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 1917:—

The list below gives the number and vicinities of claims recorded in this Division during the past year:—

Pitt lake	69
Harrison lake	39
Stave river	10
Jones lake	89
Chilliwack river	11
Sumas river	2
Lillooet river	3
Coquitlam river	1
Kanaka creek	4
Total	228

There has been quite an increase over the previous year in the number of new claims located, and, in fact, I am pleased to say there is an improvement in the office statistics all along the line.

As you will see from the above list, the greatest activity in the New Westminster Mining Division during 1917 was around Jones lake, in the Cheam range of mountains, about thirty miles east of Chilliwack City.

Lucky Four.

Chief among the prospects developed in this vicinity is the *Lucky Four* group. I am indebted to A. S. Williamson, superintendent for Sperry & White, for the following report on this property:—

"The *Lucky Four group* consists of twelve claims, situated on the summit of the Cheam range, at the headwaters of Jones creek, about fourteen miles south of Laidlaw, on the Canadian Northern Pacific Railway, the outcroppings being at an altitude of 6,250 feet. These claims were located in the fall of 1915 by prospectors from Hope, and were bonded by Sperry & White, of Vancouver, B.C., in October, 1916.

"This discovery caused considerable excitement in mining circles owing to the size and high values of the ore-body—a huge outcrop dividing two glaciers. The ore-zone is of a contact-metamorphic type. The ore-bodies appear to have an irregular outline, though in general following the line of the granite-contact. The ore consists of a mixture of chalcopyrite, bornite, chalcocite, pyrrhotite, and pyrite, and some magnetite, occurring in a gangue of quartz and lime-silicate minerals—epidote, hornblende, pyroxene, and garnetite.

"The ore-bodies occur in the contact between the igneous rocks and the older sedimentaries. Exploratory work done this year demonstrated the continuance of the ore-bodies along the strike for 2,600 feet.

"The last ore-body uncovered was found on the south slope 600 feet below the apex of the original discovery. Work was carried on for six months, during which time a good horse-trail was built by the company into the mine from Laidlaw, a distance of fourteen miles; a considerable amount of diamond-drilling was done and open-cut work along the strike of the ore-zone, all of which produced satisfactory results.

"The company intends starting operations again in the spring, as soon as the snow settles."

Prospecting-work was performed with satisfactory results on Alexandra, Anaconda, and Butte mountains, near the head of Pitt lake, on several groups of mineral claims.

Considerable work was done on the *Empress* group, situated about three miles east of Agassiz, during the early summer, but has, unfortunately, been suspended owing to litigation. During the period of operation about 100 tons of ore was shipped to Trail smelter.

OFFICE STATISTICS—NEW WESTMINSTER MINING DIVISION.

Free miners' certificates issued (individual)	242
Free miners' certificates issued (company)	2
Free miners' certificates issued (special)	1
Mineral claims recorded	228

Abandonments recorded	3
Placer claims recorded	12
Certificates of work issued	103
Certificates of improvements issued	4
Powers of attorney recorded	12
Conveyances, etc., recorded	63
Grouping notices filed	11

Revenue.

Free miners' certificates	$1,125 00
Mining receipts	1,568 75
Total	$2,693 75

INSPECTION OF MINES.

REPORT OF GEORGE WILKINSON, CHIEF INSPECTOR.

I have the honour to submit my first annual report as Chief Inspector of Coal and Metalliferous Mines covering the year ending December 31st, 1917.

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.

Geo. Wilkinson	Chief Inspector, Victoria.
James McGregor	Inspector, Nelson District.
Robert Strachan	Senior District Inspector, Fernie.
John Newton	Inspector, Nanaimo District.
Henry Devlin	Inspector, Nanaimo District.
Wm. Lancaster	Inspector, Fernie District.
J. H. McMillan	Inspector, Prince Rupert District.
H. H. Johnstone	Temporary Inspector, Nelson.

Instructors, Mine-rescue Stations.

John D. Stewart	Instructor, Mine-rescue Station, Nanaimo.
Charles O'Brien	Instructor, Mine-rescue Station, Fernie.
John Thomson	Instructor, Mine-rescue Station, Cumberland.

Organizer and Instructor, First Aid.

Dudley Michell	Instructor, Victoria.

CHANGES IN THE INSPECTION STAFF DURING THE YEAR 1917.

On April 5th Thomas Graham resigned as Chief Inspector of Mines and George Wilkinson was appointed. On August 31st, George O'Brien resigned his position as District Inspector for the North-east Kootenay District. On September 30th Thomas H. Williams resigned his position as District Inspector for the South-east Kootenay District.

In the reorganization of the inspection staff for this district, Inspector Strachan was transferred from the Nicola-Princeton District to the Crowsnest Pass District as Senior Inspector of the Crowsnest Pass District, and Wm. Lancaster was appointed as District Inspector to fill the vacancy.

The Nicola-Princeton District was divided for the remainder of the year, the coal-mines being inspected by Inspector Newton, of the Island District, and the metalliferous mines by Inspector McGregor, of Nelson.

John Thomson was appointed on November 9th as instructor and caretaker of the Mine-rescue Station at Cumberland.

TONNAGE OF COAL PRODUCED.

The total gross tonnage produced by the coal-mines of the Province for the year ending December 31st, 1917, was 2,398,715 long tons, a decrease of 86,865 from the production of 1916.

This output would have been considerably larger had not the production of the Crowsnest collieries been cut down by a strike lasting three months and a series of misfortunes. There was also a serious shortage of labour. With the exception of the Crowsnest Pass District, all the others showed an increase of production.

The Vancouver Island collieries increased their production from 1,492,761 tons in 1916 to 1,695,721 tons in 1917, an increase of 202,960 tons; this is the largest production the Vancouver Island collieries have ever made.

The Nicola-Princeton District collieries increased their production from 110,549 tons in 1916 to 151,243 tons in 1917, an increase of 40,694 tons.

The Crowsnest Pass collieries showed a decrease from 882,270 tons in 1916 to 551,751 tons in 1917, a decrease of 330,519 tons, due to the conditions mentioned above.

ACCIDENTS IN COAL-MINES.

The fatalities in and around the coal-mines during the year totalled forty-four, of which number thirty-four were killed in one accident and four in another, both of these accidents being mine explosions; the first of which occurred in No. 3 mine, Coal Creek Colliery, on April 5th, 1917, and the second in No. 6 mine, Comox Colliery, on June 3rd, 1917. This total is an increase of sixteen over 1916, due to those explosions.

The other fatal accidents which occurred during the year totalled six, a decrease of ten from that of the previous year.

There were 5,170 persons employed in and around the coal-mines.

The ratio of fatal accidents per 1,000 persons employed was 8.51, compared with 5.53 for 1916 and 10.42 for 1915. The ratio for the last ten-year period was 5.089.

The following table shows the collieries at which fatal accidents occurred during 1917, and their relation to accidents which occurred at the colliery for 1916:—

Name of Company.	Name of Colliery.	1917.	1916.
Canadian Collieries (D.), Ltd.	Comox Colliery	8	6
Canadian Collieries (D.), Ltd.	Extension Colliery	..	..
Western Fuel Co.	Nanaimo	1	3
Pacific Coast Coal Mines, Ltd.	South Wellington Colliery	..	2
British Columbia Coal Mining Co., Ltd.	East Wellington Colliery	..	..
Nanoose Collieries, Ltd	Nanoose Colliery	..	..
Middlesboro Collieries, Ltd.	Middlesboro Colliery	..	..
Merritt Collieries, Ltd.	Merritt Colliery	..	..
Inland Coal and Coke Co.	Coal Hill Colliery	..	..
Pacific Coal Syndicate.		..	..
Princeton Coal and Land Co.	Princeton Colliery	..	..
Crow's Nest Pass Coal Co.	Coal Creek Colliery	34	5
Crow's Nest Pass Coal Co.	Michel Colliery	1	12
Totals		44	28

The following table shows the various causes of the fatal accidents and their percentage of the whole, with corresponding figures for the previous year:—

Cause.	1917.		1916.	
	No.	Per Cent.	No.	Per Cent.
Fall of rock	3	6.818	7	25.000
Fall of coal	..	....	3	10.705
Haulage	2	4.545	5	17.860
Asphyxiation	..	....	1	3.570
Explosion	38	86.364	12	42.865
Miscellaneous (electrocuted)	1	2.273	..	.....
Totals	44	100.00	28	100.000

The following table shows the number of tons of coal mined for each fatal accident in their respective classes in the years 1917 and 1916:—

Cause.	1917.		1916.	
	No. of Fatal Accidents.	No. Tons mined per Fatal Accident.	No of Fatal Accidents.	No. Tons mined per Fatal Accident.
Fall of rock	3	799,572	7	355,403
Fall of coal	None.	.....	3	829,273
Haulage	2	1,199,357	5	497,564
Asphyxiation	None.	.....	1	2,487,820
Explosion	38	60,493	12	207,318
Miscellaneous	1	2,398,715	None.	.....

TONNAGE OF METALLIFEROUS MINES.

The output from the metalliferous mines for 1917 was 2,761,579 tons, being a decrease of 427,286 tons under the tonnage for 1916. This tonnage was produced from 193 shipping mines, eighty-seven of which shipped over 100 tons.

ACCIDENTS IN METALLIFEROUS MINES.

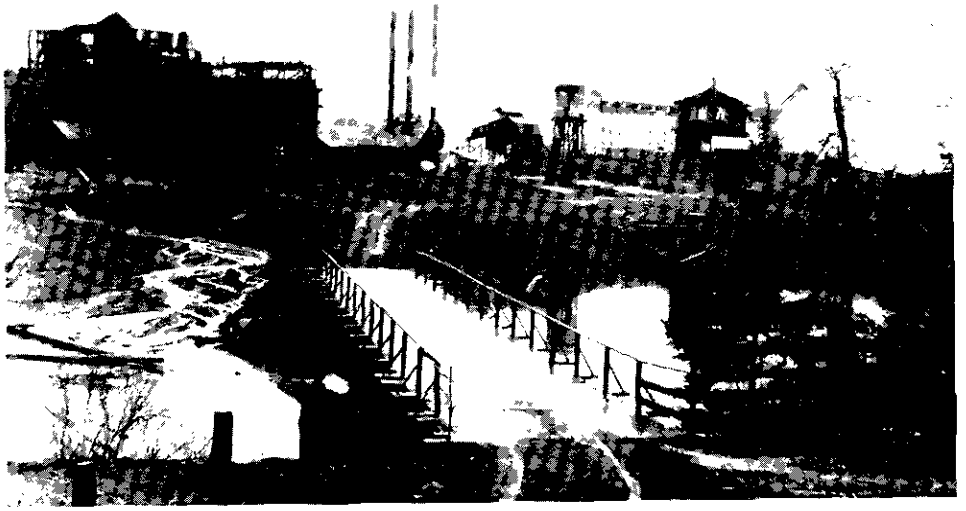
There were fifteen separate fatal accidents in and around the metal-mines during the year, causing the death of seventeen persons, being a decrease of one in number of accidents, and a decrease of three in number of fatalities compared with the figures of 1916.

There were 5,488 persons employed in and around the metalliferous mines, an increase of 183 persons compared with the figures of 1916.

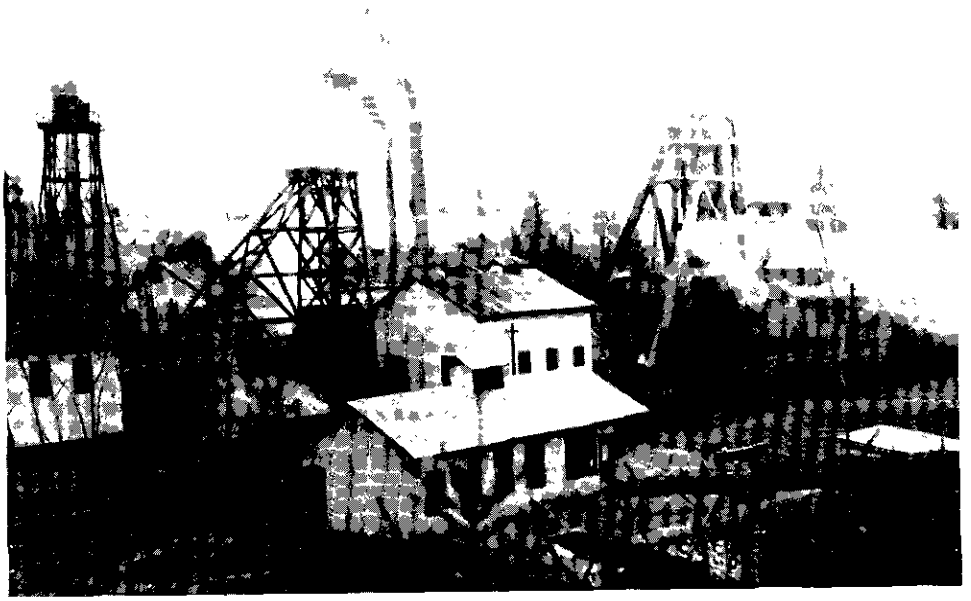
The ratio of fatal accidents per 1,000 persons employed was 3.228, compared with 3.71 for 1916. The ratio for the last ten-year period was 3.449.

The mines at which fatalities occurred are:—

District.	Mine.	Number of Accidents.
Rossland	Centre Star-War Eagle	1
Kamloops	Iron Mask	1
Skeena	Anyox	3
Rossland	Le Roi	1
Osoyoos	Nickel Plate	2
Vancouver	Britannia	1
Ainsworth	Florence	1
Ainsworth	Blue Bell	3
Omineca	Rocher Déboulé	1
Boundary	Granby-Phoenix	1
Ainsworth	No. 1	1
Slocan	Hewitt	1
Total		17



Pacific Coast Coal Mines, Washery, Boat Harbour.



Pacific Coast Coal Mines, Morden Colliery.

The following table gives the cause and percentage to the whole of the fatal accidents, with corresponding figures for 1916:—

Cause.	1917.		1916.	
	No.	Per Cent.	No.	Per Cent.
Fall of ground	6	35.294	6	30.00
Falling into chutes, raises, winzes, etc	2	11.764	2	10.00
Shafts	1	5.883	1	5.00
Mine-cars and haulage	1	5.883	2	10.00
Picking or drilling into unexploded powder	2	11.764	..	.....
Asphyxiation from powder-fumes	..	.....	2	10.00
Returning on unexploded shots	..	.....	1	.....
Premature blasts	3	17.646	2	10.00
Electricity	..	.....	1	5.00
Hit with flying rock from shots on surface	..	.....	1	5.00
Broken compressed-air pipe on surface	..	.....	2	10.00
Falling material in shafts and chutes	1	5.883	..	5.00
Killed while unloading timber from wagon on surface	1	5.883	..	.....
Totals	17	100.000	20	100.00

Fall of ground caused six deaths, or 35.294 per cent. of the whole, which is an increase in percentage of 5.294 per cent. over last year, but being the same number of deaths from the same cause.

Explosives in various forms account for five lives, or 29.41 per cent., a decrease of one in number from the same cause last year.

Chute accidents caused the loss of two lives, or 11.764 per cent. of the total this year, which is the same number of lives as last year, but an increase in percentage of 1.764 over last year. Shaft accidents were responsible for one death, the same number as the previous year, but a slight increase of percentage. Mine-cars and haulage was the cause of one death, being one less than last year from the same cause, and a decrease in percentage of 4.117.

Falling material in shafts and chutes was the cause of one death, being the same number as was killed last year from the same cause, but a slight increase in percentage. One man was killed this year unloading a wagon of timber by pure carelessness; after knocking out the stakes from the side of the wagon instead of stepping to one side while the timber rolled off, he just stooped down by the side of the wagon to let the momentum of the rolling timber carry it right over him, but one of the timbers swung around and squeezed him into the wagon.

During the year the production of mineral in tons was less than 1916, but greater than 1915.

There was a general scarcity of labour, and that obtainable, generally, was less experienced than usual, considerably increasing the risk of accident.

A great deal of work has been done in both coal and metal mines in formation of safety committees with the view to educational work on prevention of mine accidents.

At some of the metalliferous mines lectures are being arranged where the more intelligent of the foreign element are educating their fellow-workmen along lines of safety first. This should be productive of good results among that class of labour.

EXPLOSIVES.

During the year two supplementary orders were issued, adding to the permitted explosives contained in the previous Explosives Order No. 2 of September 8th, 1915, and supplementary of February 4th, 1916, and August 8th, 1916. The full list of explosives now on Permissible Order and Supplementary Orders are as follows:—

Monobel A1 ..... British List.
Monobel No. 1 ..... ,,
Dynobel No. 2 ..... ,,
Polar Permitite* ..... ,,

* Polar Permitite is known on the British List as "Super-Rippite."

Monobel*	United States List.
Monobel No. 4	" "
"Giant" Coal-mine Powder No. 5	" "
"Giant" Coal-mine Powder No. 6	" "
"Giant" Coal-mine Powder No. 7	" "
"Giant" Coal-mine Powder No. 8	" "
Polar Brushite†	" "
Vigorite No. 1	" "
Vigorite No. 2	" "
Vigorite No. 3	" "
Vigorite No. 4	" "
Miner's Friend No. 1	" "
Miner's Friend No. 2	" "
Miner's Friend No. 3	" "
Miner's Friend No. 7	" "

The following table shows the quantity of explosives used in the coal-mines during the year 1917, together with the number of shots fired, how shots were fired, tons of coal produced per pound of explosives used, and average pounds of explosive per shot fired:—

District.	Quantity of Explosives used in Pounds.	Tonnage of District.	No. of Shots fired by Electricity.	No. of Shots fired by Fuse.	Total No. of Shots fired.	Tons of Coal per Pound of Explosive.	Average Pounds of Explosive per Shot fired.
Vancouver Island	510,892	1,695,721	604,039	176,546	780,585	3.31	0.65
Nicola-Similkameen	36,883	151,243	34,960	.....	34,960	5.64	0.76
East Kootenay	14,382	551,751	10,129	433	10,562	38.36	1.36
Totals	552,157	2,398,715	649,128	176,979	826,107	4.34	0.66

The production of coal per pound of explosive used is 0.60 ton less than that of the previous year.

The Crowsnest Pass District showed an increase of 18.69 tons per pound of explosive used, the yield being 38.36 tons, compared with 19.67 for 1916.

The Nicola-Princeton District showed an increase of 1.36 tons per pound of explosive used, the yield being 5.64 tons, compared with 4.28 tons for 1916.

The Vancouver Island mines showed a decrease of 0.14 tons per pound of explosive used, the yield being 3.31 tons, compared with 3.45 tons for 1916.

MACHINE-MINED COAL.

During the year mining-machines produced 262,507 tons of coal, or 10.94 per cent. of the whole. This is a slight decrease under the figures of 1916, when the percentage of the machine-mined coal was 11.24 per cent.

Of the total machine-mined coal, the Western Fuel Company produced 182,492 tons, or 69.52 per cent.; the Canadian Collieries (D.), Limited, 44,051 tons, or 16.76 per cent.; and the Princeton Coal and Land Company, 36,000 tons, or 13.72 per cent.

* Monobel is known on the United States List as "Monobel No. 1," but is designated "Monobel" on this list to prevent confusion with "Monobel No. 1" on the British List.
† Polar Brushite is known on the United States List as "Carbonite No. 1."

The following table gives 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.	
Nicola-Similkameen	..	3	.....	36,000	36,000
Vancouver Island	5	13	44,015	182,492	226,507
Totals	5	16	44,015	218,492	262,507

Types of Machines in Use.

Type.	District.		Total.
	Nicola-Similkameen.	Vancouver Island.	
"Percussive" Post	3	8	11
"Bar" Longwall	..	5	5
"Chain" Longwall	..	5	5
Totals	3	18	21

SAFETY-LAMPS.

There were 4,176 safety-lamps in use in the coal-mines of the Province, an increase of 412 over the previous year. Of this number, 2,618 were flame-lamps of the Wolf type and 1,558 were electric lamps of various makes, an increase of 1,456 in this latter type of lamp during the year. The following table shows the distribution of lamps by districts, methods of locking, and the illuminant used:—

District.	Magnetic.	Screw or Automatic Clip.	Naphtha.	Electricity.
East Kootenay	165	960	165	960
Nicola-Similkameen	284	43	284	43
Vancouver Island	2,169	555	2,169	555
Totals	2,618	1,558	2,618	1,558

MINE-AIR SAMPLING IN COAL-MINES.

During the year 179 mine-air samples were taken in the coal-mines of the Province. Of this number, twenty-nine samples were spoiled in transit, accidents in laboratory, or by reason of incomplete record.

Much valuable information has been obtained from these samples relative to the flow of methane from the various coal-seams mined; from the data acquired it has been proved that the coal-seams operated by the coal-mines of the Crow's Nest Pass Coal Company, Limited, at Coal Creek and Michel, may be classed as being among the most gaseous seams being operated anywhere in the world. During the months of April, May, and June of this year, when the mines were idle in the Crowsnest Pass District, mine-air samples were taken regularly each month to determine the gas-flow while no coal was being mined. The results obtained were astonishing; in some cases the flow of gas was as large at the end of seventy days as when the mine was working, proving that the outflow of gas does not depend on the breaking of the coal alone, but is constantly being given off by the exposed surface of the coal and strata.

The following table shows the tabulated data obtained from the mine-air sampling in coal-mines during 1917:—

RETURNS FROM MINE-AIR SAMPLES TAKEN IN THE VARIOUS COAL-MINES OF THE PROVINCE OF BRITISH COLUMBIA DURING THE YEAR 1917.

Coal Creek Colliery.

Sample No.	Date.	Mine.	Ventilating District.	Mine Working or Idle.	Tonnage of Mine per Day.	Tonnage of Split per Day.	Chemical Analysis.				Velocity of Air in Feet per Minute.	Quantity of Air in Feet per Minute.	Hygrometer.				Cubic Feet of Methane per Minute.	Cubic Feet of Methane per Day.	Lb. of Methane per Day.	Cubic Feet of Methane per Ton of Coal mined.
							CO_2.	O.	CH_4.	N.			Barometer.	Dry Bulb.	Wet Bulb.	Humidity.				
82	Mar. 21	"B"	Main return airway	Working....	300	....	0.11	20.53	1.13	78.23	550	37,000	25.6	47	46	92	418.0	601,920	22,331	2,006
83	" 21	"	Incline and left of slope	" ...	300	200	0.22	20.25	2.15	77.38	220	12,000	25.6	50	50	100	258.0	371,520	13,783	1,857
84	" 21	"	Right side of slope	" ...	300	100	0.05	20.61	0.86	78.48	200	8,000	25.6	47	46	92	68.0	97,920	3,632	979
94	May 2	"	Main return airway	Idle 26 days.	300	...	0.09	20.62	0.77	78.52	470	42,300	26.0	49	48	92	325.0	468,000	17,362	1,560
95	" 2	"	Right side of slope	"	300	100	0.10	20.54	1.14	78.22	200	8,000	26.0	45	44	92	91.0	131,040	4,861	1,310
96	" 2	"	Left side of slope	"	300	200	0.04	20.76	0.44	78.76	200	12,000	26.0	50	49	93	52.0	74,880	2,778	374
106	June 5	"	Main return airway	Idle 61 days.	300	....	0.08	20.66	0.62	78.64	280	28,000	26.0	49	48	92	173.0	249,120	9,242	830
107	" 5	"	Right side of slope	"	300	100	0.04	20.79	0.32	78.85	75	6,500	26.0	47	45	85	21.0	30,240	1,121	302
108	" 5	"	Left side of slope	"	300	200	0.10	20.56	1.04	78.30	210	12,000	26.0	49	49	100	125.0	180,000	6,678	900
137	Nov. 20	"	Incline split	Working....	300	140	0.19	20.21	2.37	77.23	200	14,000	26.0	52	51	93	331.0	476,640	17,683	3,404
138	" 20	"	Slope split	" ...	300	160	0.21	20.42	1.59	77.78	140	9,400	26.0	53	53	100	149.0	214,560	7,960	1,341
139	" 20	"	Main return airway	" ...	300	....	0.17	20.49	1.54	77.80	400	31,000	26.0	52	51	93	477.0	686,880	25,483	2,289
85	Mar. 21	No. 1 North	"	" ...	150	....	0.29	20.27	0.28	79.16	500	33,000	25.6	56	54	87	92.0	132,480	4,915	883
97	May 2	"	"	Idle 26 days.	150	....	0.26	20.44	0.18	79.12	500	36,000	26.0	56	56	100	64.0	92,160	3,419	614
112	June 15	"	"	Idle 71 days.	150	....	0.25	20.42	0.11	79.22	650	36,400	26.2	56	54	87	40.0	57,600	2,136	384
136	Nov. 20	"	"	Working....	210	....	0.16	20.56	0.51	78.77	100	9,300	25.7	58	58	100	47.0	67,680	2,510	322
98	May 2	No. 1 South	"	Idle 26 days.	500	....	0.36	19.80	1.56	78.28	600	24,000	26.0	58	58	100	374.0	538,560	19,980	1,077
111	June 15	"	"	Idle 71 days.	500	....	0.27	20.10	1.07	78.56	520	26,000	22.2	60	58	88	278.0	400,320	14,851	890
127	Oct. 23	"	Main return airway; time, 11 a.m.	Working....	700	...	0.15	20.09	2.20	77.56	300	22,500	25.5	56	54	87	495.0	712,800	26,444	1,018
128	" 23	"	Main return airway; time, 2.30 p.m.	" ...	700	....	0.13	20.09	2.24	77.54	300	22,500	25.5	56	54	87	504.0	725,760	26,925	1,036
130	" 23	"	Main return airway; time, 9.10 p.m.	" ...	700	....	0.15	20.03	2.58	77.24	300	22,500	25.5	56	54	87	580.0	835,200	30,985	1,193
149	Dec. 19	"	Main return airway	" ...	650	...	0.12	20.29	1.52	78.07	430	32,250	24.8	53	53	100	489.0	704,160	26,124	1,083
93	Mar. 23	No. 1 East	No. 10 East	" ...	650	620	0.18	19.89	2.78	77.15	310	24,800	25.8	46	45	92	689.0	992,160	36,809	1,600
102	May 3	"	"	Idle 27 days.	650	620	0.12	20.49	1.37	78.02	230	18,400	26.0	48	47	92	252.0	362,880	13,462	558
103	" 3	"	Main return airway	"	650	....	0.09	20.54	0.99	78.38	1,700	136,000	26.0	46	45	92	1,346.0	1,938,240	71,908	2,980
109	June 5	"	No. 10 East	Idle 61 days.	650	520	0.10	20.32	1.59	77.99	500	36,000	26.0	56	50	75	572.0	823,680	30,558	1,267
110	" 5	"	Main return airway	"	650	...	0.09	20.43	0.85	78.63	1,750	140,000	26.0	49	48	93	1,190.0	1,713,600	63,574	2,636
113	" 15	"	No. 10 East	Idle 71 days.	650	....	0.07	20.46	1.35	78.12	300	16,800	26.2	54	52	86	227.0	326,880	12,127	502
125	Oct. 17	"	"	Working....	600	....	0.18	19.89	3.04	76.89	620	49,650	26.2	62	62	100	1,507.0	2,170,080	80,509	3,616
126	" 23	"	No. 10 East; time, 8.30 a.m.	" ...	600	....	0.20	19.98	2.81	77.01	200	16,000	26.0	56	53	81	449.0	646,560	23,977	1,077
129	" 23	"	No. 10 East; time, 3.30 p.m.	" ...	600	...	0.19	20.00	3.01	76.80	200	16,000	26.0	56	53	81	481.0	692,640	25,696	1,154
131	" 23	"	No. 10 East; time, 10 p.m.	" ...	600	...	0.19	19.90	3.38	76.53	200	16,000	26.0	56	53	81	540.0	777,600	28,848	1,296
143	Dec. 12	"	Main return airway	" ...	600	....	0.12	20.52	0.90	78.46	1,000	140,000	25.9	62	62	100	1,260.0	1,814,400	67,314	3,024
144	" 12	"	South side split	" ...	600	200	0.11	20.40	1.12	78.37	700	79,800	25.9	48	48	100	893.0	1,285,920	47,707	6,429
145	" 12	"	North side split	" ...	600	400	0.11	.....	0.92	.....	700	56,000	25.9	50	50	100	515.0	741,600	27,513	1,854
99	May 2	No. 2	Main return airway	Idle 27 days.	300	....	0.22	20.43	0.72	78.63	600	42,000	26.0	55	54	93	302.0	434,880	16,134	1,449
105	June 4	"	"	Idle 60 days.	300	...	0.23	20.36	0.59	78.82	600	39,600	26.0	54	53	93	233.0	335,520	12,447	1,118
141	Nov. 22	"	Rock tunnel split	Working....	250	200	0.21	20.25	1.49	78.05	100	9,600	26.2	60	60	100	143.0	205,920	7,639	1,029
142	" 22	"	High Line split	" ...	250	50	0.09	20.74	0.47	78.70	160	4,800	26.4	43	43	100	22.0	31,680	1,175	633
90	Mar. 23	No. 3	South level	" ...	350	....	0.38	19.87	3.43	76.32	145	13,000	25.8	59	57	88	445.0	640,800	23,773	1,830
91	" 23	"	Main return airway, S. level, excluding last three places on air	" ...	350	....	0.34	20.08	1.28	78.30	670	53,000	25.8	62	62	100	678.0	976,320	36,221	2,789
92	" 23	"		" ...	350	310	0.23	20.23	1.99	77.55	220	17,160	25.8	58	57	93	340.0	489,600	18,164	1,579
104	June 7	"	South level at Draper's slope*	Idle	.....	....	0.10	20.54	0.98	78.38	500	33,000	26.0	57	55	93	323.0	465,120	17,255	.....
122	Oct. 11	"	Main return at Draper's slope*	"	.....	....	0.07	20.51	0.83	78.59	500	35,000	26.1	66	61	73	290.0	417,600	15,492	.....
123	" 11	"	Main return near fan*	"	.....	....	0.25	20.31	0.55	78.89	700	58,000	25.9	66	61	73	319.0	459,360	17,042	.....

* Mine idle since April 5th, 1917.

Michel Colliery.

68	Mar. 7	Old No. 3	No. 2 slope split	Working	190	....	0.14	20.24	1.96	77.66	400	24,000	26.3	50	49	93	470.0	676,800	25,109	3,562
70	" 7	"	West incline split (idle since 1915)	"	190	....	0.05	20.78	0.17	79.00	100	6,000	26.3	46	46	100	10.0	14,400	534	75
71	" 7	"	Main return airway	"	190	....	0.16	20.30	1.48	78.06	800	80,000	26.3	46	46	100	1,184.0	1,704,960	63,254	8,973
81	April 4	"	No. 3 slope split	Idle 96 hours	190	190	0.13	20.33	1.62	77.92	700	28,000	26.0	46	46	100	453.0	652,320	24,201	3,433
82	" 4	"	Main return airway	"	190	....	0.15	20.29	1.48	78.08	800	80,000	26.0	48	46	85	1,184.0	1,704,960	63,254	8,973
89	May 3	"	No. 3 slope split	Idle 33 days	190	....	0.13	20.56	1.53	77.78	800	32,000	25.7	47	47	100	489.0	704,160	26,124	3,706
90	" 3	"	Old works on east side	"	190	....	0.15	20.42	2.00	77.43	400	24,000	25.7	50	50	100	480.0	691,200	25,643	3,637
91	" 3	"	Main return airway	"	190	....	0.19	20.50	1.55	77.76	850	85,000	25.7	48	48	100	1,317.0	1,896,480	70,359	9,981
95	June 5	"	No. 3 slope split	Idle 66 days	190	....	0.12	20.41	1.04	78.43	750	30,000	26.0	48	48	100	312.0	449,280	16,668	2,364
96	" 5	"	Old works on east side	"	190	....	0.11	20.36	1.71	77.82	400	28,000	26.0	51	51	100	479.0	689,760	25,590	3,630
97	" 5	"	Main return airway	"	190	....	0.15	20.29	1.08	78.48	760	76,000	26.0	49	49	100	821.0	1,182,240	43,861	6,222
110	Oct. 4	"	*Return from Nos. 1 and 2 slopes*	*Idle 7 mos*	190	....	0.20	20.15	1.89	77.76	270	11,340	26.2	59	56	85	213.0	306,720	11,379	.....
112	Nov. 20	"	" "	Idle 8 mos	190	...	0.19	20.21	1.45	78.15	400	20,000	26.2	62	62	100	290.0	417,600	15,492	.....
113	" 20	"	Main return airway	"	190	....	0.17	20.41	0.93	78.49	660	59,400	26.2	60	60	100	552.0	794,880	29,490	.....
76	Mar. 9	No. 3 East	No. 6 East split	Working	100	100	0.06	20.61	0.78	78.55	700	46,200	25.9	44	44	100	360.0	518,400	19,232	5,184
78	" 9	"	Main return airway	"	100	....	0.06	20.62	0.83	78.49	1,300	91,000	25.9	41	41	100	755.0	1,087,200	40,335	10,872
83	April 4	"	No. 6 East split	Idle	100	100	0.08	20.58	0.79	78.55	700	42,000	26.0	42	42	100	331.0	476,640	17,683	4,766
84	" 4	"	Main return airway	100 hours	100	....	0.05	20.60	0.90	78.45	1,350	94,500	26.0	43	43	100	850.0	1,224,000	45,410	12,240
92	May 3	"	No. 6 East split	Idle 33 days	100	100	0.08	20.61	0.76	78.55	800	48,000	25.7	44	44	100	364.0	524,160	19,446	5,241
93	" 3	"	West side split	"	100	....	0.07	20.65	0.77	78.51	700	42,000	25.7	42	42	100	323.0	465,120	17,225	4,651
94	" 3	"	Main return airway	"	100	....	0.05	20.62	0.87	78.46	1,300	91,000	25.7	42	42	100	791.0	1,139,040	42,258	11,390
98	June 5	"	No. 6 East split	Idle 66 days	100	100	0.09	20.57	0.74	78.60	750	49,500	25.8	45	45	100	366.0	527,040	19,558	5,270
99	" 5	"	West side split	"	100	....	0.06	20.65	0.73	78.56	650	42,900	25.8	44	44	100	313.0	450,720	16,721	4,507
100	" 5	"	Main return airway	"	100	....	0.07	20.62	0.77	78.56	1,300	104,000	25.8	44	44	100	801.0	1,153,440	42,792	11,534
109	Oct. 4	"	"	Working	200	..	0.13	20.49	0.93	78.45	1,400	101,500	26.1	49	49	100	944.0	1,359,360	50,432	6,796
114	Nov. 21	"	No. 6 East split	"	380	200	0.09	20.39	1.11	78.41	410	86,000	26.2	62	62	100	399.0	574,560	21,316	2,872
115	" 21	"	West side split	"	380	160	0.09	20.54	1.07	78.30	300	12,600	26.5	54	54	100	134.0	192,960	7,158	1,206
116	" 21	"	Main return airway	"	380	....	0.12	20.43	1.24	78.21	1,050	69,300	26.3	50	50	100	859.0	1,236,960	45,891	3,255
72	Mar. 8	New No. 8	No. 6 incline split	"	430	205	0.58	20.02	0.24	79.16	200	10,000	25.4	52	50	86	24.0	34,560	1,282	168
73	" 8	"	No. 4 incline split	"	430	75	0.04	20 81	0.06	79.09	120	12,000	25.4	45	45	100	7.0	10,080	373	134
75	" 8	"	Main return airway	"	430	....	0.07	20.73	0.13	79.07	750	47,250	25 4	42	42	100	61.0	87,840	3,258	204
85	April 5	"	No. 6 incline split	Idle 5 days	430	205	0.15	20.28	0.46	79.11	340	10,200	25.3	52	50	86	47.0	67,680	2,510	394
86	" 5	"	No. 4 incline split	"	430	75	0.05	20.68	0.11	79.16	300	10,800	25.3	48	46	85	12.0	17,280	641	230
87	" 5	"	No. 1 incline split	"	430	150	0.09	20.59	0.18	79.14	250	15,000	25.3	44	42	84	27.0	38,880	1,442	259
88	" 5	"	Main return airway	"	430	....	0.09	20.55	0.19	79.17	700	44,100	25.3	40	40	100	83.0	119,520	4,434	277
101	June 5	"	No. 6 incline split	Idle 66 days	430	205	0.34	20.22	0.28	79.16	100	10,000	25.4	54	52	86	28.0	40,320	1,495	196
102	" 5	"	No. 4 incline split	"	430	75	0.18	20.31	0.24	79.27	300	10,800	25.4	46	46	100	26.0	37,440	1,389	499
103	" 5	"	No. 1 incline split	"	430	150	0.10	20.76	0.06	79.08	250	15,000	25.4	44	44	100	9.0	12,960	480	86
104	" 5	"	Main return airway	"	430	....	0.20	20.43	0.17	79.20	700	44,100	25.4	42	42	100	75.0	108,000	4,006	251
108	Oct. 4	"	"	Working	460	....	0.07	20.68	0.10	79.15	870	52,200	25.7	50	49	93	52.0	74,880	2,778	162

Corbin Colliery.

79	Mar. 27	No. 4	400 level	Working	200	200	0.11	20.59	0.91	78.39	120	12,000	23.9	40	40	100	109.0	156,960	5,823	784
106	Sept. 17	"	500 level	"	220	....	0.10	20.66	0.38	78.86	180	13,000	24.4	47	47	100	68.0	97,920	3,632	443

Nicola-Similkameen District.

24	May 21	Princeton No. 1	Main return airway	Working	110	....	0.12	20.53	0.39	78.96	340	24,200	27.7	53	52	93	94.0	135,360	5,211	1,230
30	Aug. 11	"	"	"	120	....	0.10	20.60	0.27	79.03	260	23,400	27.9	56	55	90	63.0	90,720	3,492	756
25	June 4	Middlesboro No. 4	"	"	100	....	0.12	20.65	0.05	79.18	220	23,700	28.2	52	51	93	12.0	17,280	665	172
26	" 4	Middlesboro No. 4, E.	"	"	60	....	0.09	20.79	0.03	79.09	260	19,500	28.2	53	52	93	6.0	8,640	332	144
27	" 5	Middlesboro No 7	"	"	160	....	0.06	20.72	0.16	79.06	600	30,000	27.8	50	50	100	48.0	69,120	2,661	432

RETURNS FROM MINE-AIR SAMPLES TAKEN IN COAL-MINES—*Concluded.*

Coast District.

Sample No.	Date.	Mine.	Ventilating District.	Mine Working or Idle.	Tonnage of Mine per Day.	Tonnage of Split per Day.	Chemical Analysis. CO_2.	O.	CH_4.	N.	Velocity of Air in Feet per Minute.	Quantity of Air in Feet per Minute.	Hygrometer. Barometer.	Dry Bulb.	Wet Bulb.	Humidity.	Cubic Feet of Methane per Minute.	Cubic Feet of Methane per Day.	Lb. of Methane per Day.	Cubic Feet of Methane per Ton of Coal mined.
51	April 23	No. 1 North side	N. of No. 1 slope, N.E slope, and S. of No. 2 slope	Working	900	272	0.15	20.33	0.11	79.41	900	27,000	30.1	62	61	94	29.0	41,760	1,787	153
52	" 23	"	N.E. slope, No. 1 slope	"	900	160	0.32	20.00	0.23	79.45	400	24,000	30.1	68	68	100	55.0	79,200	3,389	495
53	" 23	"	No. 3 slope and N. side of No. 2 slope	"	900	468	0.87	18.61	0.80	79.72	330	17,160	30.1	61	59	93	136.0	195,840	8,381	418
63	Oct. 11	"	Newcastle level	"	720	280	0.31	20.24	0.31	79.14	200	12,000	30.3	60	60	100	37.0	53,280	2,280	190
64	" 11	"	Nos. 1 and 2 slopes	"	720	440	0.19	20.50	0.11	79.20	800	32,000	30.3	60	60	100	35.0	50,400	2,158	114
65	" 11	"	Main return airway	"	720	....	0.15	20.47	0.09	79.39	750	30,000	30.3	61	59	88	27.0	38,880	1,664	149
42	Feb. 12	No. 1 South side	"	"	650	....	0.29	20.12	0.30	79.29	1,000	50,000	30.5	66	64	88	150.0	216,000	9,244	332
44	" 12	"	No. 2 split	"	650	240	0.12	20.46	0.25	79.17	260	10,410	30.5	64	62	88	26.0	37,440	1,602	156
45	" 12	"	S.E. heading and No. 6 South	"	650	290	0.17	20.31	0.30	79.22	240	14,400	30.5	62	62	100	43.0	61,920	2,650	213
59	Sept. 6	"	Main return airway	"	800	....	0.35	19.97	0.30	79.38	800	48,000	30.1	65	65	100	144.0	207,360	8,875	259
41	Jan. 23	Reserve	"	"	500	...	0.04	20.71	0.10	79.15	1,000	80,000	30.2	54	52	86	80.0	115,200	4,930	230
46	Mar. 12	"	No. 1 split, East side	"	600	240	0.06	20.69	0.07	79.18	420	33,600	29.9	55	54	93	23.0	33,120	1,417	138
47	" 12	"	No. 2 split, East side	"	600	180	0.04	20.78	0.07	79.11	212	17,000	29.9	57	56	93	11.0	15,840	677	88
48	" 13	"	No. 1 split, West side	"	600	100	0.05	20.70	0.51	78.74	220	17,000	30.0	55	53	86	86.0	123,840	5,300	1,238
49	" 13	"	No. 2 split, West side	"	600	80	0.05	20.70	0.08	79.17	180	14,400	30.0	56	54	86	11.0	15,840	667	198
58	July 25	"	Main return airway	"	500	....	0.07	20.73	0.14	79.06	1,150	86,250	30.2	59	59	100	120.0	172,800	7,395	345
62	Sept. 20	Harewood	"	"	300	....	0.07	20.72	0.07	79.14	250	10,000	28.9	52	50	86	7.0	10,080	431	33
50	Mar. 15	E. Wellington	"	"	360	....	0.13	20.61	0.14	79.12	860	51,600	29.3	57	55	87	72.0	103,680	4,437	345
56	June 22	"	No. 1 split	"	250	60	0.07	20.71	0.07	78.96	300	18,000	30.0	57	55	87	47.0	67,680	2,896	1,128
57	" 22	"	No. 2 split	"	250	190	0.14	20.64	0.12	79.10	670	30,150	30.0	62	61	94	36.0	51,840	2,218	272
54	May 3	Morden	Main return airway	"	504	....	5.06	20.45	0.66	73.83	500	40,000	30.0	52	50	86	264.0	380,160	16,270	754
61	Sept. 13	"	"	"	400	....	0.07	20.69	0.47	78.77	700	49,000	29.9	56	56	100	230.0	331,200	14,175	828
55	June 9	Grant	"	"	95	....	0.98	20.80	0.04	79.08	350	8,750	30.1	49	48	92	3.0	4,320	184	45
61	Aug. 24	Extension No. 1	East side split	"	140	70	0.29	20.51	0.05	79.15	250	11,250	29.7	....	....	....	5.6	8,064	345	115
62	" 24	"	West side split	"	140	70	0.17	20.51	6.08	79.24	180	9,900	29.7	....	....	....	8.0	11,520	493	164
70	Oct. 23	"	Main return airway	"	77	....	0.29	20.45	0.06	79.20	600	32,400	29.3	....	....	....	19.0	27,360	1,171	355
63	Aug. 24	"	"	"	140	....	0.35	20.39	0.09	79.19	520	29,120	29.7	....	....	....	26.0	37,440	1,602	267
48	June 26	Extension No. 2	No. 2 East split	"	210	38	0.40	19.93	0.08	79.59	310	6,820	29.8	....	....	....	5.4	7,776	332	204
49	" 26	"	West side split	"	210	96	0.45	19.66	0.35	79.54	300	9,000	29.8	....	....	....	31.5	45,360	1,940	472
50	" 26	"	No. 4 East split	"	210	76	0.38	20.28	0.03	79.31	500	12,000	29.8	....	....	....	3.6	5,184	221	68
51	" 26	"	Main return airway	"	210	....	0.39	20.14	0.08	79.39	600	30,000	29.8	....	....	....	24.0	34,560	1,479	164
67	Oct. 17	"	"	"	230	....	0.36	20.05	0.09	79.50	500	30,000	29.5	....	....	....	27.0	38,880	1,664	169
41	April 24	Extension No. 3	No. 2 split	"	275	100	0.05	20.69	0.42	78.84	300	9,600	29.8	....	....	....	40.0	57,600	2,465	576
42	" 24	"	No. 1 split	"	275	175	0.61	19.59	0.19	79.61	275	11,550	29.8	....	....	....	22.0	31,680	1,355	182
43	" 24	"	Main return airway	"	275	....	0.47	19.84	0.18	79.51	350	26,250	29.8	....	....	....	47.0	67,680	2,896	246
68	Oct. 17	"	"	"	250	....	0.39	19.92	0.19	79.50	520	28,080	29.5	....	....	....	53.0	76,320	3,266	305
64	Aug. 28	Extension No. 4	East side split	"	400	225	0.05	20.80	0.06	79.09	520	26,100	29.6	....	....	....	15.5	22,320	955	99
65	" 28	"	Main return airway	"	400	....	0.08	20.77	0.07	79.08	680	47,600	29.6	....	....	....	33.3	47,952	2,052	120
66	" 28	"	West side split	"	400	175	0.07	20.74	0.16	79.03	350	16,500	29.6	....	....	....	26.4	38,016	1,627	217
69	Oct. 18	"	Main return airway	"	450	....	0.06	20.79	0.09	79.06	750	45,000	29.6	....	....	....	40.0	57,600	2,465	128
40	Feb. 12	Comox No. 4	No. 1 slope split	"	850	340	0.19	20.24	0.87	78.70	750	33,750	29.6	....	....	....	293.0	421,920	15,058	1,240
44	May 5	"	"	"	750	271	0.25	20.00	1.25	78.50	430	24,080	29.6	....	....	....	300.0	432,000	18,489	1,597
45	" 5	"	East side, No. 2 slope	"	750	239	0.37	19.79	1.57	78.27	650	22,750	29.6	....	....	....	356.0	512,640	21,940	2,144
46	" 5	"	West side, No. 2 slope	"	750	240	0.10	20.57	0.20	79.13	600	18,000	29.6	....	....	....	36.0	51,840	2,218	216
47	" 5	"	Main return airway	"	750	....	0.48	19.64	0.71	79.17	2,000	120,000	29.6	....	....	....	852.0	1,226,880	52,510	1,635
72	Nov. 10	"	"	"	650	....	0.65	19.21	1.09	79.05	2,200	158,400	29.4	....	....	....	1,726.0	2,485,440	106,376	3,823
57	Aug. 10	Comox No. 5	West side split	"	800	125	0.10	20.69	0.10	79.11	680	20,400	29.8	....	....	....	20.0	28,800	1,232	230

58	Aug.	10	Comox No. 5	Main return airway	Working	800	....	0.10	20.57	0.13	79.20	1,500	120,000	29.8	....	....	....	156.0	224,640	9,614	280
59	"	10	"	East side of No. 1 dip	"	800	512	0.10	20.64	0.25	79.01	370	22,200	29.8	....	....	....	45.0	64,000	2,773	126
60	"	10	"	West side of No. 1 dip	"	800	163	0.05	20.82	0.04	79.09	400	20,000	29.8	....	....	....	8.0	11,520	493	70
73	Nov.	16	"	Main return airway	"	600	....	0.13	20.38	3.31	79.18	1,500	120,000	29.8	....	....	....	372.0	535,680	22,927	892
52	July	11	Comox No. 7	"	"	310	..	0.11	20.62	5.24	79.03	1,500	144,000	30.0	....	....	....	42.0	60,480	2,588	1,423
53	"	11	"	No. 1 East split	"	310	42.5	0.13	20.65	0.17	79.05	350	25,200	30.0	....	....	....	7.0	10,080	431	106
54	"	11	"	No. 2 East split	"	310	94.5	0.07	20.79	0.05	79.09	400	14,400	30 0	....	....	....	46.0	66,240	2,835	2,284
55	"	11	"	No. 1 West split	"	310	29.0	0.12	20.59	0.29	79.00	400	16,000	30.0	....	....	....	69.0	99,360	4,252	690
56	"	11	"	No. 2 West split	"	310	144	0.17	20.35	0.48	79.00	480	14,400	30.0	....	....	....	288.0	414,720	17,750	1,382
71	Nov.	8	"	Main return airway	"	300	....	0.12	20.63	0.24	79.01	2,000	120,000	29.8	....	....	...				

NOTE.—In compiling the above tables it has been necessary, in cases where the samples were taken when a mine was idle, to assume the output of a working-day, so that the relative cubic feet of methane per ton of coal mined could be computed.

OUTBURST OF "BUMPS," AND AIR-BLASTS.

On November 8th, 1917, a blow-out of coal and gas occurred in No. 1 East mine, Coal Creek Colliery; details of same as furnished by Inspector Strachan are herewith given:—

"*Report of Blow-out in No. 1 East Mine, Coal Creek Colliery, on the Morning of November 7th, 1917.*

"I have the honour to confirm my telegram of the 7th inst.: 'Blow-out in No. 3 North room, No. 1 East, Coal Creek, about 2.20 a.m. this morning, displacing about 100 tons fine coal and liberating large body of gas. Workmen all safe.'

"The blow-out caused quite a panic in the mine, the workmen running out in most cases without their dinner-pails or coats. The fireboss was outside the mine at the time, and R. J. Brown, who has lately been appointed assistant manager for the afternoon shift, was on his way in when he met the workmen running out. The workmen, who are mostly foreigners, according to Mr. Brown were so scared that he found it almost impossible to get an intelligent account of the accident, but gathered from one that his partner was buried with a 'bump.' Mr. Brown, accompanied by the fireboss, who had joined him, proceeded in by the diagonal to No. 10 East entry.

"Reaching No. 22 room they found the air-current was carrying a cap of gas of over an inch, so they opened the doors on No. 10 East to allow this to clear off quicker, and proceeded in by No. 9 East and got up to where the blow-out had occurred in No. 3 North. The slack coal had filled the entire place, blocking the airway, so they broke the brattice as close up as they could reach. They then searched, but did not find any traces of any of the workmen.

"In the meantime they had sent word out to the lamp-room to see if any of the men were missing, and it was found that they had all reported, so they left the gas to drain off.

"About 8 a.m., with Mr. Caufield I visited the place, and we found the gas had considerably abated, and in the return at point marked 'A' on sketch we found 3.2 per cent. Proceeding in to No. 3 room, we tried it at the No. 9 East and found 0.6 per cent.; at point 'B' we found 2.9 per cent. on first reading, second 3.9 per cent. Sample 132 will check the latter. The gas seemed to act strangely here, varying from ½-inch cap to over 1 inch within a short space of time. I am inclined to think this was due to the opening and shutting of doors and movements of cars.

"On the inside of the break made by Mr. Brown the gas was very strong and with a peculiar odour, so I took a sample (133) and made a note on it to the effect it would be interesting to test it for some of the higher hydrocarbons.

"The blow-out had filled the place up to the roof with fine coal-dust, so we could not see the face, and at least 10 feet of the roadway was filled solid, tapering out for about 40 feet, the surface being nicely swept just as if a blast had passed over it.

"With the exception of one post which had been dislodged, the timbers did not seem to be disturbed, and even the brattice had not been blown down, the fine coal filling right up on both sides of it.

"It seems that the workmen have been troubled for some time past with slight 'bumps'; these seemed to get worse just before the blow-out, so much so that the workmen withdrew and were outside of the face when it occurred. An interesting description is given by the brattice-man, who was coming from No. 4 North to No. 3 at the time. He had just reached the parting when he felt four very distinct 'bumps,' and was waiting until the roof settled, when he heard a loud rumbling (just like beating a large sheet of iron); this seemed to travel right across in the roof over No. 4 and 3 North and towards No. 1 and 2 North, when it seemed to return, and to turn right into No. 3 room. The time from the 'bumping' till the rolling or rumbling would be about four minutes; then the whole air-current seemed to fill with very fine dust, making it almost impossible to see for a few minutes. This place is an ordinary room about 16 feet wide, and is in that part of the mine where we have always regarded the cover or surface as light, and the coal has generally been considered hard, although in this place for some days past the mining has been very easy.

"Although the cover is light, these places are in the gully which cuts the measures a little east of the mine entrance and are entering into the next mountain. It may be that there is some conditions between the mountains that contribute to these blow-outs.

"In the meantime all the places from No. 3 North and below have been stopped, and the intention is not to drive any farther through this gully or beyond it until well under the flat ground which is on to top of the mountain.

"Blow-outs have been very rare in Coal Creek, although common in Morrissey, which lies directly across the hill, when it was working. A slight blow-out did occur about two years ago, but this was in the inside workings.

"To prevent accidents from this cause drilling may be suggested, but from the close texture of the coal I am afraid this will prove of very little value.

"The only remedy which I can see that will be of permanent value for blow-outs and 'bumps' is for some seam of coal to be worked long-wall, so as to allow the settlement of the upper measures; this I think would allow the gas to drain off slowly.

"It is interesting, when we consider that, according to Mr. Rice, the caves which have been caused in the strata from the No. 2 workings, and causing the parting of the rocky strata higher up, to know why such settlements have not in some manner liberated such pockets of gas. While this place is not directly above the old workings in No. 3, still it is close enough, I should think, to be affected by them.

"The question of long-wall does not seem to be very favourably received here; still we have the conditions; if we take out a large percentage of coal, it will to a certain extent allow the roof to break and the gas to bleed off and prevent blow-outs; on the other hand, it certainly contributes to 'bumps.'

"I am sending you by express a jarful of coal-dust taken from the blow-out; I thought you might wish to send it either to Ottawa or Pittsburgh for analysis.

"What probably contributed to the general panic in the mine, and caused lots of comment, is the fact that exactly one year ago began that series of 'bumps' which cost one life and imprisoned several workmen."

"BUMPS."

No severe "bumps" have been experienced in the mines of the Coal Creek Colliery during the year 1917, but light "bumps" have taken place frequently.

No work except repairs has been done in the area affected by the severe "bumps" of November 7th and 8th, 1916, in No. 1 East mine, Fernie.

MINE FIRES AND EXPLOSIONS.

There were several mine fires and signs of fires reported during the year, which were all dealt with safely. They occurred at the following mines: Corbin No. 4 mine, of the Corbin Coal & Coke Company; No. 1 mine and the Reserve mines, Nanaimo Colliery, Western Fuel Company; Michel Colliery, Crow's Nest Pass Coal Company; Jingle Pot mine, British Columbia Coal Mining Company; No. 4 mine, Middlesboro Colliery; and Morden mine, Pacific Coast Coal Mines, Limited.

The most serious fire of the year was in the No. 1 mine, Western Fuel Company, a description of which is herewith appended; the others are mentioned in the reports of the Inspectors of the respective districts in which they occurred.

Fire, No. 1 Mine, Western Fuel Company.

This fire was started at the face of No. 11 North slant of Main heading, No. 3 wall, No. 1 shaft, at 7 p.m. on July 9th, 1917. The cause of the fire was due to Charles Styles, machineman, igniting some gas with his naked light. The fire was kindled three times and had not been properly extinguished. Some time later Richard Jackson, machineman, smelt smoke coming along the face-line with the return air. He investigated and found the big machine-mining had caught on fire. He sent for Wm. Halliday, fireboss in charge of that part of the mine on the afternoon shift, who, upon arriving, decided to short-current the air and keep it away from the fire. At 9 p.m. a telephone message was sent to Mr. Jackson, the mine manager, that some big machine-minings were on fire in No. 3 wall, but not giving him any particulars. He at once telephoned David Brown, overman, North side, and Wm. Neave, fireboss, No. 3 wall, to that effect, and asked them to hurry out and see for themselves what was the matter. In the meantime Mr. Jackson sent word to Mr. Hunt, superintendent, to have the Draeger apparatus ready if required.

T. R. Jackson, mine manager; David Brown, overman; and William Neave, fireboss, hurried to the scene of the fire, carrying with them six tins of pyrene. Upon arrival Mr. Jackson ordered the ventilating-current to take its proper course to better determine what the fire was like. This was done, and Jackson, Brown, and Neave went to within 15 feet of the fire, but found it was too large to deal with and at once dispatched a messenger to hurry the Draeger apparatus in and to bring more tins of pyrene.

That evening the writer arrived in that district by the evening train, and about 10 p.m. received a telephone message from Inspector Newton that there was a fire in No. 3 wall, No. 1 mine. He immediately hurried to the mine-rescue station, where preparation was being made to send in the Draeger apparatus. Soon after arrival the apparatus was ready, and a party consisting of John Hunt, superintendent of mines, Western Fuel Company, Inspector Newton, Instructor Stewart from the mine-rescue station, and several others and the writer immediately left by electric motor for the scene of the fire, carrying with them the apparatus. On the way in the party met the messenger sent out by Mr. Jackson. After arriving on the scene and examining the fire area, it was apparent that nothing could be done by the use of the apparatus and pyrene extinguishers; it was therefore decided to get water to it at the earliest possible moment; with this in view the compressed-air pipe-line was used for a water-line; one party was put on attaching the fire-hose on the end near the face, and another party was put on breaking the large air-line out at No. 2 wall and connecting it with a large duplex pump situated at that point. After considerable delay, owing to the water-pressure breaking the line at various places, the water was eventually gotten to the seat of fire about 5 a.m. next morning, the 10th. By this time the smoke was back a considerable distance from the face, and it was only by the use of the Draeger apparatus that the water could be poured on the fire; the men using the apparatus could get up close to the fire with the hose and had two streams of water under a pressure of 120 lb. playing on the fire. After the use of the apparatus for some time the smoke had been sufficiently cleared away to allow the men to work without the use of the apparatus. After thoroughly cooling off the place the men were put to work to load out the burned coal and other material, water being constantly used for cooling purposes, and by 7 a.m. of July 11th, 1917, all danger was past. But for the use of the Draeger apparatus the fire might have resulted in the sealing-off of the whole of the North side, and a consequent large loss of tonnage and a large number of men thrown out of employment for some time.

Great praise is due to the officials and workmen for their promptness in reporting for service and their zeal in dealing with the fire.

EXPLOSIONS.

Two explosions occurred during the year 1917. The first one occurred on April 5th at 3 p.m. at No. 3 mine, Coal Creek Colliery, of the Crow's Nest Pass Coal Company, in which thirty-four lives were lost. The second one occurred on June 3rd at No. 6 mine, Comox Colliery, operated by the Canadian Collieries (D.), Limited. These disasters are fully treated by separate reports.

AIR-BLASTS.

There were no air-blasts in the metalliferous mines during the year.

IMPROVEMENTS INAUGURATED IN THE MINES OF THE PROVINCE DURING THE YEAR.

During the year 1917 many improvements were inaugurated around the mines of the Province, such as reducing the number of naked lights in mines, installation of electric lamps, introduction of the Burrell gas-detector, treatment of coal-dust, limit of gas in the mine-air, governing withdrawal of workmen, etc. The following is a brief summary:—

Reduction of Naked Lights in Use.—After the explosion at Cumberland, which was caused by a naked light coming in contact with a small accumulation of gas, it was deemed advisable by the Department to try to displace the naked lights in the mines of the Province and replace them if possible by electric safety-lamps. With this end in view a circular letter was sent out to the different operating companies who were using naked lights in their mines, asking them to replace them with safety-lamps. The operators all readily agreed to meet the wishes of the Department, with the exception of one small company.

Since this request was made the number of naked lights in use in the mines has been reduced 60 per cent. and the remainder are being rapidly displaced.

Introduction of Electric Safety-lamps.—There has been installed in the mines of the Province during the year electric safety-lamps, distributed as follows:—

Vancouver Island mines	555
Nicola and Princeton mines	43
Crowsnest Pass mines	960
Total	1,558

The total number of electric safety-lamps in use in the Province at the end of 1917 is 1,558, and 1,456 of these have been installed during the year. Practically 37.3 per cent. of the safety-lamps in use in the Province are electric safety-lamps. Large quantities are on order by the operating companies and are being installed as fast as deliveries are made.

Introduction of the Burrell Gas-detector.—The Burrell gas-detector is being introduced for detecting smaller percentages of gas than can be detected on the safety-lamp. This apparatus has been tried out and found to give very good results, and will detect as low as $^1/_{10}$ of 1 per cent. of methane. During its trial it has been checked by chemical analysis of samples taken at the same time, and it checked very closely. On a series of tests it checked out to not more than $^2/_{10}$ of 1 per cent. in any case, and exactly with the analysis in many cases. This should prove a very valuable instrument in keeping down percentages of gas in mine atmospheres. Ordinarily to find anything below 2 to 2½ per cent. methane required a mine-air sample to be taken; this sample had to be sent to Ottawa for analysis, necessitating a delay of about fourteen days before returns could be got; whereas it is now possible to read percentages as low as $^1/_{10}$ of 1 per cent. in two minutes with the Burrell gas-detector. All the Inspectors are now equipped with this detector and six are in use at the Crowsnest Pass mines for company officials.

Treament of Coal-dust.—Considerable attention has been given to the treatment of coal-dust to minimize the dangers from this source. In the Crowsnest Pass mines the roadways in the mines have been treated with second-burnt ashes to neutralize the explosibility of the dust. Rock-dust barriers have been erected at the entrance to the different districts. Some 50,000 feet of pipe-lines have been installed in the mines to water the coal-faces and keep down the dust; this work is still in progress and is being pushed as rapidly as pipes can be secured.

Protection from Electrical Storms.—Lightning-arresters were installed at the mouth of No. 3 East and fan-drift of Old No. 3 mine, Michel Colliery.

Ventilation.—A good deal of attention has been given to the ventilation of the mines in the Crowsnest Pass District. The airways are being cleaned up, enlarged, and timbered, and two intakes and two returns have been made in some of the mines. It is the ultimate object to try and have three intakes and three returns in the larger mines to get large volumes of air in circulation at safe velocities, and to split the air frequently so as to reduce to a minimum the percentages of gas in the ventilating-currents.

A more permanent class of stopping is being put in to avoid the enormous leakages which have existed in these mines, and a large force of men is employed on this work.

"Bumps" and Installation of Seismograph.—To safeguard operations against "bumps" the services of G. Rice, Chief Engineer, United States Bureau of Mines, was secured to make an examination and report on conditions. Mr. Rice made an examination and report, giving certain recommendations; these are being largely carried out; new methods of work are being inaugurated in the mine where the "bumps" have taken place and many other precautions taken.

To try and give warning of impending "bumps" a special seismograph is being constructed by Mr. Denison, of the Meteorological Station, Victoria. This instrument will record the slow movements of the rocks, and in addition to giving a visible reading will also make a chart which can be developed and will show the reading every minute of the day; by this a complete record can be kept of the slight movements of the rocks, and it is hoped that warning of approaching heavy "bumps" will be given several days before they actually take place.

Withdrawals of Men from Faces.—In the Crowsnest Pass mines a rule has been put in force that the workmen must be withdrawn when the percentage of gas in the air is 2½ per cent. or upwards. Tests were made to establish what cap on a Wolf safety-lamp represented 2½ per cent. by analyses and tests by the Burrell gas-detector. These tests proved that a ¼-inch cap on a Wolf safety-lamp represented 2½ per cent., and orders were given that workmen must be withdrawn when the air in a working-place shows ¼-inch cap.

Co-operation with Gas Committees.—A closer co-operation now exists between the Inspection Department and the gas committees. By request from the Department of Mines the gas committee now send a report of their inspection to the Mines Department at Victoria, so that the Department is in touch with the committees' work, and their reports on conditions are compared with reports of the Inspectors from the same mines.

Much credit is due to W. R. Wilson and the officials of the Crowsnest Pass coal-mines for their co-operation with the Inspection Department in adopting any means at their disposal to render operations safe.

Many improvements are also being inaugurated by the Canadian Collieries (Dunsmuir), Limited, and the Western Fuel Company, of the Coast District, both companies having started to equip their mines with the Edison electric safety-lamps. The Western Fuel Company has also done considerable work along the lines of treatment of coal-dust and erection of rock-dust barriers. They have also appointed two safety inspectors to patrol the various mines, and have adopted other methods to foster first aid, details of which are given in Inspector Newton's report.

MINE-AIR SAMPLING IN METALLIFEROUS MINES.

During the year 1917 sixty mine-air samples were taken in the metalliferous mines of the Province. Of this number, eight samples were spoiled in transit accidents, laboratory, or by reason of incomplete record. Much valuable information has been obtained from these samples in reference to the hydrogen, carbon-monoxide, and carbon-dioxide contents.

The following table shows the tabulated data obtained from mine-air sampling in metalliferous mines:—

RETURNS FROM MINE-AIR SAMPLES TAKEN IN THE VARIOUS METALLIFEROUS MINES OF THE PROVINCE OF BRITISH COLUMBIA, 1917.

East Kootenay District.

Sample No.	Date.	Mine.	Location in Mine.	CO_2.	O.	CO.	H.	N.	Dry Bulb.	Wet Bulb.	Humidity.	Remarks.
1	May 22	Sullivan	100 feet from face of 3,900-foot tunnel	0.19	20.22	.....	.....	79.59	.....	.....	.....	
2	" 22	"	1,085 stope	0.09	20.66	.....	.....	79.25	.....	.....	.....	

West Kootenay District.

1	Jan. 3	War Eagle	1,301 drift	0 07	20.78	.....	.....	79.15	73	68	74	Sample taken 40 minutes after blasting.
2	" 3	"	1,301 drift	0.06	20.79	.....	.....	79.15	70	65	74	Sample taken 7 hours after blasting.
3	" 3	"	1,301 drift	0.15	20.70	.....	.....	79.15	70.	68	89	Sample taken 15 hours after blasting.
7	" 17	"	1,651 stope	0.74	20.06	.....	.....	79.20	86	85	95	Stope not working.
5	" 17	Le Roi	2,052 drift	0.07	20.80	.....	.....	79.13	75	72	84	Sample taken 6½ hours after blasting.
6	" 17	"	2,052 drift	0.10	20.75	.....	.....	79.15	75	74	94	Sample taken 14½ hours after blasting.
8	" 27	White Bear	*1,000-foot level (205 feet east of shaft)*	0.41	19.51	.....	0 04	80.04	62	59	82	Candle would not burn.
9	" 27	"	702 crosscut (165 feet east of shaft)	0.43	19.48	.....	0.03	80.06	56	55	93	Candle would not burn.
10	" 27	"	Pump Station, 300 level	0.07	20.82	.....	0.02	79.09	55	53	88	
11	Feb. 2	Galena Farm	Shaft 2 feet below 100 level	0.10	20.79	.....	trace	79.11	48	47	92	
12	" 2	"	100 level	0.10	20.75	.....	.....	79.15	48	46	85	
13	" 2	"	*200 level*	0.08	20.79	.....	.....	79.13	48	46	85	
15	Aug. 18	"	Shaft 2 feet below 100 level	62.7	7.17	.....	trace	30.6	50	48	85	
16	" 18	"	Shaft 2 feet below 100 level	62.1	1.7	.....	trace	30.2	50	48	85	

Nicola-Similkameen District.

2	Jan. 26	Erin	No. 2 level	0.05	20.78	.....	.....	79.19	48	48	100	Sample taken 20 hours after blasting.
3	Feb. 9	Nickel Plate	Old incline	0.12	20.75	.....	trace	79.13	40	38	84	Sample taken 8 hours after blasting.
6	May 30	Aberdeen	200 level	0.21	20.61	.....	0.02	79.16	65	65	100	Sample taken 13 hours after blasting.

Coast District.

4	Mar. 20	*Maple Bay*	*Face of 1,503 raise*	*0.38*	20.20	*trace*	*0.04*	79.28	*58*	*56*	87	*Sample taken 10.30 hours after blasting.*
5	" 20	"	Face of 900 water raise	0.31	20.50	trace	.....	79.19	65	60	73	Sample taken 12 hours after blasting.
6	" 20	"	100 feet from 1,500-foot station	0.21	20 58	.....	trace	79.21	59	58	93	Sample taken 12⅔ hours after blasting.
7	" 23	Britannia	Manson West stope, 850 level	0.05	20.79	.....	0.03	79.13	42	40	84	Sample taken 10½ hours after blasting.
8	" 23	"	Parker stope, 850 level	0.08	20.76	.....	0.03	79.13	46	43	78	Sample taken 10¾ hours after blasting.
9	" 23	"	*Manson East stope, 850 level*	0.07	20.77	.....	0.04	79.12	44	44	100	*Sample taken 11 hours after blasting.*
10	" 23	"	Perry stope, 600 level	0.09	20.78	.....	0.04	79.09	48	44	73	Sample taken 10½ hours after blasting.
11	" 23	"	Brand stope, 500 level	0 11	20.74	.....	0.02	79.13	45	44	92	Sample taken 13 hours after blasting.
12	" 23	"	McLeod stope, 500 level	0.08	20.76	.....	0.04	79.12	45	44	192	Sample taken 13 hours after blasting.
13	" 24	"	Copeland stope, 1,000 level	0.02	20.78	.....	0.03	79.17	45	45	100	Sample taken 2½ hours after blasting.
14	" 24	"	*Sleeman slope, 1,000 level*	0.04	20.78	.....	0.03	79.15	45	44	92	Sample taken 10 hours after blasting.
15	" 24	"	Barbara Glory-hole stope, 250 level	0.04	20.81	.....	0.03	79.12	38	34	69	Sample taken 11 hours after blasting.

RETURNS FROM MINE-AIR SAMPLES, ETC.—*Concluded.*

Northern District.

Sample No.	Date.	Mine.	Location in Mine.	CO_2.	O.	Co.	H.	N.	Dry Bulb.	Wet Bulb.	Humidity.	Remarks.
1	Jan. 26	Anyox	300 feet from No. 44 raise, 700 level	0.07	20.79	.....	0.03	79.11	46	40	61	Sample taken 1 hour after blasting.
2	" 26	"	No. 44 raise, 630 level	0.09	20.74	.....	trace	79.17	46	40	61	Sample taken 1½ hours after blasting.
3	" 26	"	No. 40 drift, near No. 5 pocket	0.15	20.68	.....	.....	79.17	48	40	52	Sample taken 1½ hours after blasting.
4	" 26	"	No. 3 stope, No. 1 ore-body, 385 level	0.05	20.78	.....	.....	79.17	46	41	66	Sample taken 2½ hours after blasting.
5	" 26	"	No. 80 drift, No. 17 chute, 385 level	0.30	20.46	.....	trace	79.24	47	41	61	Sample taken 20 minutes after blasting.
6	Mar. 22	"	Steel-sharpening station, 530 level	0.24	20.56	trace	trace	79.20	47	41	61	Sample taken.
7	" 22	"	No. 10 drift, near 17 chute, 385 level	0.07	20.72	.....	0.03	79.18	46	40	61	Sample taken 15 minutes after blasting.
8	" 22	"	150 level, Main tunnel, 2,000 feet from portal	0.25	20.56	.....	0.02	79.17	48	42	56	Sample taken 3½ hours after blasting.
17	Nov. 19	"	No. 20 drift, near 22 chute	0.09	20.61	trace	....	79.30	60	56	76	Sample taken 1 hour after blasting.
18	" 19	"	No. 50 drift, 385 level	0.09	20.81	trace	.....	79.19	60	56	76	Sample taken 2 hours after blasting.
19	" 19	"	No. 20 drift, No. 21 pocket	0.11	20.73	trace	.....	79.16	60	56	76	Sample taken 4 hours after blasting.
20	" 20	"	Face of Main drift, 150 level	0.11	20.75	.....	.....	79.14	62	54	58	Sample taken 2 hours after blasting.
21	" 21	Quartz Point, Anyox	No. 1 stope	0.18	20.70	.....	.....	79.12	46	40	61	Sample taken 2 hours after blasting.
22	" 21	May Quartz, Anyox	No. 21 stope, N.E. drift	0.04	20.78	trace	.....	79.18	48	46	85	Sample taken 1½ hours after blasting.
10	April 14	Silver Standard	No. 262 stope	0.11	20.73	trace	.....	79.16	46	40	61	Sample taken 4½ hours after blasting.
11	" 16	Rocher Déboulé	Crosscut tunnel, 1,200 level	0.29	20.52	trace	.....	79.19	46	38	51	Sample taken 5½ hours after blasting.
12	" 16	"	Main drift, 2,200 level	0.17	20.61	.....	.....	79.22	49	39	51	Sample taken 6½ hours after blasting.
13	May 10	Surf Inlet	No. 1 North drift, 600 feet from portal	0.56	20.44	0.04	0.02	79.94	48	42	62	Sample taken 11½ hours after blasting.
14	" 10	"	No. 10 East crosscut, 1,400 feet from portal, No. 5 level	0.35	20.59	0.02	0.02	79.02	60	56	76	Sample taken 12 hours after blasting.
15	Oct. 2	"	No. 3 stope, 550 level	0.07	20.66	.....	trace	79.17	60	56	76	Sample taken 22 hours after blasting.
16	" 2	"	No. 1 stope, 200 level	0.07	20.78	.....	0.05	79.10	60	56	76	Sample taken 2½ hours after blasting.

I am much indebted to Dr. Eugene Haanel, Director of the Mines Branch, Ottawa, for co-operation in the work, the Dominion Department furnishing the sample-bottles, with franking privileges, and making all analyses without charge of any kind.

MINE-RESCUE WORK.

During the year the Department took over the Mine-rescue Station at Cumberland, formerly run and equipped by the Canadian Collieries (Dunsmuir), Limited.

The following equipment has been installed by the Department at this station: Six 2-hour positive-pressure Draeger apparatus; one high-pressure refilling-pump; twelve 150-cubic-foot storage-cylinders; two pulmotors, type A and B; twelve Edison electric cap-lamps; and a supply of regenerating cartridges and oxygen cylinders for apparatus.

The Colliery Company has removed its apparatus from this station and put in sub-stations at the different mines.

During the year the Crow's Nest Pass Coal Company installed one set of new apparatus at Michel Colliery, and remodelled all the apparatus that has been previously installed both at Coal Creek Colliery and Michel Colliery.

The Canadian Collieries (Dunsmuir), Limited, remodelled all the apparatus at both the Extension and Comox Collieries, and added two type B pulmotors to the former equipment.

In metal-mines, the Granby Consolidated Mining, Smelting, and Power Company at Anyox added three sets of 2-hour positive-pressure Draeger apparatus to its former equipment.

There were thirty-nine certificates of competency in mine-rescue work issued by the Department during the year; eight at Fernie Station and thirty-one in the field, as shown by attached list:—

LIST OF PERSONS WHO HAVE RECEIVED MINE-RESCUE CERTIFICATES DURING THE YEAR 1917.

Date.	Name.	Where trained.	Cert. No.	Date.	Name.	Where trained.	Cert. No.
July 27th	Allan, Hamilton	Extention.	360	Aug. 27th	Ivey, George D.	Anyox	381
" 27th	Blass, Emile	"	361	" 27th	Strand, Peter	"	382
" 27th	Campbell, Andrew	"	362	" 27th	Lantermo, Antonio	"	383
" 27th	Courtney, Albert W.	"	363	Sept. 27th	Turnbull, Matthew	Fernie	384
" 27th	Galloway, James	"	364	" 27th	Charnock, John	"	385
" 27th	Greenhorn, John	"	365	" 27th	Parsons, Herbert	"	386
" 22th	Hamilton, John	"	366	" 27th	Phillips, Richard	"	387
" 27th	Hunter, Thomas	"	367	Oct. 10th	Hynds, William	"	388
" 27th	Jones, Samuel	"	368	" 10th	Morgan, William	"	389
" 27th	Maffeo, Peter	"	369	" 10th	Reid, Thomas	"	390
" 27th	McDonald, Allan	"	370	" 10th	Brown, Frank	"	391
" 27th	Nimmo, James P., Jr.	"	371	" 20th	Barlow, Benjamen R.	Princeton	392
" 27th	Rafter, Robert	"	372	" 20th	Gourlay, Robert	"	393
" 27th	Rafter, William B.	"	373	" 20th	Baxter, Robert	"	394
" 27th	Rickard, John Wm.	"	374	" 20th	Geater, James G.	"	395
" 27th	Thompson, Michael	"	375	" 20th	Dignan, William	"	396
" 27th	Winstanley, Henry	"	376	Dec. 18th	Stacey, Reginald	Michel	397
Aug. 27th	Bengtson, Victor	Anyox	378	" 18th	Mercer, James	"	398
" 27th	Peacock, James	"	379	" 18th	Newman, John	"	399
" 27th	Rowlands, Evan J.	"	380				

LIST OF HOLDERS OF CERTIFICATES OF COMPETENCY IN MINE-RESCUE TRAINING FOR THE PROVINCE OF BRITISH COLUMBIA.

Name.	Date.	Cert. No.	Name.	Date.	Cert. No.
Adamson, Robert	Sept. 2, 1913	45	Clark, Joseph	July 23, 1915	221
Addison, Walker	Jan. 26, 1916	289	Clark, Louis	July 23, 1915	214
Ainsworth, Edward	May 5, 1914	124	Clarkstone, Wm. Walter	March 6th, 1916	308
Aitken, Thomas M	Jan. 26, 1916	261	Clements, Edwin F	Oct. 13, 1916	356
Almond, Walter	July 24, 1916	343	Commons, William	June 30, 1913	22
Allan, Alexander McD	June 30, 1913	32	Coomb, Alexander	Jan. 26, 1914	117
Allan, Hamilton	July 27, 1917	360	Corlett, William D	June 1, 1914	150
Andren, Alfred	Jan. 28, 1916	303	Courtney, Albert Warren	July 27, 1917	363
Anderson, Robert	June 30, 1913	27	Craig, James	July 15, 1916	324
Arbuckle, John	July 1, 1914	157	Crawford, David	Sept. 12, 1913	80
Archibald, George	July 23, 1915	222	Crichton, Robert	Aug. 1, 1914	161
Archibald, Thomas	Sept. 6, 1916	353	Crosscombe, James	Nov. 1, 1914	178
Baggaley, John	June 10, 1913	15	Cullinane, James	Nov. 1, 1914	169
Bain, James	Nov. 1, 1913	90	Cunliffe, Thomas	Dec. 1, 1914	192
Ball, Alfred	July 24, 1916	341	Dando, Caleb	June 30, 1915	216
Ball, Benjamin	Dec. 1, 1914	190	Dando, Caleb V	June 30, 1915	213
Barlow, Benjamin R	Oct. 20, 1917	392	Dando John	June 30, 1915	212
Barnes, Benjamin J	Sept. 12, 1913	76	Davidson, Hugh McL	Nov. 25, 1915	234
Barnes, James	Nov. 1, 1914	177	Davidson, Norman	Jan. 28, 1916	301
Barton, Joseph	June 1, 1914	129	Davis, Stephen	June 22, 1916	314
Baxter, Robert	Oct. 20, 1917	394	Dean, John	Jan. 26, 1916	262
Baybutt, Thomas	Dec. 12, 1914	199	Delaney, James	Nov. 25, 1915	233
Beck, Alexander	Jan. 26, 1914	114	Devlin, Henry	Jan. 26, 1914	104
Bell, Frederick	Dec. 22, 1915	247	Dickinson, Clifford	June 1, 1914	128
Bell, John	July 1, 1914	151	Dickson, James	June 1, 1914	141
Bell, William E	July 15, 1916	329	Dignan, William	Oct. 20, 1917	396
Bengtson, Victor	Aug. 27, 1917	378	Drake, Samuel	Jan. 26, 1916	281
Bennett, Andrew M	Oct. 13, 1916	357	Duncan, James	July 1, 1914	153
Bevis, Nathaniel	Dec. 22, 1915	254	Dunnigan, James	July 23, 1915	225
Beveridge, James	July 1, 1914	158	Dykes, Joseph W	Jan. 26, 1916	257
Biggs, John	June 10, 1913	18	Ewart, Alexander	Sept. 12, 1913	71
Blair, J	Sept. 12, 1913	66	Ewing, Robert F	June 22, 1916	318
Blass, Emile	July 27, 1917	361	Fairfoull, James	Sept. 12, 1913	72
Bonar, Robert	Jan. 26, 1916	263	Fawcett, Albert	March 6, 1916	307
Bond, Frank	Sept. 12, 1913	81	Ferguson, James N	June 22, 1916	313
Brace, Tom	Sept. 12, 1913	54	Fisher, John H	Nov. 1, 1915	229
Bradshaw, George	Jan. 26, 1914	116	Foran, John T	Nov. 1, 1914	182
Bridgeman, George	Nov. 1, 1914	180	Fowler, Robert	June 30, 1913	35
Broderick, Matthew	June 30, 1915	214	France, Thomas	Nov. 1, 1913	88
Brough, William F	Jan. 26, 1916	272	Frater, George	July 15, 1916	327
Brown, Alexander	March 6, 1916	311	Frearson, Albert W	Dec. 1, 1913	95
Brown, David	Jan. 26, 1916	276	Freeland, P. B	Jan. 28, 1916	302
Brown, Edward	Nov. 1, 1914	179	Freeman, Henry N	June 1, 1914	134
Brown, Frank	Oct. 10, 1917	391	Frew, Andrew	Dec. 1, 1914	193
Brown, James	June 30, 1915	210	Galloway, James	July 27, 1917	364
Brown, John	June 30, 1915	209	Geater, James G	Oct. 20, 1917	395
Brown, John T	Sept. 12, 1913	69	Gemmell, James	Sept. 12, 1913	60
Brown, Robert J	June 30, 1913	23	Gibson, Edward	Jan. 26, 1916	285
Brown, R. S	Sept. 12, 1913	63	Gillespie, John	June 30, 1915	208
Brown, William A	Dec. 15, 1913	99	Gould, Alfred	Jan. 26, 1916	264
Brunt, Henry	July 15, 1916	335	Gourlay, Robert	Oct. 20, 1917	393
Bryce, Richard	Dec. 22, 1915	248	Graham, Thomas	Jan. 26, 1914	105
Buchanan, Henry	Dec. 22, 1915	251	Gray, George	June 1, 1914	137
Bullen, Thomas	Sept. 12, 1913	75	Green, Francis	Nov. 1, 1914	186
Bunch, Alexander	March 6, 1916	304	Greenhorn, John	July 27, 1917	365
Bushell, James P	June 30, 1913	36	Gregory, William	Sept. 1, 1914	167
Callow, Charles	Oct. 13, 1916	359	Griffiths, John	June 1, 1914	149
Campbell, Andrew	July 27, 1917	362	Groutage, Edgar E	Nov. 1, 1915	230
Cameron, Samuel	Dec. 22, 1915	250	Guinness, Matthew	Jan. 26, 1914	120
Carson, George	June 1, 1914	139	Hamer Joseph	Nov. 1, 1913	86
Caufield, Bernard	Sept. 1, 1914	166	Hamilton, John	June 1, 1914	135
Caufield, Edward	Sept. 1, 1914	165	Hamilton, John	July 27, 1917	366
Caufield, John	Sept. 2, 1913	43	Hamilton, Robert	June 1, 1914	130
Challoner, John A	Jan. 26, 1916	280	Hancock, Arthur	Dec. 15, 1913	100
Charnock, John	Sept. 27, 1917	385	Harrison, Albert E	Oct. 1, 1914	171
Chester, John	Sept. 2, 1913	44	Hawkins, John	Nov. 1, 1914	183

LIST OF HOLDERS OF CERTIFICATES OF COMPETENCY—*Continued.*

Name.	Date.	Cert. No.	Name.	Date.	Cert. No.
Hays, William	July 23, 1915	223	Marrs, John	Jan. 26, 1916	287
Healer, Robert	Nov. 1, 1915	227	March, John	July 24, 1916	342
Hemer, Herbert	June 1, 1914	132	Martin, David	June 10, 1913	6
Henderson, Robert	Dec. 22, 1915	245	Martin, David, Jr.	Aug. 1, 1914	160
Hendry, James	Sept. 12, 1913	57	Martin, Henry	May 5, 1914	123
Herd, William	June 30, 1915	203	Mason, Joseph	Dec. 1, 1914	194
Hesketh, Edward	June 1, 1914	143	Mason, Thomas	Jan. 26, 1916	279
Heyes, Edward	Dec. 1, 1914	191	Mawson, John T.	Sept. 2, 1913	46
Hindmarsh, Thomas	Sept. 6, 1916	352	Maxwell, George	Sept. 6, 1916	347
Hodgson, James	Jan. 26, 1916	273	Meek, Matthew	June 22, 1916	319
Hollands, Alexander	Sept. 6, 1916	351	Mercer, James	Dec. 18, 1917	398
Houston, Robert	June 22, 1916	312	Miard, Henry E.	June 10, 1913	11
Howden, Archibald B.	Dec. 1, 1913	93	Michell, Dudley	June 10, 1913	13
Huby, Norman	Dec. 22, 1915	252	Michell, George G.	March 6, 1916	305
Hudson, George	Sept. 12, 1913	77	Millar, John A.	Jan. 28, 1916	297
Hughes, J. C.	Sept. 12, 1913	79	Millar, Peter P.	June 10, 1913	14
Hunt, John	Jan. 26, 1916	282	Miscisco, Nicholas	June 1, 1914	144
Hunter, Frederick	Jan. 26, 1916	283	Mitchell, Henry	Nov. 25, 1915	243
Hunter, Thomas	July 27, 1917	367	Montgomery, Edgar G.	Oct. 1, 1914	172
Hunter, William	Sept. 1, 1914	163	Moore, George	July 15, 1916	323
Hutson, Frederick	Dec. 1, 1913	96	Moore, John	Sept. 2, 1913	51
Hynds, William	Oct. 10, 1917	388	Moore, William H.	June 1, 1914	125
Irving, Thomas	July 15, 1916	333	Mordy, Thomas	Dec. 22, 1915	246
Ivey, George D.	Aug. 27, 1917	381	Morgan, John	Nov. 25, 1915	241
Jackson, Thomas R.	Nov. 1, 1914	184	Morgan, William	Oct. 10, 1917	389
James, David	Nov. 1, 1913	87	Morris, David	Dec. 15, 1913	101
James, Edward	Nov. 1, 1915	228	Mottishaw, Samuel K.	Jan. 26, 1916	294
James, William	Nov. 25, 1915	242	Moyes, James	July 23, 1915	218
Jardine, Alfred	June 1, 1914	131	Murphy, Andrew	Jan. 26, 1916	265
Jaynes, Frank	June 30, 1915	201	Musgrove, John	June 30, 1913	25
Jemson, James W.	Jan. 26, 1914	119	Myers, Peter	June 30, 1915	202
John Francis	Jan. 26, 1916	260	McAlpine, John	June 30, 1913	38
John, Howell	Sept. 12, 1913	59	McArthur, John	June 1, 1914	126
Jonnson, Albin	Jan. 28, 1916	300	McCourt, John	July 1, 1914	154
Johnstone, Robert	Aug. 1, 1914	159	McDonald, Allan	July 27, 1917	370
Jolly, Andrew	July 15, 1916	332	McDonald, J.	Sept. 12, 1913	78
Jones Evan	Nov. 1, 1913	91	McFagan, Alexander	Sept. 2, 1913	49
Jones, Samuel	June 30, 1915	206	McFegan, William	June 10, 1913	12
Jones, Samuel	July 27, 1917	368	McGrath, James	Sept. 6, 1916	355
Jordon, Thomas	Jan. 26, 1916	270	McGuckie, John	June 1, 1914	110
Joyce, Walter	Sept. 2, 1913	41	McGuire, Thomas	Dec. 1, 1913	94
Kenny, Clair F	Jan. 26, 1916	268	McKelvie, James	June 30, 1913	26
Kilburn, George H.	Nov. 1, 1914	175	McKendrick, Andrew	July 23, 1915	219
Kinsman, Alexander D.	Sept. 1, 1914	164	McKibben, Matthew	July 23, 1915	220
Kirkpatrick, James	July 15, 1916	337	McKinnon, D. A.	Jan. 28, 1916	295
Kirkwood, John	Sept. 12, 1913	64	McLachlan, Alexander	Nov. 25, 1915	236
Knowles, James E.	June 1, 1914	142	McLachlan, James	June 1, 1914	145
Lancaster, William	June 10, 1913	7	McLauchlin, John A.	Jan. 28, 1916	296
Lander, Frank	Sept. 2, 1913	42	McLean, Michael	Dec. 12, 1914	198
Lane, Joseph	June 10, 1913	20	McMillan, John H.	June 30, 1915	204
Lanfear, Herbert	Sept. 2, 1913	52	McMillan, R.	Sept. 12, 1913	68
Lantermo, Antonio	Aug. 27, 1917	383	McNay, Carmichael	June 10, 1913	16
Lauderbach, Carl	June 22, 1916	320	McNeil, Robert	Dec. 22, 1915	256
Lee, George	July 15, 1916	336	McPherson, James E.	Nov. 1, 1913	83
Leeman, Thomas	Dec. 22, 1915	253	Neave, William	Jan. 26, 1914	111
Lewis, Thomas	Jan. 26, 1916	274	Neen, Joseph	Jan. 26, 1916	266
Leynard, Paul	Jan. 26, 1916	292	Neilson, William	Sept. 6, 1916	345
Lindsay, William	Nov. 1, 1914	181	Nelson, N. E.	Jan. 28, 1916	298
Littler, Matthew	Dec. 12, 1914	197	Newbury, Arthur	Jan. 26, 1916	286
Loxton, George	Nov. 1, 1913	85	Newman, John	Dec. 18, 1917	399
Lunan, George	Sept. 6, 1916	346	Newton, John	Jan. 26, 1914	103
Lynch, Stewart	June 30, 1913	28	Nimmo, James	Nov. 1, 1914	187
Maffeo, Peter	July 27, 1917	369	Nimmo, James Pollock, Jr.	July 27, 1917	371
Male, Philip	July 15, 1916	326	Nisbet, Robert	Sept. 6, 1916	350
Malone, Patrick	Nov. 25, 1915	237	Norris, Joseph	Jan. 26, 1916	293
Matlman, James	June 30, 1913	34	O'Brien, Charles	Sept. 2, 1913	39

LIST OF HOLDERS OF CERTIFICATES OF COMPETENCY—*Concluded.*

Name.	Date.	Cert. No.	Name.	Date.	Cert. No.
O'Brien, George	June 10, 1913	4	Staton, Edward	Sept. 6, 1916	349
O'Brien, Melbourne M	Oct. 1, 1914	170	Stephens, Ralph	March 6, 1916	309
Osborne, Hugh	July 23, 1915	224	Stephens, Roy	Nov. 1, 1914	174
Oswald, George L	Jan. 26, 1916	291	Stewart, Aaron	Jan. 26, 1916	269
Park, Alexander	July 15, 1916	334	Stewart, Adam	Jan. 26, 1916	271
Parkinson, Harry	July 24, 1916	344	Stewart, James	June 10, 1913	9
Parkinson, Thomas	June 1, 1914	133	Stewart, John D	Jan. 26, 1916	106
Parnham, Charles	June 30, 1915	211	Stewart, Robert T	Nov. 1, 1913	92
Parrott, John	July 15, 1916	331	Stobbart, Ralph	Jan. 26, 1916	259
Parsons, Herbert	Sept. 27, 1917	386	Stobbart, Jacob	Jan. 26, 1914	108
Patterson, John	Jan. 26, 1916	275	Stockwell, William	June 10, 1913	17
Peacock, James	Aug. 27, 1917	379	Stone, William	July 23, 1915	226
Perry, James	Jan. 26, 1914	115	Strachan, Robert	June 10, 1913	2
Phelan, Arthur	Sept. 12, 1913	56	Strand, Peter	Aug. 27, 1917	382
Phillips, James Henry	July 24, 1916	321	Strang, James	Nov. 25, 1915	239
Phillips, Richard	Sept. 27, 1917	387	Strang, James	June 22, 1916	315
Poole, S	Sept. 12, 1913	65	Strang, Thomas	Nov. 25, 1915	240
Potter, Robert	Oct. 13, 1916	358	Strang, William	Sept. 12, 1913	73
Price, Walter	June 30, 1913	29	Sutherland, John	July 15, 1916	330
Purss, David	Nov. 15, 1915	238	Taylor, Edward	Dec. 1, 1913	98
Quinn, James	July 24, 1916	340	Taylor, James	Dec. 1, 1913	97
Radcliffe, Joseph	Jan. 26, 1914	113	Taylor, J. T	Sept. 12, 1913	55
Rafter, Robert	July 27, 1917	372	Taylor, Thomas	Jan. 26, 1916	267
Rafter, William Benjamin	July 27, 1917	373	Taylor, Thomas H	Jan. 26, 1916	290
Rankin, George	June 30, 1913	31	Teahan, Denis	July 1, 1914	155
Rankin, William	June 30, 1913	33	Thacker, George	Sept. 12, 1913	62
Ratcliffe, Thomas	June 10, 1913	19	Thompson, John	June 30, 1915	207
Reid, Robert	June 1, 1914	136	Thompson, Michael	July 27, 1917	375
Reid, Thomas	Oct. 10, 1917	390	Tipton, William C	June 1, 1914	140
Richards, James	Jan. 26, 1916	284	Todd, Henry J	July 15, 1916	328
Rickard, John William	July 27, 1917	374	Touhey, James	Dec. 1, 1914	188
Roberts, Thomas D	Nov. 1, 1914	176	Turnbull, Matthew	Sept. 27, 1917	384
Robertson, James H	Jan. 26, 1916	277	Tully, Matthew	May 5, 1914	121
Rogers, Ellis	Dec. 22, 1915	249	Tully, Thomas	May 5, 1914	122
Roper, William	July 15, 1916	339	Vardy, Robert	Sept. 12, 1913	61
Rowan, Alexander	Nov. 1, 1914	185	Walker, George M	Sept. 6, 1916	354
Rowbottom, Thomas	Sept. 12, 1913	70	Wallbank, John W	June 1, 1914	127
Rowlands, Evon J	Aug. 27, 1917	380	Wallis, John	Nov. 1, 1915	231
Rutledge, Edwin	June 30, 1913	37	Wardrop, James	June 30, 1913	30
Scott, George	July 15, 1916	325	Warburton, Leonard E	Sept. 12, 1913	74
Scott, Thomas W	June 30, 1915	215	Watson, Adam G	June 10, 1913	10
Seaton, C. A	Nov. 1, 1915	232	Watson, Arthur	Nov. 25, 1915	244
Seggie, Robert	Jan. 26, 1914	118	Watson, Joseph	June 22, 1916	310
Shanks, David	Sept. 12, 1913	48	Waugh, Andrew W	Jan. 26, 1916	288
Shanks, John	June 10, 1913	5	Weeks, John	Jan. 26, 1914	109
Sharp, James	Sept. 12, 1913	67	Wesnedge, William	Sept. 12, 1913	50
Shaw, Thomas J.	Nov. 1, 1913	89	White, William	June 10, 1913	21
Shaw, William	June 30, 1913	24	Whitehouse, William	Dec. 12, 1914	196
Shelledy, Rowland B	Oct. 1, 1914	168	Wilcox, J	Sept. 12, 1913	58
Sherwin, Edward	Sept. 1, 1914	162	Wilkinson, Edward	Jan. 26, 1916	258
Simpson, Ralph	March 6, 1916	306	Williams, Thomas H	June 10, 1913	3
Skimming John	Sept. 6, 1916	348	Williams, Watkin	June 1, 1914	138
Sloan, Hugh	June 30, 1915	205	Williams, William D	Jan. 28, 1916	299
Smith, Arthur E	Sept. 12, 1913	82	Wilson, Daniel R	June 1, 1914	147
Smith, George	Nov. 25, 1915	235	Wilson, Thomas	Nov. 1, 1913	84
Smith, Thomas	Jan. 26, 1916	278	Wilson, William	June 10, 1913	8
Soloski, Angus	Dec. 15, 1913	102	Winstanley, Henry	July 27, 1917	376
Spicer, John E	Dec. 22, 1915	255	Worthington, —	Sept. 2, 1913	40
Spruston, Robert L	Dec. 1, 1914	189	Wright, John	June 22, 1916	316
Spruston, Thomas A	June 30, 1915	200	Yarrow, George	Jan. 26, 1914	112
Stacey, Reginald	Dec. 18, 1917	397	Young, Joseph	July 15, 1916	322

The following table shows the number, distribution, and type of mine-rescue apparatus and oxygen resuscitating devices maintained at the coal-mines of the Province during the year 1917:—

Company.	Draeger Apparatus.		Proto or Fleuss Apparatus.		Total Apparatus.	Resuscitating Devices.			Total.
						Pulmotor.		Lung-motor.	
	2-hour.	½-hour.	2-hour.	1-hour.		Type A.	Type B.		
Western Fuel Company	4	..	4	2	10	2	..	2	4
Canadian Collieries—									
Extension	4	..	..	..	4	..	1	..	1
Comox	4	..	..	..	4	..	1	..	1
Vancouver-Nanaimo Coal Mining Co.	2	1	..	..	3	1	..	..	1
Pacific Coast Coal Mines	2	2	..	..	4	1	..	..	1
Middlesboro Collieries	2	1	..	..	3	1	..	..	1
Inland Coal and Coke Co.	2	2	..	..	4	1	..	..	1
Merritt Colliery	..	2	..	..	2	..	..	..	..
Princeton Coal and Land Co.	1	1	..	..	2	1	.	..	1
Crow's Nest Pass Coal Co.—									
Coal Creek	5	6	..	..	11	2	..	..	2
Michel	5	5	..	..	10	1	..	..	1
Corbin Coal and Coke Co., Corbin	2	1	..	..	3	1	..	..	1
B.C. Government	22	10	..	..	32	4	4	.	8
Totals	55	31	4	2	92	15	6	2	23

The following table shows the number of mine-rescue apparatus and resuscitating devices in and around the metal-mines of the Province in 1917:—

Company.	Draeger Apparatus.			Fleuss or Proto Apparatus.	Total Apparatus.	Resuscitating Devices.			Total.
						Pulmotor.		Lung-motor.	
	2-hour.	1-hour.	½-hour.	2-hour.		Type A.	Type B.		
Consolidated Mining and Smelting Co.—									
Rossland	..	..	..	4	4	2	..	2	4
Kimberley	..	..	..	2	2	1	..	..	1
Nelson	..	..	..	..	..	1	..	..	1
Ainsworth	..	..	..	2	2	1	..	..	1
Granby Consolidated Mining, Smelting and Power Co.—									
Phoenix	..	3	.	..	3	1	..	..	1
Anyox	3	..	1	..	4	2	3	..	5
Britannia Mining and Smelting Co., Britannia	4	..	..	..	4	3	..	..	3
Standard Silver-Lead Co., Silverton	5	..	..	..	5	1	..	..	1
Montana Continental Development Co., Tramville	..	..	..	..	..	..	1	..	1
B.C. Copper Co.—									
Mother Lode	..	..	..	..	..	..	..	1	1
Copper Mountain	..	..	..	..	..	..	..	1	1
Totals	12	3	1	8	24	12	4	4	20

The number of persons employed underground in the coal and metal mines was 7,050, giving one mine-rescue apparatus for every sixty-one persons employed, and one oxygen resuscitating device for every 162 persons employed.

TECHNICAL CLASSES ON MINING.

Considerable interest has been maintained in this work around the coal-mining centres on Vancouver island.

SUPERVISION OF COAL-MINES.

During the year eleven coal companies operated thirteen collieries, with twenty-nine mines. In these twenty-nine mines 3,760 men were employed underground. In the supervision of these underground employees there were twenty-two managers, thirty-two overmen, and 188 firebosses and shotlighters, a total of 232 officials, or one official for every sixteen persons employed underground.

I desire to express my appreciation of the faithful co-operation and assistance afforded me throughout the year by the District Inspectors and Instructors in mine-rescue and first-aid work.

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, 1917:—

The equipment on hand at the station at the present time is as follows: Six sets 2-hour Draeger apparatus of the 1917 type (complete), with four spare cylinders and six adaptors for No. 1 potash cartridges; four ½-hour Draeger apparatus (complete), with eight spare cylinders; one standard pulmotor (complete) with two spare cylinders, three face-masks, and six spare rubber parts for face-masks, also four head-rings for straps for fastening same; one pulmotor, type B (complete); one litter with fresh-air hood; two high-pressure oxygen refilling-pumps with three sets of pump packing; twelve oxygen storage cylinders; ten pairs of smoke-goggles; three water-gauges and two measuring-bags; three spare pressure reducing-valves for 2-hour apparatus; two spare pressure reducing-valves for pulmotor; twenty-five spare diaphragms for 2-hour reducing-valves; two spare breathing-bags for 2-hour apparatus; two spare mouth-breathing devices; twenty-four spare guards for oxygen-cylinder valves; eight spare by-pass valves for 2-hour apparatus; twelve spare flat rubber straps for air-chambers; ten trunks for shipping apparatus and 100 feet life-line; one electro-magnet; one mould for lead plugs; twelve Ceag electric safety-lamps; twenty-two spare accumulators for Ceag lamps; twenty positive electrodes; twenty-nine negative electrodes; twelve lids for cell casings with tubes; two pounds of sulphuric acid (C.P.); six small Draeger electric safety-lamps; twelve Porox accumulators; six Edison electric cap-lamps (complete); one dozen lenses for cap-lamps (spare); one dozen safety-spring rivets (1); one dozen safety-spring rivets (2); six caps and belts for Edison safety-lamp; fifteen pounds Edison electrolite solution; half sheet celluloid paper; half pint celluloid paste; one automatic filler for Edison cells; two hydrometers; one siphon for electrolite; one voltmeter; and full stock of tools for repair-work.

Supplies on Hand, January 1st, 1917.—890 cubic feet oxygen; 106 No. ½ potash cartridges; 72 No. 1 potash cartridges; 253 No. 2 potash cartridges.

Supplies received during the Year.—1,100 cubic feet oxygen.

Supplies used during the Year.—890 cubic feet oxygen; five No. ½ potash cartridges; seven No. 1 potash cartridges; twenty No. 2 potash cartridges.

Mine-rescue Station Garage.—One Chalmers 36-horse-power five-passenger car with one spare tire (complete); two Ford runabout cars with three spare tires (complete); two car-rugs; seventy-five gallons gasolene.

Emergency Calls for Apparatus.—On July 9th, 1917, I received instructions from Inspector Newton that a fire had broken out in the Main heading of No. 3 slope, No. 1 North level, No. 1 mine, the property of the Western Fuel Company, Nanaimo, B.C. I immediately proceeded with six sets Draeger apparatus to the place where the fire occurred, and on my arrival I found that it was utterly impossible to reach the fire without the aid of the apparatus, on account of the excessive smoke generating from the fire, which had backed against the intake air for a distance of 400 feet from where the fire originated. Accompanied by D. Brown, the overman of the mine, and other rescue-men, we put on the machines, and with the aid of the fire-hose and a plentiful supply of water we were able to reach the affected area and in a very short time had the fire under control. I may say that if it had not been for valuable services rendered by using these machines, this No. 3 slope would have had to be sealed off, thus causing a great loss to the company as well as the mining community.

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, 1917:—

There was no training carried on during the early part of the year; consequently there were no supplies used, excepting a small quantity of oxygen used in the monthly tests of the apparatus.

On March 12th Dr. Douglas Corsan, of this city, rang in a call requesting my services with the pulmotor. A man who had been engaged overhauling the local cold-storage plant of the P. Burns Company was overcome by ammonia-fumes. I immediately set out for the hospital—to where the man had been removed—and after working for three hours and a half the man was sufficiently recovered to be removed to a private ward.

On April 5th a call for the mine-rescue apparatus was rung in from Coal Creek at 10.30 p.m. I immediately shipped the apparatus aboard a special train and arrived at Coal Creek a few minutes after 11 o'clock. Unfortunately, the mine was so badly wrecked as to preclude the possibility of using the apparatus.

On September 10th a crew of officials and men from Coal Creek presented themselves for a course of instruction in mine-rescue work. These men received the usual lectures and training. On September 24th a fresh crew of officials and men from Coal Creek took up a course of mine-rescue work, completing same on October 6th.

On September 16th E. L. Warburton, of the Corbin Coal and Coke Company, Corbin, requisitioned the loan of two of our machines and two full storage tanks for the purpose of dealing with a fire which was menacing the company's property. These were loaned and returned later.

On November 25th I was instructed to proceed to Michel to give a supplemental course of instruction in the use of the "positive" type apparatus to the men who had received a regular course in the use of the "negative" type. Twelve officials and men received this supplemental course, and three others completed a full course. These three satisfactorily passed through the departmental test and the subsequent examination, and upon recommendation were granted certificates of competency in mine-rescue work. The supplies for this training were furnished by the Crow's Nest Pass Coal Company.

The number of men who took up regular training during the year was eleven, eight at Coal Creek and three at Michel.

The number of men trained in the use of the "positive" type apparatus at present in this district is sixty. The distribution of these men is as follows: Crow's Nest Pass Coal Company, Coal Creek Collieries, 42; Crow's Nest Pass Coal Company, Michel Collieries, 15; Corbin Coal and Coke Company, Corbin Colliery, 3.

The following men have lost their lives: James Steel, Mine-rescue Certificate No. 47, killed in action; Wm. R. Puckey, Mine-rescue Certificate No. 53, killed in explosion; Wm. Watkins, Mine-rescue Certificate No. 146, killed in mine cave; Wm. G. Clarke, Mine-rescue Certificate No. 148, killed in explosion; Samuel Poxon, Mine-rescue Certificate No. 152, killed in action; John Monks, Mine-rescue Certificate No. 156, killed in explosion.

The equipment at this station is the same as last year. Supplies on hand December 31st are: 500 No. 2 potash cartridges; thirty-four No. 1 potash cartridges; and about 1,600 cubic feet of oxygen.

An order for 200 No. 1 potash cartridges has been placed and is expected to arrive at any moment.

The following is the expense account for this station during the year 1917:—

Canadian Pacific Railway, freight on supplies	$ 12 27
City of Fernie, light, water, and sewer rental	50 27
Compressed Gas Co., oxygen	24 00
Crow's Nest Pass Coal Co., cement and coal	59 30
Dominion Express Co., express charges	60
Draeger Oxygen Apparatus Co., valves, gaskets	11 38
Duthie Hardware Co., supplies for aviary	6 51
Falvo, G., repairs to apparatus	11 00
Ferguson, A. E., installing furnace, plumbing repairs	136 20
Fernie Co-operative Society, bird-seed	2 20
Fernie Livery Co., draying	3 50

Instructor's transport expenses	$ 44 40
Johnson, H. J., Postmaster, postage-stamps	3 00
Kennedy & Mangan, lumber for aviary	4 25
Kootenay Telephone Lines, rent of telephones, long-distance service	77 30
McLean's Drug Store, office supplies	2 85
Quail Hardware Co., door-hinges, glass, etc.	4 35
Sanderson, H. H., keys for Edison lamps	37
Suddaby Drug Store, office supplies	2 75
Trites-Wood Co., station supplies	15 00
Total	$471 50

FIRST-AID WORK.

The following is the report of Dudley Michell, Instructor in First-aid Work:—

I have the honour to submit herewith a report on the organization of first-aid instruction in the coal and metalliferous mines of the Province, together with field mine-rescue training; for the year ending December 31st, 1917.

During the year approximately 267 mining employees attended a course of lectures on first-aid work given by the various mine doctors. The total number passing final examinations and who were awarded certificates of various grades issued by the St. John Ambulance Association is placed at 123. The location of the class, number attending lectures, and number passing final examinations is as follows:—

Place.	Passed Examinations.				Total.
	First Year.	Second Year.	Third Year.	Fourth Year.	
Nanaimo	12	8	3	..	23
South Wellington	1	1	1	3	6
Cumberland	6	1	..	..	7
Merritt	9	3	..	3	15
Princeton	8	..	..	..	8
Michel	7	6	2	2	17
Rossland	..	..	..	1	1
Anyox	32	..	..	..	32
Britannia	13	1	..	..	14
Totals	88	20	6	9	123

From the commencement of systematic first-aid training in the mining centres of the Province, until the close of 1917, there have been 850 mining employees who have passed examinations in this work.

FIELD MINE-RESCUE TRAINING.

During the year I have conducted examinations in mine-rescue work at Extension, Anyox, and Princeton; during these examinations twenty-eight persons passed successfully and were awarded Government certificates of competency. The details of these examinations are as follows:—

Place.	Date.	No. passing Examination	Name of Company.	Instructor.
Extension	July 16-18	17	Canadian Collieries	J. Delaney and A. Campbell.
Anyox	Aug. 10-24	6	Granby Con. M.S. & P. Co.	D. Michell.
Princeton	Oct. 17	5	Princeton Coal and Land Co.	A. McKendrick.

First-aid and mine-rescue demonstrations were held at Merritt, in the Nicola Valley, and at Ladysmith, on Vancouver island, with the object of stimulating interest in the above work.

BUMPS AND OUTBURSTS OF GAS IN THE MINES OF CROWSNEST PASS COALFIELD.

REPORT BY GEORGE S. RICE, E.M., CHIEF MINING ENGINEER, U.S. BUREAU OF MINES.

OFFICE OF CHIEF MINING ENGINEER,
U.S. BUREAU OF MINES,
WASHINGTON, D.C., March 1st, 1917.

Hon. William Sloan,
Minister of Mines, Province of British Columbia,
Victoria, B.C.

DEAR SIR,—I have the honour to submit the accompanying report of my investigations into the causes and possibilities of avoidance in future of the disastrous "bumps" which occurred in the year 1908 and recently in November, 1916, in the Coal Creek mines of the Crowsnest Pass field; and incidental to that inquiry, what precautions might be taken in regard to outbursts of gas.

In response to a request for my services made by your Department to the Director of the United States Bureau of Mines, I was detailed to undertake the investigation, and accordingly arrived at Fernie, B.C., on December 2nd, 1916. There I was met by W. F. Robertson, Provincial Mineralogist; Thomas Graham, Chief Inspector of Mines for the Province; T. H. Williams, Inspector of the Coal Creek District; and George O'Brien, Inspector of the Michel District. These gentlemen, during the two weeks of my investigation, accompanied by the officials of the different mines, and at times by W. R. Wilson, general manager of the Crow's Nest Pass Coal Company, escorted me in and about the mines at Coal Creek and Michel, explaining the mining conditions and methods, the nature and circumstances surrounding the occurrence of the "bumps" and outbursts of methane or fire-damp.

I am also indebted to W. R. Wilson, general manager, and the various officials of the Crow's Nest Pass Coal Company, the only company now operating in the main Crowsnest field, for the courtesies extended during my investigation. Every facility was offered in visiting the mines, in obtaining information, and the services of the efficient engineering department of the company were freely given for the preparation of maps, sections, and other data.

Before leaving Fernie I drew up a preliminary report, copies of which I handed to Messrs. Robertson and Graham, so that there might be no delay in presenting my views to them as to the dangers threatening and precautions already taken at the initiative of the mining company, as well as by order of the Chief Inspector of Mines. This report recommended that permission be given to the company to reopen and use certain entries in the No. 1 East mine passing through the area most seriously affected by the "bumps" and in which work had been temporarily prohibited by Mr. Graham.

The general conclusions given in the preliminary report, which in the main features are adhered to in this final report, were arrived at after many conferences locally with those best qualified to give explanations of the phenomena encountered in the past and suggestions concerning the geologic and other natural conditions found in mining, together with the best means of meeting the difficulties.

Suggestions of special importance were received from Messrs. Robertson and Graham, and General Manager W. R. Wilson, the latter showing breadth of vision in the consideration of future work and methods of overcoming difficulties, and rendering my task far easier, by presenting a plan of future workings of the Coal Creek mines on the south side of the valley that met practically every suggestion that I had to make in the matter of safety in working.

During the investigation many samples of gas and coal, as well as of coal-dust, the latter for determining the explosibility hazard, were taken and sent to the Bureau of Mines Laboratory at Pittsburgh for analysis and special testing. These laboratory investigations, some of which

involved special methods of handling, have now been completed and show some most interesting results, and should my recommendation for a permanent commission for continuing the investigations into the geophysical and mining conditions of the Crowsnest field be carried out, would be very suggestive of certain lines of further investigation.

I trust that this report may be of value in helping to point out what may be done to make mining safer in the Crowsnest coalfield, which is of such great importance through its extensive fuel resources to the Province of British Columbia and the adjoining regions.

Very respectfully yours,

GEORGE S. RICE.

SUMMARY OF PRINCIPAL FINDINGS CONTAINED THEREIN.

The Crowsnest field is regarded by Canadian geologists as the most important coalfield in British Columbia.

This field presents unusual natural difficulties, because the coal-beds are at the base of an elevated plateau; it is impossible to reach the coal except through outcrop; the coal is also under a heavy load requiring great care in mining to prevent squeezes and "bumps."

The coal-beds are very gaseous; that is, they have large methane (fire-damp) flows at Coal Creek and Michel; and at Morrissey outbursts of gas occur unequalled except in certain mines in Belgium.

"Bumps" are not related to gas-outbursts, but they may occur, as in the State of Washington and in Great Britain, where the overlying rocks are rigid and there is great weight of cover, and when mining has either extracted too much coal in advance mining or it has not been taken out completely, starting from the outcrop, which would break the overlying rock in successive slices and thus prevent "bumps."

"Bumps" are believed to be caused by the subsidence of the roof in certain areas under rigid rocks, leaving a great unsupported span of rock stratum. When one of these has given way it means the hammer-like blow of thousands of tons of rock striking on the immediate roof or flexible stratum overlying the mine, which imparts the blow downward, breaking timber, causing extensive falls in the mine, and sending rock-tremors through the strata.

Improper mining in No. 2 mine was the cause of "bumps" in that mine in 1907-8, and in turn the subsidence over this area affecting the strata higher up caused the recent "bumps" in No. 1 mine.

"Bumps" may occur in future over the same area, but, it is probable, with decreasing force, as the rock stratum broken down in each case has less distance to fall, has less load, and is more distant in height above the mine.

If the measures proposed are carried out—viz., of taking out less than 15 per cent. of coal on the advance and taking down the rash and roof coal in the working-places in No. 1 mine—there is comparatively small danger to life for the men employed underground.

To give warning of impending outbursts of gas in certain dangerous zones with the advance of the working-places, long drill-holes should be kept drilled in advance.

To provide for the large regular flows of methane, well-kept-up airways of large area and powerful fans should be employed, with ample margin of capacity.

A permanent commission should be formed to further investigate and review the evidence collected by members of the commission, the Inspectors of Mines, and others, having among its membership a geologist, a mining engineer, a chemist, and an experienced mine operator.

GENERAL STATEMENT ABOUT "BUMPS" IN COAL CREEK MINES AND CALL FOR INVESTIGATION.

During the years 1906 to 1908 a series of "bumps," causing loss of life, occurred in the No. 2 mine at Coal Creek in the Crowsnest coalfield of British Columbia. Prior to this, "bumps" had been noted, but had not been considered serious. In January, 1907, the first loss of life occurred through a "bump," and after that time others occurred of increasing intensity, until on July 31st, 1908, four men were killed and twenty others temporarily entombed and narrowly escaped suffocation from gas. A great volume of gas was liberated by the "bump," accompanied by breaking-down of return overcasts and complete blocking of the main entry for 600 feet.

This disastrous "bump" caused the mining officials of the Province to set off a district in the No. 2 mine in which working was prohibited on account of the dangers from the "bumps."

As a further result a change was made in the system of mining, under which less than 25 per cent. of the coal is taken out, the balance to remain in pillars until the selected boundaries have been reached and the retreating work begun. The No. 1 East mine had then been started in the so-called No. 2 bed, lying about 150 feet vertically above No. 2 mine. It had been opened out unsystematically along the outcrop, but a change of plans was made, and the mine was developed on systematic lines, with narrow rooms and large pillars. The mining development was vigorously pushed from 1907 to the present, until the area of workings covered and extended beyond the area over the abandoned, prohibited district of the No. 2 mine.

Everything proceeded nicely, except for the large flows of methane encountered in the development of the mine, until 1916, when, without preliminary warning, on the nights of November 7th and 8th, three "bumps" occurred, the first two somewhat local in effect, but the third of tremendous force, which broke down timber and shook down falls of roof through a large part of the active mine-workings. It caused earth-tremors which were felt for miles, not only in Fernie, five miles away, but in other towns to the north and south of Fernie. This was all the more extraordinary as Fernie lies on a great shale-bed underlying the coal-measures.

In spite of the intensity of the "bumps" and the great destruction in the workings, only one man was killed. This death resulted from the second "bump"; several men were badly bruised in the third great "bump," and some of the escapes of the men in the mine were almost miraculous on account of the great area of roof which had fallen. Had this great "bump" occurred during the day shift the loss of life could not but have been very great, as areas in the rooms and entries through the most active working section, aggregating thousands of feet in length, were heavily caved.

A fourth, milder, and more local "bump" occurred on November 13th, and, after the investigations here reported, another "bump" of considerable severity occurred on January 12th, 1917, according to communication from Mr. Graham, affecting the west return airway for several hundred feet outby the No. 11 West. Lesser "bumps" not causing violent vibrations are heard from time to time, the sound being like a heavy knock or a distant blast.

As a result of the "bumps" of November 7th and 8th, the operating company, the Crow's Nest Pass Coal Company, and the Department of Mines of British Columbia were deeply concerned for the immediate and the future safety of the mine, especially on account of the danger to the mine-workers. Accordingly, Thomas Graham, Chief Inspector of Mines, temporarily prohibited work in certain large areas of the No. 1 East mine (inby the No. 10 East and No. 10 West). The writer was invited by the Minister of Mines, through the Director of the United States Bureau of Mines, to investigate and report upon the nature of the "bumps," and, if such are unavoidable, how danger to the underground workman might be minimized. The invitation being accepted, the writer journeyed to the Crowsnest field and investigated, in December, 1916, several Coal Creek mines and the Michel mines, at the north end of the field. He inspected practically all accessible workings, arranged the taking of samples of gas, coal, and of coal-dust, and the drilling of test boreholes in advance of, or at the side of, selected working-places to determine the gas-pressures. He conferred with all the mining men who could throw light on the problem, especially W. R. Wilson, General Manager of the Crow's Nest Pass Coal Company; W. F. Robertson, Provincial Mineralogist; Thomas Graham, Chief Inspector of Mines of the Province; T. H. Williams, Inspector of the Coal Creek District; G. O'Brien, Inspector of the Michel District; and many mine officials of the company. He is greatly indebted to all of those named for the information secured for this report—to Mr. Michell, Mining Assistant to Mr. Graham, who took charge of the sampling, also of the test boreholes drilled to obtain gas-pressures, and to A. C. Fieldner, Chemist of the United States Bureau of Mines, who made analyses and who developed a new method of testing coal samples for the amount of occluded gases given off in crushing the coal.

NATURE OF BUMPS AND OUTBURSTS.

Before proceeding to a more detailed statement of the phenomena of "bumps" and "outbursts" in the Crowsnest field it will be well to define what is meant by such terms, both as applied in the Crowsnest field and in other mining districts of the world. W. F. Robertson, in

tube-opening being held in the mouth of the casing. Either air entered at the point of collection, in spite of the care exercised by George O'Brien and D. Michell, or the wax stopper permitted entrance of air in transit. Nevertheless, it will be observed that there was from 5 to 7 per cent. of nitrogen in excess of that of normal air; hence it is probable that nitrogen is a constituent of the gases given off by the strata.

It will be observed that the analyses of the blower-gas report no ethane content, although the analyst mentions indications of hydrogen. In previous analytical work on the many mine-air and gas samples collected by the Inspectors of British Columbia in the Crowsnest mines, no hydrocarbon gas other than methane has been reported.*

The contrast with results from fine grinding are most striking; the amount of hydrocarbon gases reported by Mr. Fieldner figured to volumes of gas to volume of coal (assuming for approximate figures a specific gravity of coal of 1.3) is shown in the tables on pages 335, 336, 337.

Investigators in the past have either not crushed the coal to a finely divided state, or have only ground it to pass through 10 or at most 30 mesh. Whereas, in these tests, Mr. Fieldner ground the coal to pass through a 200-mesh sieve. He comments that it is evident that ethane and higher hydrocarbons are not given off by the coal as readily as methane. For instance, a sample of Nanaimo coal, ¼ to ½ inch in size, sealed in a vacuum bulb for ten days, gave off much more methane than ethane, while another sample of the same coal gave off, on grinding to 200 mesh, more ethane and propane than methane.

The wide diversity of volumes given off by different coals is surprising, and this diversity occurs in the same mine as shown by samples from the Reserve mine. To some extent the latter may be due to the method of sampling in the mine and the preliminary treatment and variation in grinding. It is noticeable, in comparing results of samples from the same mine, that the ratios of the different gases is of the same order. Unfortunately, the method was not developed in time to try out the various samples of coal from the Coal Creek mine; one sample, No. 16, from Coal Creek No. 3 mine was tried, and the results caused surprise, especially after testing similarly a sample from the experimental mine. This proved to give off very little gas. As regards the latter sample, the experimental-mine workings are so near the outcrop and under such shallow cover that different results might be obtained than with a sample from the Pittsburgh bed in a deeper mine. Nevertheless, the dust from the experiment-mine coal proved to be more sensitive to the propagation of an explosion than the Coal Creek and Nanaimo dusts.

The diversity in results and the unusual amounts of hydrocarbon gases given off by the Coal Creek coal points to the advisability of continuance of these laboratory investigations on samples gathered systematically from all the Crowsnest mines and other typical mines in British Columbia. It is probable that investigations of a similar nature will be made by the Bureau of Mines on coals from various parts of the United States as opportunity presents.

In the Crowsnest collieries the question of whether ethane is given off under special conditions should be studied. In gas analyses by the ordinary combustion method ethane in small quantities is not detected, and, as usually the samples of mine-air collected contain only a few per cent. of gas, ethane would go undetected, being classed as methane. Hence, not finding it hitherto should not be considered as positive evidence of its not being given off. Under the great pressure of the heavy covering, the Crowsnest coal in the process of mining is subjected to a squeezing action, which tends to crush and grind the particles of coal one against the other. This may produce a condition which laboratory grinding would be analogous to. How occluded or contained gas is held in the coal substance is an unsettled question; that is to say, is the coal substance so impervious that the gas is held in minute pores like little bottles, only to be released when these are broken, or is it held by chemical bonds, so unstable that on a slight relief of pressure the gas is given off? It is stated by physicists that external pressure which obtains even with coals at great depth is insufficient at normal temperatures to liquefy the gases.

On the other hand, the surface tension of the coal-particles is very great, and some physicists have contended that films of the gas are held on the surface of the particles of coal under such tension that the gas is in compressed state equivalent to liquefaction. If so, when the coal-bed is opened, the coal near the headings and rooms may begin to release its contained gas. In the

* It is claimed that "in 1910 Professor John Cadman found ethane in the air of the Bellevue mines of Alberta." Page 723, Transactions of the Institution of Mining Engineers (Great Britain), Vol. LI. Ethane and other hydrocarbon gases except methane have never been found in the mine-air in mines of the United States unless by leakage from deep natural-gas wells.

and less than 6,000 feet, which might be expressed by the term "possible reserves"; this making the total reserves 45,505,000,000 tons.

SECTIONS OF COAL-MEASURES.

Number of Seams over 1 Foot Thick, Aggregate Thickness of Coal and Thickness of Coal-measures in Three Typical Sections.

Locality of Section.	Number of Seams.	Total Thickness of Coal.	Thickness of Coal-bearing measures.
		Feet.	Feet.
Morrissey	23	216	3,676
Fernie	23	172	2,250
Sparwood—			
Upper measures	23	173	2,050
Lower measures	24	43	2,015

The data regarding the Crowsnest Coalfield was obtained from Memoir No. 59, "Coal Fields and Coal Resources of Canada," prepared by D. B. Dowling, of the Geological Survey of Canada, for the Twelfth International Geological Congress, and from Thomas Graham's paper, "Some Gaseous Mines in the Crowsnest Pass Coal Field," also from some personal observations in the vicinity of Coal Creek and Michel.

A number of seams are too thin and too impure to mine with commercial success at the present time, and it is considered that the available coal does not have an aggregate thickness, in beds over 3 feet thick, of more than 100 feet. Some of the thickest beds, 10 to 20 feet thick, owing to friability of the coal and poor roof, cannot under present conditions be cleanly mined out, and there is in consequence much loss of coal.

Most of the marketable coal-beds are in the lower part of the coal-measures, which, geologically speaking, are in the Kootenay formation of the Lower Cretaceous series. The Fernie shales, 2,600 feet thick, underlie the Kootenay formation, but there appears to be some doubt whether these shales belong to the Lower Cretaceous or the Jurassic.

The Crowsnest basin has been buckled into a north-and-south synclinal trough by the great dynamic forces pressing from either side (east and west) in the uplifting of the Rocky Mountain ranges. As a consequence, around the edges of the basin the beds have been steeply uplifted. (*See* photograph, Exhibit A.) While the more rigid sandstones and conglomerates overlying the more important coal-seams have protected the latter, there is abundant evidence of thrust under the capping rocks acting laterally on the coal-beds along the margin of the field and squeezing the coal in some places to increased thickness and badly crushing it. There is evidence also of a general lateral movement which has taken place in the plane of the No. 1 coal-bed, as demonstrated by a slickensided and rolled shale-band in the upper part of the coal-bed. Also there has been some local faulting and buckling of the coal-beds, which causes much difficulty in mining operations.

The anticlines produced on either side of the coal-basin by the profound east-and-west thrusts have been deeply eroded and valleys thus formed. This has led to the basin, protected by the overlying hard sandstones and conglomerates, becoming an elevated plateau.

The Elk river runs along the west side, in the Fernie shales. The elevation of the Elk River valley above sea-level at Sparwood, near the north end of the field, is 3,637 feet; at Fernie, 3,365; and at Morrissey, opposite the south-west corner of the field, is 3,101. Along the east side of the plateau the elevation of the valleys is from 4,000 to 5,000 feet. The escarpment of the plateau is from 6,000 to 7,000 feet above sea-level, the highest points rising from 300 to 400 feet above this.

The dips of the coal-beds from the edges of the basin probably carry the lowest beds down, in the middle of the trough, the depths where under the higher ridges there is from 3,500 to 5,000 feet of cover above the lower beds. Over the present advance workings of the Coal Creek mines the maximum cover is from 2,000 to 2,500 feet thick (*see* vertical cross-sections prepared by the coal company engineers, Exhibits 2 and 3), consisting largely of massive sandstones and conglomerates in the upper part. The outcropping rocks form bold escarpments skirting the valleys and sharp projecting spurs. (*See* photographs A to E.)

DESCRIPTION OF COAL-BEDS.

The coal-beds in any one locality are well defined, but it is difficult to carry the identification from one locality to another, because the coal-beds change their characteristics and the immediate rocks, shales, and sandstones lack distinctive features. The coals in the different beds that have been worked at Coal Creek, Hosmer, and Michel do not differ much in chemical composition and are coking-coals, but the coal at Morrissey had evidently been subjected to more intense crushing and the percentage of fixed carbon is higher. As only the Michel and Coal Creek mines could be entered, the description of the coal-beds now mined will be limited to these.

Michel Coal-bed Sections.—The principal bed mined at Michel is intersected by a fault parallel with the strike of the beds. Its section is as follows:—

Sections of Coal-bed No. 3 East, Michel Colliery.

ABOVE BIG FAULT. Hard Rock Roof.		BELOW BIG FAULT. Hard Roof.	
Cap-rock	1′ 6″		1′ 6″
Coal	2′ 6″		4′ 0″
Shale (mining)	0′ 8″	(Bone)	0′ 6″
Coal	3′ 0″		3′ 0″
Rock	0′ 2″	(Rock, hard)	1′ 2″
Bone and coal	0′ 9″	(Shale)	0′ 6″
Coal	3′ 6″		
Shale	1′ 5″		6′ 0″
Hard rock floor — Coal, net thickness	9′ 0″		13′ 0″

Old No. 3 mine, Michel Colliery, which adjoins the foregoing, works two beds, with an interval of 110 feet between. The upper one, which is understood to correspond with the bed worked in No. 3 East, attains a thickness of 16 feet of coal.

Coal Creek Coal-bed Sections.—A general section showing six seams which have been more or less prospected are best shown in the sections east to west and north to south at the Coal Creek Colliery (Exhibits 2 and 3). Of these, only Nos. 1 and 2 have been found to be commercially minable at present. Normally these beds are from 75 to 150 feet apart, but in a certain "crumpled zone" (*see* map, Exhibit 4) in the west parts of No. 1 East mine and No. 2 mine the beds come together.

Section of No. 2 Coal-bed.

Roof, strong shale, in some places sand, shales, and sandstone.	
Coal	3′ 6″ to 8′ 0″
Rock with streaks of coal	1′ 8″
Coal, high in ash (gaseous)	1′ 4″
Floor, shale.	

Section of No. 1 Coal-bed.

(75 to 150 feet above No. 2 bed.)

Main roof, massive shale and sandy shale.	
Roof, coal clean, friable	2′ 6″ to 3′ thick.
Rash, slickensided shale with coaly layers	1′ to 4′ „
Coal, columnar structure, soft, clean	9′ to 13′ „
Floor, shale (strong).	

KIND OF COAL IN CROWSNEST FIELD.

The Crowsnest field produces a good grade of bituminous coal, the different beds in any one locality having about the same kind of coal. Except at Morrissey, where the fixed carbon is too high to permit making coke in bee-hive ovens, the coal makes a good metallurgical coke. There are 440 ovens at Fernie coking Coal Creek coal, and 480 at Michel.

Following are analyses of the coals produced by different collieries, as given on page 116 of Memoir 59:—

Analyses of Samples taken in Coal Creek Mines, December 1st to 13th, 1916.

Colliery.	Moisture.		Proximate Analysis of Dried Coal (Moisture-free).			Dried Coal.	
	Mine Basis.	Air-dried Basis.	Volatile.	Fixed Carbon.	Ash.	Sulphur.	B.T.U.
Michel—							
No. 3	1.4	0.4	24.8	62.7	12.5	0.5	13,270
No. 7	1.9	0.7	22.6	65.5	11.9	0.4	13,360
No. 8	3.0	1.1	24.1	65.7	10.2	0.6	13,480
Hosmer—							
No. 2	1.7	0.9	21.3	63.4	15.3	0.3	12,710
No. 6	2.6	1.1	25.6	62.0	12.4	0.6	13,090
No. 7	4.0	1.3	28.0	64.5	7.5	0.6	13,990
Coal Creek—							
No. 2	2.2	1.3	26.3	64.7	9.0	0.5	13,820
No. 5	1.6	0.5	24.0	65.2	10.8	0.5	13,480

The samples were taken in certain places in the Coal Creek mines by Mr. Michell, under the direction of the author, and analyses made at the United States Bureau of Mines Laboratories at Pittsburgh by A. C. Fieldner, chemist. The samples were gathered at the respective points, ten in all, and immediately placed in tight jars (Mason jars). On reaching the Pittsburgh laboratory they were treated in one of two ways: Three samples were analysed for moisture as received, moisture when dried, volatile matter, fixed carbon, and ash; also the calorific value was determined. The other seven were opened under water to determine the amount of gas that had been given off since gathering; hence the moisture as received could not be determined, but the other components were determined, as in the first lot. While the jars had rubber gaskets and were wrapped with insulating-tape, it was evident that gas in each case had escaped in transit, as in all cases gas and air in mixture in the cans was at atmospheric pressure.

The samples were not taken by the standard method of sampling by picking a groove from top to bottom of the coal-face, but by gathering nut-sized pieces from top to bottom. This was done to obtain sampling for testing for occluded gas at the laboratory, but there is some question if such a sample is an average of the face at the respective points of sampling in the matter of ash content, but it is not probable that there is any essential difference in the ratios of the other constituents.

The special purpose in taking these samples was to determine, in conjunction with a series of road-dust and rib-dust samples taken at the same time, the explosibility of the coal-dust found in the Coal Creek No. 1 mine. Also for this purpose a large 3½-ton sample of coal was obtained from the face of the mine and shipped to the experimental mine at Bruceton, Pa., where it was crushed, pulverized, and tested. Similar coal-, rib-, and road-dust samples were sent from the Nanaimo mines, Vancouver Island, B.C. The results obtained in the tests form the subject of special reports to the Chief Inspector of Mines of British Columbia by the United States Bureau of Mines.

Face Section Samples, Coal Creek Mines.

Colliery.	Location in Mine.	Can No.	Lab. No.	Moisture, Mine Basis.	Proximate Analysis (Air-dried).				Dried Coal.	
					Moisture.	Volatile.	Fixed Carbon.	Ash.	Sulphur.	B.T.U.
Coal Creek—										
No. 1 E.	Face, 10 East	3	27155	1.08	0.50	23.25	63.60	12.65	0.31	13,529
No. 1 E.	Face, 1 N	5	27157	1.58	0.50	21.35	65.05	13.10	0.34	13,462
No. 3	Face, Main level	16	27158	1.12	0.70	24.05	66.05	9.20	0.57	14,081

Face Section Samples, Coal Creek Mines—Concluded.

NOTE.—As the following samples were used for making occluded gas determinations, the moisture was not determined.

Colliery.	Location in Mine.	Can No.	Lab. No.	Proximate Analysis (Air-dried).				Dried Coal.	
				Moisture.	Volatile.	Fixed Carbon.	Ash.	Sulphur.	B.T.U.
Coal Creek—									
No. 1 E.....	Face, No. 22 room, 10 E ..	2	27154	0.55	24.78	65.17	9.50	0.31	14,047
No. 1 E.....	Face, No. 1 room, 9 E ..	4	27156	0.40	24.23	66.52	8.85	0.32	14,063
No. 3.....	Face, No. 2 incline	17	27159	0.55	28.52	63.83	7.10	0.54	14,319
No. 2.....	Face, Main level	18	27160	0.55	27.17	70.28	2.00	0.41	14,260
No. 2.....	Face of E. slope.....	19	27161	0.45	26.99	68.46	4.10	0.45	14,879
No. 1 S.....	Face of Main level.....	20	27162	0.45	27.80	65.35	6 40	0.27	14,602
No. 1 S.....	Face of No. 5 incline.....	21	27163	0.60	26.86	67.84	4.70	0.33	14,837

NOTE.—The above samples are reported on a slightly different basis than the previous analyses quoted from the Canadian Survey Report, in which the coal was reported on a moisture-free basis. The above analyses are on air-dried basis.

GASES GIVEN OFF BY COAL-MEASURES.

It is a normal condition in deeply bedded coal to find hydrocarbon gases both in the coal itself and in the enclosing rocks. There is, however, the widest difference in the amount of gas encountered by mining in the various coalfields, and almost as great a difference between different beds in certain coalfields. Some coal-beds are considered non-gaseous, although practically every bed gives off a little gas, but unless it gives it off fast enough to accumulate as a body of gas it is usually rated as non-gaseous.

Gas is held in the strata in two ways:—

(1.) A filling of the pores of the crevices, cracks, and bedding-planes under more or less pressure, so it is given off rapidly when it is liberated by the advance of the mine-workings, or where it occurs in a roof stratum when the roof material breaks down, or there is a slip which intersects a main slip, crevice, or rock-joint in which the gas may be stored under pressure.

(2.) The other form is stored in cells of the coal and is commonly known as "occluded" gas. Such gas is liberated slowly when the coal is broken, and with each crushing of the coal more gas is liberated. With some kinds of coal there is comparatively little gas released; in other coals there is a large amount. Generally, when there is a large amount of so-called "occluded" gas, the crevices and cracks of the strata are also charged with gas.

The amounts of gas thus held in the coal, which for want of a better term will be called "occluded" gas, in different districts has been summarized in Bulletin 72 of the United States Bureau of Mines, by N. H. Darton, entitled "Occurrence of Explosive Gases in Coal Mines."

In many of the investigations which have been made to determine the amount of gas given off by broken coal, the coal has been heated. This is not a proper method of determining, as then there is more or less destructive distillation. When the tests have been made using atmospheric pressures, the volume of gas from a unit of coal has been found to vary from one-half to one and a half times the volume of the solid coal. When finely crushed and kept standing for six months, anthracite coal gave off 1.83 of gas, chiefly methane. For shorter periods the quantity given off was very much less than one volume. This Chamberlain found to be true of other coals, so that in comparing one kind of coal with another the question of size of crushing and length of time seems to be an important factor. It is necessary to know the procedure followed by experimenters in making comparison of results, since as yet there has been no standardization of method.

OCCLUDED GAS IN COAL FROM COAL CREEK MINES.

A series of special samples of nut or egg size were taken in the Coal Creek mines in different headings and rooms, put into Mason jars at the point of sampling, sealed, and sent to the Bureau of Mines, Pittsburgh Laboratory. Ten samples were taken, Laboratory Nos. 27154 to 27163, inclusive, and on reaching Pittsburgh seven of them were opened under water and were found to contain from 0.06 to 0.25 volumes of methane per volume of coal. There was a little carbon

dioxide, and it will be noted in the analyses given in the table, which follows later, that there was little oxygen. That sealed in with the coal had largely been absorbed by the coal.

It is evident from a study of the gas analyses that there was escape of gas from the containers; oxygen plus carbon dioxide is much lower in ratio to the nitrogen than should be the case. The gases in the cans on arrival were found to be at atmospheric pressure.

METHOD OF GRINDING THE COAL IN VACUO.

Tests were made on one of the samples from Coal Creek, Can No. 16, Laboratory No. 27158, to determine the amount of gas given off while the coal was being ground and subsequently in vacuo, in an apparatus devised by A. C. Fieldner, Chemist of the Bureau of Mines. The method, it later appeared, was first used by a Frenchman, Henri Ghysen, in 1902, but apparently without results of importance.

For comparison, a sample of coal from the Pittsburgh, Pa., experimental mine was similarly treated, and likewise at a later date several samples from Nanaimo mines, British Columbia. The latter samples had been sent by the Chief Inspector of Mines, Mr. Graham, in conjunction with samples of coal and dust for explosibility testing at the experimental mine. The method used by Mr. Fieldner is as follows:—

Immediately after opening the sealed glass fruit-jar, in which each separate small sample was taken and sealed at the face of the mine and then shipped to Pittsburgh, the large lumps were quickly broken to pass through a ½-inch screen. All that passed through a ¼-inch screen was rejected; 125 grammes of the ¼- to ½-inch coal was at once placed in a gas-tight steel ball-mill (constructed in the Bureau's instrument-shop) containing flint pebbles, and the mill was rapidly evacuated to 3 mm., mercury pressure. The air and gas evolved by the coal during the evacuation was collected, measured, and analysed. Inasmuch as only a few cubic centimetres of gas were removed from the coarse coal during evacuation, it was assumed that practically no occluded gas would be lost during the preliminary operations.

The evacuated mill was rotated two hours, which by a preliminary test was shown sufficient to permit 90 per cent. of the coal to pass through a 200-mesh screen. (Apparently the fine grinding is the important factor in getting results so different than found by previous laboratory investigations.) The mill was then connected to a mercury-pump and evacuated; the gas collected over water, measured, and analysed.

The samples were ground "as received" from the mine and not air-dried. Several of the samples were ground submerged in water, in order to prevent the effect of heat from grinding, as it had been suggested that ethane and propane might have been produced through such heating. This, however, did not prove to be the case. The results are given in the following table:—

Occluded Gases in Coal.

Sample No.	16	Pgh. coal
Laboratory No.	27138	...
Weight coal (grammes)	125	125
Quantity and analysis of gas pumped out of ball-mill before and after grinding—		
Before grinding—		
Total volume gas c.c.*	1,493	1,517
Analysis per cent.—		
CH_4	0.36	0.08
C_2H_6	...	...
CO_2	0.40	0.13
O_2	20.75	20.76
N_2	78.49	79.03
After grinding—		
Total volume of gas c.c.*	263.0	65.6
Analysis per cent.—		
CH_4	15.3	10.2
C_2H_6	59.8	4.7
CO_2	2.8	12.0
O_2	2.1	2.6
N_2	20.0	70.5

* At 0° C. and 760 mm. pressure.

Total occluded gases in c.c. per 100 grammes coal*—		
CH_4	37.6	6.6
C_2H_6	126.0	2.5
C_3H_8	...	...
CO_2	11.9	8.3
N_2	24.4	31.5
Total c.c.	199.9	48.9

It will be noted that 100 grammes of the British Columbia coal gave off 163.6 c.c. of methane plus ethane, and 100 grammes of Pittsburgh coal gave off 9.1 c.c. of methane plus ethane. Also in the former coal ethane was the predominating combustible gas. No CO or hydrogen was obtained from either coal. Mr. Fieldner comments that it is unfortunate that the containers leaked in transit. Had they been absolutely gas-tight it is certain that much more gas would have been obtained prior to grinding.

It appears that on evacuating the containers ethane is removed from the coal in addition to methane. No ethane was found in the gas surrounding the coal in the glass container. Neither has ethane been found thus far in the blower-gas samples from these or other mines investigated by the United States Bureau of Mines. It was suggested that possibly the ethane resulted from a heating effect during grinding of the coal in the ball-mill. Therefore, Mr. Fieldner had the experiment repeated, but grinding the coal while wet; i.e., the coal was actually covered with water in the mill while being ground. Ethane was again obtained in much the same ratio as before. Hence there is no reason to suspect decomposition by heat. Other investigators have found ethane in the gases pumped out of coal, although not in such large proportions.

Mr. Fieldner suggests valuable information might be obtained by employing some special gas-tight containers into which the fresh British Columbia coal could be put after screening at the face of the mine. The sealed container should be so designed that on arriving at the laboratory it could be connected directly to a vacuum-pump, the gases removed, and then placed in a suitable machine for rotating it so as to pulverize the coal in vacuo, and again remove and measure the gas.

Analyses were made by F. M. Seibert of gases found in glass fruit-jars containing samples of fresh coal taken by Mr. Michell, of the inspection service of British Columbia, at various working-faces of Coal Creek Colliery, British Columbia, December 7th to 13th, 1916, and sealed immediately. Analyses were made after arrival of samples at Pittsburgh, January 4th to 8th, inclusive.

COMPOSITION OF GAS IN COAL SAMPLE CONTAINERS.

Sample No.	Lab. No.	Weight of Coal.	Total Volume of Gas.	Total Volume of CH_4.	Percentage of Composition of Gas.				C.C. CH_4 per Gram of Coal.
					CH_4.	CO_2.	O_2.	N_2.	
		Grammes.	C.C.	C.C.					
17	27159	737	286	184	64.1	1.4	1.0	33.5	0.25
18	27160	788	366	90	24.6	0.9	4.4	70.1	0.11
19	27161	905	301	81	27.0	1.2	3.2	68.6	0.09
20	27162	827	338	53	15.8	0.4	1.2	82.6	0.06
21	27163	...	264	..	0.3	1.6	20.0	78.1	....

It was evident that all the containers permitted escape of gas in transit, as in all cases the contents of the cans were at atmospheric pressure. It will be noted the above gases contained no ethane.

OCCLUDED GASES IN NANAIMO COAL.

Subsequent to testing the Coal Creek and Pittsburgh coal in vacuo, samples were obtained from the Nanaimo mines of Vancouver Island, B.C., which had also been sent for explosibility

* Corrected for air leaking into ball-mill during grinding as indicated by the oxygen percentage.

testing. Incident to that inquiry, tests were made of the gases given off by the coals, using the method of fine grinding in vacuo. The results are given in the following table, including for comparison those of the Coal Creek and Pittsburgh coal previously reported in detail.

Occluded Gases in Coal from Pittsburgh, Pa.; Coal Creek, B.C.; and Nanaimo, B.C., at 760 MM. and 0° C.

Mine.	Sample.	C.C. per 100 Grammes of Coal.							
		Total.	N.	CO_2.	CH_4.	C_2H_6.	C_3H_8.	Total Paraffins, Hydrocarbons.	
								C.C.	Vols.
Pittsburgh, Pa.	..	48.9	31.5	8.3	6.6	2.5	....	9.1	0.12
Coal Creek, No. 3	16	199.9	24.4	11.9	37.6	126.0	....	163.6	2.12
Nanaimo coals—									
No. 1, Western Fuel	10	139.0	51.3	3.1	62.7	21.9	....	84.6	1.10
No. 1, "	11	169.4	9.0	2.0	128.6	29.8	....	158.4	2.05
Reserve mine *	1	46.9	43.1	1.3	....	1.0	1.5	2.5	0.03
"	2	69.6	40.5	2.9	....	20.5	5.7	26.2	0.34
" †	2	28.7	14.2	0.2	....	10.7	3.6	14.3	0.19
" ‡	2	16.7	14.1	0.3	2.0	0.3	....	2.3	0.03
" †	3	48.2	13.5	0.1	21.0	13.6	....	34.6	0.45
" †	4	24.0	14.8	0.3	....	1.8	7.1	8.9	0.11
" ‖	4	....	....	0.5	....	6.0	3.6	9.6	0.12
"	5	37.9	20.1	0.9	....	5.0	11.9	16.9	0.22

* Result approximate as to absolute quantity, as a little gas was lost in making the measurement.
† Ground in vacuo but under water, grinding not so fine as when dry.
‡ Not ground fine.
‖ Ground in atmosphere of nitrogen; hence nitrogen given off by coal could not be determined.

No carbon monoxide nor hydrogen in any sample. Samples 2 and 4 ground in atmosphere of hydrogen, which was absorbed to greater volume than the other gases evolved; in the case of 5 the contraction was 51.3 c.c.

Analyses of Blower-gas Samples from Coal Creek Mines.

Following are the analyses of gas from blowers issuing from special boreholes in the rib-side of headings in the Coal Creek mines analysed (*a*) by the Canadian Department of Mines, and (*b*) by the United States Bureau of Mines:—

Location in Mine.	CO_2.	O_2.	CH_4.	N.	Air.	Excess N.
1. No. 1 East mine, No. 1 borehole, 18 room, 10 East (*a*)	0.07	13.3	30.7*	55.3	63.5	5.3
Bottle broken in transit (*b*).						
2. No. 1 East mine, No 1. borehole, 22 room, 10 East (*a*)	0.07	14.7	22.8†	61.8	70.2	7.0
" " " (*b*)	0.10	20.69	0.14	79.07	....	....
3. No. 1 East mine, No. 3 borehole, Counter main level (*a*)	0.8	17.7	10.7‡	70.8	84.5	4.8
" " " (*b*)	0.89	18.27	11.64	69.20	....	0.5

Notes by Analyst, Canadian Department of Mines:—
* No ethane present. Presence of hydrogen in small quantities seems evident.
† No ethane or hydrogen detected in sample.
‡ Probably trace of hydrogen.

It will be observed that analyses of duplicate samples 2 (*a*) and 2 (*b*) disagree badly. It is conjectured that the wax stopping of one or both of these samples and 3 (*a*) and 3 (*b*) failed in transit.

Review of Gas Analyses.

Regarding the analyses of gases from the boreholes as the samples were gathered from special boreholes drilled to obtain pressures as hereinafter described (page 19), these boreholes being cased with pipe set in cement, it is improbable that air could have leaked into the holes from which the gas issued with some pressure. The gas was collected in evacuated tubes, the

tube-opening being held in the mouth of the casing. Either air entered at the point of collection, in spite of the care exercised by George O'Brien and D. Michell, or the wax stopper permitted entrance of air in transit. Nevertheless, it will be observed that there was from 5 to 7 per cent. of nitrogen in excess of that of normal air; hence it is probable that nitrogen is a constituent of the gases given off by the strata.

It will be observed that the analyses of the blower-gas report no ethane content, although the analyst mentions indications of hydrogen. In previous analytical work on the many mine-air and gas samples collected by the Inspectors of British Columbia in the Crowsnest mines, no hydrocarbon gas other than methane has been reported.*

The contrast with results from fine grinding are most striking; the amount of hydrocarbon gases reported by Mr. Fieldner figured to volumes of gas to volume of coal (assuming for approximate figures a specific gravity of coal of 1.3) is shown in the tables on pages 335, 336, 337.

Investigators in the past have either not crushed the coal to a finely divided state, or have only ground it to pass through 10 or at most 30 mesh. Whereas, in these tests, Mr. Fieldner ground the coal to pass through a 200-mesh sieve. He comments that it is evident that ethane and higher hydrocarbons are not given off by the coal as readily as methane. For instance, a sample of Nanaimo coal, ¼ to ½ inch in size, sealed in a vacuum bulb for ten days, gave off much more methane than ethane, while another sample of the same coal gave off, on grinding to 200 mesh, more ethane and propane than methane.

The wide diversity of volumes given off by different coals is surprising, and this diversity occurs in the same mine as shown by samples from the Reserve mine. To some extent the latter may be due to the method of sampling in the mine and the preliminary treatment and variation in grinding. It is noticeable, in comparing results of samples from the same mine, that the ratios of the different gases is of the same order. Unfortunately, the method was not developed in time to try out the various samples of coal from the Coal Creek mine; one sample, No. 16, from Coal Creek No. 3 mine was tried, and the results caused surprise, especially after testing similarly a sample from the experimental mine. This proved to give off very little gas. As regards the latter sample, the experimental-mine workings are so near the outcrop and under such shallow cover that different results might be obtained than with a sample from the Pittsburgh bed in a deeper mine. Nevertheless, the dust from the experiment-mine coal proved to be more sensitive to the propagation of an explosion than the Coal Creek and Nanaimo dusts.

The diversity in results and the unusual amounts of hydrocarbon gases given off by the Coal Creek coal points to the advisability of continuance of these laboratory investigations on samples gathered systematically from all the Crowsnest mines and other typical mines in British Columbia. It is probable that investigations of a similar nature will be made by the Bureau of Mines on coals from various parts of the United States as opportunity presents.

In the Crowsnest collieries the question of whether ethane is given off under special conditions should be studied. In gas analyses by the ordinary combustion method ethane in small quantities is not detected, and, as usually the samples of mine-air collected contain only a few per cent. of gas, ethane would go undetected, being classed as methane. Hence, not finding it hitherto should not be considered as positive evidence of its not being given off. Under the great pressure of the heavy covering, the Crowsnest coal in the process of mining is subjected to a squeezing action, which tends to crush and grind the particles of coal one against the other. This may produce a condition which laboratory grinding would be analogous to. How occluded or contained gas is held in the coal substance is an unsettled question; that is to say, is the coal substance so impervious that the gas is held in minute pores like little bottles, only to be released when these are broken, or is it held by chemical bonds, so unstable that on a slight relief of pressure the gas is given off? It is stated by physicists that external pressure which obtains even with coals at great depth is insufficient at normal temperatures to liquefy the gases.

On the other hand, the surface tension of the coal-particles is very great, and some physicists have contended that films of the gas are held on the surface of the particles of coal under such tension that the gas is in compressed state equivalent to liquefaction. If so, when the coal-bed is opened, the coal near the headings and rooms may begin to release its contained gas. In the

* It is claimed that "in 1910 Professor John Cadman found ethane in the air of the Bellevue mines of Alberta." Page 723, Transactions of the Institution of Mining Engineers (Great Britain), Vol. LI. Ethane and other hydrocarbon gases except methane have never been found in the mine-air in mines of the United States unless by leakage from deep natural-gas wells.

Crowsnest mines large volumes of gas are given off at the faces. Such gas may have been stored in the crevices and open joints, and also in part may be occluded gas.

Normally, coal of the Cretaceous, which is the geologic age of the Crowsnest beds, is "sub-bituminous" coal, which is sometimes called black lignite. But Crowsnest coals have been advanced to the bituminous and semi-bituminous stage by heat and pressure in the Rocky Mountain uplifting, expelling from the coal substance moisture and gas. The latter, when it is held in by impervious or nearly impervious covering, collects in or saturates the coal-beds and enclosing strata.

The amount of gas given off by the freshly broken coal in the mines of the Crowsnest coalfield is very great, far greater than in most coals. It was observed in certain gaseous parts of the Coal Creek mines that, if a safety-lamp was set in a depression in a freshly broken-down pile of coal, the gas from the coal would flame in the lamp and extinguish the light. On the other hand, as will be shown later, even if two volumes of gas are given off per unit of coal volume, the amount is not nearly sufficient to account for the gas carried out by the return air-currents in the Crowsnest coal-mines.

As already indicated, methane and possibly ethane is given off in coal-mines in two ways:—

First, from the volume stored at high pressure in the crevices, slips, and joint-planes of the coal and adjacent strata, also from the cavities, if any exist.

Second, to a less extent from the coal broken down by mining operations, which gives off more or less slowly gases stored in its pores. The Crowsnest coal-mines have the unenviable position of being among the most gaseous mines in the world, according to the figures obtained through mine-air sampling by the British Columbia Mining Department. These figures are obtained from Thomas Graham's paper on "Some Gaseous Mines in the Crow's Nest Pass Coal Field" (referred to previously), and also from later records of the Department.

Gas-flow, Michel Colliery.—The records show that from Michel No. 3 East mine there is discharged in the ventilating-current on working-days from 1,104 to 1,524 cubic feet per minute of pure methane (at atmospheric pressure), which for twenty-four hours makes a total of from 1,590,000 to 2,195,000 cubic feet. On the basis of the coal mined (average per day for the period), 500 to 550 tons respectively, there was discharged 3,179 and 3,990 cubic feet of pure methane per ton of coal produced.

It is noticeable that on idle days the flow decreases; for example, on September 26th, 1916, this mine had lain idle since August 7th, when an explosion had occurred, and the flow of pure methane was 929 cubic feet per minute, or a total of 1,337,760 cubic feet per twenty-four hours. The question arises, is the decrease of flow due to the headings and rooms not penetrating into new areas, or is it due to fresh coal not being broken in daily work?

As the Pittsburgh laboratory tests indicate that even in vacuo but 2.1 volumes of methane plus ethane are given off on fine grinding, this figure may be considered an extreme one. Five hundred and fifty tons, a day's output at that time of the mine, occupies about 13,750 cubic feet in-place, and if it gives off 2.1 volumes of hydrocarbon gases, the total of the gases for twenty-four hours would be 28,875 cubic feet, or but 1.3 per cent. by volume of the gas given off on an idle day. On the other hand, the flow on an idle day after standing fifty days was 60 per cent. of the maximum outflow of a working-day. Similar results, differing slightly in proportions, are found in other Crowsnest mines. Accordingly, one is forced to conclude that the larger part of the gas entering the mines comes from that stored in crevices, slips, joints, and bedding-planes; second, a considerable part comes from exposure of fresh coal-faces and fresh roof areas; and, third, a small amount from the breaking-up of the pieces of coal in mining operations. In any case, it would appear that headings driven well in advance serve a valuable purpose in drawing off stored gases.

In the Michel Old No. 3 mine the methane-flow per minute ranged in the period from April, 1915, to October 24th, 1916, from 124 cubic feet on an idle day to 1,574 cubic feet on a day of active production of coal and correspondingly of uncovering of new faces.

This mine appears to be more gaseous per ton of coal produced, the figures ranging from 5,000 to 8,000 cubic feet per ton of production, but it is believed that this method of comparison is misleading. It is probable the territory mined is more gaseous.

The weight of the gas itself removed or flowing from the strata is worthy of attention. In the two mines just referred to, which are adjacent, the average weight in tons of pure methane carried out daily by the ventilating-current was 71 tons (of 2,000 lb.), which for a whole year

would amount to 26,000 tons. When it is considered what a great pressure the coal-beds are subjected to, and the fact that they are so much fissured as to be very weak when unconfined, it is a question if the loss of gaseous material may not cause some actual subsidence of the strata in the immediate vicinity of the mines of small vertical dimension, but nevertheless it may be a slight factor in a local subsidence over and adjacent to the mine-workings.

The Michel mine on the North side has shallow cover, and hence the amount of methane given off is relatively small—20 to 40 cubic feet per minute.

Gas-flow from Coal Creek Collieries.—The Coal Creek mines working on the South side of the creek are more extensive than the Michel mines. In No. 1 East mine, on February 23rd, 1916, when the mine was idle, there was 1,247 cubic feet per minute of methane given off; and on April 14th, 1916, when the mine was working, 2,906 cubic feet was discharged. This quantity represents the maximum discharge from any of the mines according to the records secured. At this rate there was thrown out of the mine in twenty-four hours, 4,184,600 cubic feet of methane, which would weigh 78 tons (of 2,000 lb.). On the basis of the cubic feet of methane per ton of coal mined, the figures 2,789 cubic feet give a much smaller ratio than that found at the Michel mines. The production of coal was then about 1,500 tons. Evidently from this the greater part of the flow comes from the coal stratum rather than liberated from the breaking-down of the coal in mining.

In the other mine working in No. 1 bed on the South side of Coal Creek, No. 1 South, the discharge of methane per minute in the "main return" ranged from 218 cubic feet per minute on an idle day to 459 cubic feet on a working-day.

The No. 2 bed lies below the No. 1 bed from 20 to 40 feet in the western part worked by No. 2 mine, under No. 1 South, but the interval between the beds increases to 150 feet where No. 3 mine works under No. 1 East.

The No. 2 mine main return also carries the gas-drainage from the abandoned part of No. 2, in which the "bump" area was located. The main return of No. 2 carried on an idle day 140 cubic feet of methane and on a working-day 250 cubic feet. The No. 3 mine main return carried on an idle day 381 cubic feet of methane and on a working-day 947 cubic feet.

The records of the methane given off by the respective beds may be summarized as follows, representing the minimum discharge recorded for an idle day and the maximum recorded for a working-day:—

No. 1 Bed (Upper).	Idle Day, Minimum recorded, Cu. Ft. per Minute.	Working-day, Maximum recorded, Cu. Ft. per Minute.	Tonnage of Coal produced, Average per Day.	Acreage covered by Mine.
No. 1 East	1,869	2,906	1,500	198.0
No. 1 South	218	459	400	....
Totals	2,087	3,365	1,900	....
No. 2 Bed (Lower).				
No. 3 mine	381	947	250	....
No. 2 mine	140	250	300	....
Totals	521	1,197	550	402.7
Grand totals	2,608	4,562	2,450	....

On the basis of the total methane discharged, the upper bed appears to be more gaseous than the lower bed; but in view of the fact that over three times as much volume of coal is taken out from the upper bed as from the lower, it is probable there is not much difference in the amount of total free gas in a unit of area in the respective beds.

Gas Conditions in Hosmer Colliery.—The Hosmer mines, situated on the west escarpment about six miles north of Coal Creek in an air-line, were closed and these mines were not visited.

According to the Government report of 1912, entitled "Investigation of Coals of Canada," thirteen seams were being opened at Hosmer from 4 to 30 feet in thickness. The opening tunnel,

900 feet long, had cut ten seams, five of which were being developed and which had a total working thickness of 40 feet, the sections being given as follows:—

No. 2 seam, 10 feet.
„ 6 „ 6 „
„ 9 „ 5 „
„ 10 „ 20 „

The seams varied from a dip of 65 degrees to 25 degrees. The tunnels started in the Fernie shales underlying the coal-measures, reaching the latter at a distance in of 850 feet and terminating in a hard conglomerate overlying the coal-measures, and therefore the seams cut included the whole series. It appears that very troubled or faulted areas were encountered which led to the shutting-up of the new mine a few years ago. The colliery is said to have been gaseous, but outbursts were not reported.

Outbursts of Gas in Carbonado Colliery.—The Carbonado mines were opened by the Crow's Nest Pass Coal Company in 1901-2 on the western escarpment of the plateau at a point on Morrissey creek about seven miles in an air-line south of Coal Creek. According to W. F. Robertson, on the "Rocky Mountain Coal Field," published in the Annual Report of the Minister of Mines for 1909, entries driven in on the strata of the beds show these thicknesses:—

No. 1, 12 feet.
„ 2, 30 „
„ 3, 4½ „
„ 4, 16 „
„ 5, 18 „

He states that the other beds were known to be above and below these, but not developed. The coal was found to be very friable, and on account of the high percentage of fixed carbon it would not coke properly in bee-hive ovens and was too small in size for locomotive use. In 1903 there were great outbursts of gas, causing loss of life, so that the mines were closed, but were reopened in 1907; but as the gas-outbursts continued to occur the colliery was again shut down in 1909. The locality was not readily accessible on account of snow and a visit was not attempted.

In 1903, when the main entries of No. 1 mine had been driven 2,000 feet from the outcrop, a great outburst of gas occurred, in which 1,456 tons of coal was blown out of the face of the main entry, making a tunnel cavity 110 feet beyond the original face. Other lesser outbursts occurred, and in 1904 there was another great outburst in which fourteen men were killed, the coal thrown out filling the level for 400 feet according to Inspectors Dick and Morgan. The mine foreman "reported everything clear and quiet at face twenty minutes before the outburst."

Thomas Graham states: "The displacement of coal in this outburst was estimated by the management as 3,500 tons. The volume of gas given off in the first thirty minutes after the outburst was estimated by various authorities at from 2,000,000 to 5,000,000 cubic feet."

Outbursts of Gas in other Mines of the Crowsnest Field.—No such great instantaneous outbursts have occurred in mines other than the Carbonado mines, but lesser, slower outbursts have taken place in the Coal Creek mines. In the No. 2 South, 900 feet inby the main parting near a faulty and crushed zone, an outburst took place several years ago, which pushed in 750 tons of coal. It gave premonitory symptoms, so no one was lost, but for two days no one could enter the place on account of the gas and broken coal. Similar but smaller "rushes" of gas and coal have occurred in the Coal Creek mines, and frequently miners are driven from the face of the workings, as occurred during the visits of the author, by the gas and breaking coal-face.

In some virgin areas, when the entry is advancing by employment of three shifts, it has been found necessary to slow the advance on account of gas given off, by cutting out one or two of the shifts.

When the "bumps" occurred in Coal Creek No. 2 mine in 1907-8 they were accompanied by strong inflows of methane which smothered the men entrapped by the uplifting of the "bottom" or floor. Hence it was believed by some that gas-pressure might have been responsible for the "bumps." But this view had to be abandoned when the great bumps in the No. 1 East mine occurred last November, as no gas was given off when these occurred.

OUTBURSTS OF GAS OF VARIOUS KINDS.

Gases of different kinds are found in the earth's crust in many places, collected in porous strata, and in denser strata in cavities and rock joint planes when confined by impervious strata

above. The most common gases thus confined are: "Natural gas" (hydrocarbon gas), which is usually associated or in contiguous territory with petroleum, and is found in various sedimentary beds generally adjacent to thick shale-beds; "methane" (CH_4), commonly found in coal-measures; carbon dioxide (CO_2); and nitrogen, sometimes found adjacent to deeply buried limestone and occasionally in shattered eruptive rocks, as at Cripple Creek, Colorado.

Great outbursts of carbon dioxide have occurred in the coal-mines in certain small coal-basins of Central France adjacent to ancient crystalline rocks, throwing out thousands of tons of coal and causing loss of life, but outbursts of this gas (CO_2) are not known in the principal coalfields of the world.

Inbursts of natural gas into mines have occurred in Pennsylvania, West Virginia, and Illinois mines, where the measures containing such gas have underlain the coal-measures; but, although the gas-pressures are sometimes above 1,000 lb. per square inch, violent outbursts have not been reported since the distances between the gas-measures and coal-measures have been too great.

OUTBURSTS OF METHANE.

Methane-outbursts into coal-mines have not been uncommon in many coalfields besides the Crowsnest field. Such outbursts have occurred only when the coal-bed being mined is deeply covered to a depth of over 1,000 feet or more by strata containing impervious shales. Methane found in coal-measures is generally believed to have been derived from partial distillation of the bituminous matter in the coal-seams and bituminous shales, in the natural process of coal formation by chemical reactions aided by heat and pressure from deep burying and mountain upbuilding.

It is therefore believed that all coal-beds have produced large amounts of hydrocarbon gases, but where the beds are thinly covered or are covered only by pervious rocks like sandstone, or the cover is much broken by fault-planes extending to the surface, the gas has escaped. Generally, the more deeply buried the coal-beds, the farther advanced from the lignitic stage; the larger the volumes of the residual gas, methane, contained in the strata, and also the greater the pressure under which the gases are confined. In Great Britain, in deep boreholes from the surface to the coal-beds, the pressure of gas attained 500 lb. and at Belgian mines 657 lb. per square inch. (*See* United States Bureau of Mines Bulletin 72.) Nevertheless, it is commented by Belgian investigators that the highest pressures are not found in the coal areas subject to outbursts, but rather in the denser coals.

Great outbursts of methane (chiefly) have occurred in the deep Belgian mines, in one of which many years ago the ventilating-current was reversed and about 140 men smothered, the gas taking fire at the surface and burning for a day or two. Several hundred other outbursts have occurred in Belgian mines, causing many deaths of miners. Such outbursts have been accompanied by the dislodgment of quantities of coal blown out in large part as dust. It has been found that these outbursts occur in crumpled zones and at buried anticlines.

Outbursts of methane of lesser magnitude have occurred in the coal-mines of other European countries than Belgium—i.e., in Great Britain, especially in Yorkshire collieries and Scotch mines—causing fatalities. Small outbursts have also occurred in coal mines of the United States, in the anthracite district of Pennsylvania and in Colorado.

The great outbursts of methane that ocurred in the years 1903 and 1904 in the Morrissey mines in the Crowsnest coalfield, and on reopening the mines in 1909, when the mines were again closed, have been unparalleled except by the Belgian outbursts.

PRESSURE OF GAS IN COAL CREEK MINES.

On account of the apparent great force indicated by the outbursts at the mines at Morrissey and the pushing-out of the coal-faces at times in the Coal Creek mines, it was believed that the gas-pressure in the coal-bed must be very high. To determine what the pressures were, three sets of boreholes, three holes 10 to 14 feet apart in each set, were drilled into the solid coal of advance places near the face on the lower rib. The holes in each case were 8, 16, and 24 feet deep respectively. Three-eighth-inch pipes were set in each hole and allowed to project about ½ foot from the hole. The inner 1, 2, and 3 feet of each pipe respectively for the 8-, 16-, and 24-foot holes were perforated, and outby this each had a collar; burlap dipped in cement grouting was forced back against each collar to serve as stemming material; then cement and sand grouting was poured into each hole, the holes being pitched downward 1 in 24, until the grouting

nearly filled the hole; then cement mortar was used to finish filling. After the cement had set a pressure-gauge and a valve was screwed on to the end of the pipe.

In all cases gas blew freely out of the pipe, but the pressures obtained on shutting the valves were surprisingly low. When each valve was shut about a day after beginning the respective hole, the maximum pressure was quickly obtained, and thereafter there was practically no change. The maximum pressures and the temperatures of the mine-air and in the bottom of the boreholes were read by Mr. Michell, and are summarized in the following table:—

	Borehole Depths.			Temperature Fahr.	
	8 Ft.	16 Ft.	24 Ft.	Bottom 24' Hole.	Mine-air.
	Lb.	Lb.	Lb.	Degrees.	Degrees.
No. 1 East mine—					
18 room, 10 East entry (in solid coal on lower rib).....	3	0.5	13.5	46	40
22 room, 10 East entry (in solid coal on lower rib).	0.5	7	18	50	48
No. 3 mine—					
Counter to Main level (in solid coal on lower rib).....	1.5	2	2	65	60

It is difficult to account for the erratic showing, but owing to the great friability of the coals it seems probable that there is a rapid escape of gas as the mine-face advances. With such conflicting results it would not be wise to draw conclusions from the above tests. It would seem advisable to drill and case some holes considerably deeper, say 100 feet in advance, and thus obtain records of the fall of pressure with the advance of the face, which would permit curves of this fall to be drawn, and in this way help determine how a given area of coal-bed may be drained of gas with lessened danger to the men.

One method of protecting men from outbursts is to keep boreholes in advance. This is the method practised in many mining districts of the world, but hitherto it has been argued that it would not permit the advance discovery of a stored pocket of gas such as was encountered by the Carbonado mines. The author of this paper is not convinced by these arguments, but it is his judgment that if a sufficient number of boreholes be drilled, spreading fan-shaped from the main advance entries, these would approach near enough to such a pocket of gas and crushed coal to show by the gas-flow from the pipe that there was a dangerous area ahead, and until it had been drained by other boreholes the entry or room driving should cease.

Temperature in Boreholes.

The temperature in the bottoms of the 24-foot boreholes is also most surprising. Apparently the only way that the low temperatures in the boreholes in No. 1 East mine can be accounted for is by the assumption that it was from the expansion of the stored gases as they are released at or near the face. This matter also needs further investigation in connection with drilling deeper boreholes and obtaining the readings when the casings were capped, so expansion does not take place into the borehole lining.

Question of Gas-flow and Outbursts.

The matter of gas-flows and outbursts, while not so immediately acute in the operation of the Coal Creek mines as that of "bumps," yet is a most serious and, in fact, vital consideration in planning for future operations in these and other mines of the Crowsnest coalfield. Even in the question of lessening the danger of "bumps," the number of airways that must be maintained to meet the gas-flows affects the system of mining which may be adopted.

Mining Conditions and Methods in the Coal Creek Mines in relation to the "Bumps."

The No. 2 seam at Coal Creek was opened first and mined extensively by the Old No. 2 mine and No. 3 on the South side of the creek. The coal varied in thickness from 4½ feet on the dip or East side of No. 3 mine to 11 feet as taken out on the West side of No. 2 South. On the West side there is a crumpled zone in which the coal in places is 20 feet or more thick, but crushed and dirty. Through the area in the inner central portion of No. 2 mine, later affected by "bumps," and now closed off, the coal is said to have been 4½ to 5 feet thick.

The general method of mining in the Nos. 2 and 3 mines was by the pillar-and-stall system, the "stalls" or "rooms" being driven off water-levels which branch from inclines. The entries were 12 feet wide and the rooms from 16 to 20 feet wide and about 40 feet apart, the pillars thus being 40 feet wide and about 60 feet long between crosscuts. The workings and the pillars were very irregular.

In some places long-wall was started in irregular panels; in other places the pillars were withdrawn. In the "bump" area, as indicated in the attached blue-print, 50 to 60 per cent. of the coal had been mined out; this correspondingly increased the load on the pillars, which bore the weight of 2,000 feet of cover.

The roof of No. 2 mine is a fairly strong shale, but the floor is a softer shale.

I will not attempt to describe individual "bumps," which first became serious in 1906. On the mine-map, Exhibit 5, where there are eight circles enclosing letters from A to H, fatalities occurred, as the result of "bumps" in the immediate vicinity. The last, on July 31st, 1908, was the most serious. Mr. Robertson reported that "twenty-four men were cut off and all would have been suffocated had it not been for a supply of fresh air supplied by a break in the compressed-air pipes, enabling twenty men to be saved."

Mr. Robertson further states in his Annual Report for the year 1908 that:—

"A reference to this plan (of the No. 2 mine) will show that the area of disturbance in which all these 'bumps' have occurred is between the main entry and the High Line entry and immediately surrounding and including the area from which the pillars have been extracted, an area of about 1,500 by 1,000 feet, and this area stretches across from one entry to the other. These facts would indicate that the sagging of the roof over the area from which the pillars had been extracted caused an undue pressure on the immediately surrounding pillars, which, transmitted to the pavement, apparently caused it to burst upwards with the liberation of gas and accompanying shock. There was apparently no serious caving of overlying measures that might fill up the space and relieve the pressure. The area of pillar-extraction—some 30 to 35 acres—is located in the centre of the mine-workings and under an overburden of 2,000 feet. In this present case the disturbances have, so far at least, been localized; whether they will spread to the rest of the workings time only will show.

"I think that there will be no sudden outburst, provided no further attempts are made to extract pillars from a central area which has stood for some time. If the extraction of pillars had been commenced within a reasonable time and from the outcrop, the roof might probably have subsided behind such workings quietly and no serious disturbances have taken place."

Mr. Robertson's prediction relative to there being no further sudden "outburst" or "bump" in No. 2 mine proved to be correct. In accordance with his recommendations, the operating company was "prohibited from continuing any of the present workings of that part of No. 2 mine lying between the main entry and the High Line entry inside of No. 1 West level main entry, and No. 1 East level, High Line, or of extracting pillars within this area in this mine, such prohibition to include the main entry and parallels inside of No. 1 West level."

As regards Mr. Robertson's opinion "that if the extraction of the pillars had commenced at the outcrop the roof might probably have subsided behind such workings quietly" seems to be supported by what happened on the north side of Coal Creek.

After the No. 1 bed had been mined by No. 1 North and many pillars extracted and some long-wall operations conducted near the outcrop, this was followed by working the No. 2 seam by opening No. 9 mine under the No. 1, with similar extraction by pillar-drawing and long-wall; although the workings were irregular and unsystematic, the fact that extraction began near the outcrop caused a shoulder of the mountain, to a height of 1,200 feet, to quietly subside at the outcrop, the mass hinging on the solid unmined area, cracks opening across the projecting shoulder 1,200 feet above. So little disturbance did this make that it was not realized what had happened until the cracks were noted. (*See* Exhibit, Photo "B" of "shoulder" over Mines No. 1 North and No. 9.)

MINING DEVELOPMENTS AFTER "BUMPS" OF 1908.

Following the shutting-up of the "bump" area in No. 2 South mine, the work in this seam was continued only in the east and west portions, called No. 3 mine and New No. 2 mine. In these developments large pillars were left between each pair of rooms 150 feet wide, and between the two rooms of a pair a 50-foot pillar was left. The No. 1 seam, 9 to 12 feet thick, lying above

the No. 2, was then developed over the west part of Old No. 2 mine by what is termed the "No. 1 South mine," and subsequently by the opening of No. 1 East mine, immediately over the central part of No. 2 mine.

DESCRIPTION OF NO. 1 EAST MINE.

The No. 1 East mine was the only mine systematically planned of the Coal Creek mines, and the advance plan was rigidly adhered to. The main entries run due south, which is approximately on the strike of the bed; the cross-entries, 10 feet wide, which on the west side are driven "to the rise" and on the east side "to the dip," are 600 feet apart, and in the inner part of the mine 1,000 feet apart; each one of the pair is 60 feet apart. Rooms only 14 feet wide are parallel with the main entry and are also in pairs. The two rooms are 60 feet apart and the pairs 150 feet apart. Crosscuts are between each of the two rooms, but the pairs are only connected when necessary for special reasons, so that ordinarily over the "bump" area between each pair of rooms there is a pillar 150 x 600 feet. Only 25 per cent. of the coal was taken out by this advance work, and no pillars were to be pulled until the mine was retreating as a whole. (*See* Exhibit 4, map of mine.)

The coal is from 10 to 12 feet thick, to a slickensided rash 2 to 3 feet thick, which had no strength and was kept up by lagging and close timbering to prevent mixing with the coal in loading. The cross-timbering under the mine regulations does not have to be closer than 1 yard apart, but the miners who were paid $1 per set, usually preferred to place two sets to a yard. Above the rash is 2 to 3 feet of coal, usually of excellent quality; this is not obtained in this advancing work. Over the coal there is a strong sandy shale approaching a sandstone in places. Fifty feet above the coal-seam there is said to be a strong conglomerate 15 to 20 feet thick. There are also other beds of conglomerate higher in the section. Owing to the deep snow on the mountain-sides, the rock-exposures were not visible, except at the tops of the ridges.

The No. 1 East mine rapidly developed; the mining conditions were good, except the immediate top, consisting of the rash and soft coal, weighted heavily on the timbers, and after a time they had to be removed or else the false top allowed to fall, and timbering carried up to the main roof.

No explosives were used in mining, but the coal, assisted by the gas-pressure, worked off easily, and a miner could load 7 to 8 tons per day of "eight hours from bank to bank," which meant about seven hours at the face. The output of the mine attained 1,500 tons per day. The mine passed over the "bump" area of No. 2 mine, which is about 150 feet below it, without noticeable effect, and by November, 1916, the rooms to the east of the main entries were 300 to 400 feet beyond the (projected upward) edge of the abandoned No. 2 mine, and the main entries about 700 feet beyond the edge (projected upward) of the general line of faces of Old No. 2 mine, or about 5,000 feet from the entrance portal.

"BUMPS" IN NO. 1 EAST MINE, NOVEMBER, 1916.

November 7th, 1916, at 9.55 p.m., there was a "bump" affecting Nos. 8 and 9 rooms off the No. 14 East, resulting in a fall of loose rock which occurred in No. 8 room, hemming in a horse. A small fall occurred in No. 9 room, injuring a man. A party of ten men and two firebosses went to work in No. 8 room to clean up the falls to release the horse, but a more severe "bump" occurred at 1.55 a.m., causing two heavy falls in No. 8 room, burying and killing one man and hemming in eleven others. By 4 a.m. they had worked their way out through a crosscut into No. 7 room, thence out. At 5.25 a.m., November 8th, the third and heaviest "bump" occurred, which not only shook the inner part of the mine, but created earth-tremors which were felt for many miles, strongly at Fernie, and in many places a number of miles to the north and south.

Falls of false top were general inby the No. 14 East and West. Those in the main entry blocked the ventilating-current of 120,000 cubic feet per minute; the intaking air-column, being 4,000 feet in length, acted like a water-hammer; the pressure ran up, bursting the wood stoppings, and causing a reversal of the current in such strength that several men, one of them the general manager, Mr. Wilson, were hurled outby before it, sticks and stones being carried along.

There were many narrow escapes of those in the mine working to clean up the previous falls, but all escaped, though several were battered up. While hundreds of falls had occurred, practically all that could be observed were of the rash and top coal only. Apparently the main roof had stood the shocks.

A fourth but lesser "bump" occurred over the main entry on November 13th, causing the bottom to heave in the centre 2 feet, and for a distance of 200 feet opposite the No. 12 West and outby same for 120 feet. This was the only "bump" which caused the floor to lift. Since the fourth "bump" there have been roof knocks, rather than "bumps," at more or less frequent intervals, causing no damage. Neither the large nor the subsequent small "bumps" were accompanied by outbursts of gas, unlike the "bump" in No. 2 mine.

Mr. Graham, Chief Inspector of the Province, following the occurrence of the "bumps," decided to prohibit, pending investigation and further orders, work in a certain section inby the No. 10 East and West entries overlapping, but exceeding in area the prohibited district in Old No. 2 mine.

THEORY REGARDING "BUMPS."

As already implied, "bumps" are manifestations of pressure, and occur only when the mines are at great depth, usually exceeding 1,000 feet. If the measures overlying the mine are soft and pliable, such as shale-beds, "bumps" will not occur, although "mine squeezes" may take place. "Bumps" therefore occur only when there are massive and rigid beds above, such as sandstone, conglomerate, and limestone. Mine squeezes originate where the pressure thrown on the mine pillars is sufficient to crush them, or the immediately overlying roof or underlying floor is too weak to withstand the load put on it, through removal of part of the natural support by the excavations, but such squeezes will only result in "bumps," as stated above, when there are rigid rocks of great thickness above.

The cause of "bumps" is thought by the writer to be this: When an area in a coal-bed has been mined out or when a "squeeze" has occurred from the weight of the lower-lying roof, so that a subsidence or separation of the lower stratum from under the rigid rocks has occurred, then the massive rock will span the subsidence. If the diameter of this subsided area is limited —that is, let us say, 50 to 100 feet—a strong sandstone or limestone stratum would easily be self-supporting; but if the subsidence of the lower measures (though only a foot or two in vertical displacement) was 200, 300, or a 1,000 feet in diameter, so that the underside of the massive rock was not supported over this space, then it is probable that the lower layers of such a rock would not stand the strain, and a large disk-shaped piece would drop, 1, 2, or 3 feet, as the case might be, giving a blow of tremendous force which would produce the effect called a "bump," and the larger and heavier the slab the greater would be the "bump." Above such a great fallen slab there would in all probability be almost the same depth of space as was represented by the subsidence, and there would be a flat, dome-like arch, supported at the sides of the unsubsided area.

If the subsidence of the lower measures continued through enlargement of the area of mining or of "squeeze," there would probably be a great saucer-like mass of larger diameter than the previous great slab fall upon it, causing a second "bump." In time, further saucer-like masses would drop, increasing the height of the dome until it either reached the surface or reached a soft stratum which would bend. The foregoing assumes a massive stratum without joint-planes or fault-planes which would modify the character and size of the falling masses, each of which strike a great blow, and which is believed is the cause of the successive "bumps" in Coal Creek Nos. 1 and 2 mines.

In the foregoing it is assumed that the coal strata is not dipping at sufficient angle to cause slipping of the strata on the bedding-planes. Steeply dipping strata would necessarily act very differently in the movement of the mass which gives the blow. When the overlying strata is in the form of mountains with steep slopes and with great slips or fault-planes developed, the character of the rock-movements would be profoundly altered; but in any case it is believed that when thousands or hundreds of thousands or even millions of tons of rock fall only a few inches, a gigantic sledge-hammer blow is given to the mine-roof, setting up vibratory waves like the earth-tremors which are called earthquakes. The direct blow on the mine-roof may break timbers and throw down great amounts of soft roof material, cause slabbing of all the coal, or, where the coal is strong and the bottom of the floor weak, cause a sudden uplifting of the floor. The latter effect was the chief manifestation of the "bumps" which occurred in No. 2 mine from 1906 to 1908, whereas in the recent "bumps" in the upper bed of No. 1 mine the chief manifestation was through the breaking of timber and release of the soft "rash" and coal above it. The immediate roof in some cases may be permanently lowered by such a hammer-like blow, and in the recent

"bumps" in No. 1 mine there were indications from the timbering that in places the immediate roof had been smashed down 3 or 4 inches.

The great danger to the workmen is in being buried by the loose material, which in the case of No. 1 mine lies above the usual timbering, or from the sudden thrusting-up of the floor against the roof or side, as was the manifestation in the No. 2 mine in the "bumps" of 1906-8. The slabbing of coal from the entry ribs is a contributory factor to the danger of the miners, and in the case of the "bumps" in No. 2 the giving of large amounts of gas was an additional danger.

Another secondary but dangerous condition for the men in the area affected was, in the greater No. 1 mine "bumps" recently, due to falls of roof which suddenly blocked the air-current, and this sudden arrest of a large column of air 4,000 lineal feet long, actuated by a pressure measured by several inches of water-gauge, caused the bursting-in of many wood ventilating stoppings at the head of the "main intaking" entry, and built up a momentary pressure which hurled the men in its path in reverse direction to the former current.

OCCURRENCE OF "BUMPS" IN OTHER MINING DISTRICTS.

"Bumps" are known in other coal-mining districts of the world. They have been a serious menace in a certain South Staffordshire coal-mine in Great Britain working the "10-yard seam" 24 to 30 feet thick. This mine is worked by a square chamber system, and, the pillars being very high, there is probably some crush and subsidence of the immediate roof, opening an equivalent space at some unknown distance above. The strong rocks higher up, which are no longer able to span such areas of subsidence, break and cause "bumps." In these mines, when strong "bumps" occur, the timber is broken down and the coal slabs off and accidents to miners are caused thereby. In the case of the South Staffordshire mines the coal and strata have low dips and the overlying surface is practically level, the depth of the workings being about 1,500 feet or more from the surface.

In the United States "bumps" are reported to have occurred in certain coal-mines of Utah, working under the Book Cliff mountain, where the depth of cover has been 2,000 feet or over.

There have also been occurrences of "bumps" in the Carbonado mines in the State of Washington leading to fatalities. These mines are working under the shoulder of the foot-hills of Mount Rainier, and where the total cover is over 2,000 feet. The measures dip from 50 to 60 degrees at the outcrop to 15 to 20 degrees in the lower workings. The coal is mined by the room-and-pillar method, the rooms going up the dip and the coal dropped down by chutes to the level below. As soon as the rooms have gone up the proper distance, the pillars are sliced off so that at the head of an entry or level there are several rooms being driven up and several rooms outby in which the pillars are being drawn.

The floor and the roof are both hard, and in this respect the conditions differ from those at Fernie. Formerly little attention was paid to driving the rooms straight, with the result that there were sometimes very large pillars, and again sometimes small ones. It is believed that in this case the larger pillar held up the immediate roof while drawing the adjacent pillars; but when the weight on the larger pillars became such that they would no longer withstand the load they would suddenly crush down a little bit, breaking timbers, slabbing off coal, and in this way men were caught by the timbers or the coal. To meet this the operating company are now laying off the pillars regularly, and during the recent months the mine had been free from any "bumps." Whether or not a final cure has been effected still remains to be seen.

The problem of the "bumps" in the Crowsnest field is not confined to the Coal Creek area alone, but, from the natural conditions surrounding the field, similar difficulties threaten in the future all extensive mining operations, as the mines get under deeper cover, unless some system of mining can be evolved that will prevent the "bumps" from occurring.

PROPOSED LAY-OUT FOR FUTURE WORKINGS TO LESSEN HAZARD OF "BUMPS."

Before leaving Fernie after investigation of the mining conditions, the writer had a conference with the following gentlemen: Mr. Wilson, General Manager; Mr. Robertson, Provincial Mineralogist; Mr. Graham, Chief Mine Inspector; Mr. Williams, Inspector of the Coal Creek District; and Mr. O'Brien, Inspector of the Michel District. After a discussion of the phenomena of "bumps" and the danger to employees and property therefrom, Mr. Wilson was requested to give his view as to what would be the best method of avoiding the dangers of "bumps." He presented the following general plan:—

To reopen the main entries through the temporarily prohibited area and drive them on until the selected boundary of the mine is reached, when retreat would begin; to also drive a pair of parallel rooms on either side for airways, making six advance entries and airways extending into the coalfield; off the main entry there would be turned at right angles side entries every 800 feet, and from these would be turned pairs of rooms, each room of the pair 60 feet apart centre to centre, and each pair of rooms to be 200 feet apart. The rooms to be driven 600 feet, thus leaving a barrier pillar of 200 feet between the ends of rooms off one pair of entries and the ends of rooms off the next pair of entries inby. Under this plan only one-eighth or a little over 12 per cent. of the coal would be extracted in advance. The idea expressed by Mr. Wilson was to take out enough coal to develop the ground and to partially pay for advancing the entries. (*See* dotted lines on map (Exhibit 4) and sketch (Exhibit 8).) When the boundary of the district to be worked from the mine was reached, then a retreating system of some sort would be employed. Meantime it would be necessary to very much enlarge the ventilating system so as to adequately take care of the increased flow of gas which might be expected in future.

The No. 2 mine (in the lower bed) was to be extended from the present main entries and two pairs of rooms on either side also extended for air-courses; these extensions to be parallel with the workings in No. 1 mine (off the upper bed). The No. 3 mine on the lower bed was to connect by cross-entries with the No. 2 mine, which lies to the west of No. 3. The No. 3 Main level and air-course would have six parallel rooms running approximately on water-level southward. There would, of course, have to be some local modifications of the various plans to fit the natural conditions.

The general scheme is shown on the map (Exhibit 4), which is a contour map of the coalfields, showing several Coal Creek mines on the south side superposed and the proposed extension working in dots. This proposed plan was drawn up subsequent to the conference and copies given to the writer and the Provincial authorities.

REVIEW OF EVIDENCE REGARDING CAUSES OF "BUMPS."

Before proceeding to a consideration of the means that may be taken to avoid or lessen the danger from "bumps," it seems advisable to summarize the evidence regarding them.

(1.) "Bumps" occurred in No. 2 mine in 1907-8 in a certain area, about 35 acres in extent, and over which there was about 2,000 to 2,500 feet of cover. These "bumps" were manifested in the sudden upheaval of ground at local points and the giving-off of large quantities of methane, which smothered the men entrapped by the upheaved bottom. At this time the bed above this (No. 1 bed) had not been opened in this vicinity.

(2.) In November, 1916, "bumps" occurred in No. 1 East mine in bed No. 1 in an area 150 feet vertically above No. 2 mine, almost directly above, but a little inby the bump area in the lower mine. (*See* Exhibits 4 and 5.) These "bumps" were manifested in the upper mine by the breaking of timbering and throwing-down of false top, rash, and roof coal, but without noticeable discharge of gas and without affecting the floor. As the No. 2 mine under the bump area was closed, effects could not be observed, but inspection of the boundary district surrounding the Old No. 2 mine disclosed only such slight and doubtful evidence of a few cracked timbers at a couple of points as to be negligible. Men in No. 3 mine heard the crash of the "bump," but were not injured and no falls occurred.

(3.) In No. 2 bed floor was the weakest part of the seam. From 50 to 60 per cent. of the coal had been mined out in the bump area in that bed, throwing a heavy load upon the pillars. In the upper bed the weakest portion of the stratum was the rash-band and loose roof-coal.

(4.) "Bumps" in coal mines are known in various coal-mining districts of the world, and are akin to air-blasts in metal-mines, which are of serious account in the deep mines of the Rand and in the Lake Superior copper-mines.

(5.) "Bumps" occur only where there are rigid massive rocks like conglomerates, limestone, and massive sandstone in the cover over a mine, and also occur only when the workings are at great depth—that is, 1,000 feet or more.

(6.) There is great danger to underground workers as well as serious danger to the mine itself from "bumps" of a magnitude like those which have occurred; that comparatively few men have been killed is a fortunate circumstance; because, for example, if the great "bump" of November 8th, 1916, which threw down the rash and roof coal through an area of 30 or 40

acres, had occurred during the day shift, several hundred men would have been exposed to the danger of being buried or smothered by the thick dust which filled the atmosphere.

(7.) The roof of No. 2 mine is strong, and it is reported that it was not affected by the "bumps" which occurred in 1907-8. In No. 1 mine the false top, with rash and roof coal, was weak, but the main roof is strong, and close observation, so far as the heavy falls permitted inspection after the great "bumps" of November, did not disclose any weakening of the main roof.

CONCLUSIONS FROM EVIDENCE REGARDING "BUMPS."

Your investigator believes:—

(*a.*) That "air-blasts" are the result of great areas of unsupported mine-roof or hanging-wall giving way suddenly, like an overloaded bridge, and thus causing a blast of air from the collapsed workings.

(*b.*) That "bumps" only occur when there is deep cover over the mine and where there has been a subsidence of the roof over an excavation or squeezed area; the rigid strata above has not flexed downward, but spans the sunken area. When the span, through continued mining and widespread subsidence, becomes too great for the rock stratum to bridge over, enormous masses may fall, and while the distance may be only a few feet or even a few inches, the sudden arrest of rock-masses weighing possibly thousands of tons will set up a shock-wave in the underlying stratum which gives the effect of a local earthquake.

(*c.*) That after one rigid stratum has given way in the interior of the measures there is opportunity for similar giving way of successively higher strata, but, it is thought, with less and less effect on the mine-workings as the spaces become more or less filled with broken rock and the blow cushioned, also as the vertical distance above the workings becomes greater with each successive fall.

(*d.*) It is believed that had the massive rock cover been frequently broken in mining No. 2 mine from the outcrop, which usually takes place in mining, by the long-wall advancing method, "bumps" would not have occurred. One piece of supporting evidence for this belief is that on the North side, where such long-wall work is done, the cover was broken over the mine for a height of 1,200 feet vertically without causing any "bump" effects.

(*e.*) It is also believed that, using the pillar-and-stall or pillar-and-room method, had the advance mining been as systematic as at present and not taken out to exceed 25 per cent. of the coal, the weight thrown on the pillars would not have been great enough to cause their being crushed into the floor, and probably the "bumps" of 1907-8 would not have occurred.

(*f.*) It is believed that the condition of subsidence brought about in the "bump" area of No. 2 mine is directly responsible for the "bumps" affecting the No. 1 mine; in other words, had the No. 2 bed been unworked, the "bumps" would not have occurred from the method of mining carried on in the No. 1 mine. It was contended that there was no evidence of subsidence or settlement in driving the No. 1 entries and rooms. The writer's experience is that, with 150 feet intervening between the coal-beds and flexible strata, any previous movement in sinking several feet would not be discernible in the coal or shales.

(*g.*) That, had the rash and top coal of No. 1 East mine been taken down, there would have been little damage done to the mine by the "bumps" and comparatively little danger to the employees underground.

(*h.*) That, in going into undisturbed ground beyond the No. 2 mine subsided area, the danger of further "bumps" would be reduced to a minimum, provided at least 75 per cent., and preferably 80 per cent., of the coal is left intact and the pillars not withdrawn until the mine is retreating.

FUTURE REMEDY FOR "BUMPS."

The plan now proposed by Mr. Wilson, General Manager of the Crow's Nest Coal Company, after conference with Messrs. Robertson, Graham, and the writer, as shown by the dotted lines in the attached plan (Exhibit 4), under which system less than 15 per cent. of the coal will be taken out in advance, is a satisfactory method; provided that for the protection of the employees in No. 1 mine the rash and roof coal is taken down to a point as near to the face as practicable, for it cannot be assured that lesser "bumps" from breaking and dropping of rocks higher up may not continue; but by taking this precaution it is not probable that when a "bump" occurs any one would be injured.

It has been contended that there are difficulties in taking down the rash and top coal on account of a mixture of impurity with the coal, which would in turn seriously damage the coke. It would seem that this could be done by mining out the roof-coal in advance, putting up necessary timbers to support the main roof; then taking out the rash and filling same in rooms farther back; after this, mining out the main coal and putting in longer posts to catch the collars put in while working out the top coal. (*See* sketches by author, Exhibits 6 and 7.) Your investigator recommends the trial of the system to determine if practical, and, if not, some other plan which gives the desired degree of safety may be developed.

An alternate plan, proposed by the operating company for room-work, is to first mine out the main coal in the rooms, and then drop the rash and top coal by pulling out the timbers. The objection to this is that until further advance, well beyond the present "bump" area, is made with immunity from "bumps," the majority of the miners would be exposed to burying or smothering if a great "bump" occurred. While, on the other hand, where the rash and roof had been taken down as shown wherever done in the main entry of No. 1 mine, no breakage of timber or falls had occurred.

REVIEW OF EVIDENCE REGARDING THE GAS AND OUTBURSTS OF SAME.

The problem of equal importance in working the Crowsnest field coals, and especially in future developments under deeper cover and greater distance from the outcrop, is to adequately take care of the large quantity of gas. Very wisely the mines are not allowed to equip with electricity for haulage or lighting, as the danger is too great.

The following are the chief facts developed:—

(1.) That the flow of gas as measured by the analyses of the returns and the outbursts of gas which occurred at the Morrissey collieries show that the Crowsnest Pass coalfield mines are among the most gaseous in the world.

(2.) That gas is derived from two sources: (*a*) Stored in the crevices and joint-planes of rocks and coal; (*b*) occluded, or that held in the pores or cells of the coal or by surface tension.

(3.) That an unusual condition has been found in testing the amount and kind of gas given off by the broken coal, which, on the basis of one sample, shows: (*a*) That an unusual quantity of hydrocarbon gas is given off by the coal on grinding fine in vacuo; (*b*) that three times as much ethane and other hydrocarbons are given off as methane under these conditions.

(4.) That the gas-pressures within a short distance of the face of the workings are low, which, however, is not proof that high gas-pressures may not exist at a considerable distance in the solid away from the face.

RECOMMENDATIONS REGARDING GAS-FLOWS.

(*a.*) That since the gas-pressures rapidly lessen from about 18 lb. 21 feet from the face to nothing at the face of the coal, it is indicative of the importance of draining the coal-measures by advance headings.

(*b.*) To prevent the danger of outbursts overwhelming the men, as at Morrissey, it seems very desirable in faulty ground or crushed zone that drill-holes be kept in advance of the main heading, and in such ground that they be advanced at only a moderate rate—say, perhaps only one shift per twenty-four hours—in order to permit the slow draining of the gas.

(*c.*) That in those portions of the field which permit advancing long-wall this system should be used from the outcrop. Long-wall would probably prevent "bumps" and would drain the gas more slowly and more safely than pillar-and-stall work. However, advancing long-wall is not practicable with the conditions found in No. 1 East and No. 1 South at the present time, though probably it might be applied in the No. 2 bed.

RECOMMENDATIONS FOR COMMISSION OF INVESTIGATION.

It has been implied in a number of places in this report that there are obscure matters which can only be cleared up by further investigations. The research-work on gases, the recording of phenomena, such as rock-tremors, "bumps," and outbursts, and the trial of methods of mining. The importance of most of these matters is obvious from statements in the report, but the inquiries may be summarized as follows:—

(1.) The making of careful topographic survey in the vicinity of all operating mines and the establishment of monuments in advance of mine-workings by precise methods of surveying, so

that all changes may be observed, together with the observation and measurement of surface cracks which may develop.

(2.) The establishment of seismographs registering vertical waves at two or preferably three points on the face of the mountain above No. 1 South. If possible, these seismographs to be so connected up electrically that the registrations will be made at some suitable convenient point in the vicinity of the mine-mouth. It is believed that comparatively simple seismographs would be suitable for the purpose of determining in what horizon or stratum of the rock any disturbances were taking place, with the ultimate hope that some means of warning might be given apart from the matter of scientific interest. It has been claimed (with what truth is not known) that seismographs are now being used on the battle-front in France to determine the location of the enemy's big guns.

(3.) The carrying-on of experimental methods of mining the coal at the face in a practical manner, especially in No. 1 bed, so as to lessen the danger in case of "bumps" or falls of rash and roof coal, and to look into the best method of timbering for protection.

(4.) In the matter of occluded gas, to gather samples in various beds, and in conjunction with laboratory testing to determine the amount of occluded gas in different coal-beds, how it is held, and if there is any chemical instability which might or might not be connected with any shrinkage of the coal in place in the pillars of the mine-workings. In this connection plugs or monuments in the roof, sides, ribs, and floor might be established at various points in the mine to determine whether or not movement or shrinkage is going on.

(5.) In the matter of protection from fire-damp, to continue the excellent investigations begun and carried on during the past two years by the Provincial Inspection Department of gathering samples of mine-air as to dangerous conditions in any part of the mine, and to obtain data on the drainage of the gases from the coal-bed, such work being planned with the special view to determine the relative amounts of gas given off in various localities, also when the mine is working and when it is idle.

(6.) To drill a number of long boreholes, say 100 feet or more, in advance of the working-faces to determine the amount of gas given off from a given exposure of surface of the borehole at the inner end, left unpacked, say 3, 4, or 10 feet, as the case might be; also to record the gas-pressure at regular intervals from the inner end of the hole to its mouth, and thus obtain a curve of fall of pressure from the interior of the unmined coal to the face of the mine. The practical object of this would be to determine the rate at which it would be wise to allow the entries to advance, and also to determine if the gas in dangerous areas, as in crumpled, brushed zones, could not be bled off by means of such boreholes, cased or otherwise, as in the very dangerous conditions found in the Carbonado mines at Morrissey. It is your investigator's opinion that the question of methane flow and pressure is going to be of an increasingly serious nature in all of the mines in the Crowsnest field as they penetrate farther under cover.

(7.) The greatest function of such a permanent commission would be to determine how the collieries may be so laid out under the difficult conditions which confront mining operations in the Crowsnest field that all the coal which is now considered as a "reserve" may be ultimately obtained. When it is recalled that it is practically impossible to sink shafts into the larger part of the field, and that, if the coal has to be attacked from the outcrop, to mine in the interior of the field will require entries or tunnels six, eight, or ten miles in length, the magnitude of the problem is apparent.

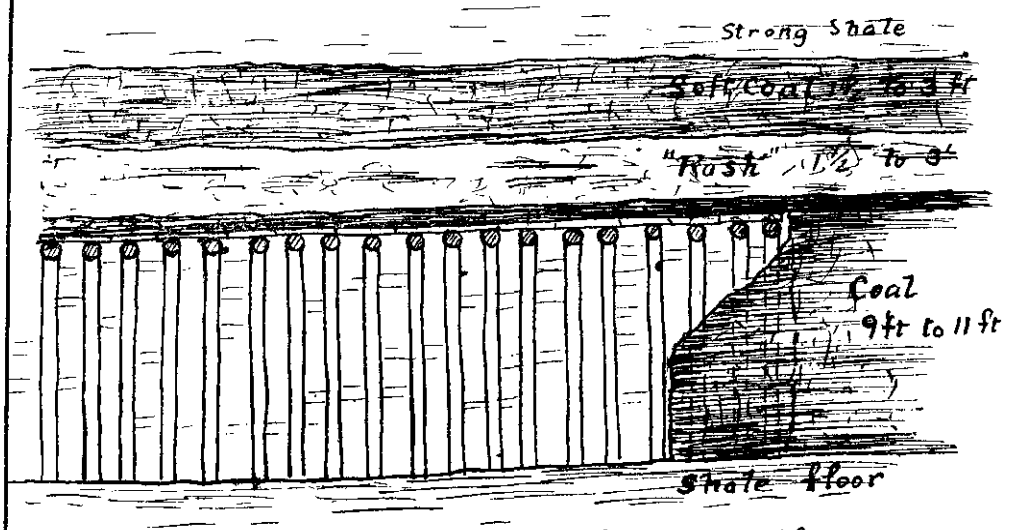
In conclusion, I cannot commend too highly the admirable attitude taken by the officials of your Province, the Provincial Mineralogist, Mr. Robertson, and the Chief Inspector of Mines, Mr. Graham, in regard to the problems which confront them. Their past action in safeguarding the miners and property by certain orders received my hearty approval. But in such problems as will confront them in future, in the matter of making the mines safe for the employees and in obtaining the highest yield from the coalfields under the very difficult natural conditions, it is important that they shall have the opportunity of conferring with and receiving the advice of a commission of ability, and which has members who can speak with authority on scientific and technical subjects. It therefore seems advisable to have on such a commission a geologist, a mining engineer, a chemist, and an experienced mine operator.

Respectfully submitted.

GEORGE S. RICE.

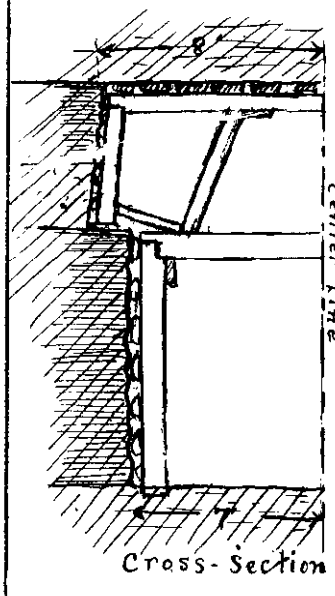
Washington, D.C., March 26th, 1917.

Exhibit N° 6

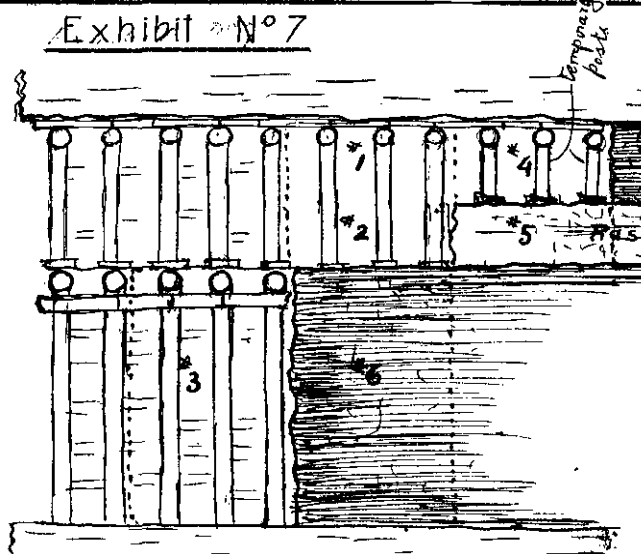


Section of No 1 Coal bed Coal Creek Colliery
and present method of mining and timbering on rooms
Scale 1 inch = 5 feet

Exhibit N° 7



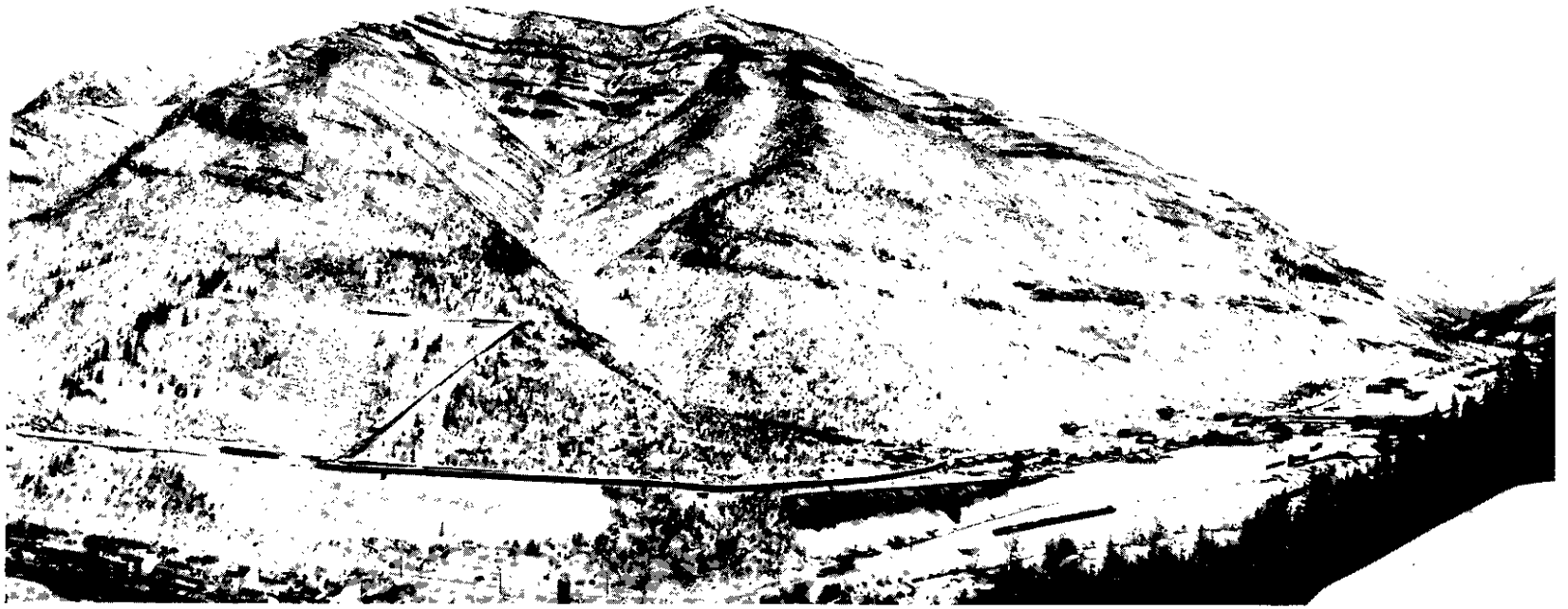
Cross-Section



Method of mining proposed for trial by G. S. Rice
numbered blocks (dotted) order of extraction

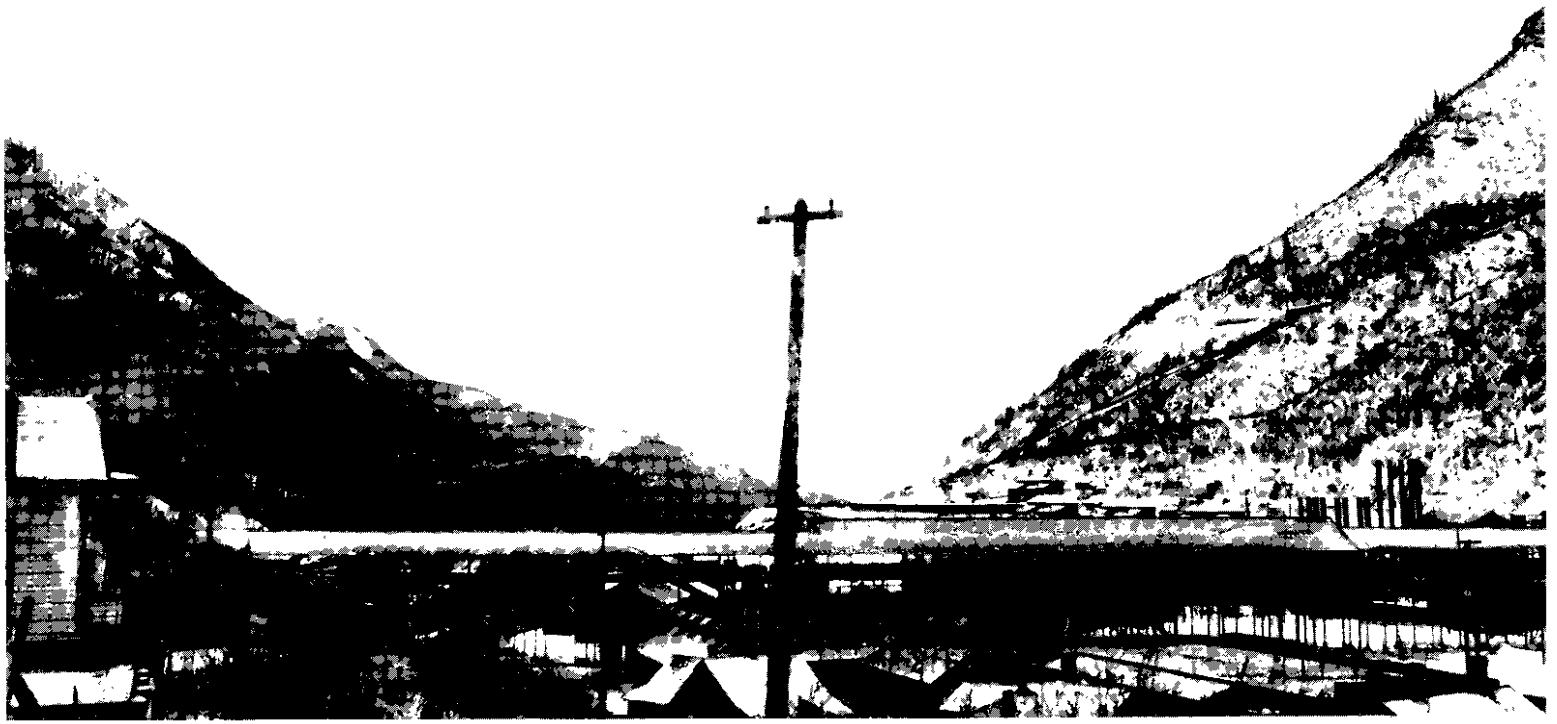
"A." Showing Steep Dips at Western Escarpment in Upper Background. View looking North-west.

"B." Showing Shoulder of North Mountain-side which is cracked away 1,200 feet vertically above No. 9 Mine, Coal Creek.



"C." Looking North across Coal Creek Valley.

"D." Looking East up Coal Creek towards Plateau.



"E." Looking West down Coal Creek.

EXHIBIT 2

SECTION OF

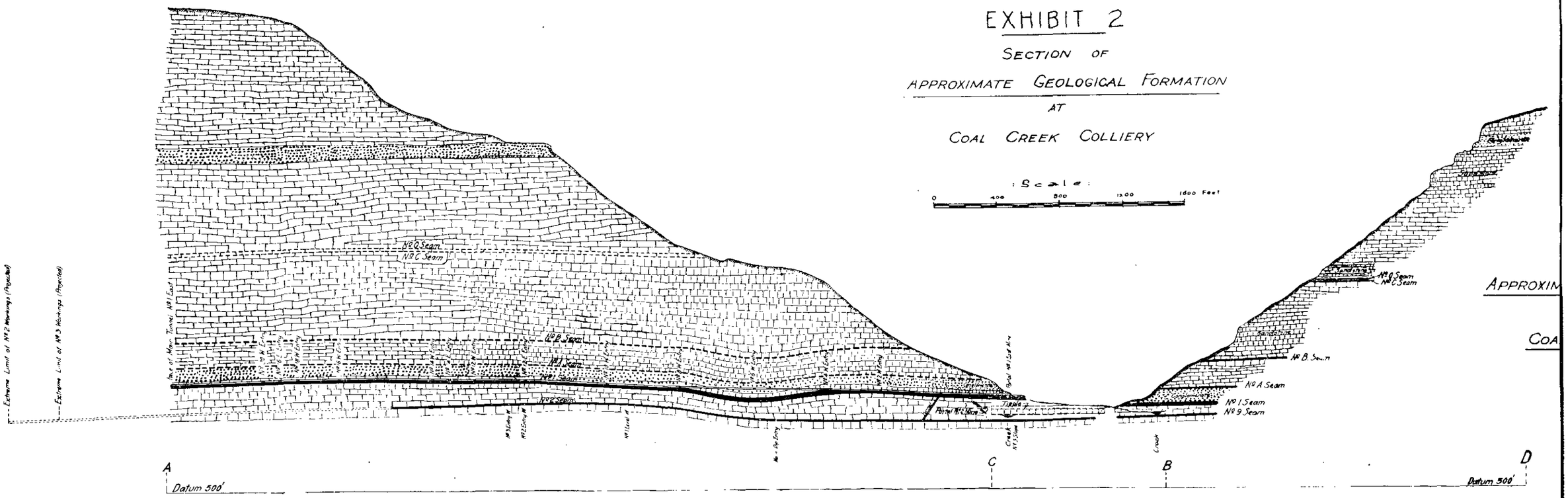
APPROXIMATE GEOLOGICAL FORMATION

AT

COAL CREEK COLLIERY

Scale:

0 400 800 1200 1600 Feet



SECTION A-B SHOWS COVER OVER No 1 EAST MAIN TUNNEL

Magnetic North

SECTION C-D SHOWS COVER OVER SEAMS ON NORTH SIDE

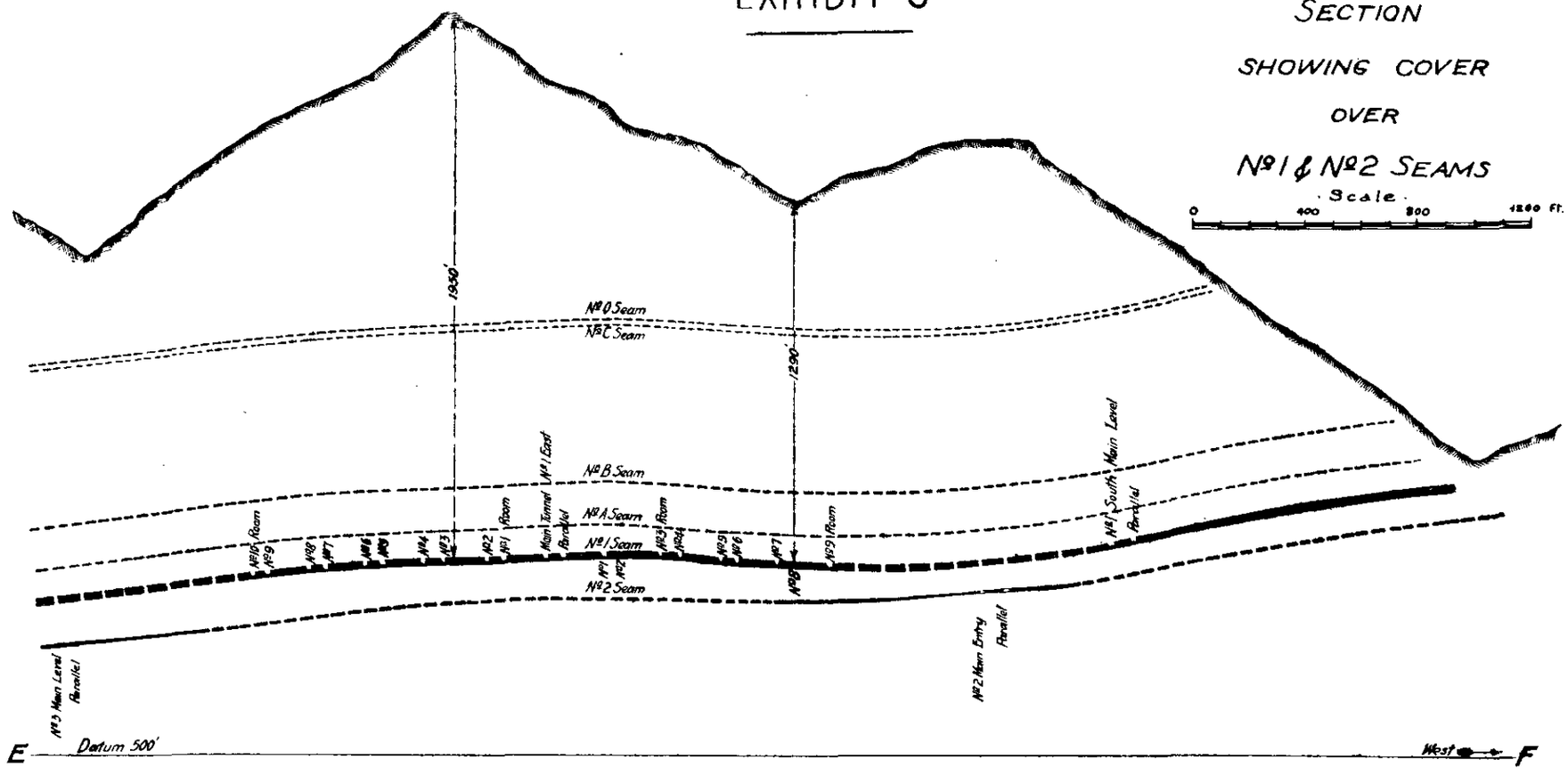
The above section was taken 800 feet West of the No 1 East Main Tunnel. Mag N 28°06'W

EXHIBIT 3

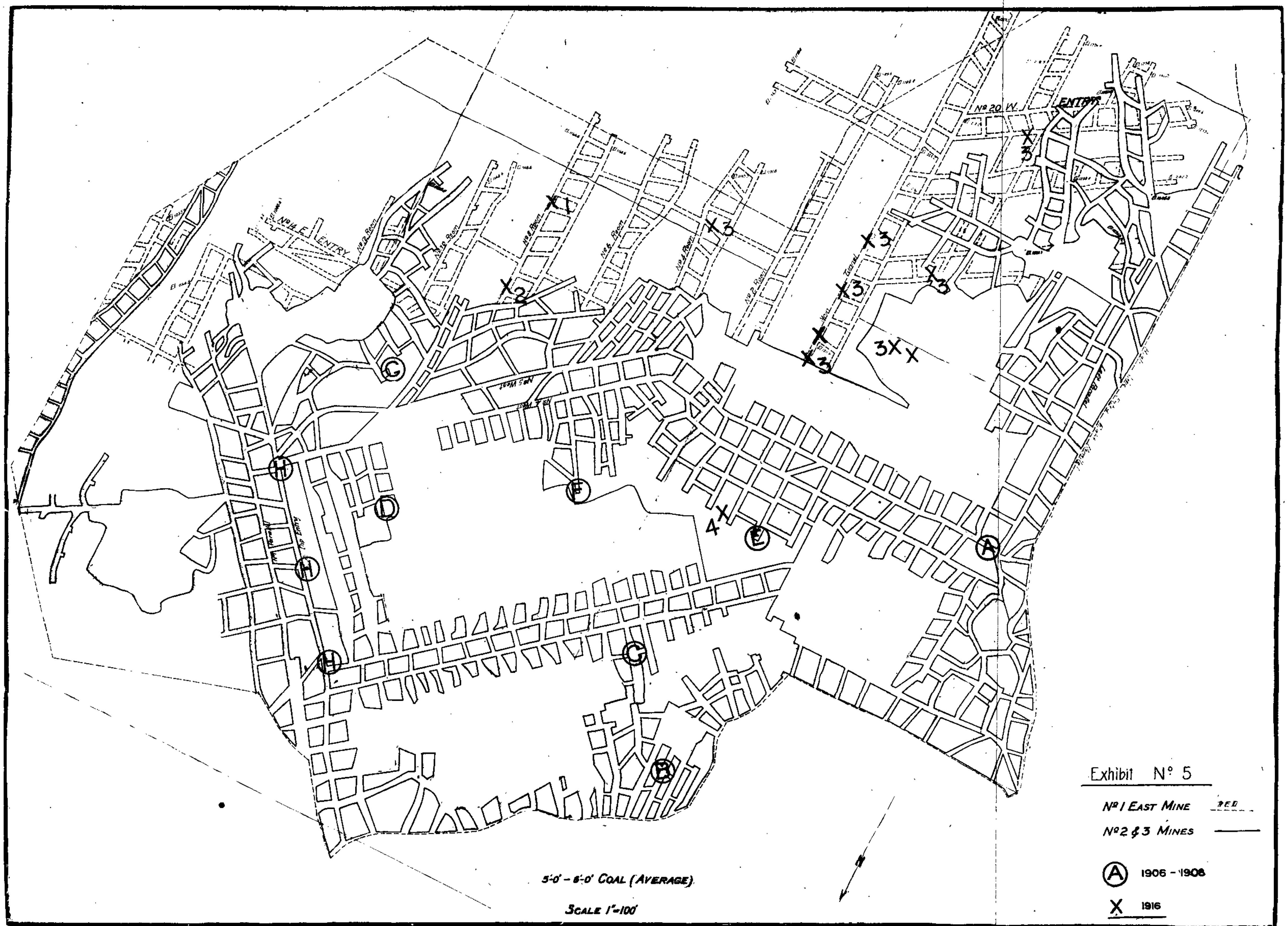
COAL CREEK COLLIERY.

SECTION
SHOWING COVER
OVER
Nº1 & Nº2 SEAMS

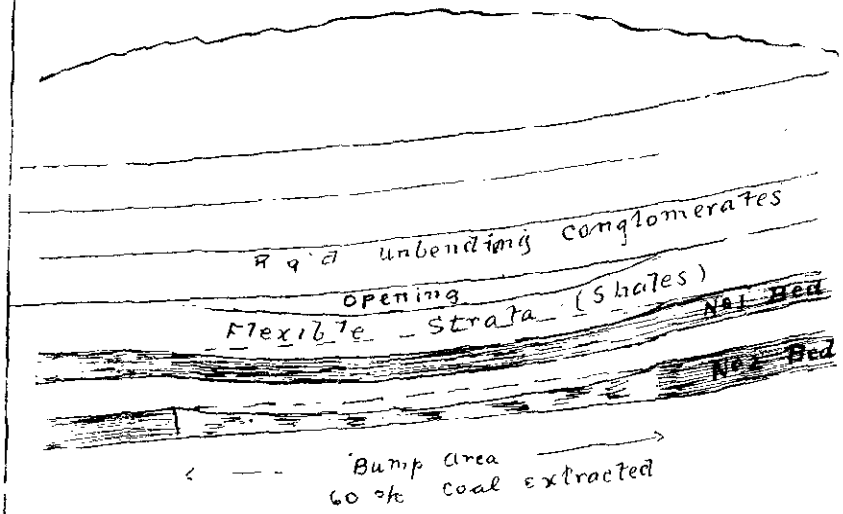
Scale.
0 400 800 1200 FT.



This Section taken 300 ft South and parallel to Nº 14 East Entry and shown as Line A-B on Contour Map

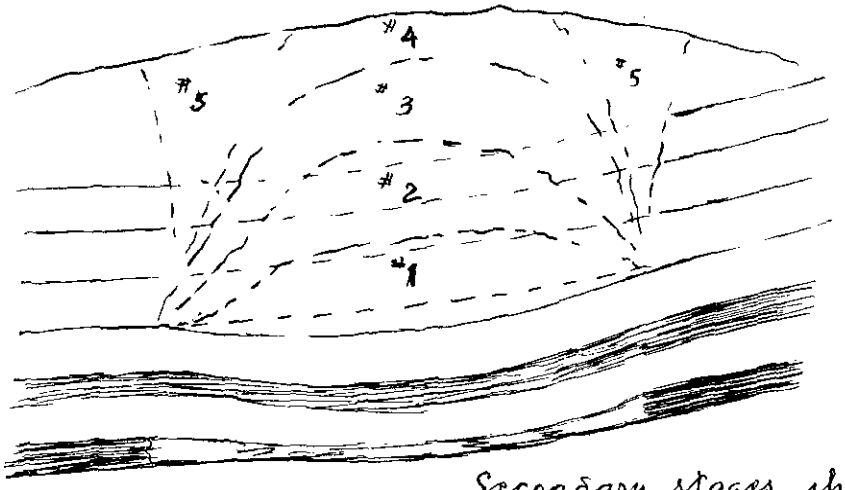


Nº 14 E. ENTRY
Nº 12 Room
Nº 10 Room
Nº 8 Room
Nº 6 Room
Nº 4 Room
Nº 2 Room
Main Tunnel
Nº 20 W. ENTRY
Nº 5 West
Nº 7 West
Air Entry
5'-0' – 6'-0' COAL (AVERAGE).
SCALE 1" = 100'
N
Exhibit Nº 5
Nº 1 EAST MINE
Nº 2 & 3 MINES
A 1906 – 1908
X 1916



Sketch profile not to scale showing conjectured sinking of flexible strata over No 2 Bed excavated (60% area with formation of wide opening under rigid beds

Exhibit N° 9



Secondary stages showing breaking of rigid beds successively until spaces are filled or surface reached The successive falls causing bump in mines below

Geo S Rice

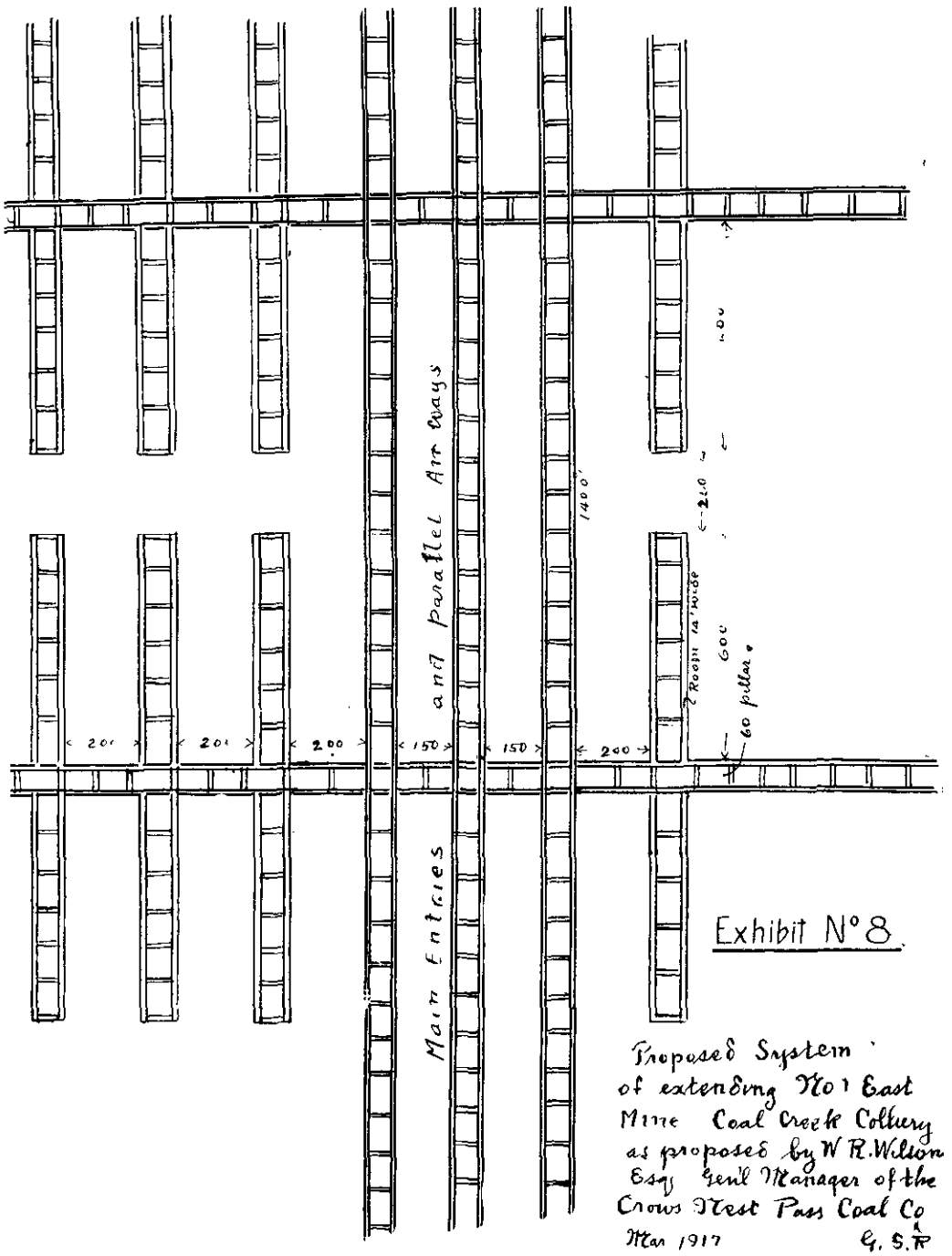


Exhibit N° 8.

Proposed System of extending No 1 East Mine Coal Creek Colliery as proposed by W R. Wilson Esq Genl Manager of the Crows Nest Pass Coal Co
Mar 1917 G. S. R

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 working 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 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 underground 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, 1917.

The Board consists of Thos. R. Stockett, of Vancouver, Chairman; Andrew Thomson, of Nanaimo, Vice-Chairman; Tully Boyce, of Nanaimo, Secretary; Geo. Wilkinson, of Victoria, Chief Inspector of Mines; Andrew Bryden, of Merritt; and Bernard Caufield, of Coal Creek.

There was one change in the personnel of the Board during the year, caused by the resignation of Thomas Graham as Chief Inspector of Mines, who was succeeded by George Wilkinson as Chief Inspector and ex-officio member of the Board.

The meetings are held in the office of the Board, Nanaimo.

Two examinations for First-, Second-, and Third-class Certificates were held during the year; the first being held on the 15th, 16th, and 17th days of May at Nanaimo, Cumberland, Merritt, and Fernie, at which there were 47 candidates, as follows: For first-class there were 14 candidates, 4 of whom passed and 10 failed; for second-class there were 8 candidates, 5 of whom passed and 3 failed; for third-class there were 25 candidates, 15 of whom passed and 10 failed.

The next examination was held on the 13th, 14th, and 15th days of November at Nanaimo, Cumberland, and Fernie; no applications being received from the Merritt Mining District, no examination was held there. At this examination there were 36 candidates, as follows: For first-class there were 9 candidates, 6 of whom passed and 3 failed; for second-class there were 6 candidates, 4 of whom passed and 2 failed; for third-class there were 21 candidates, 15 of whom passed and 6 failed.

Certificates of competency have been applied for and granted to all the successful candidates, except one first-class and two third-class, who have not yet applied (names noted on appended list).

During the year the Board had a complete set of specimen ventilation plans prepared for distribution, which was very much appreciated by prospective candidates. These specimen ventilation plans, with copies of previous questions 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 ON MAY 15TH, 16TH, AND 17TH, 1917, AT NANAIMO, CUMBERLAND, MERRITT, AND FERNIE; AND ON NOVEMBER 13TH, 14TH, AND 15TH, 1917, AT NANAIMO, CUMBERLAND, AND FERNIE.

First-class Certificates.

NAME.	DATE.	No.
Morris Wilbur Garman	Nov. 15th, 1917	
Joseph Bertram de Hart	May 17th, "	
John Cobden Hughes	" "	
Robert Laird	Nov. 15th, "	
Dudley Michell	" "	
William Harrison Moore	May 17th, "	
Samuel Kirkham Mottishaw	Nov. 15th, "	
Thomas Bowerman Williams	May 17th, "	
Ridgeway Robinson Wilson	Nov. 15th, "	

Second-class Certificates.

NAME.	Date.	No.
Walter Almond	Nov. 15th, 1917	B 213
John Bell	May 17th, "	B 212
Alexander Ewart	" "	B 208
Robert Laird	" "	B 210
John Marsh	Nov. 15th, "	B 216
Peter Millar Ramsay	May 17th, "	B 209
Thomas Tully	Nov. 15th, "	B 214
Arthur William Watson	May 17th, "	B 211
John Samuel Williams	Nov. 15th, "	B 215

Third-class Certificates.

NAME.	Date.	No.
Peter Blane Anderson	Nov. 15th, 1917	C 660
Alfred Ball	May 17th, "	C 635
Andrew Murray Bennett	Nov. 15th, "	C 661
Daniel Caldwell	May 17th, "	C 639
Samuel Campbell	Nov. 15th, "	C 662
George Carson	May 17th, "	C 663
John Charnock	Nov. 15th, "	C 653
William Devoy	May 17th, "	C 638
William Green	Nov. 15th, "	C 659
Samuel Hampton	" "	C 650
Arthur Hancock	" "	C 656
Isaac Hill	" "	C 664
Ernest Kelly	May 17th, "	C 646
Paul Laynard	" "	C 637
William Lindsay	" "	C 642
John Marrs	" "	C 640
William Morgan	" "	C 636
John Malcolm McArthur	" "	C 648
Neil McMillan	Nov. 15th, "	C 654
James William Parkinson	" "	C 655
George Harewood Perry	May 17th, "	C 643
Jasper Rutherford	" "	C 644
Francis Scarpino	" "	C 649
Charles Thomason	Nov. 15th, "	C 657
Ernest Hedley Ward	May 17th, "	C 641
William Watson	" "	C 645
Daniel Wilson	Nov. 15th, "	C 658
William Wilson	May 17th, "	C 647

Delinquents from Previous Examinations who have since received Certificates.

Second-class Candidates.

NAME.	Date.	No.
John H. Brownrigg	May 17th, 1917	B 124
John Michek	" "	B 189

Third-class Candidates.

NAME.	Date.	No.
Thomas Eccleston	May 17th, 1917	C 482
George William Nash	" "	C 565
Richardson Stephen Phillips	" "	C 620

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, "
Sharp, Alexander	October 27th, 1891
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.	NAME.	DATE.
Biggs, J. G.	July 22, 1908	Macauley, D. A.	June 10, 1911
Bonar, Robert.	Oct. 28, 1911	McCulloch, James	Sept. 10, 1910
Brace, Tom.	May 13, 1915	McGuckie, Thomas	July 22, 1908
Bridge, Edward.	July 22, 1908	McKendrick, Andrew	May 27, 1913
Brown, David.	May 21, 1914	McMillan, J. H.	Sept. 10, 1910
Brown, Robert Joyce	" 13, 1915	McVicar, Samuel	May 1, 1909
Caufield, Bernard.	" 1, 1909	Mazey, William John	Oct. 31, 1912
Church, James A. H.	June 10, 1911	Miard, Henry Ernest	May 9, "
Cox, Richard.	May 13, 1915	Michell, Dudley	Nov. 15, 1917
Crowder, James	June 10, 1911	Millar, John K.	" 22, 1906
Cunningham, John Howard.	May 9, 1912	Miller, Andrew Anderson	Oct. 31, 1912
Davidson, W. A.	" 1, 1909	Montgomery, John W.	May 1, 1909
Davies, David	June 10, 1911	Moore, Wm. H.	" 17, 1917
Davies, Thos. Owen.	May 21, 1914	Mordy, Thomas.	Sept. 10, 1910
de Hart, J. B.	" 17, 1917	Mottishaw, Sam. K.	Nov. 15, 1917
Derbyshire, James.	Nov. 9, 1907	Musgrove, J. T.	Oct. 28, 1911
Devlin, Henry.	May 1, 1909	Newton, John.	July 22, 1908
Dickson, James	Oct. 31, 1912	O'Brien, George	May 21, 1914
Elliott, Daniel.	Nov. 9, 1907	Ovington, John.	" 27, 1913
Emmerson, Joseph.	" 9, "	Peacock, Frank David	Oct. 28, 1911
Fairfoull, Robert	June 10, 1911	Penman, Hugh	May 21, 1914
France, Thos	Nov. 22, 1906	Phelan, Arthur	" 27, 1913
Fraser, Norman	Mar. 4, 1905	Powell, J. W.	June 10, 1911
Freeman, H. N.	May 1, 1909	Quinn, John Graham.	July 8, 1916
Galloway, C. F. J.	July 22, 1908	Roper, William.	May 13, 1915
Garman, Morris W	Nov. 15, 1917	Russell, John	" 21, 1914
Gascoyne, Rowland B.	May 21, 1914	Shanks, John	" 1, 1909
Glover, Francis	Oct. 31, 1912	Shaw, Alex	Nov. 14, 1905
Graham, Charles.	Nov. 14, 1905	Shaw, William	May 9, 1912
Graham, Thomas	" 9, 1907	Shenton, T. J.	Sept 10, 1910
Gray, James	" 27, 1909	Shone, Samuel.	May 1, 1909
Henderson, Robert.	" 27, "	Sloan, Hugh.	Nov. 27, "
Hewlett, Howe.	May 27, 1913	Smith, A. E.	Oct. 28, 1911
Holden, James.	" 1, 1909	Smith, Joseph.	July 22, 1908
Howden, Archibald	" 27, 1913	Spicer, J. E.	Oct. 28, 1911
Howells, Nathaniel	Oct. 28, 1911	Spruston, T. A.	Nov. 27, 1909
Hughes, John C.	May 17, 1917	Stevens, L. C.	" 27, "
Humphries, Clifford.	June 10, 1911	Stewart, R. T.	Sept. 10, 1910
Hunter, Alex. B.	July 8, 1916	Strachan, Robert	Mar. 4, 1905
Jackson, Thos. R.	Nov. 9, 1907	Strang, James.	June 10, 1911
James, William.	July 22, 1908	Thomas, J. D.	Sept. 10, 1910
Jaynes, Frank.	May 13, 1915	Thorne, B. L.	" 10, "
Jemson, Jas. W.	" 27, 1913	Touhey, James	May 21, 1914
Kellock, George	June 10, 1911	Wallbank, J.	Sept. 10, 1910
Kinsman, A. D	Sept. 10, 1910	Warburton, Ernest Leonard	July 8, 1916
Knox, T. K.	July 27, 1909	Williams, Thos. B.	May 17, 1917
Laird, Robert	Nov. 15, 1917	Williams, Thos. H.	Nov. 22, 1906
Lancaster, William	July 22, 1908	Wilson, Ridgeway R.	" 15, 1917
Leighton, Henry.	May 9, 1912	Wylie, John	July 22, 1908

SECOND-CLASS CERTIFICATES OF SERVICE.

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

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

NAME.	DATE.	Cer. No.	NAME.	DATE.	Cer. No.
Adamson, Robert	Sept. 10, 1910	B 120	Gray, David	May 1, 1909	B 76
Allan, Alex. McDairmid	May 27, 1913	B 167	Gray, George	July 8, 1916	B 207
Almond, Walter	Nov. 15, 1917	B 213	Hamilton, Robert N	May 21, 1914	B 175
Barclay, Andrew	July 29, 1905	B 25	Henderson, Robert	July 22, 1908	B 60
Baybutt, Thomas	" 8, 1916	B 206	Horrocks, Abner G	June 10, 1911	B 130
Bell, John	May 17, 1917	B 212	Howells, Nathaniel	Nov. 27, 1909	B 97
Bevis, Nathaniel	Sept. 10, 1910	B 123	Huby, Norman W	May 13, 1915	B 198
Biggs, John	May 1, 1909	B 94	Hudson, George	Sept. 10, 1910	B 121
Biggs, John G	Nov. 2, 1907	B 40	Hughes, John C	" 10, "	B 109
Blair, James	May 13, 1915	B 197	Hutton, Isaac	May 21, 1914	B 185
Brace, Tom	Nov. 27, 1909	B 96	Hutton, John	" 9, 1912	B 154
Bridge, Edward	Oct. 23, 1906	B 33	Jackson, Thos. R	Mar. 4, 1905	B 5
Brown, David	Sept. 10, 1910	B 108	James, David	Nov. 2, 1907	B 58
Brown, James L	Oct. 28, 1911	B 136	Jarrett, Fred	May 1, 1909	B 84
Brown, John C	" 23, 1906	B 39	Jaynes, Frank	Sept. 10, 1910	B 111
Brown, John Todd	May 9, 1912	B 150	John, Francis	July 8, 1916	B 200
Brown, R. J	Oct. 28, 1911	B 134	John, Howell	Sept. 10, 1910	B 122
Brown, Robert	May 21, 1914	B 183	Johnson, Moses	May 1, 1909	B 75
Brown, Robert Sneddon	" 13, 1915	B 196	Jones, William T	July 22, 1908	B 66
Brownrigg, John H	" 17, 1917	B 124	Jordon, Thos	Nov. 27, 1909	B 104
Bushell, J. P	" 1, 1909	B 81	Joyce, Walter	May 27, 1913	B 168
Carroll, Henry	July 22, 1908	B 62	Kirkwood, John Robertson	Oct. 31, 1912	B 160
Caufield, Bernard	Oct. 23, 1906	B 30	Knowles, James E	" 28, 1911	B 137
Caufield, John	July 8, 1916	B 199	Laird Robert	May 17, 1917	B 210
Cawthorne, L	May 1, 1909	B 93	Lancaster, William	Nov. 2, 1907	B 50
Challinor, Jno. Thomas	" 27, 1913	B 169	Lander, Frank	May 13, 1915	B 195
Challoner, Jno. Arthur	" 21, 1914	B 178	Lane, Joseph	" 9, 1912	B 142
Churchill, James	July 22, 1908	B 65	Lee, Robert John	Sept. 10, 1910	B 110
Clarkstone, Wm. W	May 21, 1914	B 180	Littler, Matthew	Oct. 31, 1912	B 157
Commons, Wm.	Sept. 10, 1910	B 115	Luck, George	June 10, 1911	B 128
Courtney, A. W	Oct. 28, 1911	B 138	Manifold, Albert	May 9, 1912	B 145
Cox, Richard	May 9, 1912	B 143	Marsh, John	Nov. 15, 1917	B 216
Crawford, David	" 1, 1909	B 88	Mason, Joseph	May 13, 1915	B 193
Cunliffe, Thomas	" 1, "	B 78	Massey, H	Nov. 27, 1909	B 99
Dando, John	" 27, 1913	B 164	Mather, Thomas	June 10, 1911	B 127
Daniels, David	Nov. 2, 1907	B 53	Matusky, A	May 1, 1909	B 91
Derbyshire, James	Oct. 23, 1906	B 32	Mayer, Ralph Waldo	" 9, 1912	B 144
Davidson, Hugh	May 27, 1913	B 165	Mazay, W. J	Nov. 27, 1909	B 101
Davies, Stephen	Sept 10, 1910	B 113	Merryfield, William	July 22, 1908	B 61
Dennis, Fred. W	May 21, 1914	B 174	Miard, Hy. E	Sept. 10, 1910	B 107
Devlin, Ernest H	" 21, "	B 179	Michek, John	May 17, 1917	B 189
Devlin, Henry	Nov. 2, 1907	B 44	Michell, Dudley	" 13, 1915	B 187
Dewar, Alexander	Oct. 31, 1912	B 162	Middleton, Robert	July 22, 1908	B 72
Dickenson, Clifford	May 13, 1915	B 189	Mitchell, Henry	" 8, 1916	B 201
Dunsmuir, John	Nov. 14, 1905	B 26	Monks, James	Nov. 2, 1907	B 55
Dykes, J. W	May 1, 1909	B 77	Moore, Wm. H	May 21, 1914	B 173
Eccleston, Wm	" 1, "	B 87	Morgan, John	Nov. 2, 1907	B 43
Ewart, Alexander	" 17, 1917	B 208	Morris, John	July 22, 1908	B 67
Fairfoull, James	" 21, 1914	B 186	Morton, Robert W	" 22, "	B 59
Fairfoull, R	" 1, 1909	B 83	Mottishaw, S. K	Oct. 28, 1911	B 135
Finlayson, James	July 29, 1905	B 21	Musgrave, J	May 1, 1909	B 90
Ford, Allan	May 27, 1913	B 171	Myers, Peter	" 9, 1912	B 149
Foster, W. R	Nov. 27, 1909	B 102	McDonald, J. A	Oct. 28, 1911	B 133
France, Thos	" 14, 1905	B 27	McDonald, John	May 27, 1913	B 172
Francis, David M	May 21, 1914	B 182	McFegan, W	Nov. 31, 1909	B 106
Francis, Enoch	" 1, 1909	B 86	McGarry, Martin	Oct. 31, 1912	B 156
Francis, James	July 22, 1908	B 63	McGuckie, Thomas M	" 23, 1906	B 35
Frater, George	" 8, 1916	B 204	McKelvie, J	May 1, 1909	B 92
Freeman, Henry N	Nov. 2, 1907	B 45	McKendrick, And	Sept. 10, 1910	B 112
Garbett, Richard	Oct. 31, 1912	B 161	McMillan, D	June 10, 1911	B 125
Garman, Morris Wilbur	" 31, "	B 155	McNay, Carmichael	May 9, 1912	B 151
Gillespie, Hugh	July 29, 1905	B 24	McPherson, James E	July 22, 1908	B 73
Gillespie, John	Oct. 23, 1906	B 36	Neen, Joseph	June 10, 1911	B 129
Gould, Alfred	May 13, 1915	B 190	Newbury, Arthur	May 21, 1914	B 184
Graham, Chas	Mar. 4, 1905	B 1	Newton, John	Oct. 23, 1906	B 31

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

NAME.	DATE.	Cer. No.	NAME.	DATE.	Cer. No.
Newton, Wm.	Sept. 10, 1910	B 116	Stewart, J. M.	May 1, 1909	B 95
O'Brien, Charles	May 9, 1912	B 148	Stobbart, Jacob.	" 9, 1912	B 153
O'Brien, George	" 1, 1909	B 82	Stockwell, William	Nov. 2, 1907	B 56
Ovington, John	Nov. 2, 1907	B 52	Strang, Thomas	Oct. 31, 1912	B 158
Parkinson, T.	May 1, 1909	B 80	Taylor, James	May 13, 1915	B 194
Parnham, Charles.	Nov. 2, 1907	B 49	Taylor, Thomas	July 8, 1916	B 203
Quinn, James.	May 21, 1914	B 181	Thomas, J. B.	Nov. 27, 1909	B 105
Quinn, John	" 9, 1912	B 146	Thomas, Joseph D.	Oct. 23, 1906	B 38
Ramsay, Peter Millar	" 17, 1917	B 209	Thompson, Joseph	Sept. 10, 1910	B 114
Rankin, Geo.	Nov. 27, 1909	B 103	Touhey, James	May 9, 1912	B 147
Raynes, M. T.	Oct. 28, 1911	B 139	Touhey, William	July 8, 1916	B 205
Reid, Thomas	July 29, 1905	B 23	Tonge, Thomas	" 22, 1908	B 71
Reid, Wm.	Oct. 28, 1911	B 132	Tully, Thomas	Nov. 15, 1917	B 214
Renny, James.	" 28, "	B 140	Vanhulle, Peter.	" 2, 1907	B 54
Richards, Thomas.	Nov. 2, 1907	B 57	Virgo, John	May 1, 1909	B 89
Richards, Samuel.	May 9, 1912	B 152	Walker, William	" 13, 1915	B 192
Rigby, John	July 29, 1905	B 29	Warburton, Ernest L.	" 27, 1913	B 170
Roberts, Ebenezer	Sept. 10, 1910	B 117	Watson, Adam G.	Nov. 14, 1905	B 28
Robinson, William.	July 22, 1908	B 69	Watson, Arthur W.	May 17, 1917	B 211
Rogers, George.	May 1, 1909	B 79	Webber, John Frank	Mar. 4, 1905	B 3
Roper, William.	" 9, 1912	B 141	Wesnedge, William.	Nov. 27, 1909	B 98
Russell, John	Nov. 2, 1907	B 47	White, John	" 2, 1907	B 48
Saville, Luther	" 2, "	B 51	Whitehouse, William	Oct. 31, 1912	B 163
Shanks, David.	Oct. 31, 1912	B 159	Williams, John Samuel.	Nov. 15, 1917	B 215
Shaw, Alex	July 29, 1905	B 19	Wilson, Robinson.	May 21, 1914	B 177
Shaw, Thomas John.	May 27, 1913	B 166	Wilson, Thomas	July 22, 1908	B 74
Somerville, Alex.	Mar. 4, 1905	B 4	Wilson, William.	" 22, "	B 70
Spruston, Robert Lecce.	July 8, 1916	B 202	Wood, Thos. James.	May 21, 1914	B 176
Spruston, Thos. A.	Nov. 2, 1907	B 46	Worthington, Joseph.	" 1, 1909	B 85
Stafford, Matthew	June 10, 1911	B 131			

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

NAME.	DATE.	Cer. No	NAME.	DATE.	Cer. No.
Adamson, Robert.	May 1, 1909	C 323	Bell, Fred	May 27, 1913	C 514
Allan, Alexander	Oct. 28, 1911	C 430	Bell, John	" 9, 1912	C 477
Almond, Alex.	" 1, 1907	C 252	Bennett, Andrew M.	Nov. 15, 1917	C 661
Almond, Walter.	July 22, 1908	C 286	Bennett, John.	Oct. 14, 1914	C 597
Anderson, John.	Oct. 28, 1911	C 437	Bennie, John.	June 10, 1911	C 411
Anderson, Peter Blane	Nov. 15, 1917	C 660	Beveridge, Wm.	" 10, "	C 396
Anderson, Robt.	Oct. 14, 1914	C 599	Biggs, John	Mar. 4, 1905	C 210
Angell, William	May 21, "	C 591	Biggs, Thomas	Oct. 28, 1911	C 449
Arbuckle, John.	" 13, 1915	C 622	Birchell, Richard.	" 1, 1907	C 266
Archibald, Geo.	" 21, 1914	C 569	Blair, James	" 31, 1912	C 502
Archibald, Thomas.	Oct. 28, 1911	C 454	Blewett, Ernest	July 22, 1908	C 298
Ball, Alfred	May 17, 1917	C 635	Bradley, William.	" 22, 1908	C 291
Bann, Thomas.	Oct. 31, 1912	C 494	Bridge, Edward	" 29, 1905	C 223
Baggaley, J.	July 22, 1908	C 300	Briscoe, F.	" 22, 1908	C 309
Bain, James.	May 27, 1913	C 546	Broderick, Matthew.	Jan. 21, 1913	C 525
Ball, Benjamin	" 21, 1914	C 583	Brown, Arthur A.	Oct. 14, 1914	C 596
Barker, Robert	June 10, 1911	C 415	Brown, David	Nov. 1, 1909	C 348
Barlow, B. R.	May 1, 1909	C 337	Brown, George	July 8, 1916	C 626
Barnes, B. J	" 1, "	C 346	Brown, James	Sept. 10, 1910	C 364
Bateman, Joseph William.	Oct. 28, 1913	C 551	Brown, James	June 10, 1911	C 412
Bauld, Wm	June 10, 1911	C 422	Brown, James	July 8, 1916	C 625
Baxter, Robert.	Oct 28, "	C 450	Brown, Jas. Millie.	May 13, 1915	C 615
Baybutt, Thomas.	May 27, 1913	C 548	Brown, John.	Sept. 10, 1910	C 392
Beeton, D. H.	" 1, 1909	C 338	Brown, Robert	Oct. 28, 1911	C 451

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

NAME.	DATE.	CER. No.	NAME.	DATE.	CER. No.
Brown, Robert D	June 10, 1911	C 423	Fitzpatrick, T. J	Oct. 2, 1911	C 452
Brown, Robert S	" 10, "	C 408	Flockart, David	Jan. 21, 1913	C 531
Brown, Wm. A	May 21, 1914	C 576	Ford, Allen	Oct. 28, 1911	C 445
Brown, William Gold	July 8, 1916	C 629	Fowler, Robert	" 31, 1912	C 495
Brownrigg, J. H	" 22, 1908	C 276	Francis, David Morgan	" 28, 1913	C 558
Bullen, Thomas	Sept. 10, 1910	C 379	Francis, James	" 1, 1907	C 250
Bushell, Jas. P	Oct. 1, 1907	C 264	Frater, George	May 13, 1915	C 616
Cairns, Andrew	June 10, 1911	C 420	Freeman, H. N	Nov. 14, 1905	C 230
Cairns, Robert	May 27, 1913	C 539	Frew, Andrew	" 27, 1909	C 360
Caldwell, Daniel	" 17, 1917	C 639	Frodsham, Vincent	July 22, 1908	C 282
Calverly, Joseph	Sept. 10, 1910	C 375	Furbow, John	Jan. 21, 1913	C 528
Camamile, Hollis	Oct. 28, 1911	C 443	Garbett, Richard	Sept. 10, 1910	C 377
Campbell, Samuel	Nov. 15, 1917	C 662	Gascoyne, Rowland B	Jan. 21, 1913	C 513
Carr, Peter	Oct. 31, 1912	C 497	Geater, Jas. Gordon	May 21, 1914	C 573
Carson, George	Mar. 17, 1917	C 663	Gemmell, James	Oct. 31, 1912	C 505
Catchpole, Charles	July 29, 1905	C 227	Gillham, John	May 13, 1915	C 623
Caufield, John	May 1, 1909	C 321	Glenn, James	Oct. 28, 1911	C 435
Challoner, Arthur	Oct. 28, 1911	C 433	Gordon, Davis John	May 9, 1912	C 474
Charnock, John	Nov. 15, 1917	C 653	Gourley, Robert	" 9, "	C 470
Cheetham, Ben	July 22, 1908	C 311	Gray, George	" 9, "	C 467
Chester, John	Oct. 28, 1911	C 440	Green, William	Nov. 15, 1917	C 659
Clark, Lewis	June 10, "	C 405	Greenhorn, John	May 21, 1914	C 575
Clark, Walter Pattison	May 9, 1912	C 480	Griffiths, Edward	Oct. 31, "	C 508
Clarkstone, Wm. W.	Oct. 28, 1911	C 431	Gunniss, Matthew	May 9, 1912	C 460
Cleaves, Walter	May 9, 1912	C 475	Hallinan, William	" 1, 1909	C 343
Clifford, William	July 22, 1908	C 313	Halsall, J	July 22, 1908	C 307
Commons, William	" 22, "	C 304	Hamilton, John	Oct. 28, 1911	C 444
Cooke, Joseph	Mar. 4, 1905	C 209	Hamilton, Robert Nesbitt	" 28, 1913	C 550
Coomb, Alexander	May 27, 1913	C 533	Hampton, Samuel	Nov. 15, 1917	C 650
Cope, Frank	Oct. 28, "	C 549	Hancock, Arthur	" 15, 1917	C 656
Coulthard, James	June 10, 1911	C 407	Hartley, Thomas	Oct. 31, 1912	C 510
Crawford, David	Mar. 4, 1905	C 208	Harwood, Fred	Sept. 10, 1910	C 384
Cunningham, G. F	Nov. 11, "	C 229	Harvey, Thomas	May 9, 1912	C 466
Cunliffe, Thos	Oct. 1, 1907	C 265	Harvie, George	Sept. 10, 1910	C 378
Dabb, Owen	May 21, 1914	C 578	Heaps, Robert	" 10, 1910	C 373
Dando, John	" 9, 1912	C 465	Hemer, Herbert	Oct. 14, 1914	C 595
Davidson, Hugh	" 9, "	C 464	Henney, Jonathan	June 10, 1911	C 424
Davies, Evan Thomas	" 9, "	C 463	Hendry, James	May 9, 1912	C 471
Davis, William	" 1, 1909	C 339	Heyes, Edward	" 1, 1909	C 320
Dean, Joseph	" 13, 1915	C 611	Hill, Isaac	Nov. 15, 1917	C 664
Derbyshire, A	June 10, 1911	C 401	Hilley, Fred	July 22, 1908	C 290
Dewar, Alex	Sept. 10, 1910	C 369	Hilton, R. G	Sept. 10, 1910	C 376
Devlin, Edward	Oct. 23, 1906	C 241	Hodson, R. H	Mar. 4, 1905	C 216
Devlin, Ernest Henry	May 27, 1913	C 538	Holliday, William	July 8, 1916	C 634
Devoy, William	" 17, 1917	C 638	Horbury, Joseph W	June 10, 1911	C 406
Dickenson, Clifford	" 27, "	C 532	Horrocks, A. G	May 1, 1909	C 324
Dingsdale, Geo	Oct. 28, 1911	C 459	Horwood, S	July 22, 1908	C 312
Doherty, J. J	May 1, 1909	C 340	Houston, Robert	" 8, 1916	C 631
Doney, John	Mar. 4, 1905	C 211	Howells, Nathaniel	May 1, 1909	C 316
Donnachie, John	June 10, 1911	C 425	Huby, Norman	June 10, 1911	C 394
Doodson, Robert	Oct. 28, "	C 455	Hutchison, Ben	Nov. 14, 1905	C 232
Dorrance, Orlin William	Jan. 21, 1913	C 517	Hutchison, Fred	" 27, 1909	C 358
Douglas, D. B	Oct. 23, 1906	C 235	Hynds, William	July 8, 1916	C 632
Dow, And. Y	May 21, 1914	C 587	Ireson, John	Oct. 31, 1912	C 507
Dunn, Wm	Oct. 14, "	C 606	Irvine, David	June 10, 1911	C 413
Dykes, Isaac	June 10, 1911	C 409	Jack, John	May 21, 1914	C 582
Dykes, Joseph W	Oct. 1, 1907	C 248	James, Thos	" 21, "	C 588
Eccleston, Thomas	May 17, 1917	C 482	Jardine, George Edward	Jan. 21, 1913	C 521
Edwards, John	" 27, 1913	C 542	Jarrett, Fred. J	Oct. 1, 1907	C 256
Elliott, John	" 27, "	C 541	Jaynes, Frank	July 22, 1908	C 277
Elmes, George	Oct. 31, 1912	C 511	Jemson, J. W	Mar. 4, 1905	C 205
Evans, D	July 22, 1908	C 284	Jenkins, John	Sept. 10, 1910	C 390
Ewart, Alex	Sept. 10, 1910	C 374	John, Howel	July 22, 1908	C 305
Ewing, Robert	May 13, 1915	C 608	Johnson, Moses	Oct. 1, 1907	C 258
Fairfoull, James	Oct. 28, 1911	C 453	Johnston, Robert	May 9, 1912	C 479

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

NAME.	DATE.	Cer. No.	NAME.	DATE.	Cer. No.
Jones, Alf. Geo.	May 21, 1914	C 584	McLellan, William	Mar. 4, 1905	C 219
Jones, Samuel	" 27, 1913	C 518	McLeod, James	July 22, 1908	C 296
Jones, William C.	Jan. 21, "	C 556	McLeod, John	May 13, 1915	C 609
Jones, William Ernest	Oct. 28, "	C 221	McMeakin, James	" 13, "	C 612
Jones, W. T.	Mar. 4, 1905	C 544	McMillan, D.	Sept. 10, 1910	C 363
Joshua, John	May 9, 1912	C 478	McMillan, Edward	Oct. 31, 1912	C 493
Joyce, Walter	Nov. 27, 1909	C 361	McMillan, Neil.	Nov. 15, 1917	C 654
Judge, Peter	Sept. 10, 1910	C 391	McNay, Carmichael	July 22, 1908	C 306
Keenan, Wm. James	June 10, 1911	C 426	McNeill, Adam L.	" 22, "	C 281
Kelly, Ernest	May 17, 1917	C 646	McNeill, Robert	Sept. 10, 1910	C 387
Kemp, Wm.	Oct. 14, 1914	C 594	Meek, Matthew	May 9, 1912	C 484
Kingham, Alfred	" 28, 1913	C 559	Meikle, Harry Alexander	July 8, 1916	C 627
Kirkeberg, H. S.	Nov. 27, 1909	C 350	Mercer, Jas.	Oct. 14, 1914	C 600
Lancaster, William	Oct. 23, 1906	C 243	Merrifield, George	" 23, 1906	C 239
Lane, Joseph	" 1, 1907	C 254	Merrifield, William	" 23, "	C 236
Leeman, T.	May 1, 1909	C 345	Michek, John	May 21, 1914	C 563
Lewis, Benj. J.	Sept. 10, 1910	C 386	Miles, John	June 10, 1911	C 414
Leynard, Paul	May 17, 1917	C 637	Millar, Peter	Sept. 10, 1910	C 388
Liddle, John	July 29, 1905	C 228	Mitchell, Charles	May 1, 1909	C 322
Lindsay, William	May 17, 1917	C 642	Mitchell, Henry	Sept. 10, 1910	C 366
Littler, John	June 10, 1911	C 410	Monks, James	Nov. 14, 1905	C 234
Littler, Matthew	" 10, "	C 417	Moore, George.	Oct. 23, 1906	C 242
Littler, Robert	" 10, "	C 418	Moore, John	May 1, 1909	C 335
Livingstone, Alex.	Oct. 28, "	C 436	Moreland, Thomas	July 22, 1908	C 299
Loxton, George	June 10, "	C 428	Morgan, John	July 29, 1905	C 224
Loxton, John	" 10, "	C 416	Morgan, William	May 17, 1917	C 636
Luck, George.	May 1, 1909	C 318	Morris, David	" 9, 1912	C 472
Lynch, Stewart	Oct. 28, 1911	C 432	Mottishow, Samuel K.	Oct. 23, 1906	C 237
Mackie, John.	June 10, "	C 421	Murdock, Jno. Y.	May 21, 1914	C 564
Makin, J. Wm.	Sept. 10, 1910	C 385	Myers, Peter	Oct. 28, 1911	C 446
Malone, John	May 21, 1914	C 585	Nanson, T. H.	July 22, 1908	C 280
Malone, Patrick	Oct. 1, 1907	C 247	Nash, George William	May 17, 1917	C 565
Maltman, James	" 31, 1912	C 501	Neen, Joseph	Nov. 27, 1909	C 352
Mansfield, A.	May 1, 1909	C 336	Nelson, Horatio.	Oct. 1, 1907	C 263
Marrs, John	" 17, 1917	C 640	Neilson, William	May 9, 1912	C 481
Marsh, Daniel Parks	" 27, 1913	C 543	Newman, John	Oct. 14, 1914	C 603
Marsh, John.	Oct. 1, 1907	C 270	Nicholson, James	May 9, 1912	C 469
Martin, James	June 10, 1911	C 398	Nimmo, James	" 9, "	C 461
Mason, Joseph.	July 22, 1908	C 297	Norris, Joshua	Oct. 28, 1913	C 557
Massey, Henry	May 1, 1909	C 317	Oakes, Robert	" 31, 1912	C 498
Mather, Thomas	July 22, 1908	C 293	O'Brien, Charles	Nov. 27, 1909	C 349
Matusky, Andrew	Oct. 1, 1907	C 259	Odgers, Alfred	Jan. 21, 1913	C 529
Mawson, J. T	Nov. 27, 1909	C 359	Odgers, Eli	" 21, "	C 523
Maxwell, Geo.	May 21, 1914	C 571	Orr, Alexander	Oct. 28, 1911	C 434
McAlpine, John	Mar. 4, 1905	C 217	Osborne, Hugh	" 28, 1913	C 555
McArthur, John Malcolm	May 17, 1917	C 648	Oswald, Geo. L.	Sept. 10, 1910	C 370
McBroom, Al.	July 2, 1908	C 287	Owen, Thomas	May 1, 1909	C 347
McCourt, John	Oct. 14, 1914	C 605	Parks, Alexander	Jan. 21, 1913	C 519
McCulloch, James	May 1, 1909	C 315	Parker, L.	May 1, 1909	C 341
McDonald, John	Oct. 28, 1911	C 448	Parkinson, James William	Nov. 15, 1917	C 655
McFagen, Alexander	May 9, 1912	C 490	Parkinson, T.	July 22, 1908	C 289
McFegan, W.	" 1, 1909	C 319	Parrott, Jas. E.	May 21, 1914	C 590
McGarry, Martin	" 1, "	C 326	Parson, Herbert	" 13, 1915	C 621
McGrath, James	July 8, 1916	C 630	Pearson, Jonathan	" 9, 1912	C 473
McGuckie, Jno. M.	May 21, 1914	C 562	Penman, Hugh	Oct. 28, 1913	C 552
McGuckie, Thomas	July 29, 1905	C 226	Perry, George Harewood	May 17, 1917	C 643
McGuire, Thomas	Oct. 28, 1913	C 553	Perry, James	March 4, 1905	C 215
McIntyre, Neil.	May 21, 1914	C 574	Phillips, Richard Stephen	May 17, 1917	C 620
McKelvie, J.	July 22, 1908	C 285	Pickup, A.	July 22, 1908	C 310
McKenzie, Peter	June 10, 1911	C 427	Picton, W.	May 1, 1909	C 333
McKibben, Matthew	May 21, 1914	C 580	Plank, Samuel	Nov. 14, 1905	C 233
McKinley, John	Oct. 28, "	C 442	Poole, Samuel	May 27, 1913	C 536
McLaughlin, James	May 9, 1912	C 485	Potter, Robert.	Oct. 31, 1912	C 503
McLachlan, Alex	June 10, "	C 419	Price, Walter	Sept. 10, 1910	C 371
McLean, M. D.	Sept. 10, 1910	C 389	Quinn, James	Oct. 28, 1911	C 441

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

NAME.	DATE.	Cer. No.	NAME.	DATE.	Cer. No.
Quinn, John	Oct. 28, 1911	C 429	Strachan, John	Oct. 14, 1914	C 604
Radford, Albert	May 21, 1914	C 579	Strang, James	May 13, 1915	C 614
Rallison, R.	July 22, 1908	C 279	Strang, Thomas	June 10, 1911	C 400
Rankin, George	" 22, "	C 275	Strang, Wm.	" 10, "	C 395
Rankin, Wm. Shaw	May 9, 1912	C 489	Sutherland, John	May 27, 1913	C 545
Ratcliffe, Thomas	Oct. 1, 1907	C 253	Taylor, Charles M.	Mar. 4, 1905	C 213
Raynor, Fred	" 1, "	C 257	Taylor, Hugh	Jan. 21, 1913	C 530
Reid, Robert	Sept. 10, 1910	C 383	Taylor, James	May 21, 1914	C 567
Reid, Thos.	May 21, 1914	C 592	Taylor, J. T.	Oct. 28, 1911	C 447
Reid, Wm.	June 10, 1911	C 403	Taylor, Leroy	Sept. 10, 1910	C 381
Reilly, Thomas	July 22, 1908	C 303	Taylor, Thomas	May 21, 1914	C 577
Renney, Jas.	Nov. 27, 1909	C 354	Thacker, Geo.	" 27, 1913	C 537
Richards, James	" 1, 1907	C 249	Thomas, Thomas	Sept. 10, 1910	C 365
Richards, Samuel	Oct. 23, 1906	C 244	Thomas, John B.	Nov. 14, 1905	C 231
Richardson, J. H.	" 28, 1911	C 458	Thomas, Joseph	Mar. 4, "	C 220
Rigby, John	July 29, 1905	C 225	Thomas, Warriett	Oct. 1, 1907	C 273
Roberts, Ebenezer	May 1, 1909	C 327	Thomason, Charles	Nov. 15, 1917	C 657
Robinson, Michael	" 1, "	C 332	Thompson, Thomas	Oct. 1, "	C 267
Robson, Thomas	" 21, 1914	C 566	Thompson, John	" 31, 1912	C 509
Rogers, Ellis	" 13, 1915	C 624	Thompson, Joseph	" 1, 1907	C 269
Roper, William	July 22, 1908	C 274	Thomson, Duncan	Mar. 4, 1905	C 218
Rowan, Alexander	Oct. 31, 1912	C 500	Touhey, William	May 27, 1913	C 547
Rowan, John	" 14, 1914	C 602	Tully, Thomas	" 9, 1912	C 468
Rowbottom, Thomas	" 31, "	C 492	Tune, Elijah	" 9, "	C 476
Royle, Edward	" 31, 1912	C 506	Turnbull, Matthew	Oct. 14, 1914	C 598
Russell, Robert	Nov. 27, 1909	C 351	Vardy, Robt.	May 21, "	C 570
Rutherford, Jasper	May 17, 1917	C 644	Vaughan, John Henry	Oct. 28, 1913	C 560
Rutledge, Edwin	July 22, 1908	C 302	Walker, George	July 8, 1916	C 633
Scott, Henry	" 22, "	C 294	Walker, Jas. Alexander	Oct. 31, 1912	C 496
Saunders, Eustace L.	Jan. 21, 1913	C 520	Walker, Wm.	May 21, 1914	C 586
Scarpino, Francis	May 17, 1917	C 649	Wallace, Fred	Oct. 1, 1907	C 260
Seggie, Robert	Jan. 21, 1913	C 524	Warburton, Ernest Leonard	June 10, 1911	C 399
Shanks, David	Sept. 10, 1910	C 372	Ward, Ernest Hedley	May 17, 1917	C 641
Sharp, James	May 1, 1909	C 325	Wardrop, James	Oct. 31, 1912	C 504
Sharples, J. T.	Sept. 10, 1910	C 380	Watson, Adam G.	Mar. 4, 1905	C 212
Shearer, L.	May 1, 1909	C 330	Watson, Arthur W.	May 27, 1913	C 535
Shipley, John W.	Oct. 28, 1911	C 456	Watson, George	July 22, 1908	C 288
Shooter, Joseph	" 1, 1907	C 261	Watson, Joseph	Jan. 21, 1913	C 515
Shortman, J.	May 1, 1909	C 331	Watson, William	Oct. 22, 1906	C 246
Simister, J. H.	Nov. 27, "	C 353	Watson, William	May 17, 1917	C 645
Simister, W.	May 1, "	C 334	Webb, Herbert	Oct. 28, 1911	C 457
Simms, Hubert Allan	Jan. 21, 1913	C 526	Weeks, John	Mar. 4, 1905	C 214
Sinclair, William	" 21, "	C 527	White James	Oct. 31, 1912	C 499
Skelton, Thos	May 1, 1909	C 344	White, John	" 22, 1906	C 245
Smith, A. E.	Sept. 10, 1910	C 367	Whitehouse, Wm.	June 10, 1911	C 402
Smith, Joseph	Mar. 4, 1905	C 207	Wilkinson, Edward	Oct. 28, "	C 438
Smith, Richard Beveridge	Oct. 28, 1913	C 561	Williams, John Sam.	June 10, "	C 404
Smith, Thos. J.	" 1, 1907	C 271	Williams, Watkin	" 22, 1908	C 301
Smith, Thomas	May 9, 1912	C 486	Wilson, Daniel	Nov. 15, 1917	C 658
Sopwith, Reginald Scott	Jan. 21, 1913	C 512	Wilson, Robinson	June 10, 1911	C 397
* Sparks, Edward	Oct. 1, 1907	C 255	Wilson, Thomas M.	Oct. 1, 1907	C 272
Spencer, G.	May 1, 1909	C 329	Wilson, William	" 1, "	C 262
Spruston, R. L.	Nov. 27, "	C 355	Wilson, William	May 17, 1917	C 647
Spruston, Thomas A.	Mar. 4, 1905	C 206	Winstanley, H.	July 22, 1908	C 283
Stafford, M.	Sept. 10, 1910	C 382	Wintle, Thomas A.	" 29, 1905	C 222
Starr, Wallace	May 9, 1912	C 488	Witherington, George	Oct. 28, 1913	C 554
Staton, Edward	" 21, 1914	C 581	Wood, Thos. James	" 31, 1912	C 491
Steele, Walter	Oct. 28, 1911	C 439	Worthington, J.	July 22, 1908	C 295
Stewart, George	May 27, 1913	C 534	Wright, John	May 21, 1914	C 593
Stewart, James M.	Oct. 23, 1906	C 240	Wright, Robert	" 21, "	C 589
Stockwell, William	" 23, "	C 238	Wright, William	Jan. 21, 1913	C 522

* C 314 issued in lieu of C 255 destroyed by Fernie fire.

COAL-MINE 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.	Name.	Date.	Certificate No.
Adam, Robert	Oct. 12, 1904	C 42	Marsden, John	May 3, 1904	C 21
Addison, Thos	Dec. 10, 1904	C 52	Marshall, Howard	Dec. 6, 1905	C 127
Aitken, James	Oct. 24, 1904	C 44	Miard, Harry E	March 3, 1905	C 76
Allsop, Harry	Oct. 11, 1904	C 34	Middleton, Robt	Feb. 11, 1905	C 71
Ashman, Jabez	Feb. 5, 1907	C 131	Miller, Thos. K	Feb. 21, 1905	C 74
Auchinvole, Alex	March 29, 1905	C 89	McKenzie, John R	Oct. 12, 1904	C 40
Barclay, Andrew	April 27, 1904	C 19	McKinnon, Arch'd	April 3, 1905	C 102
Barclay, James	April 27, 1904	C 20	McMillan, Peter	March 29, 1905	C 94
Barclay, John	April 17, 1905	C 111	McMurtrie, John	March 29, 1905	C 96
Bickle, Thos	Oct. 11, 1904	C 37	Moore, Wm. H	June 17, 1905	C 119
Bowie, James	May 13, 1905	C 116	Morris, John	Dec. 27, 1904	C 57
Briscoe, Edward	Oct. 10, 1906	C 129	Myles, Walter	April 3, 1905	C 100
Campbell, Dan	March 29, 1905	C 93	Nash, Isaac	June 1, 1904	C 120
Carr, Jos. E	Oct. 11, 1904	C 36	Neave, Wm	Oct. 12, 1904	C 43
Carroll, Harry	March 29, 1905	C 98	Nelson, James	April 27, 1904	C 16
Clarkson, Alexander	April 27, 1904	C 18	Newton, John	Oct. 12, 1904	C 39
Collishaw, John	Feb. 7, 1905	C 68	Nimmo, Jas. P	April 3, 1905	C 103
Comb, John	March 23, 1904	C 2	Nimmo, Richard E	April 18, 1911	C 133
Cosier, Wm	March 29, 1905	C 86	O'Brien, Geo	Feb. 6, 1905	C 66
Courtney, A. W	Nov. 2, 1904	C 45	Pearse, Thomas W. H	April 14, 1916	C 138
Crawford, Frank	April 6, 1904	C 7	Perrie, Jas	March 15, 1905	C 81
Daniels, David	April 27, 1904	C 12	Perry, James	June 13, 1904	C 27
Davidson, David	April 3, 1905	C 106	Price, Jas	Nov. 8, 1904	C 50
Davidson, John	March 29, 1905	C 87	Rafter, Wm	March 29, 1905	C 95
Devlin, Henry	Oct. 12, 1904	C 41	Reid, Thos	Nov. 3, 1904	C 47
Dobbie, John	Nov. 27, 1905	C 126	Reid, James	March 23, 1904	C 1
Dudley, James	March 22, 1905	C 114	Richards, Thos	April 27, 1904	C 14
Duncan, Thomas	Aug. 29, 1906	C 128	Ross, John	April 3, 1905	C 101
Dunlap, Henry	Nov. 21, 1904	C 51	Roughead, George	Jan. 30, 1907	C 130
Dunn, Geo	Dec. 19, 1904	C 56	Ryan, John	Dec. 28, 1904	C 59
Dunsmuir, John	March 29, 1905	C 90	Sanders, John W	April 3, 1905	C 107
Eccleston, Wm	March 15, 1905	C 80	Shenton, Thos. J	July 25, 1904	C 30
Fagan, David	April 6, 1905	C 109	Shepherd, Henry	June 13, 1904	C 26
Farquharson, John	April 27, 1904	C 17	Smith, Geo	March 29, 1905	C 84
Findlayson, James	June 6, 1904	C 25	Somerville, Alex	March 24, 1904	C 3
Fulton, Hugh T	April 3, 1905	C 105	Stauss, Chas. F	Feb. 9, 1905	C 69
Gibson, Edward	May 30, 1905	C 118	Steele, Jas	March 29, 1905	C 92
Gilchrist, Wm	March 29, 1905	C 85	Steele, John	June 4, 1913	C 4
Gillespie, Hugh	April 6, 1904	C 8	Stewart, Duncan H	March 28, 1904	C 137
Gillespie, John	April 6, 1904	C 5	Stewart, John	April 3, 1904	C 104
Gould, Alfred	April 17, 1906	C 112	Stewart, Daniel W	May 16, 1904	C 23
Green, Francis	Oct. 11, 1904	C 38	Stoddart, Jacob	Feb. 21, 1905	C 73
Handlen, Jas	June 16, 1904	C 122	Strachan, Robt	April 27, 1904	C 15
Harmison, Wm	Feb. 3, 1905	C 65	Strang, James	April 27, 1904	C 10
Hescott, John	Jan. 16, 1905	C 62	Sullivan, John	July 4, 1916	C 139
Hoggan, Wm	June 6, 1911	C 134	Thomas, John	March 29, 1905	C 97
John, David	Nov. 8, 1904	C 49	Vass, Robt	Dec. 12, 1904	C 53
John, Evan	July 25, 1916	C 140*	Vater, Charles	April 6, 1904	C 66
Johnson, Geo	May 9, 1904	C 124	Webber, Chas	Sept. 13, 1904	C 32
Johnson, Wm. R	March 1, 1905	C 75	Webber, Charles F	Sept. 13, 1904	C 33
Jones, Evan	April 30, 1913	C 136	Whiting, Geo	May 29, 1905	C 117
Kerr, Wm	March 29, 1905	C 91	Wilson, Austin	Feb. 7, 1905	C 67
Lander, Frank	Jan. 9, 1905	C 61	Wilson, Thos	April 27, 1904	C 11
Lanfear, Herbert	Jan. 27, 1905	C 63	Woodburn, Moses	March 29, 1905	C 83
Lewis, Thos	Oct. 11, 1904	C 35	Yarrow, Geo	Nov. 3, 1904	C 46
Malpass, James	Nov. 7, 1904	C 113			

* Issued in lieu of No. C 132, lost.

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 1917.

LARDEAU DISTRICT.

During the past year there has been some improvement in mining in this district; a few properties along the line of the Canadian Pacific Railway east of Revelstoke which have been closed for years have been reopened and shipments made to the smelter. In addition, development-work has been systematically followed, especially during the summer months.

In other portions of this district, near Ferguson, Trout Lake, and Duncan river, some small shipments have been made from the many properties under development, and prospecting is still active in parts. H. H. Johnstone, Inspector of Mines, who made several inspections of the operating mines, reports that the requirements of the "Metalliferous Mines Inspection Act" are being fully carried out.

AINSWORTH DISTRICT.

Mining and prospecting have been fairly active during the year in this district, excepting the first two months, when mining was delayed owing to severe frost closing off the water-supply to some extent both for milling and power purposes. Considerable development has been carried on, with promising results.

Upon inspections made of these properties I have found them in safe condition, especially where they require close timbering, and the ladder-ways, travelling-ways, and machinery have received the necessary attention to keep them in good repair.

SLOCAN DISTRICT.

This has been one of the most successful years in mining in this district, notwithstanding the shortage, for the first two months, of water for milling and power purposes; the same conditions existed in all sections of this part of the Division. More workmen were employed last year than at any previous time, and although the smelter at Trail, at which the greater amount of the products of this district is treated, was closed for several weeks at the end of the year, the mines with very few exceptions continued to operate on development.

Many new properties have been opened up, some of which shipped for the first time, and the older properties have been continuously prospected and developed with increased energy. When these mines have been inspected by myself or Mr. Johnstone we have found them complying with the requirements of the "Metalliferous Mines Inspection Act."

YMIR DISTRICT.

There has been no important change to report in the mining situation in this section, there being only one mine in operation, the *Yankee Girl*, which has been operated continuously, with an increased force during the last few months. I have always found upon inspection the requirements of the "Metalliferous Mines Inspection Act" adhered to.

SHEEP CREEK.

There is little or no improvement in the mining conditions to report from this district; the previously largest gold-producer, the *Queen* mine, has been closed during the whole year. The only other mine in the district which has been operated continuously is the *Emerald*, a silver-lead producer, while the *Second Relief* was operated intermittently. These mines when inspected have been found in a safe and clean condition.

TRAIL DISTRICT.

The principal mines of this district are situated at Rossland. Owing largely to a shortage of coke at the smelter the mines were not operated continuously during the past year, not shipping much more than half-time. During the slack period a great many improvements have been accomplished, such as improving shafts, travelling-ways, ladder-ways, airways, and haulage-ways.

The movement in the deeper mines owing to pressure causing what are known as "air-blasts" has not been so active; no doubt the cessation of mining at intervals has assisted in this direction. In an endeavour to prevent or lessen this trouble some of the large worked-out stopes which will not close or cave are being filled with waste, which will no doubt be an improvement.

The disorganized conditions of work has cooled the enthusiasm in first-aid work which once existed in this district; but now that conditions are becoming normal again, an attempt will be made to revive the old-time desire to be up to date. The same careful system is carried on as in the past with regard to safety in every department in and around these mines and works.

BOUNDARY DISTRICT.

In this district, as in the Trail District, the shortage of coke at the smelters prevented the mines from operating continuously during the first half of the year, and not until the last few weeks has the shortage been overcome. The system of mining has not been changed since my last report. The mining is performed in the same careful manner as in the past, and vigilance is exercised in keeping airways, travelling-ways and haulage-ways in safe condition.

The explosives used in these mines, as in all others in the West Kootenay and Boundary Districts, are of the low-freezing type, which renders it safer to prepare for use, as it rarely has to be thawed before using. Appended is a list of the accidents which have occurred in and around the mines of the West Kootenay and Boundary Districts for the year 1917.

EAST KOOTENAY INSPECTION DISTRICT.

REPORT OF ROBERT STRACHAN, 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, 1917.

The inspections during the first eight months of the year were made by T. H. Williams, who resigned at the end of August.

The following mines were operated during the year, or some part of the same: *Sullivan*, at Kimberley, by the Canadian Consolidated Mining and Smelting Company, which also operated the lower portion of the *St. Eugene*, at Moyie, and has leased the upper portion to J. Taylor and associates; the *Burton*, at Elko; and the *Couverapee*, at Field.

Inspector Williams also made a visit to the *Paradise* mine, in the Windermere Mining Division, but, as there were no men at work in the mine, he made no inspection.

Only one accident was reported during the year, at the *Sullivan*, where a man was seriously injured by a trip of cars. Samples of mine-air were taken at the *Sullivan* mine, a list of which is attached; the conditions reflected were fairly good. At the *Sullivan* mine the conditions as to timbering and generally around the mine were very good. A long tunnel was driven during the year to tap the ore at depth; this tunnel is over 6,000 feet long and was very well ventilated by a small power-driven fan. Generally the "Metalliferous Mines Inspection Act" is very well complied with.

At the *St. Eugene* the present work is in recovering ore which could not successfully be mined with machines; this is taken out and sacked to be sent to the smelter. There is no machinery in use. The explosives are all kept in proper magazines, and the workmen and officials are all competent workmen.

At the *Burton* mine a small amount of development was accomplished during the year under the management of J. L. Parker. The work seemed to be very well done and the Act fairly well complied with. There is no machinery, all the work being done with hand-steel. The explosives used are Polar Ammonia Dynamite.

At the *Couverapee* mine during Mr. Williams's visit all the workmen, ten in number, were engaged on repairing the trail leading to the mine.

COAST INSPECTION DISTRICT.

REPORT OF JOHN NEWTON, INSPECTOR.

I have the honour to submit my annual report of the metalliferous mines in my inspectorate for the year ending December 31st, 1917.

Britannia. J. W. D. Moodie, general manager; E. J. Donohue, secretary-treasurer; E. P. Browning, general superintendent. The *Britannia* mine, the property of the Britannia Mining and Smelting Company, is situated on Howe sound, about twenty-eight miles from the city of Vancouver, and is reached by a daily steamship service. During the previous year a large amount of development-work has been done, both in the mine and to the surface plant.

Development-work.—Raises have been driven from the 500-foot level to the surface, making a large glory-hole of the whole mountain. Another glory-hole has been in operation for the last six months at what is called the 850-foot level, which is producing a large output of ore.

Connection from the 1,050-foot level through the mountain to what is called the *Empress* side of the South valley, making three connections through the mine to the South Valley side. Another connection has been made from the 1,200-foot level to one that was started from that on the 2,200-foot level.

A new bunk-house has been built on the *Empress* side to accommodate the workmen working in that part of the mine.

The new water-tunnels from the South valley to the Beach have all been completed, the water reaching the Beach about the month of October.

During my inspection of the mine I have always found it well ventilated and the mine worked on a safe basis. Any suggestion that I may have made for the safety of the workmen has been carried out immediately.

Marble Bay. This mine is situated in the Nanaimo District, with E. F. Eastman, managing director, in charge, and E. Stephens general superintendent. The company is operating on the 900- and 1,500-foot levels and a considerable amount of diamond-drilling has been done to prove the ore-bodies, with fairly satisfactory results.

When last I visited the mine I found it well ventilated and in a safe condition.

Machinery installed: One 10-drill Rand compressor; one 4-drill Ingersoll compressor; one Lidgerwood hoist; two return-tubular boilers, 84 and 96 horse-power respectively; one 10-k.w. generator.

Retriever Group. This group is situated on the west side of the island. A tunnel is in a distance of 300 feet. When I visited the mine only four men were working underground.

No other mines on this island were operating when I last visited the island.

NORTHERN INSPECTION DISTRICT.

REPORT OF J. H. MCMILLAN, INSPECTOR.

I have the honour to submit my second annual report as Inspector of Mines under the "Metalliferous Mines Inspection Act" for the Skeena, Omineca, Portland Canal, and Atlin Mining Divisions.

The mining industry of northern British Columbia during the past year has been exceptionally active and encouraging from a productive point of view. The larger operating mines have not only maintained a normal production, but in some cases have increased their output considerably, particularly the Granby Consolidated Mining, Smelting, and Power Company, Limited. The daily output of this mine is now around the 3,000-ton mark, and may now be classed as the largest producing copper-mine in the Province.

The labour question in this northern country is one that presents many difficulties from an operating point of view, and during the year considerable difficulty was experienced in getting sufficient labour to keep the mines running at capacity. The class of labour available was of a very mixed character, and it is gratifying to note that under such conditions the number of serious and fatal accidents have been very small as compared with previous years.

During the year the Belmont Surf Inlet Mines, Limited, operating on Princess Royal island, completed and put into operation its mill and flotation plant, and up to the present the results have been highly satisfactory.

The plant was built to handle 250 tons daily; however, the property is showing up so well that there is a possibility of additional machinery being installed to double the present production. This company is also developing the *Pugsley* property, which is a continuation of the same mineralized zone as that on which the *Surf Inlet* mine is located, and the development-work so far has been very encouraging.

The *Rocher Déboulé* mine, operating in the Hazelton district, has maintained a fair production during the year. Development-work on this property, particularly on the lower levels, has been carried on all year, with encouraging results.

The *Silver Standard* mine, also situated in the Hazelton district, operated more or less steadily during the entire year. The owners of this property are installing a Faust gravity concentrating plant and mill, also power plant, with the view of mining on a much larger scale than formerly.

The Telkwa coalfields are again receiving considerable attention from various quarters, and contain in places an excellent quality of steam and domestic coal.

The chief drawback to the opening-up of these coalfields at present is the problem of transportation. The fields that are of commercial value are in most cases from fourteen to forty miles from the trunk line of the Grand Trunk Pacific Railway and the intervening country mountainous, which would mean a high cost in railway-construction. The coafield is badly broken up in places and tilted beyond recognition. There are sections of this field on the higher plateaux that are of commercial value, and which have not been disturbed to as great an extent as the lower-lying portions.

The following are the principal operating mines and the districts in which they are located:—

OBSERVATORY INLET.

Hidden Creek. This mine operated steadily during the entire year. The general conditions throughout the mine are satisfactory, and many new and novel features have been adopted for the purpose of reducing the number of accidents to a minimum. It is gratifying to be able to report that the efforts of the management in this respect have been very successful, and that the number of fatal and serious accidents during the year have been small as compared with previous years.

This mine has not only maintained its former output, but has increased it almost 100 per cent. by the installation of heavier rolling-stock on the 385-foot level, which is the main shipping-level from the mine to the crusher-bins. The entire track on this level has been relaid with 45-lb. steel, and the track-gauge increased from 24 inches to 36 inches. The new cars used on this level have a capacity of 140 cubic feet as against 75 cubic feet of the former cars, which have for the present been transferred to the upper levels. Two 12-ton Westinghouse motors have been installed on the 385-foot level, replacing the former 6-ton type.

The result of this additional equipment is that the production can be practically doubled without increasing the staff to any great extent, and on the whole the present haulage arrangements are a great improvement on the old system in so far as safety is concerned. The present output of the mine is around the 3,000-ton mark a day.

The system of mining is chiefly open-stope and glory-hole work, and the underground workings are becoming quite extensive. A departure from the open-stope system of mining is being made on the 385-foot level, and I understand the ore-bodies lying below this level will also be worked on the shrinkage system. This system will afford better and safer working conditions, and will greatly reduce the number of accidents due to falls of rock from the back and walls of the stopes. In this new system of mining bulldozing-chambers are provided and cut out of the solid rock, and are reached by separate manways from the main levels. The adoption of these chambers will do away with the antiquated and rather dangerous practice of bulldozing in the chutes on the shipping-levels.

Safety-first work has been vigorously pursued at this mine during the year, and it is gratifying to note the interest the employees are taking in the movement. The various officials of the company and heads of departments have taken a keen practical interest in the work, and there is no doubt whatever but that the co-operation of the management and employees in this respect has to a considerable extent contributed to the results achieved.

First-aid work has also been given some attention during the year; lectures were given by the local physicians throughout the year, and over forty men have secured certificates of competency in first aid to the injured. A number of first-aid stations have been installed both inside and outside of the mine, each containing the necessary materials for the treatment of any accidents that may occur in the vicinity.

A station in connection with mine-rescue work has also been built and equipped with several sets of up-to-date Draeger apparatus. Dudley Michell, the Government Instructor in first-aid work, visited the mine during the year, and examined several teams of men in mine-rescue work, all of which passed very successfully and secured diplomas,

Samples of the air of this mine were taken by me at various times during the year, and the analyses of these samples show that the mine atmosphere is in general comparatively free from injurious or explosive gases.

The old style of bunk-houses at this mine is now a thing of the past; each man has his own iron bedstead and mattress, and the rooms are kept in a strictly sanitary condition. The wash-house and dry at the mine are modern in every respect and are kept in an absolutely sanitary condition at all times.

Several new cottages and apartment blocks have been built at the mine for the convenience of the married employees, and are rented out at very reasonable rates, and have all the conveniences of the modern home.

The hospital at the mine is well equipped and a physician in attendance continually. The general hospital is situated at the beach; it is thoroughly up to date and governed by a highly proficient staff of nurses, with Dr. J. Broe in charge.

Quartz Point. This mine, operated by the Granby Company, is situated across the bay from the town of Anyox, and has been worked more or less continually during the entire year. The material mined is quartz, which is used exclusively at the smelter for fluxing purposes. The vein is opened up by a series of tunnels along the shore-line. The general system of mining is stope and pillar, and the output runs from 40 to 150 tons a shift.

The conditions throughout this mine are exceptionally good, the walls are strong and require little timbering, and the discipline appeared at all times to be excellent. The bunk-houses, etc., are comfortable and are kept in strict sanitary condition. Samples of the mine atmosphere were taken during the year, and analyses of these show the ventilation to be very good.

May Quartz-mine. This mine is situated at the head of Observatory inlet and is operated only during the summer months. The material mined is barren quartz, and, like the *Quartz Point* mine, the entire output is used for flux at the smelter. The vein is reached by a short tunnel, and has been drifted on for some distance on both sides. The system of mining is overhand stoping. The walls are exceptionally strong and require but little timbering.

The general conditions are very good and the sanitary requirements at the camp well looked after. Samples of the air of this mine were taken during the year, and analyses of these show the mine atmosphere to be exceptionally good.

Maple Bay. This mine is situated on Portland canal; it was operated more or less during the year, but was closed down temporarily during December on account of climatic conditions. The output of this mine is used also for flux at the smelter, and several shipments were made during the summer months.

The vein runs from 6 to 8 feet wide and dips at 45 degrees. The operations have been confined chiefly to drifting on the vein, the main tunnel being in slightly over 1,200 feet from the portal. Very little timbering is necessary.

The main tramway from the dock at the beach is 3,500 feet long and is operated by a 4-ton gas-driven locomotive. The ore is lowered from the mine to the tramway bins by a 12-horse-power American hoist, over a tramway 500 feet long and having an average grade of 25 per cent.

The equipment consists of one return-tubular boiler, 50 horse-power, with oil-burners attached, and an air-compressor of 450 cubic feet capacity. The general conditions are good and all buildings kept in a strictly sanitary condition.

Macy. This mine is situated near the head of Alice arm and consists chiefly of open-cut work. The material mined is barren quartz for fluxing purposes. The general conditions are all that could be desired, and the various rules

of the "Metalliferous Mines Inspection Act," in so far as operations are concerned, fully observed. The sanitary conditions are excellent.

During my various visits to the mines operated by the Granby Company I have at all times found the requirements of the "Metalliferous Mines Inspection Act" fully observed, and the daily reports as to the condition of the underground workings and machinery entered up to date.

ALICE ARM DISTRICT.

Dolly Varden. This mine, owned by the Dolly Varden Mines, Limited, is situated eighteen miles inland from the head of Alice arm, which branches off from Observatory inlet a few miles below Granby bay. The mine was operated more or less steadily during the year, the operations consisting chiefly of drifting on the Nos. 1, 2, 3, and 4 levels, which are now in 125, 400, 60, and 600 feet respectively. The Nos. 1, 2, and 4 levels are connected by raises for ventilation purposes, No. 3 tunnel being a new development.

No large shipments have as yet been made, the idea of the management being to get the mine into shape to produce a good tonnage as soon as the railway from tide-water to the mine is completed. This railway is now completed for nine miles.

Considerable diamond-drilling was done on the property during the summer, which has proved the ore-bodies to be very extensive and the values satisfactory. The chief metal content is silver.

It was expected the railway from tide-water to the mine would be completed during the year, but owing to a scarcity of labour, and difficulty in getting the necessary material, this was found to be impossible.

The management intended taking out some ore during the winter months by packing from the mine to the end of the steel, but these arrangements had also to be cancelled owing to the abnormal climatic conditions that prevailed in the district during the fall.

No additional machinery of note was installed during the year. The general conditions in and around the mine are satisfactory.

Molybdenite Co. Very little work has been done on this property during the year. At the present time the mine is closed down entirely.

HAZELTON DISTRICT.

Rocher Deboule. This mine is situated on the north side of Rocher Déboulé mountain and is reached by trail ten miles in from Skeena Crossing, a station on the Grand Trunk Railway. The mine was operated more or less steadily during the entire year. Development-work during the year on the main vein has not been as encouraging as was anticipated, but it is quite possible that the hopes of the management will yet be fully realized by further exploration. No new mining equipment of any kind has been installed during the year.

During the year one fatal accident occurred at this mine, due to some vein-filling sloughing away from the foot-wall of the No. 3 vein, 1,200-foot level, near the face of the drift. The accident in itself was very simple and could have been avoided had those in charge of the work in this drift paid a little closer attention to the condition of the walls. It appears to me to be a very difficult matter to get the foreign element employed in the mines of this northern country to fully appreciate the responsibilities, not only with regard to their personal safety, but their duty towards their fellows.

The general conditions in and around this mine are very good, and are fully in accord with the requirements of the "Metalliferous Mines Inspection Act." The reports as to the condition of the underground workings, etc., and machinery are entered up daily, and on my several visits were always entered to date.

Delta Copper Co. The property owned by this company is situated on the south side of Rocher Déboulé mountain. Operations during the year have been chiefly confined to construction-work. Considerable machinery and equipment has been taken in and partly installed. The company owns the *Delta* and *Highland Boy* groups of mineral claims, and did a little development on each during the year, from which two car-loads of ore was shipped out. The general conditions are very favourable, and the requirements of the "Metalliferous Mines Inspection Act" fully observed.

Silver Standard. This mine, which is situated on Glen mountain about seven miles from the town of New Hazelton, was operated steadily up till the end of July, when operations were temporarily suspended until such time as the new concentrator which is now under construction is completed.

A new power plant is being installed at the mine, consisting of one Chicago pneumatic air-compressor with a capacity of 350 cubic feet of air at 100 lb., driven by a 60-horse-power Atlas gas-engine. A Sullivan drill-sharpener has also been installed in the new blacksmith and machine shop built near the portal of the 250-foot tunnel, and new boarding and mess houses built to take care of 100 men. A 3½-ton Packard motor-truck has been purchased which will be used for conveying the ore from the mine to the mill, a distance of three miles. The company has made considerable improvements on the road leading from the mine to the mill, so that the truck may operate throughout the entire year. A water-conduit has been installed from a point on Two-mile creek to the mill, a distance of one mile.

New mess and boarding houses are being built at the mill camp, which is about five miles from New Hazelton; also ore-bunkers with a capacity of 600 tons. The mill being installed is the Faust gravity system, and consists of one 9 x 15 Champion ore-crusher, three sets 18 x 36 rolls, two sets of jigs, five-compartment rougher, six-compartment cleaner, three Faust type tables, together with settling-tanks, conveyors, classifiers, screens, etc. Provision is also being made for the installation of flotation-machines, which may be added later if found necessary.

Power for the mill will be supplied by a 75-horse-power return-tubular boiler, operating a 60-horse-power steam-engine. The entire plant will be completed by February.

The general conditions in and around this mine are excellent. Several samples of the mine-air were taken by me during the year, and in each case were found to be free from injurious gases. The provisions of the "Metalliferous Mines Inspection Act" are fully observed, and the daily reports as to the condition of the mine-workings and machinery entered to date. No serious accidents of any kind occurred at this mine during the year.

American Boy. This mine, owned by the Harris Mines, Limited, is situated on Nine-mile mountain, about nine miles from New Hazelton. Very little work has been done on the property during the year. The workings consist of an inclined shaft which has been sunk for a distance of 300 feet. Levels have been turned off at intervals from the shaft and drifted on for some distance on each side of the shaft. The general conditions are in accord with the requirements of the "Metalliferous Mines Inspection Act."

Hazelton View Group. This property, owned by the New Hazelton Gold-Cobalt Company, is situated on the north side of the Rocher Déboulé mountain, at an elevation slightly over 5,400 feet. The principal workings consist of an adit-tunnel which follows the vein for a distance of 700 feet. An aerial tramway has been installed on the property and extends from the portal of the tunnel to a point half a mile down the mountain. The ore is sacked at the mine and conveyed over this tramway, and later packed over trail to the Grand Trunk Railway, a distance of about five miles. The general conditions are all that could be desired and are in full accord with the requirements of the "Metalliferous Mines Inspection Act."

Cap Group. This property, owned by Denis Comeau and partners, was operated for a short time during the summer months and a little development done. At present the property is inactive. The general conditions are favourable and in accord with the requirements of the "Metalliferous Mines Inspection Act."

Golden Wonder. This mine, owned by D. Sutherland and associates, is situated on the north side of the Rocher Déboulé mountain and is reached by trail from Hazelton. An inclined shaft has been sunk for a distance of sixty feet. At the time of my visiting the property some open-cut work was also being done on another vein west of the shaft. The general conditions were satisfactory and in accord with the requirements of the "Metalliferous Mines Inspection Act."

COAST DISTRICT.

Surf Inlet. This mine is situated on Princess Royal island, about 150 miles from Prince Rupert, and is owned by the Belmont Surf Inlet Mines, Limited; W. F. Holler, superintendent. The best part of the year was taken up in the construction of the mill and flotation plant and the installation of other necessary machinery.

The entire plant was completed and put into operation in August, and since that time has been operating steadily with excellent results. The present mill capacity is 250 tons a day, but I understand that additional plant will be installed to handle twice the above tonnage.

The mine proper is in good shape, and the walls, generally speaking, are strong and require but little timbering, with the exception of one point where it will be necessary to square set. The system of mining is overhand stoping. The mine will be illuminated throughout with electricity and all haulage underground done by storage-battery locomotives. At the present time two 6-ton storage-battery locomotives are operating on the main shipping-level.

The mine-workings are in good condition, ventilation is also fair, and the general discipline satisfactory. The quarters for employees are very comfortable; the rooms are steam-heated and kept in a strictly sanitary condition. Recreation-rooms are also being provided and a number of cottages are being built. An up-to-date hospital is being built at the mine and will be supervised by competent nurses and a resident physician. The general conditions are entirely satisfactory, and with one or two exceptions the "Metalliferous Mines Inspection Act" has at all times been strictly observed. The daily reports as to the condition of the mine-workings and machinery are kept entered up to date.

The power plant at the mine consists of two Leonard return-tubular boilers, 50-horse-power each, and tested to 150 lb. a square inch, and one Ingersoll Rand air-compressor with a capacity of 1,200 cubic feet at 100 lb. per square inch, coupled to a 250-horse-power alternating-current motor. The entire plant is electrically operated, the power being conveyed from the power station situated near tide-water at the head of Surf inlet.

LIST OF ACCIDENTS IN METALLIFEROUS MINES, 1917.

REPORT BY JAMES McGREGOR, AND T. H. WILLIAMS, INSPECTORS.

No.	Mine.	Date.	Name.	Occupation.	Details.
1	Centre Star, Rossland..	Jan. 2	J. A. McLean.	Miner.....	Died on January 2nd, 1917, from injuries received on September 1st, 1916, caused from air-blast.
2	Utica, Kaslo	" 18	Otto Arvison..	Mucker.....	Struck by falling timber, causing ruptured kidney.
3	Utica, Kaslo	Feb. 2	G. Stedili....	Miner.....	Bruised and sprained back, caused by fall of rock.
4	Le Roi No. 2, Rossland.	" 18	W. J. Farney..	Compressor-[engineer	Amputation of left forearm, fractured right arm, caused by coming in contact with electric wires while cleaning machine, which rendered him unconscious.
5	Le Roi, Rossland .. .	Mar. 14	Mike Notti....	Nipper.....	Fracture of skull; fatal. Presumed to have met with accident on turn-sheet.
6	Granby, Phoenix	" 31	A. Thomas....	Brakeman ..	Fractured fingers with laceration, caused by falling rock from chute.
7	Le Roi, Rossland	Apr. 14	A. L. Acorn...	Timberman..	Muscles of left arm severed, caused by falling rock.
8	Le Roi, Rossland.....	" 14	R. Bridgeman.	" ..	Muscles of right arm lacerated, caused by falling rock.
9	Sullivan, Kimberley....	May 14	Geo. B. Drury.	Miner	Crushed and dragged along with trip of cars, causing fracture of three ribs, right forearm, small umbilical hernia, extensive abrasions of back, arms, legs, and probable rupture of left kidney.
10	War Eagle, Rossland...	June 13	Robt. Gordon..	Motorman...	Burn on right shoulder, caused by electricity.
11	Florence, Ainsworth ..	" 18	Jas. Morkette.	Miner.....	Rock fell from hanging-wall, causing concussion of brain and broken leg; fatal.
12	Bluebell, Ainsworth ...	July 1	Louis Taidich .	"	Tops of three fingers of left hand taken off between hoisting rope and drum.
13	Bluebell, Ainsworth....	Aug. 30	Fred Paulson..	"	Killed by box of powder going off from unknown cause.
14	Bluebell, Ainsworth....	Aug. 30	F. Adamanti..	Mucker.....	Same accident as above; fatal.
15	Bluebell, Ainsworth....	" 30	N. Uzelac.....	Miner.....	Same accident as above; fatal.
16	Motherlode, Greenwood	Sept. 25	Jas. Poggie....	"	Bruised toe, caused by falling rock.
17	Sovereign, Sandon.....	" 30	C. Cunningham	Manager....	Broken leg at ankle, caused by falling down ladder-way.
18	Bluebell, Ainsworth....	Oct. 9	C. Poly.	Mucker.....	Lacerated left hand, caused by rock rolling out of chute.
19	Yankee Girl, Ymir.....	" 10	Tom Mazura ..	"	Leg pinned under overturned car, causing bruised and cut ankle.
20	No. 1 Mine, Ainsworth.	" 17	Frank Dearin.	Labourer....	Head crushed by timber rolling off a wagon; fatal.
21	Granby, Phoenix	" 18	John Nerhus..	Miner	Killed by falling slab of rock.
22	Bluebell, Ainsworth....	" 21	H. Holmberg..	"	Scalp-wound, caused by falling rock.
23	Bell, Beaverdell	" 27	Chas. Oliver...	"	Bruises about head and body, caused by falling against timbers.
24	Bluebell, Ainsworth....	Nov. 9	Anthony Bolo.	"	Bruised hip by being caught between skip and timbers.
25	Le Roi No. 2, Rossland.	" 14	Wm. Jones....	"	Badly shaken up by drilling into missed-fire shot, which exploded.
26	Le Roi No. 2, Rossland.	" 14	John Tomich..	"	Badly injured in all parts of body, with eyesight in danger of loss. Same accident as above.
27	Bell, Beaverdell	" 27	John Larson ..	Tool-[sharpener	Bruises to chest, caused by falling off a skid.
28	Hewitt, Silverton	Dec. 10	E. Stathis.....	Mucker	Fell down raise, sustaining fractured base of skull; fatal.

REPORT BY ROBERT STRACHAN AND JAMES MCGREGOR, SIMILKAMEEN DISTRICT.

29	Iron Mask, Kamloops..	Jan.	13	Joseph Moore.	Diamond-[drill helper	Neck and back broken between skip and foot-wall plates of shaft; fatal.
30	Nickel Plate, Hedley...	Mar.	25	Lemuel Fife...	Miner	Drilled into unexploded powder in hole; fatal.
31	Nickel Plate, Hedley...	Mar.	25	Daniel Rankin.	"	Same accident as above; fatal.
32	Horn Silver, Similka-meen	July	10	C. L. Condit ..	"	Severe cuts on head, back, and legs, caused by falling rock.
33	Nickel Plate, Hedley...	Nov.	28	Mike Iverich ..	Nipper.....	Severe injuries about head and face, caused by being dragged by broken cable after a runaway.

REPORT BY JOHN NEWTON AND J. H. MCMILLAN, COAST DISTRICT.

34	Hidden Creek, Anyox..	Feb.	9	Mike Radeka..	Miner	Killed by falling rock from back of stope.
35	Hidden Creek, Anyox..	"	16	F. Armstrong .	"	Carried through grizzly and into pocket, causing severe laceration of scalp and badly broken forearm.
36	Britannia.....	May	19	Alex. Basero..	Mucker	Large scalp-wound and back injured by falling rock.
37	Britannia.....	"	25	Wm. Vyse....	"	Fractured left femur, bridge of nose, left cheek-bone, laceration of head and hands, caused by powder going off.
38	Britannia.....	"	30	Carl Olson	Miner.....	Fell through grizzly to chute below, with fatal results.
39	Marble Bay, Vananda..	"	31	J. Burghiner..	"	Rock fell from back, causing a scalp-wound.
40	May-Beatrice, Anyox ..	June	21	Nick Gullune..	Labourer....	Skull fractured by fall of rock; fatal.
41	Hidden Creek, Anyox..	July	11	P. A. Gustafson	Brakeman ..	Crushed between end of car and side of chute; fatal.
42	Britannia.....	"	31	James McDade	Skip-tender .	Right ankle fractured between car and rail on skip.
43	Coast Copper Co. Quat-sino	Aug.	12	David Spooner	Miner.....	Foot crushed between end of skip and floor.
44	Rocher Déboulé, Hazel-ton	"	20	John Lepetech	"	Killed by falling rock from hanging-wall.
45	Britannia.....	"	20	B. Tonelli	"	Loss of thumb and first finger of left hand, caused by attempting to remove unexploded cap from fuse.
46	Marble Bay, Vananda..	Dec.	5	R. J. Hazard..	"	Bruises on body, caused by drilling into unexploded powder.
47	Surf Inlet.....	"	7	Otto Harditkka	Mucker.....	Rock fell from roof, causing scalp-wound and bruises.
48	Hidden Creek, Anyox..	"	12	Joe Tokoff....	Crusher-bar-[man	Corneal laceration, caused by drilling into unexploded powder.

TABULATED LIST OF ACCIDENTS IN METALLIFEROUS MINES, 1917.

	Cause of Accident.	Extent of Injury.			
		Fatal.	Serious.	Slight.	Total.
A	Blasting	3	..	1	4
B	Defective powder	..	..	..	..
C	Drilling into old holes containing powder	2	2	1	5
D	Powder in muck	..	1	..	1
E	Shafts and cages, accidents connected with	1	1	2	4
F	Falling down shafts, stopes or winzes	1	1	2	4
G	Falling down chutes	1	..	..	1
H	Mine-cars	1	2	1	4
I	Rock falling in stopes, levels, etc	5	..	5	10
J	Rock falling down chutes or openings	1	3	2	6
K	Timbering	..	1	..	1
L	Miscellaneous, underground	1	..	2	3
M	Miscellaneous, surface	1	1	3	5
	Totals	17	12	19	48
	Accidents for each 100,000 tons ore mined	0.615	0.434	0.688	1.737
	Accidents for each 1,000 men employed	3.1	2.2	3.5	8.8

COAL-MINING IN BRITISH COLUMBIA.

BY WM. FLEET ROBERTSON, PROVINCIAL MINERALOGIST.

During the year 1917 there was mined in the various collieries of the Province 2,398,715 tons (2,240 lb.) of coal, a decrease from the preceding year of 86,865 tons, equivalent to nearly 3.1 per cent.

While the total figures for the Province thus show a decrease, this is wholly attributable to a diminished production in the Crowsnest District—a decrease of 330,519 tons, which more than absorbed increases of 202,960 tons in the Vancouver Island District and of 40,694 tons in the Nicola-Princeton District.

The Crowsnest District in 1917 was still suffering from the "bumps" and explosions of the previous year, and again in 1917 was the scene of another explosion in April, all of which seriously curtailed the output of the Crow's Nest Pass Coal Company.

In addition to this, the scarcity of labour, together with labour troubles both at the collieries and smelters, reduced the output of coke by nearly 40 per cent.

The following table shows, for the past ten 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
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
1916	East Kootenay District	882,270	1,674	527	1,125	784
	Coast District	1,603,310	3,386	474	2,569	624
	Whole Province	2,485,580	5,060	491	3,694	673
1917	East Kootenay District	551,751	1,481	372	944	584
	Coast District	1,846,964	3,689	501	2,816	656
	Whole Province	2,398,715	5,170	463	3,760	638

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, 1914, and 1915 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 safe-guarding the mine and workmen. In the year 1917 it will be observed that while the *per capita* output of the Coast collieries also shows an increase, the Crowsnest District shows a very considerable decrease, which is caused by the fact that a large amount of the underground labour in these collieries is engaged in non-productive work, such as repairing the damage from the former explosion and in opening up a new system of mining which it is expected will tend to greater safety of employees and also of the property.

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 three-quarters 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, frequently referred to in the past, has diminished and promises to practically cease, as supply of oil is scarcely attainable now, and even then only at a price which is not competitive with coal.

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. Owing to war conditions the operation of all the collieries in the Crowsnest field, in Alberta and British Columbia, has been placed under the control of a Commissioner—W. H. Armstrong—appointed by the Federal Government.

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 larger coasting steamers and railways, which in later years have all been using California crude oil as fuel, will now be forced to come back to the use of coal, which will mean a largely increased production from Coast collieries.

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 1917 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 1917.

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	935,469		147,811	
" export to United States	754,568		12,711	
" " other countries	38,211			
Total sales		1,728,248		160,522
Lost in washing	226,430			
Used in making coke	248,740			
Used under colliery boilers, etc.	198,102		117	
Total for colliery use		673,272		117
		2,401,520		160,639
Stocks on hand first of year	15,500		3,681	
" last of year	12,695		2,947	
Difference taken from stock during year		2,805		734
Output of collieries for year		2,398,715		159,905

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	157		111		268	
Whites—Miners	1,723				1,723	
Miners' helpers	80				80	
Labourers	924		353		1,277	
Mechanics and skilled labour	435		384		819	
Boys	77		72		149	
Japanese—Miners	97				97	
" Labourers			15		15	
Chinese—Miners	263				263	
" Labourers			375		375	
Indians	4				4	
Totals	3,760		1,410		5,170	

COLLIERIES OF THE COAST DISTRICT.

The gross output of the Coast collieries, including the Nicola valley, for the year 1917 was 1,846,964 tons (of 2,240 lb.) of coal actually mined, while some 2,811 tons was taken from "stock," making the actual consumption of coal 1,849,775 tons.

Of this gross consumption 1,428,604 tons was sold as coal, 140,452 tons was consumed by the producing companies as fuel, and 226,430 tons was lost in washing; while 54,289 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.

In 1916, 63 per cent. was sold for consumption in Canada, and the balance, or 37 per cent., was exported to the United States.

In 1917, 60 per cent. was sold for consumption in Canada, 37 per cent. exported to the United States, and 3 per cent. to other countries.

The following table gives an aggregate summary of the output of the Coast collieries for the year 1917, and shows the disposition 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	861,672		31,559	
" export to United States	528,721			
" " other countries	38,211			
Total sales		1,428,604		31,559
Lost in washing	226,430			
Used in making coke	54,289			
Used under colliery boilers, etc.	140,452		117	
Total for colliery use		421,171		117
		1,849,775		31,676
Stocks on hand first of year	15,442		2,743	
" last of year	12,631		1,473	
Difference taken from stock during year		2,811		1,270
Output of collieries for year		1,846,964		30,406

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	109		88		197	
Whites—Miners	1,234				1,234	
Miners' helpers	76				76	
Labourers	798		114		912	
Mechanics and skilled labour	172		234		406	
Boys	63		47		110	
Japanese—Miners	97				97	
" Labourers			15		15	
Chinese—Miners	263				263	
" Labourers			375		375	
Indians	4				4	
Totals	2,816		873		3,689	

The following tables show the output of coal and the disposition made of it in the subdivisions of the Coast District:—

COAL-OUTPUT, ETC., 1917, 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	736,580		31,559	
" export to United States	514,908			
" " other countries	38,211			
Total sales		1,289,699		31,559
Lost in washing	224,878			
Used in making coke	54,289			
" under colliery boilers, etc	129,522		117	
Total for colliery use		408,689		117
		1,698,388		31,676
Stocks on hand first of year	14,948		2,743	
" last of year	12,281		1,473	
Difference taken from stock during year		2,667		1,270
Output of collieries for year		1,695,721		30,406

COAL-OUTPUT, ETC., 1917, 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	125,092			
" export to United States	13,813			
Total sales		138,905		
Lost in washing	1,552			
Used in making coke				
" under colliery boilers, etc	10,930			
Total for colliery use		12,482		
		151,387		
Stocks on hand first of year	494			
" last of year	350			
Difference taken from stock during year		144		
Output of collieries for year		151,243		

COLLIERIES OF THE EAST KOOTENAY DISTRICT.

The gross output of the collieries of the East Kootenay District for the year 1917 was 551,751 tons (2,240 lb.) of coal actually mined, while 6 tons was added to stock, making the actual consumption of coal 551,745 tons. Of this gross consumption of coal, 299,644 tons was sold as coal, 57,650 tons was consumed as fuel by the producing companies, while 194,451 tons was converted into coke, producing 129,499 tons of coke, while 536 tons was added to stock, making the coke sales for the year 128,963 tons.

The East Kootenay collieries exported to the United States about 75 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 1917 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	73,797		116,252	
" export to United States	225,847		12,711	
" " other countries				
Total sales		299,644		128,963
Used in making coke	194,451			
Used under colliery boilers, etc.	57,650			
Total for colliery use		252,101		
		551,745		
Stocks on hand first of year	58		938	
" last of year	64		1,474	
Difference added to stock during year		6		536
Output of collieries for year		551,751		129,499

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	48		23		71	
Whites—Miners	489				489	
Miners' helpers	4				4	
Labourers	126		239		365	
Mechanics and skilled labour	263		150		413	
Boys	14		25		39	
Japanese						
Chinese						
Indians						
Totals	944		437		1,381	

INSPECTION OF COAL MINES, 1917.

The coal-producing areas of the Province are divided into the Coast District, which included the Vancouver Island and the Nicola-Princeton coalfields, and the East Kootenay District.

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 the 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.

JOHN NEWTON, INSPECTOR (OFFICE, NANAIMO).

Owing to the resignation of the two Inspectors in the East Kootenay District, the Inspector of this district was moved to Fernie, and the district is being at least temporarily inspected by John Newton from the Nanaimo office.

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.

EAST KOOTENAY DISTRICT.

The East Kootenay District is subdivided into two Inspection Districts—i.e., Northern Inspection District and Southern Inspection District. Both these districts are inspected by Robert Strachan as Senior Inspector and Mr. Lancaster, Inspector with headquarters at the Mine-rescue Station at Fernie.

NANAIMO INSPECTION DISTRICT.

REPORT OF JOHN NEWTON, INSPECTOR.

I have the honour to submit my annual report for the year ending December 31st, 1917, on the various coal-mines in my inspectorate, consisting of the Western Fuel Company, Pacific Coast Coal Mines, Nanoose, and British Columbia Collieries.

A short description is given of each colliery in this district, with the names of certificated officials.

RESCUE AND FIRST-AID WORK.

I am pleased to say that the interest in this work mentioned in my last report has been maintained. All the mines in the district have a number of fully efficient men and equipment ready for any emergency.

The Government station, with J. D. Stewart in charge, which is in a central position, is always ready to meet any demands that can be made upon it.

During the year samples of mine-air have been taken in each and every split, every return airway, and in every mine in my inspectorate. Copies of same have been forwarded to your Department.

The Western Fuel Company.

Head Office—San Francisco, Cal.

Capital, $1,500,000.

Officers.	*Address.*
C. P. Heaton, President,	San. Francisco, Cal.
T. E. Pollock, Chairman,	San. Francisco, Cal.
R. R. Pollock, Vice-Chairman,	San. Francisco, Cal.
D. C. Norcross, Secretary,	San. Francisco, Cal.
G. B. Bowen, General Manager,	Nanaimo, B.C.
John Hunt, General Superintendent,	Nanaimo, B.C.
T. R. Jackson, Mine Manager, No. 1 Mine,	Nanaimo, B.C.
James Dickenson, Mine Manager, Reserve Mine,	Nanaimo, B.C.
Richard Battey, Harewood 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, Harewood, and Reserve.

The following returns show the combined output of all the company's mines for the past year:—

AGGREGATE RETURNS FROM WESTERN FUEL COMPANY'S MINES FOR YEAR 1917.

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	240,961			
" export to United States	329,059			
" " other countries				
Total sales		570,020		
Lost in washing	20,000			
Used under colliery boilers, etc.	67,957			
Total for colliery use		87,957		
		657,977		
Stocks on hand first of year	7,558			
" last of year	8,008			
Difference added to stock during year		450		
Output of collieries for year		658,427		

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	32		20		52	
Whites—Miners	454				454	
Miners' helpers	22				22	
Labourers	299		30		329	
Mechanics and skilled labour	103		91		194	
Boys	58		30		88	
Japanese						
Chinese—Labourers			156		156	
Indians						
Totals	968		327		1,295	

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 general operations of the mine as far as development-work is concerned are identical to my report of 1916, with the exception of the new rock tunnel mentioned in that report. This tunnel has been completed. Operation begins at the head of No. 3 slope and extends across the measures for a distance of 700 feet on a 2-per-cent. grade; area of same, 7 x 12 feet in the clear. The work has greatly facilitated the handling of coal from this district.

PROPOSED NEW WORK.

A new Prescott pump has been installed, with a capacity of 700 gallons a minute, alongside the other pump of the same make and dimensions. Another turbine-pump has been installed on what is called No. 3 level, with a capacity of 450 gallons a minute.

It is proposed to abandon the endless-rope system of haulage and adopt the direct haulage from the Diagonal slope, making the Diagonal engine haul direct to the shaft bottom, a distance of 4,000 feet. When this work at the head of the slope and shaft-bottom is completed to suit the arrangements set forth, the workmen working on the South side of the mine will be conveyed to and from their work in special cars provided with special safety appliances.

Early in 1918 two shafts are to be sunk on what is known as the Five-acres District, West Nanaimo. These shafts are to tap the Wellington seam at a depth of approximately 300 feet. Present boreholes on this property show good coal; further drilling operations are to be pushed to determine elevations and extent of coalfield.

Early in 1918 (January) it is the intention to pump out the New Douglas slope, so that connections can be made with the Old Chase River mine to enable the extraction of pillars from same.

During the year the company has introduced the Edison electric head-lamps, mostly to drivers, pushers, trackmen, and timbermen, which has greatly reduced the number of accidents to men following this kind of work, and it is the intention to eliminate all open lights in all the mines operating under their jurisdiction. Number of lamps in use at the present time, 230 Edison head-lamps, 45 Wico, and 20 Ceag.

In addition to all these improvements towards "safety first," the company has erected dust-zones in all the intake and return airways; also two men constantly on the night shift, watering all roadways and working-places. There is also a line of water-pipes all along the main and tail haulage-roads, with sprays at intervals—two at the foot of the Diagonal slope, one at the foot of the Right incline, and two on the bull-wheel siding. A boy is stationed on an elevated platform at the outside end of this siding with a hose attached from the discharge-pump and sprays all the trips as they are passing outside.

MINE-RESCUE WORK.

Regarding this branch of work, I am pleased to be able to report that some of the companies in my district, especially the Western Fuel Company, have taken this work up in a manner which reflects great credit to both managers and workmen.

During the year the Western Fuel Company appointed inspectors to examine its various mines in regard to "safety first." Years ago this company was among the first of the Vancouver Island coal operators to adopt the "safety first" principle in the operation of its mines, and not only did it adopt the motto of "safety first," but it has carried it out in practice as far as practicable ever since. To further show that "safety first" is possible and practicable, it has appointed two safety-first inspectors to examine the whole of the mines operated by the company.

The company is to be commended for taking up this crusade in such a practical manner. In selecting Geo. Yarrow and J. Jemson for the positions of inspectors it exercised a wise choice, as both men are experienced and capable miners, who not only have had years of creditable service in the employ of the company, but are among the pioneers both in "first aid" and "safety first." With this movement established on such a practical basis, no doubt much good of an educational character will be accomplished and the number of accidents reduced.

It is not the intention of the company to carry on an aggressive campaign, but rather an educational one. To appeal to the personal element is the object of the company, and it is by coming into personal contact with the men in the various mines that the safety-first committee must look for a reduction in the number of accidents.

To further stimulate the movement and to encourage the workmen, the company has inaugurated a rather novel method of instructing first aid which is proving very successful, as over 100 members are already on the roll, and every meeting is being enthusiastically attended. The class is divided into groups of five, with a captain in charge. The captain's duty is to instruct his team in the principles of first aid and stretcher-drill. The senior men are assuming the position of instructors. A general meeting is called once a week, and much interest is taken in these meetings, the aim of which is to discuss the reading of a paper, which is read by some member of the class.

To further encourage the work, a social time is held once a month, where a paper is prepared and read on "safety first," general discussion following. To help out the social time the company makes a satisfactory donation, and also donates an additional $50 among the members of the class, to be divided equally, or disposed of as the members may please. The captains and instructors receive a special donation which recompenses them for the little extra work they do in connection with their teams. It is proposed to carry on the work until April, when an examination will be held and certificates awarded. The most proficient will receive special recognition and a prize from the company. There will also be a special prize awarded to the best five-man team.

With such an encouraging beginning and every promise of a most satisfactory term, the company is to be congratulated, and if the members of the class stick together much valuable knowledge will be acquired to the mutual benefit of all concerned.

The equipment of the company is as follows: Four 2-hour Draeger apparatus, 1904 and 1909 type; four 2-hour Proto apparatus; three 1-hour Proto apparatus; one pulmotor; one recharging pump; sixteen oxygen storage-cylinders; eight 2-hour cylinders; eight Proto cylinders; five 1-hour Proto cylinders; and a sufficient supply of potash regenerators.

NANAIMO COLLIERY.

T. R. Jackson, Manager.

No. 1 SHAFT, ESPLANADE.

David Brown, Overman of the North Side of No. 1 Mine; Robert Adam, William Johnson, William Neave, John Wallbank, John Sutherland, George Stewart, Thomas Smith, Alexander Rowan, John Rowan, William Holliday, Ernest Kelly, David John, William Brown, James Millie Brown, George Bennett Bradshaw, George Jardine, James Perry, James McMeekin, James Dudley, John Thompson, and Paul Laynard, Firemen.

Development-work.

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 the other, 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 types, 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-workmen by going into places where they are forbidden. In addition, notices are posted in all sections of the mine, warning workmen against the violation of the general and special rules.

The ventilation of 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 62,000 cubic feet of air a minute passing into this No. 1 mine, divided into three splits.

No. 3 Split, off No. 2 Slope.

There was 4,250 cubic feet of air a minute passing into the split for the use of twenty-five men and five horses, or an average of 106 cubic feet of air for each unit employed. No explosive gas found; timbering and roadways good.

No. 1 Slope.—There was 8,000 cubic feet of air a minute passing into the slope for the use of twenty-seven men and three horses, or an average of 222 cubic feet of air for each unit employed. No explosive gas found; timbering and roadways good.

No. 3 Slope.—There was 9,900 cubic feet of air a minute passing into the slope for the use of forty-six men and eight horses, or an average of 141 cubic feet of air for each unit employed. No explosive gas found; timbering and roadways good.

No. 2 Split, No. 2 Slope.

There was 11,750 cubic feet of air a minute passing into the split for the use of forty-six men and five horses, or an average of 192 cubic feet of air for each unit employed. No explosive gas found; timbering and roadways good. These sections were fairly free from coal-dust.

North-east Slope, off No. 2 Slope.

There was 7,700 cubic feet of air a minute passing into the section for the use of thirty-two men and five horses, or an average of 159 cubic feet of air a minute for each unit employed. No explosive gas found; timbering and roadways good. The section was fairly free from coal-dust.

Protection Pillars, Protection Shaft.

I examined all available parts of the pillars and found them free from gas, well ventilated, and the faces well cogged up.

This shaft is used only for the raising and lowering of the workmen engaged in the North side of the mine. The only operations carried out are extracting of pillars for generating power supplied to mining-machines and winches, etc.

Machinery installed: Three Canadian Rand compressors, two 2,500 and one 1,800 cubic feet of air a minute.

Safety-lamps are used in this section of the mine, with the exception of Nos. 1 and 2 slopes. Permitted explosives are used for breaking the coal, fired by electric batteries.

South Side of the Mine, Douglas Seam.

Jacob Stobbart, Overman of the Section; Samuel Kenmore Mottishaw, Henry Ernest Devlin, John Weeks, Alfred Odgers, Joshua Norris, Francis Green, Moses Woodburn, Joseph William Dykes, William Bradley, Robert Potter, Matthew Broderick, James Richards, William C. Brown, and Matthew Stafford, Firemen.

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.

This section of the mine forms the deepest workings and is worked on the pillar-and-stall system. The South-east levels have nearly reached the boundary which divides the Reserve mine from the South side of No. 1 mine, which is 400 feet in thickness.

In the extraction of pillars this part of the mine has always been a source of danger through gob-fires. To cope against any danger from this source a line of wood stoppings 6 x 6 inches in thickness and 6 feet long, faced with 6 inches of concrete, has been built, dividing these pillars off into panels. The pillars are drawn a reasonable distance toward the stoppings, and another line is built for the same purpose. Thus, if a fire broke out when the pillars were being extracted, they could be sealed off immediately.

To overcome the many dangers of being caught by cars in this district, all drivers, rope-riders, and trackmen are equipped with the Edison head-lamp.

On my last inspection I measured 42,300 cubic feet of air a minute passing, divided into two splits.

No. 1 Split.—There was 9,000 cubic feet of air a minute passing into the split for the use of forty-six men and four horses, or an average of 155 cubic feet of air for each unit employed. No explosive gas found; timbering and roadways good.

No. 2 Split.—There was 14,300 cubic feet of air a minute passing into the split for the use of sixty men and fourteen horses, or an average of 140 cubic feet of air for each unit employed. No explosive gas found; timbering and roadways good.

No. 2 North Level.—There was 4,000 cubic feet of air a minute passing into the section for the use of eighteen men and two horses, or an average of 166 cubic feet of air for each unit employed.

A large quantity of gas was found all along the caves in the South-east headings. The use of explosives is strictly prohibited in this section as long as conditions of this kind prevail. Timbering and roadways good. The section of the mine is fairly free from coal-dust, with the exception of No. 6 South heading.

The following are the official returns from the No. 1 shaft and Protection Island collieries for the year 1917:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	165,106			
" export to United States	235,258			
" " other countries				
Total sales		400,364		
Lost in washing	14,086			
Used under colliery boilers, etc.	52,949			
Total for colliery use		67,035		
		467,399		
Stocks on hand first of year	4,676			
" last of year	1,033			
Difference taken from stock during year		3,643		
Output of colliery for year		463,756		

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	20		10		30	
Whites—Miners	284	3.61 - 8.00			284	
Miners' helpers	12	3.16 - 3.71			12	
Labourers	196	3.16 - 5.50	14	3.00 - 3.76	210	
Mechanics and skilled labour	59	3.16 - 4.93	51	3.30 - 5.83	110	
Boys	42	1.26 - 3.24	16	0.55 - 2.66	58	
Japanese						
Chinese			90	1.65 - 2.58	90	
Indians						
Totals	613		181		794	

Description and length of tramway, plant, etc.—Mine operated 300 days.

RESERVE MINE.

James Dickson, Manager; James Renney, Overman; Albert Manifold, Edward Wilkinson, George Oswald, Richard Smith, George Frater, George Moore, Benjamin Cheetham, John McCourt, Harry Allsopp, Frederick Bell, Frederick Hilley, Arthur Challoner, Richard Rallison, and James Wardrop, Firemen.

The 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 10 feet in area is driven across the measures on a 1-per-cent. grade to the rise. 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.

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.

To open up and prove the area above the steep pitches in two of the headings, storage-chutes were built from the main haulage levels up to where the pitch lightens, to a point where the coal would not run. From this point small cars with a capacity of about 14 cwt. are then used to the face of the workings, the haulage being done by small horses and compressed-air winches. By this method the coal is hauled from the faces and dumped into the storage-chutes, drawn from chutes when required into the large 2-ton mine-cars which are used on the main haulage level.

During 1917 considerable development-work has been carried out on all sides of the mine. The East levels have been extended over 3,000 feet, and with the exception of 60 feet were driven in coal the whole distance. Two slopes were started to the dip on the left side of the East level. The first, going in good coal for about 250 feet, struck thin coal and stopped. The second slope is now in 300 feet and in good coal all the way; the pitch in the slope is 16 degrees.

On the West side of the mine the Main level was extended 500 feet, mostly in rock, and was abandoned. On the left side of the West level a series of places were driven up to the pitch, the angle of inclination gradually increasing until the vertical was reached.

Three "blind" shafts were extended upwards, and the normal part of the seam was reached at an elevation of 150 feet above the West level. At a point 1,500 feet from the shaft an incline was started on the left side of the West level to reach the coal that had been proved by the above workings. After cutting 600 feet in rock on a pitch of 18 degrees the position of the seam was reached and connection made with the above-mentioned workings.

A geared hoist with 12- x 14-inch cylinders driven by compressed air is installed at the top of the incline to deal with the haulage question in this section. At present the output from this part of the mine averages 250 tons a day.

On the South side of the mine two prospect headings have been driven south 500 feet to prove the ground in that direction. On the South side of the East level the workings reached a point beyond which the management decided not to advance farther.

The pillars in this section are now being extracted. Permanent stoppings, constructed of 12- x 12-inch timbers, have been built in all roadways giving access to the section where the pillars are being withdrawn, leaving only sufficient area in certain stoppings for the air-current and haulage; so that, in the event of any heating or fire occurring, no time would be lost in sealing off if such course was decided upon.

The mine has been almost free from explosive gas, and when it has been found, it has been found only in small quantities. In the above-mentioned pillar-work explosive gas has not been found on any occasion.

The ventilation is carried along the main levels on both sides of the mine and maintained by permanent stoppings of 12- x 12-inch timbers between intake and return airways, these being kept close up to the face of the levels. The main intakes are naturally damp and systematic watering is carried out in the main places and around the chutes.

Two slopes on the right side of the West level were extended to a total distance of 1,200 feet, the last 500 feet being mostly rock. At this point it was decided to abandon the slopes and take out the few pillars which had been formed. This was done and the pillars were extracted back towards the top of the slopes.

On September 7th, when the last two pillars were being extracted, smoke was discovered issuing from the gob on the right side of the Main slope, where a few small pillars had been taken out. An effort was made to locate the seat of the fire, but owing to the heavy caving of the ground this was found to be impossible.

Stoppings were at once started in the slopes to seal off the whole district and the drainage of the mine turned into the slopes. The stoppings, which were built of 12- x 12-inch timbers, faced with 9-inch wall concrete immediately afterwards, were completed at 6 a.m. the following morning.

On my last examination I found 54,000 cubic feet of air a minute passing divided into four splits.

No. 1 Split, East Side.—There was 12,000 cubic feet of air a minute passing into the split for the use of thirty-four men and three horses, or an average of 272 cubic feet of air for each unit employed. No explosive gas found; timbering and roadways good.

No. 2 Split.—There was 14,000 cubic feet of air a minute passing into the split for the use of thirty men and three horses, or an average of 360 cubic feet of air for each unit employed. No explosive gas found; timbering and roadways good.

No. 3 Split.—There was 12,000 cubic feet of air a minute passing into the split for the use of twenty men and two horses, or an average of 461 cubic feet of air for each unit employed. No explosive gas found.

West Side.—There was 26,000 cubic feet of air a minute passing into the section of the mine for the use of fifty-five men and four horses, or an average of 388 cubic feet of air for each unit employed. Timbering and roadways good; no explosive gas found.

This mine is fairly free from coal dust.

The following are the official returns of the Reserve Colliery for the year ending December 31st, 1917:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	65,633			
" export to United States	64,136			
" " other countries				
Total sales		129,769		
Lost in washing	4,471			
Used under colliery boilers, etc	14,375			
Total for colliery use		18,846		
		148,615		
Stocks on hand first of year	2,882			
" last of year	1,438			
Difference taken from stock during year		1,444		
Output of colliery for year		147,171		

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		7		13	
Whites—Miners	108	3.61 - 8.00			108	
Miners' helpers	4	3.71			4	
Labourers	84	3.16 - 4.93	11	3.00 - 3.76	95	
Mechanics and skilled labour	33	3.16 - 4.93	28	3.30 - 5.70	61	
Boys	10	1.26 - 2.02	11	0.55 - 2.66	21	
Japanese						
Chinese			51	1.65 - 2.49	51	
Indians						
Totals	245		108		353	

Description and length of tramway, plant, etc.—Mine operated 301 days.

HAREWOOD MINE, WELLINGTON SEAM.

Richard Battey, Manager; John White, Overman; John Docherty, John Bell, William Henry Moore, John Kirkwood, James Handlen, and Thomas Reid, Firemen.

This mine was closed down in September, 1902 and reopened on July 4th, 1917. The tunnel was closed up and track laid to the top of the slopes, which were driven up from the old shaft.

Operations on the coal were commenced in the first week of August and consisted of skips off the pillars on the rise side of No. 1 level and solid stall workings in the counter-slope driven towards the tunnel entrance. Skips were also taken off pillars in Nos. 2 and 3 levels to the right of Main slope and the solid workings to the left of slopes in No. 3 level.

The whole of the present working-places are in the solid, except one place in No. 3 level, through which a main road has been run, which is intended to cut out No. 2 level, leaving the pillars on the high side. Only one pillar has been drawn on the rise side of No. 1 level. The other pillars will all be left as they are until later.

Solid workings have been started below No. 3 level, and it is the intention to extend the workings down the Main slopes, commencing places on both sides, until the old stalls which worked from the old shaft are reached on the right side of slope. In the Main or No. 1 level they have places on both sides, and it is the intention to run the coal down a self-acting incline from the rise workings on to the level starts, driven for that purpose.

The mechanical or rather electrical haulage in use at present consists of a winch hauling from the slope, and motor on the Main level direct to tipple; power being supplied from power-house at shaft by overhead cables.

Machinery installed: One Jeffery haulage-motor and one electric hoist. The ventilation of the mine is produced by a fan of the Murphy type (6 feet diameter double), central drive, Ideal horizontal engine, with a capacity of 35,000 cubic feet of air a minute.

On my last visit I found 31,900 cubic feet of air a minute passing into the mine, divided into two splits.

No. 1 Split.—There was 14,400 cubic feet of air a minute passing into the split for the use of fifty men and five horses, or an average of 221 cubic feet of air for each unit employed. No explosive gas found; timbering and roadways good.

No. 2 Split.—There was 17,500 cubic feet of air a minute passing into the split for the use of fifteen men and two horses, or an average of 833 cubic feet of air for each unit employed. No explosive gas found; timbering and roadways good.

This mine is fairly free from coal-dust. Safety-lamps are used exclusively in the mine. Permitted explosives, fired by electric batteries, are used.

On all dates I examined all record-books required under section 91, subsections (4) and (36), of the "Coal-mines Regulation Act," and found the requirements of the above Act carried out.

The following are the official returns of the Harewood Colliery for the year ending December 31st, 1917:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	10,222			
" export to United States	29,665			
Total sales		39,887		
Lost in washing	1,443			
Used under colliery boilers, etc.	633			
Total for colliery use		2,076		
		41,963		
Stocks on hand first of year				
" last of year	5,537			
Difference added to stock during year		5,537		
Output of colliery for year		47,500		

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		3		9	
Whites—Miners	62	3.93 - 7.50			62	
Miners' helpers	6	3.43 - 3.71			6	
Labourers	19	3.43 - 4.38	5	3.00 - 3.76	24	
Mechanics and skilled labour	11	3.43 - 4.93	12	3.43 - 4.98	23	
Boys	6	1.37 - 2.36	3	0.55 - 2.66	9	
Japanese						
Chinese			15	2.18 - 2.37	15	
Indians						
Totals	110		38		148	

Description and length of tramway, plant, etc.—Mine operated 116 days.

British Columbia Coal Mining Co., Ltd.

(SUCCESSOR TO VANCOUVER-NANAIMO COAL MINING CO., LTD.)

Head Office—Vancouver, B.C.

Capital, $300,000.

Officers.	*Address.*
William Warner, President,	439 Granville Street, Vancouver, B.C.
Howard Gallagher, Secretary-Treasurer,	744 Hastings Street W., Vancouver, B.C.
H. N. Freeman, Superintendent,	P.O. Box 834, Nanaimo, B.C.

The following returns show the complete output of the colliery for the year ending December 31st, 1917, under both companies:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	49,522			
" export to United States	179			
" " other countries				
Total sales		49,701		
Lost in washing	4,875			
Used under colliery boilers, etc.	8,498			
Total for colliery use		13,373		
		63,074		
Stocks on hand first of year	1,488			
" last of year				
Difference taken from stock during year		1,488		
Output of colliery for year		61,586		

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	4		4		8	
Whites—Miners	66				66	
Miners' helpers						
Labourers	33		10		43	
Mechanics and skilled labour	2		18		20	
Boys	3				3	
Japanese			13		13	
Chinese						
Indians						
Total	108		45		153	

NEW EAST WELLINGTON COLLIERY.

Henry Nevill Freeman, Manager; W. H. Moore, Overman; Geo. Gray, C. Dickinson, Jos. W. Dykes, Stephen Davis, A. Bryden, and R. Reid, Firemen.

The mine is situated two miles due west from the city of Nanaimo, on Ranges 10 and 11, in the Mountain district, and is known as the Old Wellington seam. It is penetrated by two slopes running N. 70° E., and pitching about 35 degrees, for a distance of 1,400 feet. At this point headings are turned off N. 65° E., which have reached the boundary. At a distance of 300 feet from the foot of the slope on No. 1 East level, dip workings are driven 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 methods; the coal, being of a very hard nature and free from impurities, 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. 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.

The ventilation of the mine is produced by a Browning reversible fan, with a capacity of 100,000 cubic feet of air a minute, coupled to a 74-horse-power, 12 x 16 Houston, Stanwood & Gamble engine, making 250 revolutions a minute, with a 2½-inch water-gauge; also a 4 x 9 Sheldon fan, kept ready under steam in case of emergency.

A gob-fire broke out at 3 a.m. on the morning of October 5th in the old worked-out area of No. 5 West level, and after an examination of the same, accompanied by Chief Inspector Wilkinson, we found that owing to the extracted area and the remaining pillars being so small it was utterly impossible to erect permanent stoppings; so after a consultation with Mr. Freeman, the manager, and the overman, Mr. Moore, it was decided to erect the stoppings in the Main and Return slopes. This was successfully done on October 7th.

On November 22nd, after an examination accompanied by Chief Inspector Wilkinson, Inspector Devlin, the manager and overman, and after samples of the mine-air taken at the return stoppings, it was decided to open the stoppings again, and work of removing the gases was proceeded with up to November 28th, when it was discovered that the fire was not extinguished; consequently the mine was sealed off again on November 29th, remaining closed up to the present time.

The following is the official return from the Vancouver-Nanaimo Coal Mining Company, Limited, up to August 31st, when it ceased to exist:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	43,575			
" export to United States				
" " other countries				
Total sales		43,575		
Lost in washing	4,368			
Used under colliery boilers, etc.	7,430			
Total for colliery use		11,798		
		55,373		
Stocks on hand first of year	457			
" last of year				
Difference taken from stock during year		457		
Output of colliery for year		54,916		

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MORDEN MINE.

William Roper, Manager; Joseph Neen, Overman; E. J. Parrott, Wm. G. Brown, Thos. Robson, David McMillan, Frank Jaynes, Neil McIntyre, and John Donnachie, Firemen.

This mine is operated on the Douglas seam, and is situated on Section 11, Range 8, Cranberry district, and about two miles from the town of South Wellington.

The plant consists of three 150-horse-power Goldie & McCulloch 72- x 18-inch boilers, 160 lb. working-pressure; one pair 24 x 36 hoisting-engines equipped with safety overwinding device, 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, 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.

The mine is penetrated by two shafts; 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.

A new shaft-bottom has been completed below the level of the old one, with two slopes driven direct from the bottom of the shaft, which will pass through the centre of the company's property.

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.

Connections have been made between the new slopes and the old one. All the coal from the mine is hauled to the new shaft-bottom by an electric hoist, which is erected on reinforced-concrete at the head of the Main slope.

The coal is well adapted for steam purposes, and varies from 3 to 30 feet in thickness. The two Main slopes are in troubled ground at the present time, but it is to be hoped they will soon reach the coal again.

What is called the East slope is in very good coal, averaging about 7 feet in thickness. The mine is worked on the pillar-and-stall system.

The mine is worked exclusively by safety-lamps of the Wolf pattern; only permitted explosives are used, fired by electric battery.

The old slope has reached the boundary-line, and all pillars on the right of this slope have been extracted.

On Monday, November 19th, a small heating took place in the old gob of this slope, where the pillars had been extracted, which necessitated the putting-in of four concrete stoppings, thus sealing the section from the other parts of the mine.

The No. 4 shaft or return-air shaft is now being used exclusively as an emergency shaft. An engine with steam on and a hoisting-cage in the shaft is always ready to hoist the men in case of any emergency. A complete set of Draeger apparatus is always ready.

On my last inspection I measured 46,000 cubic feet of air a minute passing for the use of fifty-eight men and five horses, or an average of 630 cubic feet of air for each unit employed.

Explosive gas found in Fielding's place, No. 1 Right level off the East slope, and a gas-cap in R. Wright's place in a crosscut off counter-slope. The timbering and roadways are good. Coal-dust is prevalent in the mine, but arrangements have been made to have this menace loaded out.

On all dates I examined all record-books required under section 91, subsections (4) and (36), of the "Coal-mines Regulation Act," and found the requirements of the above Act carried out.

The following are the official returns for the Fiddick and Morden Collieries, which are also the full returns for the whole company, for the year ending December 31st, 1917:—

SALES AND OUTPUT FOR THE YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	69,287			
" export to United States	43,704			
" " other countries				
Total sales		112,991		
Lost in washing	17,296			
Used under colliery boilers, etc.	20,351			
Total for colliery use		37,647		
		150,638		
Stocks on hand first of year	1,028			
" last of year	928			
Difference taken from stock during year		100		
Output of colliery for year		150,538		

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	10	4.50	5	5.40	15	4.50-5.40
Whites—Miners	98	5.00			98	5.00
Miners' helpers						
Labourers	44	3.55			44	3.55
Mechanics and skilled labour	2	3.55-3.85	39	2.80-4.65	41	2.80-4.65
Boys			5	1.75	5	1.75
Japanese						
Chinese			60	2.10	60	2.10
Indians						
Totals	154		109		263	

Name of seams or pits—Working on the upper Douglas seam.

Description of seams, tunnels, levels, shafts, etc., and number of same—At the Morden mine coal is reached by means of shafts: No. 3 shaft, 655 feet in depth, 10 x 18 feet in the clear; No. 3 air-shaft, 630 feet in depth, 10 x 10 feet in the clear.

Description and length of tramway, plant, etc.—At Morden mine the plant consists of three 150-horse-power and one 100-horse-power return-tubular boilers; one pair 24 x 36 hoisting-engines with safety overwinding device, with steam-reverse and steam-brake; two 10-foot sheaves and two self-dumping cages; one Canadian Rand cross-compound air-compressor; two 150-kw. electrical generators connected with 13 x 20 x 9 high-speed engines; one Sheldon ventilating mine-fan, directly-connected to a 17 x 20 engine. There is a thoroughly equipped machine-shop and also mine-rescue station at South Wellington, containing two 2-hour apparatus and one ½-hour apparatus. A standard-gauge railway seven miles and a half long connects the mines with Boat Harbour, the shipping-point, equipped with wharves and bunkers, and where an extension to the wharves has been built and loading equipment now being completed which will accommodate the largest ocean-going steamers.

The Nanoose Collieries Co., Ltd.

Head Office—Vancouver, B.C.

Capital, $50,000.

Officers.	*Address.*
W. J. Vanhouten, President,	Vancouver, B.C.
K. S. Robinson, Vice-President,	Vancouver, B.C.
W. H. Wilson, Secretary-Treasurer,	Vancouver, B.C.
J. J. Grant, Superintendent,	Wellington, B.C.

Value of plant, $40,378.

NANOOSE COLLIERIES.

John John, Manager; J. Saunders, John Michie, Jos. Renalda, and John McLeod, Firemen.

This mine is situated at Nanoose Bay, about five miles in a north-westerly direction from what is known as North Wellington, which was formerly worked under the old Dunsmuir Company, and is known as the Old Wellington seam.

A shaft 8 x 16 has been sunk on this property a distance of 133 feet, with levels turned off east and west. The coal varies from 3 to 4 feet in thickness, lying in two trenches, with rock varying from 2 to 5 feet in thickness between the coal.

The two main headings are not working; they ran up against a down-throw fault, which threw the seam down about 26 feet; after proving the seam for about 300 feet, and no improvement, the company decided to abandon them for the time being and do some diamond-drilling to try and locate the coal. Two slopes are being driven in a south-easterly direction to prove the seam underlying the submarine area.

A new head-frame has been erected with a capacity of handling 500 tons a day. The new loading-wharf which was under construction in my last report has been completed. A number of cottages have been built on the Comox road to accommodate the workmen of the mine. A new hoist and boilers have also been completed.

The ventilation of the mine is produced by a small fan capable of producing 12,000 cubic feet of air a minute. The mine is worked on the pillar-and-stall system, with permissible powders fired by batteries. Open lights are used, as there never has been any gas seen. The mine is fairly free from coal-dust.

On my last inspection, accompanied by Chief Inspector Wilkinson, we found 15,000 cubic feet of air a minute passing into the mine for the use of twenty-eight men and three horses, or an average of 405 cubic feet of air for each unit employed. Timbering and roadways are good.

On all dates I examined all record-books required under section 91, subsections (4) and (36), of the "Coal-mines Regulation Act," and found the requirements of the above Act carried out.

The following are the official returns for the year ending December 31st, 1917:—

SALES AND OUTPUT FOR THE YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	16,075			
" export to United States	9,747			
" " other countries				
Total sales		25,822		
Used in making coke				
Used under colliery boilers, etc.	2,000			
Total for colliery use		2,000		
Stocks on hand first of year				
" last of year				
Difference taken from stock during year				
Output of collieries for year		27,822		

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		3		6	
Whites—Miners	36	4.25-7.50			36	
Miners' helpers						
Labourers	15	3.70-4.00	6	3.25-3.75	21	
Mechanics and skilled labour			8	3.50-4.25	8	
Boys						
Japanese						
Chinese			16	1.90-2.15	16	
Indians						
Totals	54		33		87	

Name of seams or pits—Grant mine.

Description of seams, tunnels, levels, shafts, etc., and number of same—Continuation of the Wellington seam to north and west of the old Wellington workings. Entered by three-compartment shaft 8 x 16 feet in the clear, depth 130 feet. Coal-seam is in two benches, upper and lower; lower bench averages 22 inches and upper about 24 inches, with shale between. Main level driven to the east 650 feet; heading driven off Main level 300 feet from shaft to a distance of 900 feet; slope branches off the Main level 150 feet to the east of the shaft; slope has been driven 500 feet.

Description and length of tramway, plant, etc.—Pit-head with double-drum hoisting-engine of 110 horse-power; Waterous boiler, 85 horse-power, at 125-lb. steam; one air-compressor, capacity 210 feet of air a minute; one Stuyvesant fan, capacity 25,000 feet of air a minute; machine and blacksmith shops with equipment; fifteen 3- and 4-room houses and eight 2-room cabins.

Canadian Collieries (Dunsmuir) Limited.

Head Office—Victoria, B.C.

Capital, $15,000,000.

Officers.	*Address.*
Sir William Mackenzie, President,	Toronto, Ont.
Hy. S. Fleming, Chairman, Executive Committee,	New York.
H. S. Adlington, Secretary,	Montreal, Que.
A. J. Mitchell, Treasurer,	Toronto, Ont.
Thos. Graham, General Superintendent,	Cumberland, B.C.

The Canadian Collieries (Dunsmuir), Limited, during the year 1911 acquired all the holdings of the Wellington Colliery Company, Limited, and during the past four years has been operating the following mines:—

The Extension Colliery, in the Cranberry District (Extension); T. A. Spruston, manager.

The Comox Colliery, in the Comox District; J. W. Montgomery, George O'Brien, J. G. Quinn, 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, LTD., MINES FOR YEAR 1917.

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	360,735		31,559	
" export to United States	132,219			
" " other countries	38,211			
Total sales		531,165		31,559
Lost in washing	182,707			
Used in making coke	54,289			
Used under colliery boilers, etc	30,716		117	
Total for colliery use		267,712		117
		798,877		31,676
Stocks on hand first of year	4,874		2,743	
" last of year	3,345		1,473	
Difference taken from stock during year		1,529		1,270
Output of collieries for year		797,348		30,406

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	38		44		82	
Whites—Miners	444				444	
Miners' helpers	3				3	
Labourers	355		35		390	
Mechanics and skilled labour	33		50		83	
Boys						
Japanese	97		2		99	
Chinese	263		143		406	
Indians						
Totals	1,233		274		1,507	

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, 1917, 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 No. 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. Nos. 4 and 7 mines have been in continuous operation during the year. No. 5 mine reopened on April 16th and has been in continuous operation since. In No. 6 mine operations ceased on June 15th on account of shortage of labour. No. 8 shafts have not operated during the year.

The rescue-station of the company at Cumberland has been taken over by the Mines Department, with John Thomson in charge as caretaker and instructor.

THE HYDRO-ELECTRIC PLANT.

This plant has been in continuous operation through the year. A short length of transmission-line has been built for supplying electric power underground.

The power-house has been operated very satisfactorily and no repairs or improvements were needed. The output of power shows the same steady increase as in former years.

UNION BAY.

At Union Bay the coke-ovens have been in continuous operation. A second battery of 100 ovens has been built and put into operation, together with an electrically driven charging-larry and the necessary coal-conveying equipment.

The coal-washing plant has been extended and improved; nine additional coal-washing jigs have been installed, a new wing being added to the building for the purpose. A new pumping plant was installed, the pumps being housed in a special building and group driven by a 150-horse-power motor.

Improvements were made to the coal-handling machinery on the shipping wharves. The general water-supply service has been improved and additional fire hydrants installed. New offices were built and all clerical and official work for the district consolidated. The electrical and mechanical engineering for all the company's properties are carried on at Union Bay.

No. 4 MINE, COMOX.

George O'Brien, Manager; Robert Adamson, Overman, No. 1 Slope; John Dando, Overman, No. 2 Slope; William Walker, Shiftboss; Sidney Horwood, Thomas Richards, John Bennie, Arthur Phelan, George Stewart, Daniel Parks Marsh, John Liddle, James Reid, William Beveridge, Arthur William Watson, Thomas Eccleston, Robert Reid, John George Biggs, James Quinn, Robert Ewing, and Robert Snedden Brown, Firebosses.

This mine is situated about two miles from Cumberland and about twenty miles from the shipping-point at Union Bay.

The ventilation is produced by a Sullivan reversible fan driven by a 350-horse-power motor, direct-coupled, running at 245 r.p.m., and capable of delivering 196,000 cubic feet of air a minute, against a 6-inch water-gauge.

The mine has been in continuous operation during the year. A 50-horse-power electric hoist and a small fan were installed at the new opening in the Upper seam. This new opening, not showing up very good, was closed down again.

Safety-lamps of the Wolf type are used in this mine and all blasting is done with permitted explosives, fired by electric battery. Orders have been placed for sufficient Edison storage-battery safety-lamps to fully equip the mines with electric lights. Part of the equipment has arrived and is being installed in No. 4 mine. The remainder will be installed as rapidly as possible.

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 4,000 feet, where levels are turned off east and west—Nos. 15, 16, 17, 18, 19, and 20 on the West side. There are no operations on the East side of No. 1 slope at the present time, No. 19 East level being used as a travelling-road between Nos. 1 and 2 slopes.

No. 15 West level is being widened out and repaired and a new slope put down from a point 1,500 feet from the mouth of the level; this slope will cut off the levels below No. 15 close to the faces, making an improvement in the haulage. This work on the West side of No. 1 slope is practically all solid work, with the exception of a few pillars to the rise side of No. 15 West level, and skipping some pillars in Nos. 17 and 18 West between the old and new slopes.

All the levels are in good coal ranging from 5 to 7 feet in height, with a band of rock running in the centre from 12 to 15 inches thick and having a fairly good roof.

No. 1 slope has not been driven ahead much during the year, probably on account of the slope being in faulty ground.

During my inspection in December I measured 19,750 cubic feet of air a minute passing into No. 1 slope for the use of seventy men and eleven mules, or an average of 191 cubic feet of air a minute for each unit employed. I found timbering in fairly good condition and the roadways in good order, with the exception of one place in No. 15 West level, where there was some bad rock that required stripping down. I found no explosive gas in No. 1 slope. This part of the mine was fairly free from coal-dust.

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 9,000 feet, forming the deepest workings of the mine.

No. 2 slope is not advancing at the present time. Considerable work has been done repairing the return airways in Nos. 1 and 2 slopes and repairing stoppings. The ventilation has been changed back to the original system, using the two Main slopes as intakes, instead of one slope as intake and the other the return.

Levels are turned off this slope east and west—Nos. 15, 16, 17, 18, 19, and 20 on the East side, and Nos. 15, 16, 17, 18, 19, and 20 on the West side. Nos. 15 East and 15, 16, and 17 West are extracting pillars; all other levels are working on the pillar-and-stall system. The levels that are advancing are in good coal ranging from 5 to 6 feet in height, with a band of rock in the centre from 12 to 15 inches thick. The roof is a friable fireclay and requires careful timbering.

When I made my inspection in December I measured 41,000 cubic feet of air a minute passing into No. 2 slope, divided into two splits.

In the East side split there was 22,000 cubic feet of air a minute passing for the use of sixty-six men and ten mules, or an average of 229 cubic feet of air a minute for each unit employed.

In the West side split there was 10,000 cubic feet of air a minute passing for the use of twenty-five men and three mules, or an average of 290 cubic feet of air a minute for each unit employed.

I found a small quantity of explosive gas in the following places in No. 2 slope: In No. 17 stall, off No. 19 East level; in face of No. 19 East level and in face of No. 19 West level; also a slight gas-cap in face of No. 18 East level and No. 17 West level pillars. I found timbering in fairly good condition, with the exception of a portion of No. 19 West level, which was under repair. The roadways were in fair order, with the exception of a portion of No. 16 East level, which was in poor condition.

This part of the mine was fairly free from coal-dust, with the exception of a portion of the main haulage slope and a portion of No. 17 West level.

No. 5. MINE, COMOX.

John Graham Quinn, Manager; Thomas Taylor, Overman; Peter Myers, John Ernest Spicer, Jasper Rutherford, Thomas Smith Wilson, Isaac Nash, Duncan Thomson, James Brown, John Sutherland, Frank Crawford, Frederick Horwood, James Strang, Samuel Jones, and James Touhey, Firebosses.

This mine was reopened on April 16th and has been in continuous operation since. The new plant put into operation consists of a one-car rotary dump, a conveyor for conveying coal to the picking-tables, and one additional picking-table. Underground the main pump-house has been remodelled and two 5-stage turbine pumps, direct-driven by 75-horse-power motors, have been installed at the shaft-bottom. A 4-ton locomotive was put into operation, together with a motor-generator set on the surface for operating the same.

The development of No. 1 dip is being carried on; this is being done by four Sullivan type C.E. 7 coal-cutters. The West side of the shaft is being opened up. A new incline has been driven and a section of long-wall opened up in this district; this is being mined by a Sullivan C.E. 7 type coal-cutter. There has also been a 50-horse-power electric hoist installed in this district for running the coal down to the shaft-bottom; about one-fourth of the output from this mine is now being mined by machines.

The Sirocco fan for ventilating this and No. 6 mine has been in continuous service during the year, and has proved satisfactory.

When I made my inspection in December I measured 93,600 cubic feet of air a minute passing into the mine, divided into three splits.

In the West side split there was 21,600 cubic feet of air a minute passing for the use of twenty-five men and four mules, or an average of 540 cubic feet of air a minute for each unit employed.

In the split on the East side of No. 1 dip there was 19,000 cubic feet of air a minute passing for the use of sixty-two men and eleven mules, or an average of 200 cubic feet of air a minute for each unit employed.

In the split on the West side of No. 1 dip there was 18,800 cubic feet of air a minute passing for the use of thirty-five men and five mules, or an average of 376 cubic feet of air a minute for each unit employed. I found a little explosive gas in face of No. 4 West level, off No. 1 dip.

I found timbering and roadways in fair condition. This mine is free from coal-dust.

No. 6 MINE.

John Graham Quinn, Manager; Thomas Mordy, Overman.

This mine ceased operations on June 15th on account of shortage of labour. I regret to report that there was a fatal accident in this mine on June 3rd, 1917, which caused the loss of four lives by an explosion of gas; just how this accident occurred it would be a hard matter to determine.

Some improvements were made to the pit-head frame during the year. This shaft is being converted into a hoisting shaft for water-hoisting from Nos. 5 and 6 mines, which are connected. The water from these mines contains a considerable quantity of sulphuric acid, which is a source of great trouble and expense in pumping.

To avoid the expense of pump repairs and the frequent break-downs of pumping arrangements, water-boxes have been built on the cages at No. 6 mine, and the water from Nos. 5 and 6 mines is now being hoisted instead of pumped. The pumps in No. 5 are held in reserve for emergency.

When I made my inspection in December I measured 23,000 cubic feet of air a minute passing around the workings of the mine. I found explosive gas in the rock tunnel off No. 1 dip, owing to the intake airway of this section being blocked with water.

The attention of the management was directed to the state of the ventilation of this section, with instructions to have the same put in better shape and the gas removed. I found timbering and roadways in fairly good condition.

No. 7 MINE, COMOX.

John Wilson Montgomery, Manager; Robert Brown, Overman; Robert Walker, James Monks, William James Keenan, Watkin Williams, James Lawther Brown, Thomas Henry Nanson, Norman Wilson Huby, and John McMurtrie, Firebosses.

This mine has been in continuous operation during the year. The pumping system has been improved; a 7-stage motor-driven turbine-pump has been installed. This pump has a capacity of 400 gallons a minute against a 900-foot head, and is driven by a 150-horse-power motor.

An electric cable was installed through a borehole into the lower workings to supply electric power to the above pump. This is the first time electric power has been used underground in No. 7 mine, all the power being furnished previously by compressed air, supplied by a 2,700-cubic-foot motor-driven Rand compressor on the surface.

The fault in No. 3 West level has been driven through and the seam opened up. A slope has been driven off No. 7 West level to cut off the places in No. 8 West level, thus concentrating the haulage from these two sections on one road. No. 10 West level has been unwatered and is being put into shape for operating again.

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. The seam varies from 2½ to 3½ feet thick 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.

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 of the mine, running north-east. Levels are turned off on the East side 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 thick.

The principal plant at this mine 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.

When I made my inspection in December I measured 104,000 cubic feet of air a minute passing into the mine, divided into three splits.

In the split on the West side there was 14,000 cubic feet of air a minute passing for the use of forty-five men and four mules, or an average of 245 cubic feet of air a minute for each unit employed.

In No. 1 East split there was 13,800 cubic feet of air a minute passing for the use of thirty-two men and three mules, or an average of 336 cubic feet for each unit employed.

In No. 2 East split there was 12,800 cubic feet of air a minute passing for the use of thirty-eight men and four mules, or an average of 256 cubic feet of air a minute for each unit employed.

I found a small quantity of explosive gas in the following places in No. 7 mine: In No. 1 slant, No. 2 slant, and in No. 3 gateway, off No. 3 slant, No. 9 West level; also in inside slant, off No. 9 East level, and No. 1 slant, off No. 3 West level.

I found timbering and roadways in good condition. This mine is free from coal-dust.

Safety-lamps of the Wolf type are used exclusively in No. 7 mine; blasting is done with permitted explosives, and all shots fired by electric battery.

The total quantity of air passing into this mine in December was 104,000 cubic feet of air a minute, and the quantity passing into the several splits was 43,600 cubic feet a minute, making a loss in leakage of 60,400 cubic feet a minute through doors, stoppings, and old workings.

No. 8 Mine, Comox.

This mine has not been operated during the year. The plant is operated regularly at intervals to keep same in good operating condition.

The following are the official returns from the Comox Collieries for the year ending December 31st, 1917:—

Sales and Output for Year.	Coal.		Coke.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	224,126			31,559
" export to United States	77,668			
" " other countries	27,004			
Total sales		328,798		
Lost in washing	115,090			
Used in making coke	53,289			
Used under colliery boilers, etc	11,874		117	
Total for colliery use		180,253		117
		509,051		31,676
Stocks on hand first of year	3,549		2,743	
" last of year	2,455		1,473	
Difference taken from stock during year		1,094		1,270
Output of collieries for year		507,957		30,406

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	8		29		37	
Whites—Miners	192				192	
Miners' helpers						
Labourers	227		28		255	
Mechanics and skilled labour	9		29		38	
Boys						
Japanese	97		2		99	
Chinese	258		102		360	
Indians						
Totals	791		190		981	

Name of seams or pits—Comox mines.

Description of seams, tunnels, levels, shafts, etc., and number of same—Nos. 4, 5, and 6 shafts and Nos. 4 and 7 slopes.

EXTENSION COLLIERY.

Thos. Arthur Spruston, Manager. Nos. 1, 2, and 3 Mines.

The general supervision of these mines in this colliery is entrusted to Mr. Spruston, who has an overman in charge of each mine. This colliery has been working full time throughout the year.

At Extension the Nos. 1, 2, and 3 mines are connected by tunnel driven 14 x 17 feet in the clear, with a double track running practically the whole distance. A wood flume 18 x 18 inches is laid parallel to the tracks for the whole length of the tunnel to take care of the water from all of the mines, and maintains the roadway in the tunnel in a good state of repair. The underground employees are taken to and from their work in each respective mine along this tunnel, which is a little over a mile in length, by means of a "riding trip" of cars hauled by a Baldwin-Westinghouse electric locomotive.

A new wash-house 120 x 32 feet has been built at Extension during the year, and accommodates practically all the workmen in and around the Nos. 1, 2, and 3 mines. Great praise has been expressed by the workmen for the facilities afforded in the use of this wash-house to change their clothes on coming out of the mines.

Firebosses' and officials' rooms are isolated from the main building; steam heat is used at a normal temperature thoughout the building. The bath-room is situated in the centre of the two wings; twenty spray-baths and eight wash-basins are installed, everything conforming from a sanitary standpoint. The workmen's train from Ladysmith lands alongside of the wash-house, thus providing ample room for the workmen in getting on and off the train.

The power-house equipment consists of three 250-volt d.c. generators, operating in parallel. No. 1 is a Crocker-Wheeler generator of 112-k.w. capacity, direct-coupled to a 15 x 14 Ideal engine. No. 2 is a Westinghouse, 150-k.w. capacity, connected to a Fleming-Harrisburg compound engine, size 14 x 14 x 32. No. 3 is a General Electric, 150-k.w. capacity, direct-connected to a 16 x 16 Robb-Armstrong engine; power is supplied by three Goldie & McCulloch return-tubular boilers of 108.8-horse-power capacity each.

The washery at Ladysmith consists of three "washers" of the following dimensions: Nos. 1 and 2, diameter 8 feet 9 inches, depth 5 feet 6 inches; No. 3 diameter 8 feet 3 inches, depth 5 feet 9 inches; computed capacity of each washer 300 tons for twelve hours. During the year a Masco table 14 x 17 feet has been installed to recover a certain percentage of waste. A 40-k.w., 250-volt Allis-Chalmers-Bullock generator supplies power to operate this table, which is driven by a 25-horse-power General Electric type H. motor, which also supplies light for all purposes on the shipping wharf, transfer wharf, and around the plant. This generator is driven from the main Pelton wheel, which also supplies power to run the washery.

No. 1 or Tunnel Mine, Extension.

William Wilson, Overman; William Wesnedge, Albert Radford, John Greenhorn, David John Gordon, and John Davidson, Firebosses.

During the year the lower part of the Main and No. 2 slopes have been unwatered and development-work commenced. Two main levels have been turned off the Main slope, Nos. 4 and 5 East and a new slope, No. 3, on the West side. Nos. 5 and 6 East levels have been driven off No. 2 slope, which is worked on the long-wall system. On the West side of No. 2 slope there is only one level, No. 6 West, working at the present time, on the pillar-and-stall method. The haulage equipment in this mine consists of two Ottumwa electric hoists. On the Main slope, a distance of 4,000 feet, a 100-horse-power electric hoist driven by a Westinghouse motor is used to haul the coal out, where it is delivered on top of the slope to be handled by the electric locomotive. The coal is hauled up No. 2 slope by a 50-horse-power electric hoist driven by a General Electric motor.

Safety-lamps of the Wolf type and the Edison storage-battery electric lamps are used throughout the mine, and all blasting is done with permitted explosives, fired by electric battery.

The mine is ventilated by a Murphy type exhaust-fan with a capacity of 45,000 cubic feet of air a minute, against a 1.7-inch water-gauge, driven by a 40-horse-power Allis-Chalmers-Bullock motor.

When I made my inspection in December last I measured 27,650 cubic feet of air a minute passing into the mine, divided into two splits.

In the East side split there was 10,000 feet of air a minute passing for the use of twenty men and three mules, or an average of 344 cubic feet of air a minute for each unit employed.

In the West side split there was 7,500 cubic feet of air a minute passing for the use of eleven men, or an average of 681 cubic feet of air a minute for each unit employed.

I found this mine free from explosive gas; the timbering and roadways were in good condition. This mine is free from coal-dust.

No. 2 Mine, Extension.

Hugh McLean Davidson, Overman; John Joshua Jones, Joseph Mason, Robert Lecce Spruston, William Cosier, Joseph Watson, and George Rankin, Firebosses.

A large amount of recovery-work has been done in the sections of this mine that have been idle since the labour troubles in 1912. New roadways have been driven through the old gob, and where possible the old roadways cleaned up and retimbered. Some sections of the mine are worked on the pillar-and-stall method and some on the long-wall system; the coal varying from 2½ to 9 feet thick in the Slope district. Nos. 1, 2, 3, and 4 levels are working on the East side, and Nos. 1, 2, 2½, and 3 on the West side; only pillar-work is in operation on the West side.

During the year the lower part of the slope and No. 3 East level has been unwatered, and a large amount of material recovered which has been under water since 1912; this will open up quite a large area of workable territory of good coal.

Opening-up work in No. 4 East motor-road has been continued during the year. Nos. 1, 2, 17, and 21 inclines have been opened up on the rise side, and Nos. 1, 2, and 3 Diagonal slants have been opened up on the dip side of the level.

The haulage equipment of this mine consists of one 100-ton Ottumwa electric hoist, driven by a type M.D.S., General Electric motor, which hauls the coal from the slope. A 6-ton Morgan-Gardiner electric locomotive is used to haul the coal from No. 4 East district.

The pumping equipment consists of a 5-stage Mather & Platt pattern turbine-pump, 375 gallons a minute capacity, at a 250-foot head, running 1,400 r.p.m., driven by a 75-horse-power, type D.S.C. General Electric motor; also a 3-stage Mather & Platt turbine-pump, 375 gallons a minute capacity, at a 225-foot head, running 175 r.p.m., belt-driven by a 50-horse-power, type S. Westinghouse motor. The water from No. 4 East level is dealt with a single-stage Goulds centrifugal pump, 100 gallons a minute capacity, belt-driven by a 15-horse-power Imperial electric motor.

Safety-lamps of the Wolf type and the Edison electric lamps are used throughout the mine; all blasting is done with permitted explosives, fired by electric battery. This mine is ventilated by a Murphy fan of 40,000 cubic feet capacity, against a 1.9-inch water-gauge, and is driven by a 25-horse-power, type D.L.C. General Electric motor.

When I made my inspection in December I measured 24,500 cubic feet of air a minute passing into the mine, divided into three splits.

In the West side split there was 8,600 cubic feet of air a minute passing for the use of twenty-five men and five mules, or an average of 215 cubic feet of air a minute for each unit employed.

In No. 2 East split there was 6,000 cubic feet of air a minute passing for the use of fifteen men and two mules, or an average of 285 cubic feet of air a minute for each unit employed.

In No. 4 East split there was 9,900 cubic feet of air a minute passing for the use of twenty-six men and four mules, or an average of 255 cubic feet of air a minute for each unit employed.

I found timbering in fair condition, with the exception of several broken stringers in No. 1 West and No. 2 East levels, which required retimbering; roadways were in fair order.

I found this mine free from explosive gas. This mine is fairly free from coal-dust, with the exception of a portion of No. 1 West level.

No. 3 Mine, Extension.

Thomas Strang, Overman; George Smith, James Pollock Nimmo, Jr., James Nelson, Daniel Campbell, David Davidson, and Patrick Malone, Firebosses.

Operations in this mine have been carried out successfully during the year, which consists of pillar-and-stall work and the extraction of pillars. Nos. 4 and 5 West levels have been opened up off the motor-road, and are being driven with the object of recovering some pillars and

material that had been left in that section of the mine during the labour troubles, and maintaining a good return airway from the Slope district. Good work is being done in No. 4 West level, being well cogged and packed, and large round timbers used for roof-supports.

Two rock tunnels have been put through the "overlapping" fault off McCoy's incline, and has opened up an area of thin coal averaging 3 feet 6 inches thick, which is worked on the long-wall system. Malone's dip and drum road sections are worked on the pillar-and-stall method, the coal averaging from 4 to 9 feet thick. Nos. 10 and 14 inclines and the Heading district work consists of pillar-extraction.

The haulage equipment consists of a 50-horse-power Ottumwa electric hoist driven by a 27-horse-power General Electric motor. There are seven gravity-inclines in this mine, which in turn deliver the coal to the foot of the slope, where it is handled by the above-mentioned electric hoist and delivered to the electric locomotive.

The water in this mine is taken care of by a single-stage Goulds centrifugal pump, 100 gallons a minute capacity, driven by a 25-horse-power Allis-Chalmers-Bullock motor. This mine is ventilated by a Guibal fan with a capacity of 65,000 cubic feet of air a minute, against a 1.7-inch water-gauge.

Safety-lamps of the Wolf type and the Edison storage-battery electric lamp are used throughout the mine, and all blasting is done with permitted explosives, fired by electric battery.

When I made my last inspection in December I measured 21,000 cubic feet of air a minute passing into the mine, divided into two splits.

In No. 1 split there was 12,000 cubic feet of air a minute passing for the use of fifty men and seven mules, or an average of 169 cubic feet of air a minute for each unit employed.

In No. 2 split there was 9,000 cubic feet of air a minute passing for the use of thirty-five men and six mules, or an average of 170 cubic feet of air a minute for each unit employed.

I found no explosive gas in No. 3 mine; the timbering was in good condition, with the exception of one place in No. 12 incline, where the timbers were a little behind; the roadways were in fairly good order. This mine is practically free from coal-dust.

No. 4 MINE, EXTENSION.

James Strang, Manager; David Martin, Overman; John Wright; Henry Winstanley, Albert Warren Courtenay, James Glen, John Barclay, and Thomas Wilson, 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. This mine has been in continuous operation during the year. During the year the main East level has been cleaned up and retimbered, and the slopes on the East and West sides have been unwatered. Opening-up work on an extensive scale was carried out on the West side slope, Nos. 1, 2, and 3 levels being turned off on the East side, and Nos. 1, 2, and 3 levels on the West side, the coal being very thin, averaging about 2 feet 3 inches, and was worked on the long-wall system. Owing to the coal thinning out on the East and West sides and the seam being intermixed with several bands of dirt, it was deemed necessary during the latter part of the year to abandon this Slope district, together with the East side slope, which had run into barren ground.

Only pillar-extraction was in operation on the upper side of the main East and West levels at the time of my visit in December. The haulage equipment at this mine consists of two 50-horse-power Ottumwa electric hoists for hauling out of the slope. The mine is ventilated by a Guibal fan producing 60,000 cubic feet of air a minute, against a ½-inch water-gauge.

When I made my last inspection in December I measured 42,000 cubic feet of air a minute passing into the mine, divided into two splits.

In the East side split there was 24,000 cubic feet of air a minute passing for the use of twenty-six men and one mule, or an average of 827 cubic feet of air a minute for each unit employed.

In the West side split there was 18,000 cubic feet of air a minute passing for the use of thirty-eight men and three mules, or an average of 382 cubic feet of air a minute for each unit employed.

I found this mine free from explosive gas; the timbering and roadways were in good condition and the mine free from coal-dust.

I regret to state that this mine was closed down in the latter part of December owing to the recent heavy rains flooding the workings of the mine.

No. 5 Mine, South Wellington.

T. A. Spruston, Manager; William Clifford, Joseph Thompson, and Peter Carr, Firebosses.

This new mine is situated at South Wellington, about 600 yards south of the S.W. Depot. Development-work started on the Main slope in September, 1917, and is down a distance of 700 feet, and, with the exception of about 100 feet of coal, has been in rock the whole distance. The first 200 feet of the slope is timbered with 12- x 12-inch square sets, 2-foot centres, and 14 feet wide; roof and sides lagged with 10- x 4-inch cedar lagging. The lower 500 feet is timbered with 12-inch round, peeled fir timbers, 3-foot centres, and lagged same as square sets.

Ventilation is produced by a 4-foot Stine fan, rope-driven by a 6 x 8 steam-engine. A turnout has been formed to drive towards the air-shaft which has already been sunk. A temporary plant has been installed, consisting of a portable boiler and a 10- x 14-inch steam hoisting-engine. Railway connection has been put in by the Esquimalt & Nanaimo Railway Company. Excavation and grading of the mine-yard is progressing. Excavation for the power-plant buildings, 112 x 54 feet, including boiler-house, power-house, machine-shop, hoist-house, and blacksmith-shop, is completed, and work begun on the foundation.

When I made my inspection in December I measured 3,500 cubic feet of air a minute passing into the mine for the use of six men, or an average of 583 cubic feet of air a minute for each unit employed.

I found timbering and roadways in good condition and the mine free from explosive gas. This mine is free from coal-dust.

The company has a rescue-station at Extension of frame construction, 24 x 53 feet, which contains a smoke-room, observation-room, work-room, and dressing-room fitted up with lockers, bath, and wash-basin. The equipment of the station consists of four 2-hour sets Draeger apparatus (which have been remodelled and brought up to date), one oxygen-pump, four oxygen-tanks, and four electric safety-lamps (Draeger type).

There has been some training done at the station in mine-rescue work during the year, seventeen men having obtained Government certificates of competency.

During the year no fatal or serious accidents have occurred in these mines, which speaks well for the officials and workmen in maintaining discipline, having for their motto "safety first."

The following are the official returns from the Extension Collieries for the year ending December 31st, 1917:—

Sales and Output for Year.	Coal.		Coke.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	136,609			
" export to United States	54,551			
" " other countries	11,207			
Total sales		202,367		
Lost in washing	67,617			
Used in making coke	1,000			
" under colliery boilers, etc., and employees' use	18,842			
Total for colliery use		87,459		
		289,826		
Stocks on hand first of year	1,325			
" last of year	890			
Difference taken from stock during year		435		
Output of colliery for year		289,391		

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	30		15		45	
Whites—Miners	252				252	
Miners' helpers	3				3	
Labourers	128		7		135	
Mechanics and skilled labour	24		21		45	
Boys						
Japanese						
Chinese—Labourers	5		41		46	
Indians						
Totals	442		84		526	

Name of seams or pits—Wellington Extension mine.
Description of seams, tunnels, levels, shafts, etc., and number of same—Nos. 1, 2, and 3 mines connected by main tunnel; No. 4 slope situated one mile south of main tunnel.

NICOLA-PRINCETON INSPECTION DISTRICT.

REPORT OF JOHN NEWTON, INSPECTOR.

I have the honour to submit my annual report as Inspector of Coal-mines for the Nicola-Princeton Inspection District for the year 1917.

In October of the present year I received instructions from Chief Inspector Wilkinson to include the Nicola-Princeton District in my inspectorate, owing to Inspector Strachan being removed to the Fernie District. Therefore, I beg to submit a report of this district for the months of October, November, and December, 1917. This district comprises Nos. 4, 4 East, 7, and 8 mines, operated by the Middlesboro Collieries, and No. 1 of the Merritt Collieries, all situated at a distance of one mile from the town of Merritt. No. 1 mine, Princeton, also No. 1 mine, Tulameen Collieries, are situated near the town of Princeton.

Middlesboro Collieries, Ltd.

Head Office—Vancouver, B.C.

Capital, $1,107,700.

Officers.	*Address.*
E. W. Hamber, President,	Vancouver, B.C.
G. S. Raphel, Vice-President,	Vancouver, B.C.
Thomas Sanderson, Managing Director and Secretary,	Vancouver, B.C.
C. M. O'Brian, Director and Treasurer,	Vancouver, B.C.
Robert Fairfoull, Mine Manager,	Middlesboro, B.C.

Value of plant, $250,000.

MIDDLESBORO COLLIERY.

Robert Fairfoull, Manager.

The Middlesboro Colliery, consisting of Nos. 2, 4, 4 East, and 7 mines, is operated by the Middlesboro Collieries, Limited, and is situated about one mile from the town of Merritt. A branch line of the Kettle Valley Railway about a mile long provides communication with both the main line of the Canadian Pacific Railway and the Boundary country.

The operating mines at present are No. 4, 4 East, and 7 mines, all operating in No. 4 seam of the Coal Gully or Lower series.

No. 4 MINE.

This mine, which includes the No. 6 mine, is reached by a crosscut tunnel cutting Nos. 5, 4, and 6 seams. Mining during the past year has been confined to the No. 4 seam. The seam is about 18 feet thick, pitching to the south at an angle of about 20 degrees. The method of working is pillar and stall. No development-work has been done in this mine during the past year, the mining of coal being confined to the extraction of pillars.

A Sheldon fan 8½ feet in diameter, driven by an Ideal engine, provides the ventilation. The fan is reversible and is capable of producing 90,000 cubic feet of air, against a 4-inch water-gauge.

On October 20th a fire was discovered in the rise workings, or what is known as the No. 3 incline. This incline is connected with the surface and about 200 feet above the lower levels. Owing to the caved ground and the fire obtaining oxygen from the surface, it is practically impossible to extinguish it. A complete line of stoppings are built to isolate the danger from the other parts of the mine, which is nearly all completed, and when finished will practically seal off this portion of the mine.

Safety-lamps of the Wolf type are used exclusively in this mine, and in addition a few electric head safety-lamps of the Edison type are used.

No. 4 EAST MINE.

This mine is also being operated in the No. 4 seam and is situated about 900 feet to the east of the tipple. The main dip has been driven to a point about 1,000 feet from the surface. The inclination of the seam is about 15 degrees to the east. Only development-work has been done so far in this mine. The method of working is pillar and stall.

No. 7 MINE.

This mine is situated in No. 4 seam, the entrance being 300 feet higher than the tipple. The Main slope has reached a point about 3,000 feet from the entrance, and is driven the whole distance in coal. The dip of the seam in this mine is to the south and at an angle of 25 degrees.

The method of working is pillar and stall. The size of the pillars are being gradually increased as the depth increases, and on the lower levels are 90 x 175 feet. Only the upper portions (about 8 feet thick) of the seam are being worked. Haulage is by chutes on the levels and compressed-air hoists to the surface, when the coal is lowered to the tipple by gravity-plane. The ventilation is produced by a fan of the Guibal type driven by compressed air. Fan is 52 inches in diameter and 24 inches wide, being built reversible.

No. 8 MINE.

Work in this mine has been confined to the driving of a slope and counter, which eventually will be connected to the No. 7 mine by a crosscut tunnel, and through which it is the intention to take the coal. This seam is about 6 feet thick.

The coal thorughout all the mines is mined by hand. Monobel and No. 7 coal-mining powders, with electric detonators, only being used. All the coal is brought to a common tipple in cars which have a capacity of 1.5 tons.

No additions have been made to the surface plants during the past year, the plant being at present the same as in the Minister of Mines' Report for the year 1916.

Certificated officials: Robert Fairfoull, manager of all the mines; James Fairfoull, overman; Matthew McKibben, fireman of No. 4 East mine.

On my last inspection I found 28,200 cubic feet of air a minute passing into the mine for the use of twenty men, or an average of 1,410 cubic feet of air for each unit employed.

I called the attention of the management to the system of ventilation that is adopted in this mine. The mine is fairly free from coal-dust. No explosive gas found; timbering and roadways good.

No. 4 MINE.

Certificated officials: Alexander Ewart, overman; William Halliman and George Hudson, firemen.

On my last inspection I found 23,000 cubic feet of air a minute passing into the mine for the use of twenty-seven men and four horses, or an average of 589 cubic feet of air for each unit employed.

The fumes coming off the fire area are not as strong as they were on my previous inspection. The mine is fairly free from coal-dust, with the exception of the main haulage-road. No explosive gas found; timbering and roadways good.

NOS. 7 AND 8 MINES.

Certificated officials: John McDonald, overman; Lewis Clark, George Walker, Thomas Rowbottom, and George Maxwell, firemen.

On my last inspection I found 16,000 cubic feet of air a minute passing into the mine for the use of thirty-six men and one horse, or an average of 410 cubic feet of air for each unit employed. No explosive gas found; timbering and roadways good.

On all dates I examined all record-books required under section 91, subsections (4) and (36) of the "Coal-mines Regulation Act," and found the requirements of the above Act carried out.

The following are the official returns of the Middlesboro Colliery for the year ending 1917:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	79,453			
" export to United States				
" " other countries				
Total sales		79,453		
Used in making coke				
Used under colliery boilers, etc.	4,172			
Total for colliery use		4,172		
		83,625		
Stocks on hand first of year	292			
" last of year	125			
Difference taken from stock during year		167		
Output of colliery for year		83,458		

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	11	....	4	5.50	15	.....
Whites—Miners	53	4.00 - 8.00	.....	.....	53	.....
Miners' helpers	19	3.50 - 3.75	.....	.....	19	.....
Labourers	28	3.30 - 4.50	17	3.00 - 3.50	45	.....
Mechanics & skilled labour	.....	.....	15	3.75 - 5.00	15	.....
Boys	.....	.....	6	2.20 - 2.50	6	.....
Japanese	.....	.....	.....	....	.....	....
Chinese	.....	.....	.....	....	.....	....
Indians	.....	.....	.....	.....	.....	... .
Totals	111	.....	42	.....	153	....

Name of seams or pits—Nos. 4, 6, 4 East, and 7 mines.

Description of seams, tunnels, levels, shafts, etc., and number of same—Nos. 4 and 6 mines: These seams are reached from the surface by a level tunnel passing through a part of No. 5 mine, then crosscut from No. 5 to No. 4 seams, and then from No. 4 to No. 6 seams. The work in No. 4 mine was confined to pillar-drawing, and repairs in No. 6. No. 4 East: Operating in No. 4 seam, the entrance to which is situated a short distance from the entrance to No. 4 mine. Operations in this mine were confined to driving the counter and main slopes. No. 7 mine: This mine also is operating in the No. 4 seam, on the opposite side of Coal gully to the other mines. Work in this mine has also been confined to development-work during the past year.

Description and length of tramway, plant, etc.—The main power plant is situated at the tipple, and consists of four return-tubular boilers, each 150 horse-power. A Canadian Rand compressor, with a capacity of 2,000 feet of free air a minute, supplies the power for underpound compressor, with a capacity of 2,000 feet of free air a minute, supplies the power for underground haulage, etc. A 27½-kw. generator is used for lighting purposes. Water is supplied for household, fire-protection, and steam-raising purposes from a pumping-station situated near the Coldwater river.

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.
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, at an elevation of 500 feet higher up.

No. 3 MINE.

Andrew McKendrick, Overman; Geo. Hudson, John T. Brown, Wm. Neilson, and Geo. Maxwell, Firebosses and Shotlighters.

No. 3 mine, which is the only one working during the year, 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 between this property and the Middlesboro Colliery. Crosscut tunnels at Nos. 3 East and 6 West on the No. 3 seam are driven to cut the No. 5 seam, which lies about 140 feet higher up in the measures.

The No. 3 seam is about 12 feet thick, sandstone roof, dip at an angle varying from 15 to 30 degrees to the south-east. The method of work is pillar and stall, and during the past year the work has been confined to the extraction of pillars.

The No. 5 seam is 5½ feet thick, practically the same pitch and direction as the No. 3 seam. The method of work is double-stall, stalls being driven up the full pitch from 20 to 30 feet wide, leaving pillars 30 feet thick. During the year the work in this seam has consisted of partially opening-up of stalls and partially from extraction of pillars.

In both seams the coal is pushed to the slope, and then hoisted by a 60-horse-power Ottumwa hoist to the surface.

The ventilation is produced by a Sheldon fan, single inlet, 6 feet diameter, producing 20,000 cubic feet of air a minute. Speed of fan, 300 revolutions a minute; water-gauge, 0.75 inch.

All the coal is mined by hand, and only those explosives appearing on the permitted list are used for blasting. All shots are fired with electric detonators and battery by competent persons appointed for the purpose as provided by section 91, Rule 12, of the Act. The cars, which have a capacity of almost a ton, are lowered from the slope entrance to the top of the gravity-tram by an 18-horse-power Beatty hoist, which hauls the empty trips back.

The gravity-tramway is a three-railed track with passing in the centre, 1,800 feet long, handling six 1-ton cars to the trip, on a 40-degree pitch, using a 1-inch steel rope. This delivers the cars to the tipple, where they are dumped on an ordinary tip-dump; the coal is then screened and picked before being delivered to the bins, which have a capacity of 500 tons.

The power plant at the mine consists of two Leonard type boilers, each 40 horse-power, which furnish 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 cars on the tipple, also for the pump used to deliver water to the mine plant. The other surface equipment consists of machine-shop, carpenter and car-repair shops, and office buildings.

Only safety-lamps of the Wolf type are used in the mines, and these are cleaned and tested at the lamp-room near the entrance to the mine, and re-examined by the fireboss before being allowed into the mine.

The tipple is connected to the Kettle Valley Railway, which affords access to the Canadian Pacific Railway main line and the Boundary country.

This colliery was in operation until the beginning of March, when it was closed down for the remainder of the year.

The following are the official returns of the Inland Coal and Coke Company for the year ending December 31st, 1917:—

Sales and Output for Year.	Coal.		Coke.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	6,989			
" export to United States				
" " other countries				
Total sales		6,989		
Used in making coke				
" under colliery boilers, etc.	497			
Total for colliery use		497		
		7,486		
Stocks on hand first of year	190			
" last of year				
Difference taken from stock during year		190		
Output of colliery for year		7,296		

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	5.00	2	5.00	7	5.00
Whites—Miners	40	4.50			40	4.50
Miners' helpers	32	3.25			32	3.25
Labourers	6	3.25	6	3.00	12	3.00
Mechanics and skilled labour			5	4.00	5	4.00
Boys						
Japanese						
Chinese						
Indians	4	3.25			4	3.25
Totals	87		13		100	

Name of seams or pits—Nos. 3 and 5 seams.

Description of seams, tunnels, levels, shafts, etc., and number of same—No. 3 seam is an average of 10 feet thick and quite clean for this field, with a good sandstone roof and floor. It is opened up with a slope from the surface some 1,500 feet long, with levels driven at right angles. The room system is used, with a small section of drawing pillars. No. 5 seam is 5½ feet thick, of bright block coal, lying 250 feet above No. 3, with which it is connected by a rock tunnel to No. 3 seam, and where all the coal is hoisted.

Description and length of tramway, plant, etc.—The three-rail tramway is 2,000 feet long to the tipple and bunkers on the railroad spur at the foot of the hill. A Stine wheel handles the trips of six loaded and six empty cars with the greatest ease, and is capable of handling

an output of 1,000 tons a day. The steam plants consist of two 40-horse-power boilers at the mine; one 14 horse-power at the tipple to handle the cars and pump water for mine and domestic use up on the hill, a head of 640 feet; and one 12-horse-power boiler on the Coldwater river, pumping water to the tipple water-tank. Owing to the rise in wages and material and inability to secure a reasonable price for the coal sold to the C.P.R. and K.V.R., the only market available to this field, the property was shut down early in March and remained closed for the year.

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.
G. I. Wilson, Secretary-Treasurer,	Vancouver, B.C.
Andrew Bryden, Mine Manager.	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 past year has been confined to the No. 2 slope. This has now been sunk on the seam for about 800 feet, and three levels have been driven to the east for about 150 feet.

This thickness of the coal is about 5 feet, but owing to its proximity to the outcrop the thickness of the coal has been very irregular, and a considerable amount of trouble has been experienced with faulty ground. Only a small force of men has been employed and the progress made was necessarily slow.

This property was given up by the above syndicate in June, and was taken over by the Pacific Coast Colliery Company of British Columbia, under the charge of Howell John, overman. The only work done was keeping the water under control.

The following is the combined output of the colliery under the Pacific Coast Coal Syndicate and the Pacific Coast Colliery Company for the year ending December 31st, 1917:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada				
" export to United States				
" " other countries				
Total sales				
Used in making coke				
Used under colliery boilers, etc.	206			
Total for colliery use		206		
Stocks on hand first of year				
" last of year				
Difference { added to / taken from } stock during year				
Output of colliery for year		206		

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				1	
Whites—Miners	1				1	
Miners' helpers						
Labourers						
Mechanics and skilled labour			1		1	
Boys						
Japanese						
Chinese						
Indians						
Totals	2		1		3	

The following is the output made by Pacific Coal Syndicate:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada				
" export to United States				
" " other countries				
Total sales				
Used in making coke				
Used under colliery boilers, etc.	180			
Total for colliery use		180		
Stocks on hand first of year				
" last of year				
Difference { added to / taken from } stock during year				
Output of colliery for year		180		

Name of seams or pits—No. 1 slope.

Description of seams, tunnels, levels, shafts, etc., and number of same—Stope is down 565 feet in variable coal of an uncertain quality. Both roof and floor are of very soft material, requiring almost solid timbering to hold the smallest opening. When the coal is thick enough to mine it is of good quality, but owing to dislocation of the strata the results so far are not encouraging. The Pacific Coal Syndicate relinquished their bond on the property in May.

Description and length of tramway, plant, etc.—Two small boilers of 12 horse-power to run the hoist and Fairbanks pump, which takes care of water making in the mine.

The following is the output made by the Pacific Coast Colliery Company:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada				
" export to United States				
" " other countries				
Total sales				
Used in making coke				
Used under colliery boilers, etc	26			
Total for colliery use		26		
Stocks on hand first of year				
" last of year				
Difference { added to / taken from } stock during year				
Output of colliery for year		26		

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 feet; distance driven, 800 feet; running N. 51° E., pitching at 30 degrees. There are three levels turned off the slope; thickness of seam, 5 feet. No. 2 shaft, depth 147 feet; slope driven off bottom of shaft for 706 feet; thickness of seam, 18 feet.

Description and length of tramway, plant, etc.—Length of tramway on surface, 200 feet, 3-foot gauge. Plant consists of two 10-horse-power vertical boilers; one 7 x 10 double-drum hoisting-engine; two Fairbanks duplex pumps; and a Sheldon fan capable of delivering 12,000 cubic feet of air a minute.

Merritt Collieries, Ltd.

(OPERATING UNDER LEASE FROM THE DIAMOND VALE COLLIERY.)

Capital, $30,000.

Officers.	*Address.*
Robert Brown, President,	Merritt, B.C.
E. J. Grant, Vice-President,	Vancouver, B.C.
H. D. Green, Secretary,	Vancouver, B.C.
Robert Brown, Treasurer,	Merritt, B.C.
A. E. Smith, Superintendent,	Merritt, B.C.

Value of plant, $5,107.22.

DIAMOND VALE COLLIERY.

A. E. Smith, Manager; James McGrath, John Brown, and Hugh Osborne, Firebosses.

The Diamond Vale property lies on the other side of the Coldwater river from the Middlesboro Colliery, and practically consists of all the flats lying between the Coldwater and Nicola rivers, and is situated one mile up the valley from Merritt, B.C., on the Nicola Branch of the Kettle Valley Railway.

The mine is entered by a slope. Work was resumed in December, 1916, after a long period of idleness. The slope is down 600 feet. A level has been turned off this slope at the bottom to the right and is in about 350 feet. From a point 300 feet down the Main slope a Diagonal slope has been turned off to the left and is down about 600 feet. Levels have been turned off this slope.

The method of working is by pillar and stall, the pitch being great enough to require chutes in the stalls. The mine is being ventilated by a fan of the Guibal type. Safety-lamps of the Wolf pattern are used exclusively in this mine, with four Edison electric head-lamps. A little experimenting has been done with a pick-machine.

On my last inspection I found 11,880 cubic feet of air a minute passing into the mine for the use of twenty-seven men, or an average of 440 cubic feet of air for each unit employed.

No explosive gas found; timbering and roadways good. This mine is fairly free from coal-dust.

The following are the official returns from the Merritt Collieries, Limited, for year ending December 31st, 1917:—

Sales and Output for Year.	Coal.		Coke.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	12,649			
" export to United States				
" " other countries				
Total sales		12,649		
Waste used in making coke				
Used in making coke				
" under colliery boilers, etc	708			
Total for colliery use		708		
Stocks on hand first of year				
" last of year				
Difference added to stock during year				
Output of colliery for year		13,357		

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	4	5.50	3	4.50	7	5.00
Whites—Miners	26	5.00			26	5.00
Miners' helpers						
Labourers	12	3.75	2	3.00	14	3.65
Mechanics and skilled labour	6	4.00			6	4.00
Boys	2	2.50	3	2.25	5	2.40
Japanese						
Chinese						
Indians						
Totals	50		8		58	

Name of seams or pits—No. 2 seam, No. 3 slope.
Description of seams, tunnels, levels, shafts, etc., and number of same—Slope.
Description and length of tramway, plant, etc.—Tramway, none. Plant: Two locomotive type of boilers and one upright hoisting-engine, 8 x 12 inches; Guibal type of fan driven by 8 x 10-inch compressor for driving coal-cutter and rock-drill; and small dynamo for lighting purposes.

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.
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; Andrew McKendrick, Overman; Robert Baxter, Robt. Gourley, Ben. J. Barlow, and Jas. G. Gaeter, 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 Main slope at this mine is now sunk for a distance of 2,500 feet on the coal-seam, which is about 24 feet thick, and lies at an inclination of about 12 degrees. Owing to the thickness of the seam only the top 10½ feet of coal is being worked at present; the method of work is pillar and stall, pillars being left 50 feet square, stall driven 9 feet wide. During the past year about 50 per cent. of the coal was obtained from development; the remainder from the extraction of pillars.

The haulage is by small air-driven hoists in the inside workings and horse on the levels to the Main slope, where the cars are lifted to the surface by a steam-hoist situated outside the mine.

Surface.—The surface equipment consists of a tipple with link-belt screening plant made by the Link Belt Company, of Chicago, with a capacity of 500 tons a day. The coal is hauled out of the mine upon the tipple by a 50-horse-power Jenckes hoist, direct haulage. The cars, which are made at the mine, have a capacity of 1.5 tons and are equipped with Hadfield's wheels. They are dumped over a self-acting rotary dump of the Robison type. The coal then passes on to the link-belt shaker screen, and is made into three sizes—namely, slack, nut, and lump; which last, however, after passing over the picking-conveyor, is separated into lump and egg upon a bar screen placed over the bunkers. There are four compartments in the bunkers—slack, nut, egg, and lump. The coal passes from the bunkers up the link-belt loading-conveyor to the loading-chute, which is equipped for open or box cars. The car scales are Fairbanks, with a capacity of 80 tons, and the cars stand upon the scales while being loaded. The box-car loader is of the Victor type. The tipple is driven by a 50-horse-power link-belt vertical engine. The loading-conveyor is driven by a 30-horse-power link-belt vertical engine. The power plant consists of three boilers—two 75-horse-power Goldie-McCulloch return-tubular and one 50-horse-power Gray type. A 60-kw. 3-phase alternating-current dynamo, driven by a 90-horse-power high-speed Goldie-McCulloch engine, supplies light for the mine and the town of Princeton. There are two Canadian Rand air-compressors—one with a capacity of 750 cubic feet of air a minute and one with a capacity of 1,116 cubic feet of free air a minute. There is an excellent machine-

shop equipped with McDougall lathe, shaper, screening-machine, steam-hammer, etc.; also wash-house, powder-magazine, oil-houses, lamp-shop, and suitable offices. The fan is a Guibal type, made at the mine, with a capacity of 42,000 cubic feet of air a minute to $^{9}/_{10}$ inch, running at a speed of 140 revolutions a minute. A 30,000-gallon water-tank supplies the plant and is ample for fire-protection.

Underground.—The mine is approached through a covering of gravel (glacial wash) varying from 20 to 40 feet in thickness, and the fan is placed at the top of the ventilating-shaft, which is some 50 feet west of the main haulage slope. This slope is down 2,260 feet and is at present the main intake airway. The system of mining is the pillar and stall, which is worked in small panels, as the mine is subject to spontaneous combustion, and quite a large area of the top old workings are stopped off owing to fire. The panels are cut out into levels, inclines, rooms, and crosscuts, the average width of which is 15 feet, and the pillars left approximately 50 feet square. These pillars are extracted as soon as possible, and the whole of the worked-out district or panel is stopped off with concrete stoppings before any heating-up takes place. This has been found so far to be very satisfactory. The coal-seam is 24 feet thick, of which the top 10 feet is worked, and it lies at an inclination of 12 degrees. The haulage below is by means of small air-hoists and the McCinty system is now being installed. The coal is all machine-mined by machines of the post-puncher type, air-driven, except the pillar coal. The mine is free from coal-dust and is not very heavily watered.

This mine is worked exclusively with safety-lamps of the Wolf type, also twenty electric head-lamps of the Wico type are in use.

On my last inspection I found 42,000 cubic feet of air a minute passing into the mine, divided into two splits.

West Side Split.—There was 8,000 cubic feet of air a minute passing into the split for the use of fourteen men, or an average of 571 cubic feet of air for each unit employed.

East Side Split.—There was 22,000 cubic feet of air a minute passing into the split for the use of thirty-eight men, or an average of 600 cubic feet of air for each unit employed.

A quantity of explosive gas was found in the caved area in No. 5 West level; timbering and roadways good. The mine is fairly free from coal-dust.

The following are the official returns from the Princeton Coal and Land Company for the year ending December 31st, 1917:—

Sales and Output for Year.	Coal.		Coke.	
(Tons of 2,000 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	26,001			
" export to United States	13,813			
" " other countries				
Total sales		39,814		
Lost in washing	1,352			
Used under colliery boilers, etc.	5,347			
Total for colliery use		6,899		
Stocks on hand first of year	12			
" last of year	225			
Difference added to stock during year		213		
Output of colliery for year		46,926		

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	3	5.50	4	
Whites—Miners	16	4.20 - 8.00			16	
Miners' helpers						
Labourers	6	3.50 - 3.67	8	3.50 - 4.00	14	
Mechanics and skilled labour	26	3.50 - 3.67	7	3.75 - 4.20	33	
Boys			3	1.75 - 2.00	3	
Japanese						
Chinese						
Indians						
Totals	49		21		70	

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. The slope is down a distance of 2,500 feet, driven on the pitch of the seam, with main and counter levels on strike of the seam, and 500 to 1,000 feet respectively both east and west. There is an air-shaft down to the seam and has a depth of 60 feet. The coal is mined by machines, of which three are used.

Description and length of tramway, plant, etc.—The plant consists of tipple having a length of 250 feet, with bunkers having a capacity of 240 tons; two 75-horse-power and one 50-horse-power boilers; machine-shop with all necessary equipment.

Coalmont Collieries.

(FORMERLY COLUMBIA COAL AND COKE COMPANY, LTD.)

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.

This property was not operated during any part of year 1917.

Tulameen Coal Company.

(FORMERLY UNITED EMPIRE COLLIERY, PRINCETON, B.C.)

The Tulameen Coal Company'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.

TULAMEEN COLLIERY.

Hugh Gillispie, Overman.

On my last inspection I found only six men working underground doing repair-work. The ventilation was good, owing to the improvement in the return shaft.

MIDWAY COLLIERY.

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 years 1915, 1916, or 1917.

EAST KOOTENAY INSPECTION DISTRICT.

REPORT OF ROBERT STRACHAN, SENIOR, INSPECTOR.

I have the honour to submit the annual report of the inspection of the mines in the East Kootenay Inspection District for the year 1917.

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 had extensive and fully equipped collieries, became 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 Carbonado Collieries of the Crow's Nest Pass Coal Company at Morrissey closed down finally in 1909 and have not since been worked.

The district is divided into two separate Inspection Districts. The Southern East Kootenay District, which was during the year 1917 until end of August 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, which was until end of August 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.

Owing to the resignations of George O'Brien and T. H. Williams, the former to take charge of a colliery on Vancouver island and the latter to take charge of Michel Colliery here, I was directed to take charge temporarily of both districts, assisted by Mr. Lancaster, who was appointed Inspector at the end of August. Later I was instructed to transfer my headquarters from Merritt to Fernie as senior Inspector in charge of the Crowsnest Pass District.

The mines operating during the year were the same as in 1916—namely, Coal Creek, Michel, and Corbin Collieries; the first two owned by the Crow's Nest Pass Coal Company, Limited, and the latter by the Corbin Coal and Coke Company, Limited, Spokane.

No attempt was made during the year to do any work in either the Morrissey mines, owned by the Crow's Nest Pass Coal Company, Limited, or the Hosmer mines of the Canadian Pacific Railway Natural Resources Department.

Attached is a list of the accidents reported during the year, resulting in thirty-five fatalities and fourteen seriously injured. Thirty-four of these fatalities were due to one accident, an explosion in No. 3 mine, Coal Creek, on April 5th; the other was due to haulage in Michel.

Coal Creek Colliery provides forty of the accidents, Michel seven, and Corbin two; apart from the explosion, nine were due to haulage, five to falls of coal, and one due to falling timber.

Compared with the previous year, our accident rate is greatly increased, due principally to the deplorable explosion in No. 3 mine, Coal Creek, the rate of increase with respect to all the injuries being 40 per cent. and fatalities 108 per cent.

In Coal Creek it will be noted that, apart from the explosion, there were no fatal accidents during the year, as compared with five the previous one. In Michel in 1916 there were twelve men killed by an explosion and no deaths due to other causes, and this year there is one fatal accident due to haulage.

The cause of the explosion of gas in No. 3 mine has not yet been determined; up to the end of the year twenty-eight of the thirty-four bodies have been recovered, leaving six still in the

mine. The work of recovering the mine has been steadily pursued, and I expect about the end of April we will have reached the faces of the main entries, where the remaining bodies are presumed to be. Data of the positions of the bodies found and general conditions are being taken for the purpose of assisting in determining the cause of the accident.

In No. 3 East, Michel Colliery, work has been steadily pursued in recovering this mine after the explosion of August 8th, 1916, but so far the body of Bratticeman Marmol has not been recovered. No. 13 East and West levels have now been repaired and cleaned up, with no signs of this body, and work has been commenced on No. 13 room, No. 6 East, which is the last of the places where the bratticeman was supposed to be.

No prosecutions were made during the year under the "Coal-mines Regulation Act," and only two under the special rules, in both cases for a breach of Special Rule 70 at Coal Creek Colliery, having damaged their safety-lamps in the mine. A list of these, with the penalty imposed, is attached.

Samples of mine-air for the purpose of analysis have been taken regularly during the year, at least twice in the main air-currents and once in the splits, and sent to the Department of Mines, Ottawa. A list of these results are attached.

Many samples were taken for other purposes, such as to find the conditions in the general body of the air-current at the working-faces, the increased percentage of gas in the air-current due to continuous working of the places more than eight hours, checking the Burrell gas-detector, and from blow-outs of gas in No. 1 East mine, Coal Creek.

The results of these have been that since September an order has been issued, as provided for by section 91, rule 4, requiring an interval of at least four hours between the finishing of work in the rooms or stalls by one shift and the commencement of work by the next. The results of this so far has been very satisfactory, as it allows an interval for the gas to be carried off produced by one shift mining before the following shift commences to work. It also allows of the settlement of the dust created by the previous shift.

A standard has also been established in all the mines for the withdrawal of the workmen when the percentage of inflammable gas in the general body of the air-current reaches a certain point. The standard set by the British "Coal-mines Act"—namely, 2½ per cent.—has been adopted as the point of withdrawal.

In Coal Creek, after considerable investigation, it has been fairly well established that a ¼-inch cap of gas on the Wolf safety-lamp comes very near this standard and is now recognized as the point for the withdrawal of the workmen. In Michel so far we have not definitely established the withdrawal point on the safety-lamp, but expect to do so in the near future, and in the meantime the Burrell gas-detector is being used and the above standard of withdrawal complied with.

The Burrell gas-detector is in use both at Coal Creek and Michel for the purpose of detecting smaller percentages of gas than can be ordinarily detected with the safety-lamp. The investigations along this line have definitely settled at Coal Creek Colliery that the gas-cap on the Wolf safety-lamp reflects a much higher percentage of gas than was formerly supposed; in fact, almost double.

With respect to coal-dust, fair progress has been made to load this out in most of the mines; barriers of shelves on which flue-dust has been spread have been erected for the purpose of preventing the propagation of an initial explosion, and lately a method of sprinkling the roadways and faces with water has been commenced.

While it will take some time to get an efficient method installed, there is no doubt that, unless this course is adopted, dangers from explosions of gas and dust are to be expected; therefore it is sincerely hoped that energetic steps will be taken not only to install such a system, but to utilize it and keep it efficient. It is generally recognized now that most of the destruction caused by an explosion, whatever its initial cause, is due to coal-dust, and no system of dealing with this danger is adequate which fails to cope with it at the working-faces, which are generally the principal source not only of the finest coal-dust, but also of most of the initial explosions.

From the amount of gas given off in these mines to the ton of coal produced, which is exceeded by very few in the world, the maintenance of large volumes of air, so as to keep the percentage of gas as low as possible, is absolutely necessary to afford the workmen a fair measure of safety.

In the latter part of the year trouble has been experienced with blow-outs of gas in the No. 1 East mine, Coal Creek, where in one case a blow-out displaced at least 140 tons of coal, mostly in the shape of very fine dust, creating a large cavity ahead of the working-face and projecting an enormous amount of methane into the air-current. An idea of the conditions which must have prevailed at the time of the blow-out can be conceived when seven hours later a sample of this gas showed 90.5 per cent. methane, with no traces of the higher hydrocarbons. Fortunately the disturbance in the overhead strata gave the workmen sufficient time to escape before the blow-out occurred.

No trouble has been experienced with very severe "bumps" during the latter part of the year, but, as no active mining was being done in the bump area, it is very hard to give an opinion whether trouble from this source is to be apprehended in the future or not. G. S. Rice, from the United States Bureau of Mines, made a report on this problem in the early part of the year.

The most important improvement during the year has been the replacing of the Wolf safety-lamp for general use by the Edison portable electric lamp, issued by the Edison Storage Battery Company and approved by the United States Bureau of Mines for use in coal-mines. With the exception of the firebosses and bratticemen, who still use the Wolf safety-lamp for testing purposes, all the workmen at both Coal Creek and Michel have been equipped with this lamp. A few of these are also in use at Corbin, and I am in hopes that only a very short time will elapse before they are in common use there also. The electric lamp, in addition to giving a greater margin of safety in gas or dust, affords a very much better light and should materially assist in reducing accidents from falls of roof or sides.

Trouble with fires in the mine has been experienced in Corbin during the year, where the 600 Left level on the No. 4 seam had to be sealed off from this cause. At this colliery the No. 1 seam is over 100 feet thick, and at least three levels of the No. 4 seam are on fire; the lower levels in the No. 4 seam are being flooded in an attempt to extinguish the fire there, but so far the indications are that some method of filling in the area left vacant by the extraction of coal with either fine sand, earth, or ashes containing at least less than 10 per cent. of carbonaceous matter will be the only means of ensuring some part of this coal for future use, and I think, in the interest of the conservation of our coalfields, it should be investigated.

A slight heating was observed in the No. 3 mine at Michel, but energetic measures were taken to cope with it, and so far no active fire has developed.

The amount of mine-rescue apparatus maintained at the collieries is similar to last year; in Michel the apparatus has been changed from negative to positive type; that at Corbin still remains in the negative type.

All the apparatus is of the Draeger make at Coal Creek; five of the 2-hour type and six of the ½-hour type, recharging-pump, and two pulmotors, while a fairly good supply of potash regenerators and oxygen is maintained. Michel, a similar amount, but one pulmotor; Corbin, two of the 2-hour type, recharging-pump, pulmotor, and an ample supply of potash cartridges and oxygen.

The lack of interest in maintaining efficiency in the use of the apparatus is very disappointing, and, although a very well-equipped station with an instructor in charge is maintained here at Fernie, only eight took a course in this work during the year, and these were from Coal Creek, no one taking a course from either Michel or Corbin. The reason for this is not far to seek; with no remuneration for the work, the expense incurred in coming to Fernie to take the course, from either Michel or Corbin, is prohibitive. Late in the year I sent the instructor to Michel to impart some instruction and assist in changing the apparatus from negative to positive type, and three took a course there, while twelve took sufficient lessons to make themselves acquainted with the new type.

Personally, I should like to suggest that the work of the instructor be made more elastic, as it is very desirable to have a uniform system of training, and that the training be maintained. At present we can only consider the station at Fernie here as an adjunct to the Coal Creek Colliery, for the reason that, while the workmen at Coal Creek can take a course without any expense or inconvenience, it costs about $30 for a workman in Michel and about $50 from Corbin.

The output of coal is less than last year, due principally to the stoppage of work at all the collieries during April, May, and June, incidental to the adjusting of an agreement between the companies and the workmen; and also at Coal Creek, due to No. 3 mine being cut off the producing list following the deplorable explosion of April 5th.

Labour has also been scarce during the year owing to the large number of workmen who have enlisted for military service overseas, resulting in the employment of a larger percentage of non-English-speaking workmen, and this seems to have contributed to some extent to our high accident rate, for, apart from the explosion in No. 3, Coal Creek, only two out of the fifteen recorded injured were English-speaking workmen. In this matter I regret to say that very little effort is made along the lines of educating these workmen in a field where the necessity for such is so great.

The reports from the collieries show 841 lb. of Polar Permitite, 5,947 lb. Monobel, 619 lb. dynamite, and 6,975 lb. of stumping-powder used for blasting purposes during the year.

In Coal Creek no explosives were used for blasting coal, and at Michel the only mine using them was No. 8; therefore the explosives used in Coal Creek and Michel, apart from No. 8 mine, were used for rock-work. The stumping-powder was used principally at the No. 3 mine, Corbin, for loosening the coal for the steam-shovel.

The total shots fired were 10,562, with about 0.1 per cent. miss-fires, and these were all at Corbin, there being fourteen miss-fires reported from there. The amount of coal produced per shot would be 52.2 tons, but this is not a fair estimate, as I have already pointed out very little coal was produced at either Coal Creek or Michel with explosives.

At Michel steps were taken during the year to ground all possible conductors of lightning or electricity leading into the mines, as this was one of the suggested causes of the explosion in No. 3 East mine in August, 1916, but no steps were taken at any of the other collieries along these lines.

I should like to suggest that, in future legislation, this as a possible source of danger in mines should be dealt with, and that proper lightning-arresters be erected at or near the entrance to all mines.

Copies of the general and special rules, plans of the mines, and copies of the "Systematic Timbering" order are posted at all the mines and maintained in fairly good condition.

In conclusion, I wish to thank the workmen and officials for the many courtesies extended to me while in charge of the district, and trust that in 1918, with their assistance and cordial co-operation, we will have a considerable reduction in the accident rate; it is only through this co-operation that such results can be obtained.

The following is a brief description of the mines working during the year, accompanied by the official returns.

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 H. Williams, 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 amount and disposition of this combined output of the company's collieries is fully shown in the following table:—

COMBINED RETURNS FROM CROW'S NEST PASS COAL CO.'S MINES FOR YEAR 1917.

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	39,200		116,252	
" export to United States	166,253		12,711	
" " other countries				
Total sales		205,453		128,963
Used in making coke	194,451			
" under colliery boilers, etc.	50,776			
Total for colliery use		245,227		
		450,680		
Stocks on hand first of year	58		938	
" last of year	64		1,474	
Difference added to stock during year		6		536
Output of collieries for year		450,686		129,499

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	46		14		60	
Whites—Miners	449				449	
Miners' helpers						
Labourers	120		279		399	
Mechanics and skilled labour	258		125		383	
Boys	14		21		35	
Japanese						
Chinese						
Indians						
Totals	887		439		1,326	

COAL CREEK COLLIERY.

Bernard Caufield, Manager; R. J. Brown, Assistant Manager.

This colliery, which is situated on both sides of Coal creek, is connected at Fernie by a five-mile branch of the Morrissey, Fernie & Michel Railway to both the Canadian Pacific and Great Northern Railways.

The mines in operation during the year were: On the north side of the creek, No. 1 North, No. B North, and No. 9; on the south side, No. 1 East, No. 1 South, and Nos. 2 and 3 mines.

The Nos. 1 North, East, and South are working the No. 1 seam, which varies from 15 to 40 feet thick; Nos. 2, 3, and 9 are working No. 2 seam, which varies from 5½ to 7 feet.

The method of work in all the mines is pillar and stall, or some modification of the same. The sizes of the pillars vary according to the seam, and generally the rule is to drive the entries in pairs, leaving as large a pillar between each pair as possible.

Practically all the work is development, and no attempt has been made during the year to extract any pillars. The direction of dip is generally east, and varies from 8 to 12 degrees.

The coal is handled in the inside of the mine, generally by horse or compressed-air hoist, and to the outside by either endless-rope hoist or compressed-air locomotive.

In the case of No. 1 South, No. 1 North, No. 1 East, and No. B North, gravity-inclines lower the coal to the level of the tipple, and from there it is taken by either compressed-air or steam locomotives to the tipple. The tipple, which is of steel construction, is 840 feet long and extends right across the valley, and is very well equipped to handle a large output.

Two separate and independent dumps, each driven by electric motors, dump the coal on to a feed-conveyor which supplies the shaking screens; here the slack is separated, going into a bunker, from which it is drawn to load open cars, and taken to Fernie to supply the coke-ovens. The lump coal is delivered to the picking-tables, where all the foreign matter is taken out.

Provision is made for loading into either open or box cars, two of Smith hydraulic box-car loaders providing an easy means, with the minimum of breakage of the coal in loading these cars.

The main power plant is situated on the north side of the creek and consists of fourteen boilers, having a total of 1,600 horse-power, while an auxiliary plant on the south side provides 605 horse-power. Three air-compressors provide a total capacity of 6,600 cubic feet of free air a minute, compressed to 100 lb. to the square inch, for the use of hoists, pumps, etc., inside the mine. A high-pressure compressor with a capacity of 1,346 cubic feet of free air a minute, compressing to 1,100 lb. to the square inch, supplies the power for the compressed-air locomotives. Electric power, which is used for motors on the tipple, fans, and lighting purposes, is supplied by two separate Robb-Armstrong engines, 20 x 20 inches, each of which drives two 400-ampere, 250-volt generators, and also one Crocker-Wheeler 279-ampere, 220-volt generator.

A very complete and well-equipped lamp-room is provided, and, as I have already mentioned, during the year, owing to the change from the Wolf safety-lamp to the Edison electric lamp, it was necessary to completely change the equipment, and it reflects great credit that this change was accomplished without any loss of time to the workmen and very little inconvenience.

Change-room and wash-house accommodation is provided for 950 workmen, the lockers all being of the steel-lath type, each workman being provided with wash-basin and he provides his own soap and towel.

All the horses are brought out of the mines at the end of the shift, and three large stables provide accommodation for about 140 horses. Adequate machine, blacksmith, carpenter, and locomotive repair-shops are maintained at the mines, in addition to those at Fernie for repairing and maintaining the plant, and also large and commodious offices and warehouses built of hollow concrete blocks.

A large number of workmen's houses have been erected at Coal Creek for the convenience of the workers, and a very good train service is maintained with the town of Fernie, where the remainder of the workmen reside and the principal offices of the company are situated.

No. 1 North Mine.

Joe Worthington, Overman; Thos. Tully, Edward Routledge, and Matthew Turnbull, Firebosses.

This mine, which is situated about 300 feet higher and 2,000 feet west of the tipple, is driven 6,000 feet into the mountain on the north side of the creek, working the western part of the Old No. 1 seam, and owing to faults has been mostly exploratory work during the year.

Ventilation, which is produced by a small 2- x 5-foot fan of the Guibal type, driven by belt from a 30-horse-power motor, provides about 27,000 cubic feet of air a minute for the use of thirty-one men and five horses; the speed of the fan being 184 revolutions a minute, and motor 1,025, with a water-gauge of 1.3 inches.

Within the last four months we have twice found small quantities of explosive gas, mostly in small feeders in the roof. Generally the ventilation has been fairly good, and most of the mine is moist, small quantities of dust being found generally at the working-faces.

No. 9 Mine.

Robert Fowler, Fireboss.

No. 9 mine was abandoned some years ago; work for the purpose of reopening it has been carried on all year with a force of about five men, but very little coal, except such obtained in the course of the repair-work, was produced. The general conditions have been very good, and while small percentages of gas have been observed in the air-current, no explosive gas has been observed.

Ventilation, which is produced by a 16-foot diameter fan of the Guibal type, driven by belt from a 16- x 18-inch steam-engine, measured on the intake 8,000 cubic feet a minute for the use of five men and one horse. This fan is capable of producing a greater quantity of air, but this amount generally keeps the mine fairly clear. The speed of the fan is 60 revolutions a minute; engine 38, with a water-gauge of $^{9}/_{10}$ inch.

B North Mine.

William Commons, Overman; James White, Evan Jones, and Herbert Parsons, Firebosses.

This mine, the only one working on the B seam, which is higher up in the series of coal-seams than either Nos. 1 or 2, is situated 1,800 feet east of and 200 feet higher than the tipple. The seam is about 10 feet thick, but so far only the upper 5 feet is being worked. The roads are driven partially in both parts of the seam, the coal produced in the lower part being used at the colliery boilers.

The ventilation, which is produced by a 3- x 10-foot double-inlet, reversible Brazil fan, driven by belt from a 30-horse-power Westinghouse motor, produces about 42,000 cubic feet of air a minute for the use of fifty-eight men and six horses; the speed of the fan being 150 revolutions a minute, and the motor 1,050, with a water-gauge of $^{8}/_{10}$ inch.

Explosive gas has been found at least four times during the last four months, and quite a large percentage of gas has been recorded in the air-current, indicating the necessity of having larger quantities of air circulated, so as to effect a considerable reduction in these percentages, especially in a mine where the haulage is in the return airway.

The timbering at the faces was generally good and the roadways were kept in fairly good condition, while an ample supply of timber seemed to be kept convenient for the workmen. The mine, especially on the main roadways, is fairly damp, but steps should be taken to cope with the coal-dust in and around the working-faces.

No. 1 South Mine.

Frank Landers, Overman; William Stockwell, William Hynds, John Strachan, James Taylor, and William Morgan, Firebosses.

Situated about 200 feet higher and half a mile west of the tipple, this mine works the No. 1 seam in the west portion of the mountains on the south side of the creek. It has now been driven in for a distance of about 4,500 feet; so far no pillars have been drawn.

Ventilation is produced by an 8- x 3-foot 4-inch fan driven by a belt from a 40-horse-power motor, and at the time of my last inspection was producing 36,000 cubic feet of air a minute for the use of sixty-six men and ten horses. Speed of fan, 265 revolutions a minute; motor, 765 revolutions a minute; water-gauge, 2.7 inches.

During the last four months explosive gas has been found in this mine every time we inspected it, and in some cases in at least four different places, while very large percentages have been recorded in the air-currents. The conditions under which this mine is worked, leaving a large amount of very tender coal and foreign matter, locally termed "rashings," overhead, with

the slight or heavy "bumps" which cause this material to run, leaves large cavities which fill up with methane, running in some cases to 50 and 60 per cent. When this running or caving occurs it is no unusual occurrence for large bodies of gas to be brought down into the air-current, which creates a very dangerous condition. Very close supervision is necessary under such conditions, so as to protect the workmen.

The mine has generally been very well timbered, and while there has on occasions been a scarcity of timber, I have not found any workmen actually without the necessary amount to protect them.

In regard to dust, as is to be expected from the conditions I have already described, this mine is very dusty, and it means continual loading-out of coal-dust; in addition, barriers consisting of flue-dust have been erected throughout the mine to prevent the spread of an initial explosion, should such unfortunately occur. A system of treating the roadways and working-faces with water has also been promised, and should be a great factor in reducing the dangers from this cause.

With about sixteen working-places on the air-current, the amount of gas given off is such that either a very much greater amount of ventilation will be necessary to reduce the percentage of gas or the air-current will require to be split, because we are rapidly coming to the conclusion that in mines like this or No. 1 East, and under the conditions which they are operating, about eight working-places are sufficient on an air-current.

No. 1 EAST MINE.

John Caufield, Overman; Harry Dunlop, James Duncan, Thos. Reed, James Maltman, and John Mawson, Firebosses.

Working the eastern portion of the No. 1 seam, this mine is situated 800 feet east of and 90 feet higher than the tipple. The haulage from the inside to the tipple is by endless-rope, bogie system, with trips of three cars.

This mine, which was laid out on a very extensive plan, suffered considerably from "bumps" in the end of 1916, and between trouble of securing sufficient labour, explosion in No. 3 mine, and stoppages due to adjustment of agreement, very little has been done to reopen the portion wrecked from that cause during the year. The only portion working has been the No. 10 East slope, and probably owing to the breaking of the strata by the "bumps" considerable trouble has been experienced in maintaining sufficient ventilation in this district.

Explosive gas and high percentages have been very common until lately, when the air-current was split, affording separate air-currents for the North and South splits, with about an average of eight places on each split. A great deal of work was also accomplished on the stopping in the shape of erecting permanent stopping, either of wooden blocks or concrete, and in making a new airway.

Ventilation, which is produced by a double-inlet, reversible Wilson fan driven by belt from a 125-horse-power steam engine, measured at the time of my last inspection 140,000 cubic feet of air a minute for the use of thirty-nine men and six horses. The speed of the fan was 124 revolutions a minute, and the engine the same, while the water-gauge showed 3.5 inches.

As I have already mentioned, there are two splits—namely, the North split, with 32,800 cubic feet a minute for the use of twenty men and three horses, and the South split, with 30,000 cubic feet a minute for nineteen men and three horses.

All the working-places and roadways were very well timbered, and generally the mine was very good in this respect, while an ample supply of mine-timber seemed to be kept convenient for the miners.

The conditions in this mine with respect to dust are very similar to those already mentioned in No. 1 South, and in the last two months steps have been taken to install a system of sprinkling the roads with water, which is to be extended to the working-faces. It will take some time to get an efficient arrangement installed, but it will certainly reduce to a great extent the dangers from coal-dust.

In November trouble was experienced with a blow-out of gas in the No. 3 North room in this mine, as already mentioned, and everything points out that it is absolutely necessary to circulate great quantities of air, take active measures to deal with the coal-dust, and have strict discipline in a mine with so many sources of danger.

No. 2 Mine.

Carmichael McNay, Overman; Jas. P. Bushell, Herbert Lanfear, and Walter Clarkstone, Firebosses.

This mine, situated on the south side of the creek and on the same level as the tipple, is one of the oldest mines in the camp. All the old workings have been gradually cut off and the recent or new workings are all practically in the shape of development, having reached a distance of 6,700 feet from the outside.

Ventilation, which is produced by a double-inlet, reversible fan of the Wilson type, measured 37,700 feet a minute for the use of forty-five men and seven horses. Speed of fan was 120 revolutions a minute, with a water-gauge of 2.8 inches.

While the general conditions as to ventilation have been fairly good in this mine, within the last four months we have found explosive gas in this mine five times, generally in small cavities in the roof. Timbering at the faces and the roadways has been fairly good, and a fairly good supply of timber seems to be kept convenient for the workmen. In some places treatment is required for the coal-dust, although the haulage-road is fairly clear of same.

No. 3 Mine.

John Biggs, Overman; John Henney, William A. Brown, and R. S. Phillips, Firebosses.

This mine is working the eastern portion of the No. 2 seam, on the south side of the creek, and is reached by a slope 2,250 feet long, driven down the full pitch of the seam, averaging about 10 degrees.

Since the deplorable explosion which occurred in this mine on April 5th last there has been no active mining of coal, all the work being in the way of repairing the mine. This work has now reached 447 feet inside No. 6 incline, or within about 1,000 feet of the face of the main levels. The work is certainly being very well done, and flue-dust zones to prevent the spread of an explosion have been installed, while a watering system to deal further with the coal-dust is at present partially installed.

The mine is still ventilated with one split, but an overcast is being constructed to make two or probably three splits. The ventilation, which is created by a fan similar to that of Nos. 2 and 1 East, was producing at the last inspection 56,700 cubic feet of air a minute for the use of thirty men and two horses. The speed of fan was 149 revolutions a minute, and the engine 112; the water-gauge showed 3.4 inches. The mine is fairly free from coal-dust and conditions generally were very good.

The following are the official returns from the Coal Creek Collieries for the year ending December 31st, 1917:—

Sales and Output for Year.	Coal.		Coke.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	29,655		72,977	
" export to United States	144,462		1,540	
" " other countries				
Total sales		174,117		74,517
Used in making coke	114,346			
" under colliery boilers, etc.	35,061			
Total for colliery use		149,407		
		323,524		
Stocks on hand first of year	27		536	
" last of year	64		1,206	
Difference added to stock during year		37		670
Output of collieries for year		323,561		75,187

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	33		8		41	
Whites—Miners	300				300	
Miners' helpers						
Labourers	81		168		249	
Mechanics and skilled labour	176		80		256	
Boys	8		11		19	
Japanese						
Chinese						
Indians						
Totals	598		267		865	

The following shows the number of days the Coal Creek Collieries worked each month during 1917:—

January (12 days' strike)	13½	September	21½
February	20½	October	19
March	22½	November	23
April (strike)	1	December (4 days idle account extreme weather)	17½
May "	..		
June "	..		
July	24	Total	191½
August	26		

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 (not operated), same seam.

MICHEL COLLIERY.

Thomas H. Williams, Colliery Manager.

This colliery, operated by the Crow's Nest Pass Coal Company, Limited, is situated on both sides of Michel creek, and is about twenty-three miles north-east of Fernie. The mines operated during the year are as follows: Old No. 3 mine and No. 3 East mine on the South side, and New No. 8 mine on the North side.

The Canadian Pacific Crowsnest branch, which runs through the property, and the Great Northern Railway branch from Rexford afford shipping facilities for the coal. With the exception of about three months' stoppage during the adjustment of an agreement between the workmen and the employers, work was fairly steady during the year. The mines operated were Nos. 3, 3 East, and 8, until late in the year, when active production of coal ceased in No. 3, due principally to scarcity of labour.

No. 8 MINE.

William Whitehouse, Overman; Fred Hutchinson, Wm. Dunn, Thos. Baybutt, John Newman, and Thos. James, Firebosses.

This mine, generally termed New No. 8, in contradistinction to Old No. 8, which was sealed off for fire some years ago, is situated on north side of the creek and about 535 feet above the elevation of the tipple. A tunnel 400 feet long, driven at right angles to the strike of the seam, intersects the seam, and levels are driven east and west, from which three pairs of inclines have been driven. The coal-seam averages about 12 feet thick and is worked pillar and stall, stalls being about 14 feet wide and leaving pillars about 60 feet square.

The average pitch is about 15 degrees and the haulage is by horse to the inclines, compressed-air hoists lowering the loaded cars and bringing up the empty. On the Main level a compressed-air locomotive takes the trips to the top of a self-acting incline, where it is weighed and dumped into a coal-bin, from where it is drawn as required to load the skip which takes it to the level of the tipple. The skip is self-dumping; from here the coal is taken by the ordinary mine-cars, operated by an endless rope, to the tipple.

The ventilation is produced by a 4- x 8-foot reversible Murphy fan, driven by belt from a 40-horse-power compressed-air-driven engine. Measured during December the fan was producing 43,750 cubic feet of air a minute, with the fan running 135 revolutions a minute and a water-gauge of 0.45 inch. This is divided into three splits and the ventilation conditions have been very good.

At no time within the last four months have I found explosive gas, and the results of the analysis of samples taken show a very small percentage of gas in the air-current. There were 86 men and ten horses in the mine during the inspection.

Explosives of the permitted kind are used for blasting in this mine, under the supervision of competent persons appointed for the purpose as provided by the "Coal-mines Regulation Act." I have generally found the working-places very well timbered and a good supply of timber provided for the use of the miners. The roadway and airways are in good condition and the mine generally is fairly well free from coal-dust.

No. 3 East Mine.

Thos. Cunliffe, Overman; Ed. Heyes, Ben Ball, Alfred Ball, Andrew Frew, and Walter Almond, Firebosses.

Situated about 3,000 feet from the tipple and south-east of the same, this mine has been opened by a tunnel driven in the coal-seam. The Main slope is a continuation of the tunnel, and levels have been driven east and west about every 200 feet. The coal-seam, which averages about 10 feet thick, is worked by pillar-and-stall method, stalls being about 14 feet wide and pillars 60 feet square. The haulage is by horse to the slope, which is operated by a steam-hoist situated outside. From the tunnel entrance the coal is hauled by compressed-air locomotives to the tipple.

Ventilation is produced by a reversible Wilson fan, driven by rope from a 125-horse-power steam engine, and at the time of our last inspection was producing 69,300 cubic feet of air a minute for the use of sixty-two men and eight horses, with a water-gauge of 2 inches.

During the last four months I have only once found explosive gas, and the analysis of air samples taken show the air-current fairly free from high percentages. No explosives are used for blasting, and I have generally found the working-faces well timbered, while a plentiful supply of timber is provided for the use of the workmen. I have found the roadways and airways in good condition, but considerable coal-dust on the roof and sides and at the working-faces. The management has promised, and I may say has started, to install a sprinkling system to cope with this, and in the interest of the safety of the workmen it should be energetically followed up.

No. 3 Mine.

Matthew Littler, Overman.

Very little work, except the repairing of airways and reopening an old roadway where signs of heating were in evidence, has been done in this mine during the latter part of the year. The method of work and haulage is very similar to that of No. 3 East, this being another part of the same coal-seam.

The ventilation, which is produced by a 6- x 12-foot fan of the Guibal type, driven by a 125-horse-power steam-engine, measured 39,000 cubic feet a minute for the use of nine men, with a water-gauge of 1.2 inches. The roadways and airways are being maintained in very good condition, but there is a great deal of very inflammable coal-dust present. Mine-air samples analysed show this mine to give off considerably more gas than either of the other two.

All the coal from the south side of the creek, Nos. 3 and 3 East, is hauled up an incline to the tipple by a double endless-chain arrangement, which travels on car-wheels with axles which act as spreader-bars, as pushers, and as retarders of the mine-cars when on the incline. Tracks for the mine-cars are inside the tracks for the cross-bar wheels, and when the car is delivered

to the chain-haul the cross-bar moves up to the rear car-wheels and pushes the car up the incline to the dump. The dump, which is simply a continuation of the track, increases from 20 to 60 degrees pitch, and when the door of the car is open the coal discharged on to the dump; the cross-bar, continuing to travel around a large sprocket-wheel, pushes the empty car on to a swing-lift transfer, while the bar, following the sprocket-wheel, carries the rear end of the car with it over the top of the sprocket and on to the upper or overhead track, by which the car returns down the incline. On the North side, or No. 8 side, the cars are dumped by an automatic dump, and after being dumped a transfer arrangement allows them to return underneath the loaded track to the endless rope, which takes them to the coal-bin at the foot of No. 8 incline. The tipple is fully equipped with picking-tables and screens, and the slack is taken by a belt-conveyor to the slack-bins, from which it is drawn and hauled by small steam-locomotives to the coke-ovens.

All the machinery around the tipple is driven by electric motors, and two Smith gravity box-car loaders allow of the handling of lump coal with the minimum of breakages. Power is provided for hoists and pumps by two low-pressure compressors, one a Walker capable of handling 3,500 cubic feet of air a minute, the other a Rand with a capacity of 4,500 cubic feet, both compressing to 100 lb. to the square inch. A high-pressure Rand compressor, with a capacity of 1,450 cubic feet a minute, compressing to 1,200 lb., provides power for the compressed-air locomotives. Two generators of 250 kw. each provide the power for the motors on the tipple and light for the town of Michel, where the majority of the workmen reside.

A very large and commodious change-room and wash-house is provided for the workmen, besides machine, carpenter, car-repair, and other shops, also office and warehouse with the other necessary buildings for carrying on the work. Eleven boilers with a combined capacity of about 1,600 horse-power provides steam for the engines, both the boiler-room and the power plant being housed in fire-proof buildings of brick construction.

The following are the official returns from the Michel Colliery for the year ending December 31st, 1917:—

SALES AND OUTPUT FOR YEAR.	COAL.		COAL.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	9,545		43,275	
" export to United States	21,791		11,171	
" " other countries				
Total sales		31,336		54,446
Used in making coke	80,105			
" under colliery boilers, etc.	15,715			
Total for colliery use		95,820		
		127,156		
Stocks on hand first of year	31		402	
" last of year			268	
Difference taken from stock during year		31		134
Output of colliery for year		127,125		54,312

NUMBER OF HANDS EMPLOYED, DAILY WAGES PAID, ETC. (INCLUDING 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	13		6		19	
Whites—Miners	149				149	
Miners' helpers						
Labourers	39		111		150	
Mechanics and skilled labour	82		45		127	
Boys	6		10		16	
Japanese						
Chinese						
Indians						
Totals	289		172		461	

The following shows the number of days Michel Colliery worked each month during 1917:—

January (10 days' strike)	15	September	23½
February	23	October	26
March	26½	November	26
April (strike)	..	December (4 days idle account extreme weather)	18
May ,,	..		
June ,,	..		
July	24	Total	209
August	27		

Name of seams or pits—New No. 3 (top section of No. 3 seam); Old No. 3 (lower section of No. 3 seam), operated only five months of year; New No. 8; Old No. 8 seam continued; No. 8 North (not operated during 1917).

Corbin Coal and Coke Company, Limited.

Head Office—Spokane, Wash.

Capital, $10,000,000.

Officers.	*Address.*
D. C. Corbin, President,	Spokane, Wash.
Austin Corbin, Second Vice-President,	New York, N.Y.
A. M. Allen, Secretary-Treasurer,	Spokane, Wash.
R. S. Ord, General Manager,	Spokane, Wash.
E. L. Warburton, Mine Manager,	Corbin, B.C.

Value of plant, $400,000.

CORBIN COLLIERY.

E. L. Warburton, 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.

During the year work was retarded by the stoppage incidental to the adjustment of an agreement between the workmen and the company, and later by severe bush fires which threatened the town of Corbin. The mines operated were: No. 4, working the 400, 500, and 600 levels; the No. 3, generally termed the "Big Showing"; and some development-work on the Nos. 2 and 5 seams, which turned out fairly promising.

No. 4 MINE.

Tom Brace, Overman; Thos. Bullen, Geo. Elmes, and Jas. Blair, Firebosses.

As mentioned in the earlier part of this report, the lower levels on this seam have been on fire for some time; therefore the levels operating were Nos. 400, 500, and 600. The method of work is generally to drive two or more levels from the outcrop, one series along the foot-wall, the other on the hanging-wall, and to connect these by crosscuts forming pillars about 50 feet square. All the workings are in coal, as the seam varies from 150 to 200 feet thick and lies almost perpendicular. Raises about 5 feet square connect one series of levels to the other and afford the means of access and ventilation. No attempt has been made during the year to extract any pillars.

Ventilation, which is produced by a 4- x 12-foot fan of the Guibal type, driven direct by a steam-engine, was producing at the time of our last inspection 30,000 cubic feet of air a minute for the use of thirty-two men and two horses, with a speed of 120 revolutions a minute and a water-gauge of 1 inch.

During the last four months we have found explosive gas twice, generally in small pockets in the roof coal above the timber; with this exception conditions have been very good. The mine is fairly well timbered and a plentiful supply of timber has been provided convenient for the workmen. The mine is fairly damp and both faces and roads are fairly free from coal-dust.

Haulage is by horse from the working-faces to the outside of the levels, and an outside incline permits of the dropping-down of the loads and hauling-up of the empty cars by a steam-hoist situated at the foot of the incline.

No. 3 MINE, OR "BIG SHOWING."

John Virgo, Fireboss.

Situated about two miles from and 800 feet above Corbin, this mine is operated as an open quarry. The method is to strip off the surface with steam-shovels, which load the debris into dump-cars for disposal, leaving the coal exposed for another shovel to load it into the railway-cars.

Four separate benches permit of the stripping and loading without interference, the railway into the pit being in the shape of a horse-shoe, the steam-shovel on the inside and the track on the outside. Both the shovel and the track are moved up as required. Where the coal is strong, holes are drilled and blasted to permit the shovel to operate.

A standard-gauge railway eight miles long switchbacks up to this mine, permits of a fairly rapid, if steep, grade, and in the past considerable trouble has been experienced in keeping the road free from snow, as the elevation is 6,200 feet above sea-level. To reduce trouble from this source, three turntables have been installed during the year at the head of each leg of the switch-back, so that the locomotive and plough can be turned without having to return to Corbin as previously.

The present pocket of coal being operated is 280 feet thick and is estimated to contain over 1,000,000 tons of coal, and during the past summer over 120,000 cubic feet of surface was removed; the ratio of coal exposed to surface removed is about 2 to 1.

It is needless to state that there are no gas, ventilation, or coal-dust problems here, and the work generally is very well supervised.

In the Nos. 2 and 5 seams, both of which average over 15 feet thick, some development has been done, but not sufficient to determine the complete thickness and extent of the seams. The intention is during the present year to further extend this work to supplement the present output.

The coal is hauled from the foot of No. 4 incline to the tipple by horse, and is either dumped into the storage-bins or on to the Marcus screen, to be cleaned and sorted as required.

The power plant consists of four boilers with a capacity of 300 horse-power, a 4-stage compressor for providing power for the compressed-air locomotives which formerly were used in hauling from the No. 1 seam, and a 120-kw. alternator which provides light for the works and the residences in the town of Corbin.

Blacksmith, machine, and car-repair shops are provided in addition to commodious ware-houses and offices. A lamp-room where the safety-lamps of the Wolf type are cleaned and repaired is fairly well equipped, and a fair-sized wash and change room is provided for the workmen.

The following are the official returns from the Corbin Colliery for the year 1917:—

SALES AND OUTPUT FOR YEAR.	COAL.		COAL.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	34,597			
" export to United States	59,594			
" " other countries				
		94,191		
Total sales				
Used in making coke				
" under colliery boilers, etc	6,874			
Total for colliery use		6,874		
Stocks on hand first of year				
" last of year				
Difference { added to / taken from } stock during year				
Output of colliery for year		101,065		

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		9		11	
Whites—Miners	40				40	
Miners' helpers	4				4	
Labourers	6		60		66	
Mechanics and skilled labour	5		25		30	
Boys			4		4	
Japanese						
Chinese						
Indians						
Totals	57		98		155	

During 1917 three turntables were installed on hill track to "Big Showing" to facilitate ploughing out this line in winter and obviating the necessity of coming to Corbin to turn plough. Also a little development was done at prospecting in Nos. 2 and 5 mines with promising results, and it is expected they will be shipping coal during the present year. During the year fire was discovered in 600 Left level, No. 4 mine; work on this has not been sufficiently advanced to determine whether due to old fire in No. 1 mine or local; meantime it is sealed off. Work during the year was retarded by strike of miners, also by bush fire, which extended down the Flathead valley and threatened Corbin.

Name of seams or pits—Coal mountain, operated by No. 3 mine or "Big Showing," open-work, and No. 4 mine, underground workings.

Description of seams, tunnels, levels, shafts, etc., and number of same—Vertical, operated by rooms and crosscuts 11 x 12 feet underground; open-work, operated by steam-shovels, Shay engines, and main line equipment.

Description and length of tramway, plant, etc.—As per previous reports.

SUMMARY—TABLE SHOWING ACCIDENTS OCCURRING IN B.C. COLLIERIES IN TEN YEARS—1908 TO 1917.

For the year	1908.				1909.				1910.				1911.				1912.				1913.				1914.				1915.				1916.				1917.				Total for 10 years.			
Output of coal.....tons	2,109,387				2,400,600				3,139,235				2,193,062				3,025,709				2,570,760				1,810,967				1,972,580				2,485,580				2,398,715				24,106,593			
Number of persons employed.....	6,095				6,418				7,758				6,873				7,130				6,671				5,732				4,991				5,060				5,170				61,898			
Nature of Injury and 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	..	8	9	32	..	7	39	..	..	6	6	..	..	10	10	7	2	3	12	..	..	13	13	..	1	2	3	23	2	8	33	12	..	..	12	38	..	..	38	113	5	57	175
Falls of coal	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	3	5	2	10	1	6	11	18	35	65	52	152
Falls of rock	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	7	6	7	20	2	4	14	20	50	92	90	232
Mine cars and horses	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	5	15	7	27	1	11	5	17	46	195	115	356
Powder, etc., explosion	..	2	4	6	1	1	3	5	1	1	3	5	..	1	2	3	2	1	..	3	..	2	..	2	2	3	..	5	..	..	1	1	..	..	1	1	..	..	1	1	6	11	15	32
Hoisting, ropes, etc.	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	..	5	4	9	1	5	5	11	9	31	28	68
Mine timber	1	3	..	4	..	2	3	5	1	4	2	7	..	..	5	5	1	2	2	5	3	6	1	10	..	2	2	4	..	..	..	....	..	2	2	4	..	1	3	4	6	22	20	48
Underground, miscellaneous	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	1	3	5	9	1	2	5	8	35	18	39	92
On surface, miscellaneous	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	..	..	1	1	..	..	1	1	15	36	33	84
	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	28	36	29	93	44	29	45	118	315	475	449	1,239

ACCIDENTS IN BRITISH COLUMBIA COLLIERIES DURING 1917.

Cause of Accident and Nature of Injury.	W.F. Co. Nanaimo.			C.C. Extension.			C.C. Comox.			P.C.C.M. S. Wellington.			B.C.C.M. Co. E. Wellington.			N.C. Ltd. Nanoose			M.C. Ltd. Middlesboro.			M.C. Co. Diamo'd Vale.			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.			Total for 1917.			
	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.	Fatal.	Serious.	Slight.	Total.
Gas—Explosion of																																											38
Fatal							4																					34												38			
Serious																																											
Slight																																											
Falls of Coal																																											18
Fatal							1																																	1			
Serious		2						2																					1			1									6		
Slight			1			1															3			4												2						11	
Falls of Rock or Roof																																											20
Fatal	1						1																																	2			
Serious		1						2																								1									4		
Slight			3			1			5						1						4																					14	
Mine Cars and Horses																																											17
Fatal																															1									1			
Serious		1			1			3			1						1												1			3									11		
Slight												1									3									1												5	
Shots or Powder																																											1
Fatal																																											
Serious																																											
Slight												1																														1	
Ropes, Hoisting or Haulage																																											11
Fatal							1																																	1			
Serious		2						3																																	5		
Slight			2						2						1																											5	
Post or Timber																																											4
Fatal																																											
Serious		1																																							1		
Slight			1																		2																					3	
Miscellaneous—Underground																																											8
Fatal							1																																	1			
Serious								2																																	2		
Slight									2												2																		1			5	
Miscellaneous—Surface																																											1
Fatal																																											
Serious																																											
Slight																					1																					1	
Total	1	7	7		1	2	8	12	9		1	2			2		1				15			4				34	2	1	1	5				2			1	44	29	45	118
Number of men employed	1,295			526			981			263			153			87			153			58			70			865			461			155			103			5,170			

ANALYSES OF ACCIDENTS DURING YEAR 1917.

District.	No. of Accidents per 1,000 Men employed.				Tons of Coal mined per Accident.			
	Fatal.	Serious.	Slight.	Total.	Fatal.	Serious.	Slight.	Total.
East Kootenay	23.56	4.72	2.02	30.38	15,764	78,802	183,917	12,261
Coast	2.43	5.96	11.38	19.78	205,218	83,952	43,975	25,300
Total for Province	8.51	5.60	8.70	22.63	54,516	82,714	53,304	20,328

PER CAPITA PRODUCTION OF COLLIERIES.

District.	Gross Tons of Coal mined in 1917.	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	551,751	1,481	372	944	584
Coast	1,846,964	3,689	500	2,816	656
Total for Province	2,398,715	5,170	464	3,760	638

ACCIDENTS IN MINES DURING 1917.

COAL-MINES.

District.	Fatal.	Serious.	Slight.	Total.
East Kootenay	35	7	3	45
Nicola	..	..	20	20
Coast	9	22	22	53
Totals	44	29	45	118

METAL-MINES.

East Kootenay	..	1	..	1
West Kootenay	9	7	11	27
Similkameen	3	1	1	5
Coast	5	3	7	15
Totals	17	12	19	48
Grand totals of all accidents	61	41	64	166

DETAILED STATEMENT OF ACCIDENTS IN B.C. COLLIERIES DURING 1917.

COAST COLLIERIES.

REPORTED BY HENRY DEVLIN AND JOHN NEWTON, INSPECTORS.

No.	Colliery.	Date.	Name.	Occupation.	Details.
1	Nanaimo (W.F.C.)	Jan. 19	G. Gahoff	Timber-packer.	Crushed and amputated finger, caused by being crushed between two timbers.
2	Reserve (W.F.C.)	" 19	Jas. Smith	Miner	Broken leg, caused by post falling on it.
3	Comox No. 4 (C.C.)	Feb. 2	John Clarke	"	Left wrist sprained between car and post.
4	Comox No. 4 (C.C.)	" 2	Chow Lee	Rollerman	Crushed between car and roof, causing severe bruises and sprain of head, back, and face.
5	East Wellington. (B.C.C.M.C.)	" 7	Charles Scott	Miner	Thumb and first joint of second finger of left hand taken off by being crushed between rope and pulley.
6	Morden (P.C.C.M.)	" 7	Con. Stolzenburg	Rope-rider	Struck by trip of cars, causing both legs to be broken.
7	Comox No. 4 (C.C.)	" 17	Sanziro Uno	Miner	Struck electric wires with his head, causing him to be electrocuted; fatal.
8	Comox No. 4 (C.C.)	" 17	Jung Sek Quoy	Miner's helper.	Lacerated wound of abdominal wall with bowel and omentum protruding, caused by being struck by passing trip of cars.
9	Reserve (W.F.C.)	" 20	James Wells	Labourer.	Struck by cone on the end of a rope, causing slight concussion and bruises.
10	Extension No. 4. (C.C.)	" 21	Thomas Greenwell.	Rope-rider	Inguinal hernia, caused by pushing a car.
11	Nanoose (N.C.C.)	May 9	Harry Zaccarello	Pusher.	Left leg broken by being crushed between car-bumper and post.
12	Extension No. 2. (C.C.)	" 14	John Harness	Miner	Rock fell from roof, cutting his head.
13	Comox No. 4 (C.C.)	" 22	Low Sing	"	Rock fell from roof, causing instantaneous death.
14	Comox No. 6 (C.C.)	June 3	George Bertram	Surveyor.	Died from carbon-monoxide poisoning, caused by explosion of gas.
15	Comox No. 6 (C.C.)	" 3	John D. Brough	Chainman	Same as above.
16	Comox No. 6 (C.C.)	" 3	Louis Murdock	Assistant surveyor	Same as above.
17	Comox No. 6 (C.C.)	" 3	Frank Bobba	Fireboss	Same as above.
18	South Wellington (P.C.C.M.)	" 13	Geo. Tilley	Miner	Bruised back, caused by being squeezed between car and rib.
19	East Wellington. (B.C.C.M.)	" 13	Thomas Reid	"	Struck by falling timber and rock, causing bruises to legs, chest, and broken seventh rib.
20	Nanaimo (W.F.C.)	" 14	John Waggett	"	Struck by falling prop, which fractured two ribs.
21	Reserve (W.F.C.)	July 4	Chas. Gowland	Pusher.	Two broken bones in ankle, caused by being locked in coils of rope.
22	Reserve (W.F.C.)	" 10	James Bellini	Miner	Rock fell from roof, causing cuts on head, arm, and back.
23	Comox No. 5 (C.C.)	" 21	John Resio	"	Fractured pelvis, caused by fall of overhanging coal and rock.
24	Comox No. 7 (C.C.)	" 25	Edward Towers	"	Rock fell from roof, causing fatal injuries.
25	Comox No. 4 (C.C.)	" 25	John Furbow	Fireboss	Rock fell from side, causing bruised and lacerated back, abdominal muscles, forearm, and hand.

ACCIDENTS IN COAST COLLIERIES—*Concluded.*

No.	Colliery.	Date.	Name.	Occupation.	Details.
26	Comox No. 4.... (C.C.)	July 25	John Potter.....	Driver.....	Fracture of two ribs, sprain of left shoulder and ankle, bruises and abrasion of left loin. Same accident as No. 25.
27	Comox No. 4.... (C.C.)	" 26	Billy Yuen (Oak)..	Miner	Simple fracture of right tibia and left fibula, caused by door slamming on same.
28	Extension No. 1.. (C.C.)	" 26	William Timmins..	"	Bruised left hip, caused by fall of rock
29	Comox No. 7.... (C.C.)	Aug. 8	Thomas Lumsden..	Rope-rider	Run over by trip of loaded cars; fatal.
30	Nanaimo..... (W.F.C.)	" 11	John James	Miner	Left leg broken by fall of top coal.
31	Reserve..... (W.F.C.)	" 24	Geo. Ward.....	"	Cut on head and bruised foot, caused by fall of rock.
32	Comox No. 7.... (C.C.)	Sept. 7	Young Yen	"	Amputated and fractured fingers, caused by fall of rock.
33	Comox No. 5.... (C.C.)	" 11	Fong Jai Ming	Labourer.....	Injuries to head and back, caused by fall of rock.
34	Comox No. 4.... (C.C.)	" 14	Daniel Gilles.....	Timberman....	Compound fracture of left leg, severe bruises and sprain of back and hip, caused by fall of rock.
35	Nanaimo ..... (W.F.C.)	" 15	James Deres.....	Driver.....	Right ankle broken, caused by being crushed against stop-block.
36	Comox No. 4..... (C.C.)	" 17	Chew Jew.....	Pusher.....	Right hip dislocated by being crushed between car and rib.
37	Comox No. 4.... (C.C.)	" 28	I. Yamada.....	Miner	Fracture of right leg, caused by fall of rock.
38	Morden..... (P.C.C.M.)	Oct. 12	William Tait.....	"	Powder-burns over face, right shoulder, and arm, muscles bruised and lacerated, caused by returning too soon on shot.
39	Comox No. 7.... (C.C.)	" 17	Richard Donnelly..	"	Bruised and sprained left foot, caused by fall of rock.
40	Comox No. 4.... (C.C.)	" 18	John Simpson	Rope-rider	Severe bruise and sprain of muscles of neck, caused by being crushed between top of car and timber.
41	Comox No. 5.... (C.C.)	Nov. 1	Charles Mussato...	Machine-helper	Both legs broken by being struck by bar of machine, which caught his legs against machine.
42	Comox No. 5. .. (C.C.)	" 7	Alexander Bell	Miner	Fall of rock, causing simple fracture of right thigh.
43	Reserve ..... (W.F.C.)	" 8	Wm. McKie.....	"	Fractured left arm, caused by fall of rock.
44	Reserve ..... (W.F.C.)	" 10	Ed. Wilkinson	Fireboss	Fractured rib, caused by falling slip of rock.
45	Harewood..... (W.F.C.)	" 12	Jos. C. Hughes....	"	Right collar-bone broken while coupling two cars together.
46	Reserve ..... (W.F.C.)	" 19	Albert Crassetti...	Miner	Left leg broken by fall of coal.
47	Comox No. 4.... (C.C.)	" 26	Chow Wing.....	Tail-rope [coupler	Attempted to jump on trip of cars and was dragged some distance by trip, causing compound fracture of left leg.
48	Comox No. 7.... (C.C.)	Dec. 7	Thomas Monks....	Hoistman	Cut fingers, caused by being caught between end of crank-pin brasses and crank-pin disk.
49	Nanaimo .. ... (W.F.C.)	" 18	James Foy.....	Driver.....	Left leg broken by being crushed between timber and trap-door.
50	Comox No. 5.... (C.C.)	" 20	Hamilton Bate	Switchman....	Car of trip turned over, crushing his leg, causing compound fracture of right leg.
51	Comox No. 7.... (C.C.)	" 22	E. Kranovitch	Pusher..	Trampled over by mule, causing broken collar-bone.
52	Comox No. 4.... (C.C.)	" 31	Jew Long.....	Driver.....	Loaded car ran over his foot, crushing same.
53	Nanaimo..... (W.F.C.)	" 31	John McAllister...	Miner	Crushed by fall of rock, causing instant death.

NICOLA COLLIERIES.

REPORTED BY ROBERT STRACHAN AND JOHN NEWTON, INSPECTORS.

No.	Colliery.	Date.	Name.	Occupation.	Details.
54	Inland C. & C. Co.	Feb. 7	Antonio Coutlee....	Driver.....	Punctured wound in foot, caused by stepping on a nail.
55	Middlesboro .... (M.C.L.)	Mar. 20	John Danish	Rope-rider....	Squeezed between car and post, causing a bruised back.
56	Middlesboro..... (M.C.L.)	April 9	Hugh Campbell....	Miner	Cut hand, caused by fall of coal.
57	Middlesboro .... (M.C.L.)	" 10	Alex. Nelson	Tipple-boy ...	Compound fracture of right thumb, caused by piece of coal falling on it.
58	Middlesboro .... (M.C.L.)	" 23	Eli Gates.....	Driver.....	Index finger bruised between door and piece of coal.
59	Middlesboro .... (M.C.L.)	" 28	Ernest Hendry.....	Loader.....	Broken toe, caused by fall of rock.
60	Middlesboro ... (M.C.L.)	May 4	Chas. Ostoff.....	"	Punctured wound in arm, caused by protruding nail.
61	Middlesboro .... (M.C.L.)	April 30	John Little.....	Driver.....	Right side of body bruised against side of working.
62	Merritt C.C.....	May 4	Joseph Limb.....	Miner	Finger crushed between two pieces of rock.
63	Merritt C.C.....	" 21	James Wheat.....	"	Bruised hip, caused by fall of clay.
64	Middlesboro .... (M.C.L.)	" 30	John Hoggan	Rope-rider....	Right foot bruised by car-wheel.
65	Middlesboro .... (M.C.L.)	June 18	Gus Klemela	Miner	Bruised hip and leg, caused by fall of rock.
66	Middlesboro .... (M.C.L.)	July 1	R. S. Brown.....	Fireboss	Was removing rails and had a finger bruised and lacerated between same.
67	Merritt C.C.	" 7	Wm. McCreight....	Miner	Chin and shoulder bruised by falling coal.
68	Middlesboro .... (M.C.L.)	" 23	George Walker.....	Fireboss	Bruised back and hip, caused by fall of coal.
69	Middlesboro .... (M.C.L.)	" 21	Wm. Cumberland..	Miner	Fell through scaffold against car, bruising and fracturing a rib.
70	Middlesboro .... (M.C.L.)	" 26	Henry Kinnear	"	Finger crushed between two pieces of rock.
71	Middlesboro ... (M.C.L.)	Aug. 4	Oscar Myers.....	"	Bruised and fractured ribs, caused by falling against a barrel.
72	Middlesboro .... (M.C.L.)	" 6	John Josit	"	Cut on right leg, caused by fall of rock.
73	Merritt C.C.....	Sept. 10	Andrew C. Hutton..	Labourer.....	Struck by falling piece of coal while loading box car.

EAST KOOTENAY COLLIERIES.

REPORTED BY T. H. WILLIAMS, GEORGE O'BRIEN, AND ROBERT STRACHAN, INSPECTORS.

74	Michel ..... (C.N.P.C.C.)	Feb. 17	R. Dametto.....	Driver.....	Crushed between car and centre post, fracturing his right leg.
75	Michel.. ..... (C.N.P.C.C.)	" 20	Sam Harmatuk ...	Rope-rider....	Struck on head by falling timber, causing fracture of the base of skull and lower jaw, lacerated wound of right cheek, and bruised shoulder.
76	Coal Creek..... (C.N.P.C.C.)	" 26	Massino Maffioli....	Rock-miner ...	Fractured left ribs, caused by being crushed between side of car and timber.
77	Corbin..... .. (C.C. & C.C.)	Mar. 7	Andrew Kusica....	Miner	Crushed fingers of left hand, caused by falling rock.
78	Michel..... (C.N.P.C.C.)	" 24	J. Parkin.....	Hoistman.....	Left leg severely crushed (necessitating amputation) between bumpers of cars.

ACCIDENTS IN EAST KOOTENAY COLLIERIES—*Concluded.*

No.	Colliery.	Date.	Name.	Occupation.	Details.
79	Coal Creek (C.N.P.C.C.)	April 5	W. R. Puckey	Fireboss	Killed by mine explosion.
80	Ditto	" 5	Hugh Melarkey	Pumpman	" "
81	"	" 5	James H. Machin	Rope-rider	" "
82	"	" 5	Albert Barton	Motorman	" "
83	"	" 5	Patrick Gormley	Conductor	" "
84	"	" 5	Hugh J. McDougall	Driver	" "
85	"	" 5	Ven. Clarkstone	"	" "
86	"	" 5	Thomas Evans	"	" "
87	"	" 5	George Richardson	"	" "
88	"	" 5	Vittorio Bagioli	"	" "
89	"	" 5	Augustin Leonard	Miner	" "
90	"	" 5	Leonard Hector	"	" "
91	"	" 5	William Brown	"	" "
92	"	" 5	Joe Bravin	"	" "
93	"	" 5	Auguste Redoulez	"	" "
94	"	" 5	Frank Puillandre	"	" "
95	"	" 5	Giovanni Giacomazzi	"	" "
96	"	" 5	Benardo Giacomazzi	"	" "
97	"	" 5	Joe Stelliga	"	" "
98	"	" 5	John Monks	"	" "
99	"	" 5	Edward Coates	"	" "
100	"	" 5	Gioachima Bosetti	"	" "
101	"	" 5	William G. Clarke	"	" "
102	"	" 5	Joseph Campbell	"	" "
103	"	" 5	William Silverwood	"	" "
104	"	" 5	Harry Haydock	"	" "
105	"	" 5	Joseph Atkinson	"	" "
106	"	" 5	Jules Falip	"	" "
107	"	" 3	James Smith	"	" "
108	"	" 5	Frank Smith	"	" "
109	"	" 5	Henri Falip	"	" "
110	"	" 5	William Bird	"	" "
111	"	" 5	Firmin Benazeth	"	" "
112	"	" 5	Thomas Checkley	"	" "
113	Michel (C.N.P.C.C.)	July 14	Philip Bloha	Rope-rider	Killed by cave, caused by trip on which he was riding knocking out sets of timber.
114	Michel (C.N.P.C.C.)	Aug. 27	G. Picco	Driver	Right leg broken by timber-tram striking it.
115	Coal Creek (C.N.P.C.C.)	Sept. 4	Tom Resko	"	Thrown off runaway horse, breaking his arm and causing a cut over right eye.
116	Michel (C.N.P.C.C.)	Nov. 17	V. D. Agnola	Miner	Fracture of left thigh, caused by falling rock.
117	Coal Creek (C.N.P.C.C.)	Dec. 28	Nick Postaele	Timberman's [helper	Large scalp-wound and serious injuries to leg (necessitating amputation), caused by fall of coal.
118	Corbin (C.C. & C.C.)	" 31	Mike Kosiv	Miner	Bruised back, caused by fall of coal.

PROSECUTIONS UNDER "COAL-MINES REGULATION ACT."

As is incumbent upon the Inspector, he has laid information before the local Magistrates in the following cases of infractions by the workmen in the mines of the General and Special Rules and Regulations which are provided for the safety of all underground employees. The carelessness of one man endangers the lives of his fellow-workmen, and is treated as a criminal offence.

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 11	A. Waugh	Miner	Nanaimo No. 1.	Returning on a missed-fire shot	Fined $5 and costs.
Mar. 12	Nich Bulatovitch	"	Extension No. 2	Having matches and tobacco in his possession while in a safety-lamp mine	Fined $10 and costs.
" 12	Edward Towers	"	" "	Same offence	Fined $5 and costs.
July 23	Felix Duchane.	"	" No. 3	Not timbering his working-place in accordance with Special Rules	Fined $10 and costs.
" 23	Joseph Kritz..	"	" "	Charging a shot-hole before it was examined by shot-lighter	Fined $10 and costs.
Aug. 12	Mah Pat.....	"	Comox No. 4..	Same offence	Fined $5 and costs.
Sept. 21	Joe Maio.....	"	Coal Creek....	Breaking safety-lamp.....	Fined $10 and costs.
Oct. 12	Fred. Luk.....	"	"	Same offence	Fined $10 and costs.
" 30	D. Caldwell...	Shotlighter..	Morden.....	Firing a shot before it was safe to do so	Case dismissed.
Dec. 19	Dan Kopich...	Miner	Comox No. 4..	Having matches in his possession while in a safety-lamp mine	Fined $10 and costs.
" 20	V. Tork	Haulageman.	Princeton	Having pipe and matches in his possession while underground	Fined $5 and costs.
" 29	Fred Vaga	Loader.....	Nanaimo No. 1	Same offence	Fined $10 and costs.

METALLIFEROUS MINES SHIPPING IN 1917.

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.

Belmont Surf Inlet	Surf inlet	Belmont Surf Inlet Mines, Ltd.	Surf Inlet	Copper, gold, silver.
Esperanza	Alice arm	Pedro Salinas	Alice Arm	Gold, silver.
Granby Point	Anyox	Granby Cons. M. S. & P. Co.	Vancouver	"
Hidden Creek	"	" "	"	Gold, silver, copper.
Jitney		Frizzell	Prince Rupert	" "

QUEEN CHARLOTTE MINING DIVISION.

Campbell & Wilds	Jedway	Campbell & Wilds	Jedway	Copper.
Early Bird	Gold harbour	J. McLellan	Queen Charlotte	Gold.
Ikeda	Ikeda bay	S. J. Castleman	Vancouver	Gold, silver, copper.
Quinitsa				Copper.
Read Island	Jedway	J. Westerman	Jedway	Gold, silver, copper.
Tasu	Tasu harbour	T. E. Young	Victoria	" "

OMINECA MINING DIVISION.

Babine Bonanza	Babine mountains	J. Cronin	Smithers	Silver, lead.
Cap Group	Rocher Déboulé mount.	Magnus Johnson	Hazelton	Gold, silver, copper.
Copper Crown	20 miles south of Telkwa	Chisholm Bros.	Telkwa	Silver, copper.
Copper Queen	Leach mountain	Fred Griffin	"	Gold, silver, copper.
Frisco	Legate creek	Wm. Tuttle	Pacific	Copper, silver.
Harvey	Babine range	P. V. Harvey	Smithers	Silver, copper.
Highland Boy	Skeena Crossing	H. E. Clement	Tramville	Gold, silver, copper.
M. & K.	Legate creek	M. Orr	Pacific	Silver, lead, copper.
Santa Maria	Howson basin	T. Jefferson	Telkwa	Silver, copper.
Silver Creek	Hudson Bay mountain	P. Schufer	Vancouver	Gold, silver, lead.
Silver Standard	Glen mountain	D. McLeod	"	Silver, lead, zinc.
Rocher Déboulé	Tramville	D. J. Williams	Tramville	Gold, silver, copper.
Victoria	Babine range	P. J. Higgins	Burke, Idaho	Silver, lead.

EAST KOOTENAY.

FORT STEELE MINING DIVISION.

Burton	Elko	A. T. Caldwell	Fort Steele	Copper.
Minnie	Black Currant creek	A. R. McGregor	Crawford Bay	Silver, lead.
Park	Marysville	W. W. Gifford	Spokane	"
Quantrell	Kimberley	E. E. Jones	Kimberley	"
Selkirk	Marysville	W. W. Gifford	Spokane	"
St. Eugene	Moyie	W. W. Lindsay	Kimberley	"
Sullivan	Kimberley	The Consolidated M. & S. Co.	"	Silver, lead, zinc.

WINDERMERE AND GOLDEN MINING DIVISIONS.

Copper Butte	Golden	C. R. L. Co.	Windermere	Silver, copper.
Couverapee	Field	W. J. van Houten	Vancouver	Silver, lead.
Isaac	Isaac creek	H. E. Forster	Wilmer	"
Lead Queen	Wilmer	J. M. McLeod	"	"
Monarch	Field	W. J. van Houten	Vancouver	Silver, lead, zinc.
Paradise	Toby creek	R. R. Bruce	Invermere	Silver, lead.
Silver Belt	Spring creek	F. C. Stockdale	"	Silver, copper.
Tennessee	Spruce Creek	J. W. Conver	Golden	Copper.

WEST KOOTENAY.

AINSWORTH MINING DIVISION.

Mine or Group.	Locality.	Owner or Agent.	Address.	Character of Ore.
Albion	Ainsworth	Leo Mining Co	Spokane	Silver, zinc.
Bell	Retallack	C. F. Caldwell	Kaslo	Zinc.
Bluebell	Riondel	S. S. Fowler	Riondel	Silver, lead.
Cork	Zwicky	W. H. Burgess	Kaslo	"
Flint	Kaslo creek	J. A. Carter	"	"
Florence	Ainsworth	F. R. Wolfle	Spokane	"
Gallagher	"	A. D. Wheeler	Ainsworth	"
Highland	"	Consolidated M. & S. Co.	Trail	"
Little Phill	"	J. W. Smith	Ainsworth	"
Maestro	"	Consolidated M. & S. Co.	Trail	"
Silver Hill	Crawford Bay	Silver Hill Mines, Ltd.	Nelson	"
Silver Hoard	Ainsworth	W. S. Hawley	Spokane	"
Silver Queen	Duncan river	J. M. Miller	South Bellingham	Gold, silver, lead.
Spokane Trinket	Ainsworth	J. McDougall	Ainsworth	Silver, lead.
Sun				"
Utica Mines, Ltd	Kaslo	C. B. White	Kaslo	"
Whitewater	Whitewater	W. H. Burgess	"	Silver, lead, zinc.

SLOCAN MINING DIVISION.

Black Grouse	Carpenter creek	J. D. Ryan	Three Forks	Silver.
Bon Ton	Jackson basin	D. Brandon	Silverton	Silver, lead.
Caledonia				"
Daniel	Sandon	G. T. Gormley	Sandon	Silver, zinc.
Echo	Silverton	Echo Silver Lead Min. Co.	Spokane	Silver, lead.
Freddie Lee	Sandon	M. McCune	Sandon	"
Galena Farm	Silverton	Galena Min. & Milling Co.	Spokane	Silver, lead, zinc.
Gem	Carpenter creek	Frank Edwards	Sandon	Silver, lead.
Grey Copper	Slocan	J. Whittier	Vancouver	"
Hartney	New Denver	J. L. Lloyd	New Denver	"
Idaho-Alamo	"	Thos. Avison	"	Silver, lead, zinc.
Ivanhoe	Sandon	W. M. Bennett	Sandon	Silver, lead.
Lone Batchelor	Three Forks	A. McCorvie	"	"
Lucky Jim	Zincton	A. W. Allen	Victoria	Zinc, lead, silver.
Lucky Thought	Silverton	Consolidated M. & S. Co.	Trail	Silver, lead, zinc.
Noonday	Sandon	J. B. White	Spokane	Silver, lead.
Number One	"	J. M. Harris	Sandon	"
Payne	"	W. H. Burgess	Kaslo	"
Queen Bess	"	C. Cunningham	Sandon	"
Rambler-Cariboo	"	W. A. Cameron	"	"
Reco	"	J. M. Harris	"	"
Ruth	"	J. Anderson	"	Silver, lead, zinc.
Standard	Silverton	Standard Silver Lead Mining Co.	Silverton	" "
Slocan Star	Sandon	O. V. White	Sandon	" "
Sovereign	"	C. Cunningham	"	Silver, lead.
Surprise	"	J. McFadden	"	Silver, lead, zinc.
Van-Roi	"	C. Cunningham	"	" "
Victoria	"	J. Worgan	"	Silver, lead.
Wonderful	"	C. Cunningham	"	"

SLOCAN CITY MINING DIVISION.

Black Prince	Slocan City	F. M. Black	Winnipeg	Silver, lead.
Enterprise	Ten-mile creek	S. S. Fowler	Riondel	"
Lily B	Slocan City	G. Long	Slocan City	"
Meteor	Lemon creek	G. H. Aylard	Victoria	Gold, silver.
Ottawa	Slocan City	Consolidated M. & S. Co.	Trail	Silver.

NELSON MINING DIVISION.

Athabasca	Morning mountain	A. E. Rand	New Westminster	Gold.
California	Nelson	J. R. Cassin	Spokane	Gold, silver.
Emerald	Salmo	J. Waldbeser	Salmo	Silver, lead.
Eureka	Eagle creek	J. Bunyan	Nelson	Gold, silver, copper.
Granite-Poorman	Granite		Granite	Gold, silver.
H.B.	Deer creek	W. G. Harris	Silverton	Zinc.
Molly Gibson	Kokanee creek	Consolidated M. & S. Co.	Trail	Silver, lead.
Molly	Lost creek	H. C. Bennett	Nelson	Molybdenite.
Orinoco	Beasly	M. Egan	"	Silver, copper.
Pioneer	Salmo creek	E. Ballinger	Salmo	Gold, silver, lead.
Queen Victoria	Nelson	Canada Copper Corporation	Greenwood	Gold, silver, copper.
Rio Tinto	"			Silver, copper.
Silver Dollar	Salmo	L. R. Clubine	Salmo	Silver, lead.
Southern Bell	"	C. E. Wilson	"	"
Yankee Girl	Ymir	Hobson Silver Lead Co.	Ymir	Gold, silver.

ARROW LAKE MINING DIVISION.

Mine or Group.	Locality.	Owner or Agent.	Address.	Character of Ore.
Millie Mack	Burton	H. E. Forster	Wilmer	Gold, silver, lead.

TRAIL CREEK MINING DIVISION.

Berlin	Grenville mountain	H. D. Griswold	Paulson	Gold, silver, copper.
Centre Star	Rossland	Consolidated M. & S. Co.	Rossland	" "
I.X.L.	"	J. R. Cranston	"	Gold, silver.
Le Roi	"	Consolidated M. & S. Co.	"	Gold, silver, copper.
Le Roi No. 2	"	Le Roi No. 2, Ltd.	"	" "
Mountain Chief	Renata	E. F. McDaniel	Renata	Silver, copper.
White Bear	Rossland	Consolidated M. & S. Co.	Rossland	Gold, silver, copper.

REVELSTOKE MINING DIVISION.

Lanark	Illecillewaet	W. B. Dornberg	Illecillewaet	Silver, lead.

TROUT LAKE AND LARDEAU MINING DIVISIONS.

Beatrice	Camborne	Manager	Camborne	Silver, lead.
Copper Chief	Trout creek	R. D. Featherstonhaugh	Trout Lake	"
Ethel	Trout lake	Silver Crown M. Co.	Spokane	"
Ferguson Mines	"	Ferguson Mines, Ltd.	Kaslo	Gold, lead, silver, zinc.
Fidelity	Gerrard	F. C. Elliott	Victoria	Gold, silver, lead.
Foggy Day	Trout lake	J. S. Lamphere	Trout Lake	Gold, silver.
Monte Cristo	Gerrard	"	"	Silver, lead.
Multiplex	Camborne	O. T. Bibb	Revelstoke	Gold, silver, lead.
Silver Queen	Lardeau	Conaway Mining Co.	So. Bellingham, Wash	Silver, lead.
Towser	Ferguson	J. F. Carey	Spokane	Gold, silver, lead.
Triune	"	R. H. Battey	Detroit, Minn.	" "
True Fissure	Trout lake	A. L. Houston	Nelson	Silver, lead, zinc.

BOUNDARY.

GRAND FORKS MINING DIVISION.

Carlton				Copper.
Emma	Coltern	Consolidated M. & S. Co.	Trail	Gold, silver, copper.
Union	Franklin camp	Lewis Johnson	Grand Forks	Gold, silver.

GREENWOOD MINING DIVISION.

B.C.	Eholt	Canada Copper Corporation, Ltd.	Greenwood	Gold, silver, copper.
Bell	Wallace mountain	F. F. Ketchum	Beaverdell	Silver, lead.
Big Copper	Copper camp	John Moran	Greenwood	Silver, copper.
Blue Jay				Gold.
Bounty Fraction	Beaverdell	I. H. Hallet	Greenwood	Silver.
Cordick				Silver, copper.
Elkhorn	Greenwood	George White	Greenwood	Gold, silver.
Granby	Phoenix	Granby M.S. & P. Co.	Vancouver	Gold, silver, copper.
King Solomon	Greenwood	D. C. Corbin	Spokane	" "
Kokomo	Wallace mountain	G. M. Barrett	Beaverdell	Silver, lead.
Mother Lode	Greenwood	Canada Copper Corporation, Ltd.	Greenwood	Gold, silver, copper.
Oro Denoro	"	"	"	" "
Prince Henry	"	Prince Henry Mining Co.	"	Gold, silver, lead.
Rambler	"	W. H. Rambo	Beaverdell	Silver.
Sally	Wallace mountain	James Drum	"	Gold, silver, lead.
Sappho	Greenwood	C. E. Johnson	Greenwood	Silver, copper.
Standard Frac.	"	P. J. Kennedy	Beaverdell	Silver.
Sunset	"	New Dominion Copper Co., Ltd.	Greenwood	Gold, silver, copper.
Surprise No. 3	Skylark camp	Cunningham & Kane	Phoenix	Silver, copper.

OSOYOOS MINING DIVISION.

Dolphin	Keremeos	C. W. Jordan	Keremeos	Silver, copper.
Golconda	Osoyoos			Molybdenite.
Horn Silver	Similkameen	E. W. Condit	Similkameen	Gold, silver.
Nickel Plate	Hedley	Hedley Gold Mining Co.	Hedley	"

SIMILKAMEEN, NICOLA, AND VERNON MINING DIVISIONS.

Mine or Group.	Locality.	Owner or Agent.	Address.	Character of Ore.
Copper Mountain	Princeton	Canada Copper Corporation, Ltd.	Greenwood	Gold, silver, copper.
Aberdeen	Nicola	T. J. Corwin	Merritt	" "
Joshua	"	Donohoe Mines Corporation	Quilchena	Gold, silver, lead, copper.
Lucky Mike	"	O. A. Schmidt	Nicola	Silver, copper.

YALE, ASHCROFT, AND KAMLOOPS MINING DIVISIONS.

Emancipation	Yale	M. Merrick	Hope	Gold, silver.
Highland Valley	Ashcroft	F. Keffer	Spokane	Silver, copper.
Evening Star	Kamloops	A. S. McArthur	Kamloops	Copper.
Fog Horn	Thompson river	Axel Chindgren	Chu Chua	Silver, lead.
Iron Mask	Kamloops	Kamloops Copper Co., Ltd.	Kamloops	Gold, silver, copper.
Margaret	Thompson river	A. B. Hogg	"	Silver.
Maxine No. 2	Kamloops	C. B. Frederick	Tranquille	Gold, silver, copper.
Queen Bess	"	B. T. Foote	Blackpool	Silver, lead, zinc.
Tenderfoot	Savona	R. W. Gibbs	Savona	Siver copper.
Wind Pass	Chu Chua	T. Campbell	Chu Chua	Gold, silver, copper.

LILLOOET MINING DIVISION.

Lorne	Cadwallader creek	A. F. Noel	Lorne Mine	Gold, silver.
Pioneer	"	Andrew Ferguson	Vancouver	"

SOUTH COAST.

VANCOUVER MINING DIVISION.

Bowena	Bowen island	C. M. Oliver	Vancouver	Gold, silver, copper.
Britannia	Britannia beach	Britannia Mining & Smelting Co.	Britannia Beach	" "

NEW WESTMINSTER MINING DIVISION.

Empress	Agassiz	Barclay Bonthrone	Vancouver	Copper.

NANAIMO MINING DIVISION.

Alaska	Campbell river	J. B. Woodworth	Langara	Gold, silver, copper.
Copper Queen	Vananda	George Brister	Vananda	" "
Crayeroft	Crayeroft island	Crayeroft Copper Mines	Crayeroft Island	Silver, copper.
Ingersoll	Quadra island	F. H. Rosher	Victoria	"
Loyal	Vananda	E. W. Watson	Vananda	Gold, silver, copper.
Marble Bay	Texada island	A. F. Eastman	Tacoma	" "
Planta	"	W. L. Planta	Nanaimo	" "
Puget Sound Iron Co.	Vananda	W. H. Lee	Vananda	Silver, copper.
Santa Anna	Valdes island	J. McConville	Vancouver	Gold, silver, copper.
Watson E. W.	Powell river	E. W. Watson	Powell River	Silver, copper.

VICTORIA MINING DIVISION.

Blue Grouse	Cowichan lake	H. Ketchen	Victoria	Silver, copper.
Margaret	Sooke	G. Fraser	"	"
Sunnyside	Cowichan lake	J. D. Grayson	"	"

CLAYOQUOT AND QUATSINO MINING DIVISIONS.

Cape Comerell	Shusharti	J. J. Skinner	Shusharti	Gold.
Indian Chief	Sidney inlet	S. Silverman	Seattle	Gold, silver, copper.
Yreka	Quatsino sound	N. S. Clark	Vancouver	Copper.

ALBERNI MINING DIVISION.

Lewis, J. C.	Alberni	J. C. Lewis	Alberni	Silver, copper.
Monitor	Alberni canal	J. B. Skene	Port Alberni	Copper.
Torse	Alberni	Anthony Watson	Alberni	Silver, copper.
Wolverton	"			"

LIST OF CROWN-GRANTED MINERAL CLAIMS.

CROWN GRANTS ISSUED IN 1917.

CASSIAR.

Claim.	Division.	Grantee.	Lot.	Acres.	Date.
Ajax	Omineca	Charles F. Booth, James E. Dean	535	27.66	April 2
Beach	Skeena	Dolly Varden Mines Company	3799	51.65	Dec. 27
Begonia Fraction	Queen Charlotte	Ikeda Mines, Ltd.	1878	51.54	Jan. 31
Belle	Omineca	Donald McLeod	3304	38.84	April 17
Belle Fractional	"	New Hazelton Gold-Cobalt Mines, Ltd.	3306	22.90	Feb. 19
Bellis Fraction	Queen Charlotte	Ikeda Mines, Ltd	99	29.37	Jan. 31
Big Hill	Atlin	Christopher William Andrew Neville	228	25.55	Aug. 29
Blue Bell Fraction	Queen Charlotte	Ikeda Mines, Ltd.	1963	3.73	Jan. 31
Blue Jay	Portland Canal	William Henry Cooper and Helen Flewin	3225	47.60	Mar. 24
Brian Boru No. 1	Omineca	John Creagh	607	51.65	June 13
Brian Boru No. 2	"	John Creagh	608	50.22	June 13
Brookland	Portland Canal	Charles Edward Ingersoll	511	50.11	Oct. 30
Caribou	Skeena	Wakeley Aylesworth Williams	3510	43.00	Oct. 10
Cascade Falls No. 5	Portland Canal	Thomas Roberts	272	40.26	June 28
Cockscomb	Queen Charlotte	Ikeda Mines, Ltd.	1875	37.40	Jan. 31
Cosmos Fraction	"	Ikeda Mines, Ltd.	1870	29.49	Jan. 31
Daly	Portland Canal	James McDonald and Frederick Charles Winkler	3685	51.65	Sept. 22
Dougal	Skeena	Dolly Varden Mines Company	3638	47.52	Sept. 10
Dougal Fraction	"	Dolly Varden Mines Company	3642	1.22	Sept. 10
Eagle	Atlin	Hugh McDonald	384	30.23	Feb. 19
Eagle Bird	"	John Batistos Fenk	227	41.38	Dec. 20
Edith	Portland Canal	James McDonald and Frederick Chas. Winkler	3686	51.65	Sept. 22
Elk	Omineca	New Hazelton Gold-Cobalt Mines, Ltd.	3302	31.76	May 1
Even Star	Atlin	John Hartman Senn	224	43.61	Dec. 13
Ferns Fraction	Queen Charlotte	Ikeda Mines, Ltd.	1884	0.44	Jan. 31
Forty-five	Portland Canal	Charles Edward Ingersoll	512	45.80	Oct. 30
Gentian	Queen Charlotte	Ikeda Mines, Ltd.	1879	38.42	Jan. 31
Gopher	Atlin	Augusta Minnie Fenn	229	40.77	Dec. 13
Hazelton	Omineca	John C. K. Sealy and George Railson	3469	41.38	Oct. 30
Hazelton View	"	New Hazelton Gold-Cobalt Mines, Ltd.	3299	38.00	May 1
Hock	Atlin	Augusta Minnie Fenn	225	41.56	Dec. 13
Iris Fraction	Queen Charlotte	Ikeda Mines, Ltd.	1858	28.45	Jan. 31
Lady Isaac Fraction	Skeena	Granby M. S. and Power Company	1533	15.74	April 2
Lead Pick	Omineca	New Hazelton Gold-Cobalt Mines, Ltd.	3300	30.56	May 1
Lecroy	"	Guy Farrow	4098 R. 5	47.58	June 28
Lilac Fraction	Queen Charlotte	Ikeda Mines, Ltd.	1886	1.29	Jan. 31
Lois	Portland Canal	James McDonald and Frederick Chas. Winkler	3687	51.65	Sept. 22
Lucy	Atlin	Albert Creelman Smith	961	38.60	Feb. 19
Marigold Fraction	Queen Charlotte	Ikeda Mines, Ltd.	1882	1.40	Jan. 31
Moly One Fraction	Skeena	Molybdenum Mining and Reduction Co., Ltd.	3649	3.73	Sept. 19
Moose	Omineca	New Hazelton Gold-Cobalt Mines, Ltd.	3301	36.84	May 1
Nasturtium	Queen Charlotte	Ikeda Mines, Ltd.	1863	6.12	Jan. 31
Pine Apple Fraction	"	Ikeda Mines, Ltd.	1866	17.80	Jan. 31
Rose	Atlin	Arthur Jennings	386	36.90	Feb. 19
Silver Bell	Skeena	Miles Percy Donald and John Maddever Morrison	3644	41.94	Dec. 13
Simcoe	Atlin	Joseph Herman Chisel and James Irvine	382	45.12	Mar. 15
Sullivan	Portland Canal	James McDonald and Frederick Chas. Winkler	3684	51.65	Sept. 22
Thistle Fraction	Queen Charlotte	Ikeda Mines, Ltd.	1896	9.63	Jan. 31
Tiger	Skeena	The Granby M. S. and Power Company	6732	44.16	April 2
Victoria	Omineca	Donald McLeod	6737	43.95	April 17
View Fraction	"	New Hazelton Gold-Cobalt Mines, Ltd.	3305	21.38	Feb. 19
Waterfront	Skeena	Dolly Varden Mines Company	3639	51.04	Sept. 10
Waterfront Fraction	"	Dolly Varden Mines Company	3800	4.57	Dec. 27
Wolf	"	David W. Cameron	3795	49.87	Dec. 13
Wolf No. 2	"	David W. Cameron	3794	46.98	Dec. 13
Wolf No. 3	"	David W. Cameron	3796	44.48	Dec. 13
Wolverine	"	David W. Cameron	3797	36.69	Dec. 13

EAST KOOTENAY.

Alice	Fort Steele	Consolidated M. and S. Co.	12015 G. 1	45.02	Nov. 19
Bakke Fractional	"	Consolidated M. and S. Co.	12017 G. 1	42.58	Nov. 19
Cannon	"	Consolidated M. and S. Co.	12012 G. 1	50.00	Nov. 19
Clara	Windermere	Leonard Rees and John Hurst	12502 G. 1	51.65	May 5
Cruikshank	Fort Steele	Consolidated M. and S. Co.	3703 G. 1	51.50	Nov. 19
Edith	"	Consolidated M. and S. Co.	12016 G. 1	42.82	Nov. 19
Emma Fraction	"	William J. Langley, Charles C. Farrell, Walter C. Burchette, Edwin C. Smith, Robert L. T. Galbraith, Judson B. Langley, Andrew J. Devlin	6568 G. 1	7.40	Oct. 10
Gamble	"	Consolidated M. and S. Co.	12013 G. 1	51.33	Nov. 19

EAST KOOTENAY.—*Concluded.*

Claim.	Division.	Grantee.	Lot.	Acres.	Date.
Grey Eagle	Fort Steele	John Wright	8915 G. 1	41.08	April 3
Ida	Windermere	Leonard Rees and John Hurst	12501 G. 1	50.96	May 5
Iron Cap	"	Sarah James Farnham	5347 G. 1	51.65	June 11
Iron Crown Fraction	"	Ada Florence Scovil	5349 G. 1	14.54	June 11
July	Fort Steele	Consolidated M. and S. Co.	3700 G. 1	51.33	Nov. 19
Kitto Fraction	"	Consolidated M. and S. Co.	3702 G. 1	48.55	Nov. 19
Lois Fraction	"	Consolidated M. and S. Co.	6834 G. 1	51.18	Nov. 19
March	"	Consolidated M. and S. Co.	3699 G. 1	51.23	Nov. 19
Mispah	"	Elgin Earl Jones	12434 G. 1	32.18	April 2
Nellie Fraction	"	Consolidated M. and S. Co.	12010 G. 1	26.52	Nov. 19
Red Line No. 1	Windermere	Sarah James Farnham	5345 G. 1	51.65	June 11
Red Line No. 2	"	Ada Florence Scovil	5346 G. 1	47.62	June 11
Steele	"	John Williamson, Samuel Cobb, Frank L. Cottle, George H. Scott	12499 G. 1	47.05	Dec. 13
Steele No. 2	"	John Williamson, Samuel Cobb, Frank L. Cottle, George H. Scott	12500 G. 1	45.18	Dec. 13
Walde	Fort Steele	Consolidated M. and S. Co.	3701 G. 1	50.84	Nov. 19

WEST KOOTENAY.

Alice S.	Slocan City	Chester Westervelt Harper	12068 G. 1	51.65	Jan. 22
Anaconda	Trail Creek	James N. Cran	934 G. 1	8.79	May 28
Aspen	Nelson	Agnes Billings	12471 G. 1	35.25	June 11
Badger	Trail Creek	James Matthew Jordan	1227 G. 1	32.76	May 7
Batt Fraction	Nelson	Jonathan Rogers	9187 G. 1	1.68	July 19
Big Trout	Trail Creek	James Matthew Jordan	1276 G. 1	42.95	May 7
Black Rock	"	John D. McDonald	1821 G. 1	28.74	April 27
Blue Elephant	"	George W. Urquhart	1280 G. 1	51.47	April 27
Bonanza No. 2	"	Joe Cloman	5718 G. 1	49.00	April 30
Bondholder	Slocan	Roy F. Ainslie, George W. Bartlett	1257 G. 1	46.87	Dec. 13
Boston	Ainsworth	Patrick James Keogan	4913 G. 1	41.20	July 18
Camp Bird	Trail Creek	H. C. Athelstan Cornish	1283 G. 1	13.60	April 27
Carbonet No. 2	Slocan	Margaret Garland	6811 G. 1	51.65	Sept. 18
Cariboo	Ainsworth	Alex. Thomas Garland	631 G. 1	23.85	Mar. 14
Caroline	Nelson	Agnes Billings	12468 G. 1	14.84	June 11
Chetopha	Slocan	Thomas Jones Lloyd	3534 G. 1	45.56	June 12
Condor	"	Henry Homer Falding	3518 G. 1	40.51	June 12
Consolation	Trail Creek	Richard Roberts	1282 G. 1	41.16	Sept. 20
Crown	Arrow Lake	David Nevins, and Harry C. Randall	12460 G. 1	21 97	May 15
Cuba No. 2	Ainsworth	Patrick James Keogan	4914 G. 1	49.88	July 18
Daniel	Slocan	George T. Gormley	5193 G. 1	44.54	Jan. 30
Doherty	Ainsworth	Alex. T. Garland and George Eton McCready	12402 G. 1	43.47	Mar. 15
Eden	Trail Creek	John Joseph Mulligan, Thos. Patrick Mulligan, and James Weir	1127 G. 1	30 90	Sept. 20
Ego	"	Walter Cook	1823 G. 1	39.02	May 4
Emma	Nelson	Agnes Billings	12470 G. 1	31.13	June 11
Fairview	Trail Creek	Frank H. Watson	1058 G. 1	37.63	Sept. 4
Fairy	Slocan	Henry Homer Falding	4508 G. 1	30.77	June 12
Florence Silver Fraction	Ainsworth	Ferdinand Ralph Wolffe	9665 G. 1	35.40	Oct. 10
Good Hope	Nelson	Agnes Billings	9053 G. 1	38.29	July 6
Green Crown	Trail Creek	H. C. Athelstan Cornish	1232 G. 1	13.79	April 27
Green Mountain	"	Hubert Galt Oliver	638 G. 1	42.90	May 4
Harrisburg	"	Walter Cook	1449 G. 1	31.00	April 27
International	Nelson	Agnes Billings	12473 G. 1	36.46	June 11
Iron Mask	Trail Creek	Murdoch McLean	3520 G. 1	51.65	June 11
Jersey	"	Hubert Galt Oliver	646 G. 1	42.22	April 30
Keystone Fraction	Ainsworth	D. F. Stroheck	9670 G. 1	29.40	May 29
Kitchener	Slocan	Howard Cameron	4487 G. 1	45.88	Jan. 20
Louise	Nelson	George H. Green	12187 G. 1	24.61	Dec. 18
Lucky Girl	"	John William Crowthers	9190 G. 1	51.08	Oct. 2
Maggie Aikins	"	Frank Aikins and Philip Casey	10776 G. 1	51.65	Sept. 18
Marie	"	Agnes Billings	10371 G. 1	21.22	July 7
Michigan	"	Frank Aikins and Philip Casey	10775 G. 1	45.88	Sept. 18
Mohawk	"	Agnes Billings	12472 G. 1	39.32	June 11
Montana	"	Frank Aikins and Philip Casey	10778 G. 1	49.62	Sept. 18
Mountain Bell	"	Charles Augustus Coffin	4023 G. 1	51.65	July 12
Mountain Cougar Fract.	Ainsworth	Ferdinand Ralph Wolffe	9664 G. 1	40.14	Oct. 10
Monte Carlo	"	Alex. Thomas Garland	635 G. 1	15.25	Mar. 14
New Bonanza	Trail Creek	Chas. Augustus Coffin	5717 G. 1	31.90	June 19
Ontario	"	Ben F. Jordan	1057 G. 1	49.27	April 30
Opatunka	Slocan	Thomas Jones Lloyd	3523 G. 1	45.56	June 12
Paterson	Slocan City	Chester Westervelt Harper	12069 G. 1	43.54	Jan. 22
Pine Log	Slocan	Roy F. Ainslie and George W. Bartlett	1258 G. 1	51.65	Dec. 13
Road View	Trail Creek	Willard Graham	3783 G. 1	51.12	April 27
Silverton Fraction	Nelson	Percy Ferdinand Horton	12469 G. 1	6.74	June 9
St. Louis	Trail Creek	James N. Cran	935 G. 1	51.65	May 28
Summit Bell	Nelson	Frank Aikins and Philip Casey	10777 G. 1	51.65	Sept. 18
Sunday Sun No. 2	Trail Creek	Percy W. Racey	1161 G. 1	15.18	June 12
Tourmaline	"	James Matthew Jordan	457	10.55	Sept. 25
Utah	Nelson	Agnes Billings	9335	46.62	July 7
Van-Roi Fraction	Slocan	Van-Roi Mining Co., Ltd	10594 G. 1	43.21	April 3
Victoria No. 6	"	Roderick Dewar and John Worgan	3154 G. 1	35.16	April 3
Wallace	Ainsworth	James Melley	12453 G. 1	48.70	Sept. 4
Wide West	Trail Creek	George Talbot	1287 G. 1	18.80	June 11
Yosemite Fraction	Nelson	Jonathan Rogers	10254 G. 1	3.24	July 29
Young America	Trail Creek	John D. McDonald	1233 G. 1	34.69	April 30

BOUNDARY.

Claim.	Division.	Grantee.	Lot.	Acre.	Date.
Copper Mine Fraction	Greenwood	William Edward McArthur	3600	0.85	Sept. 25
Gem Fraction	"	Isaac Hoyt Hallett	2347 G. 1	6.00	July 9
Great Western Fraction	Similkameen	Frederick A. Howse	322 S.	37.88	Sept. 19
Independence	"	Peter Hoogenhorzem	2017 S.	49.70	Aug. 29
Keystone Fraction	Greenwood	Isaac Hoyt Hallett	2296	42.10	July 18
Little Dalles	"	Robert Forshaw	2628	46.71	April 3
Oronoco	Similkameen	John A. Johnson	2158 S.	32.60	April 13
Reco	"	Albert T. Bryant, Guy A. Lafferty, Charles W. Staples, Will J. Lawrence	1509 S.	46.15	June 19
Silver Dollar	"	Albert T. Bryant, Firman R. Whitwell, George W. Aldous, James Gellatly	66 S.	39.92	Aug. 29
Tripod Fraction	Grand Forks	B.C. Copper Co.	1463 S.	50.13	May 9
Union Fraction	"	Louis Johnson, Patrick Maginnis	1678 S.	1.56	Feb. 12

VANCOUVER ISLAND AND COAST.

Albany	Victoria	San Jaun M. and M. Co.	772	47.27	May 4
Alberta	"	San Jaun M. and M. Co.	773	45.37	April 30
Alexander	Quatsino	Teta River Mining Co.	679	51.53	Mar. 16
Alfrida	Victoria	San Jaun M. and M. Co.	777	49.42	May 15
Alpha Fraction	Vancouver	Britannia Mining and Smelting Co.	3702 G. 1	9.61	Jan. 3
American Flag	Victoria	San Jaun M. and M. Co.	151	20.43	May 14
Argus	Vancouver	Britannia Mining and Smelting Co.	4154 G. 1	51.62	April 20
Bass	"	Britannia Mining and Smelting Co.	4371 G. 1	49.46	Dec. 21
Bessie	Alberni	Big Interior G. M. Co.	592	51.65	July 30
Blue Jay	"	John C. Eden	527	23.40	Nov. 26
Canary	Vancouver	Britannia Mining and Smelting Co.	4382 G. 1	51.65	Dec. 27
Ceti Fraction	"	Britannia Mining and Smelting Co.	4157 G. 1	48.80	Dec. 6
Corvi	"	Britannia Mining and Smelting Co.	4156 G. 1	51.65	Jan. 6
Crane	"	Britannia Mining and Smelting Co	4397 G. 1	50.79	April 20
Della	Alberni	Big Interior G. M. Co.	591	51.65	July 30
Della Fraction	"	Big Interior G. M. Co.	601	14.04	July 30
Dove	Vancouver	Britannia Mining and Smelting Co.	4387 G. 1	51.24	Dec. 27
Drake Fractional	"	Britannia Mining and Smelting Co.	4399 G. 1	42.23	April 20
Duck Fraction	"	Britannia Mining and Smelting Co.	4389 G. 1	48.46	April 20
Eagle No. 7	Alberni	James A. Moore	297	30.30	Nov. 13
Eagle No. 8	"	James A. Moore	298	29.08	Nov. 13
Empress	Nanaimo	Alexander James Leitch	279 R.	44.90	Feb. 19
Engvick	Alberni	Big Interior G. M. Co.	604	45.97	July 30
Eros	Quatsino	Teta River Mining Co.	676 A.	0.63	Mar. 16
Flurry Fraction	Vancouver	Britannia Mining and Smelting Co.	4374 G. 1	50.20	Dec. 26
Gander	"	Britannia Mining and Smelting Co.	4400 G. 1	51.23	April 20
Golden Gate	Clayoquot	Elizabeth Ann Chesterman	1302	44.63	Mar. 1
Grouse Fraction	Vancouver	Britannia Mining and Smelting Co.	4392 G. 1	50.62	April 20
Hazel	Victoria	San Jaun M. and M. Co.	778	50.54	May 15
Holly	"	San Jaun M. and M. Co.	779	48.55	May 15
Ina	Vancouver	Britannia Mining and Smelting Co.	4221 G. 1	50.53	April 20
Jack of Clubs	Clayoquot	Elizabeth Ann Chesterman	1301	43.40	Mar. 1
June	Vancouver	Britannia Mining and Smelting Co.	4408 G. 1	51.06	Mar. 5
Jupiter	"	Britannia Mining and Smelting Co.	4146 G. 1	51.12	Dec. 6
Kalappa	Clayoquot	Elizabeth Ann Chesterman	1299	51.65	Mar. 1
Kate	Alberni	Big Interior G. M., Ltd.	593	45.46	July 30
Kendrick	"	Big Interior G. M., Ltd.	603	51.65	July 30
King George	Victoria	Frank Caffery	159	36.03	May 1
Lanz	Vancouver	Britannia Mining and Smelting Co.	4642 G. 1	51.65	Dec. 27
Linnet	"	Britannia Mining and Smelting Co.	4379 G. 1	51.28	Dec. 26
Lupi	"	Britannia Mining and Smelting Co.	4152 G. 1	51.65	April 20
Mamie	Alberni	Big Interior G. M., Ltd.	594	51.65	July 30
Maple Leaf	Victoria	San Jaun M. and M. Co.	775	45.00	May 15
Marie	Alberni	Big Interior G. M., Ltd.	595	49.65	July 30
Marmot Fraction	Vancouver	Britannia Mining and Smelting Co.	3574 G. 1	45.51	April 19
Marne Fraction	"	Britannia Mining and Smelting Co.	4575 G. 1	39.87	April 20
Mars Fraction	"	Britannia Mining and Smelting Co.	4147 G. 1	44.65	Dec. 6
Mercury	"	Britannia Mining and Smelting Co.	4150 G. 1	47.64	Jan. 3
Minnie	Alberni	Big Interior G. M. Co.	602	48.37	July 30
Moonlight	Victoria	San Juan M. and M. Co.	780	51.25	May 1
Mountain View	"	San Juan M. and M. Co.	781	51.54	May 1
Neptune	Vancouver	Britannia Mining and Smelting Co.	4148 G. 1	51.65	April 20
Nippon Fraction	"	" "	4574 G. 1	26.87	April 20
No. 66	"	" "	2931 G. 1	51.65	Jan. 2
No. 77	"	" "	2933 G. 1	51.61	Jan. 2
No. 79	"	" "	3939 G. 1	51.63	Jan. 2
No. 82	"	" "	3951 G. 1	51.61	Jan. 2
No. 83	"	" "	3952 G. 1	51.55	Jan. 2
No. 56	"	" "	4012 G. 1	51.65	Jan. 2
No. 76	"	" "	2932 G. 1	51.61	Jan. 5
No. 78	"	" "	2934 G. 1	51.65	Jan. 5
No. 55	"	" "	4011 G. 1	51.65	Jan. 5
No. 61	"	" "	3719 G. 1	46.87	April 19
No. 58	"	" "	4014 G. 1	51.23	April 19
No. 59 Fractional	"	" "	4005 G. 1	51.61	April 19
No. 62	"	" "	2927 G. 1	46.36	Dec. 4
No. 64	"	" "	2929 G. 1	51.65	Dec. 4
No. 48	"	" "	3717 G. 1	50.15	Dec. 4
No. 67 Fraction	"	" "	3943 G. 1	49.17	Dec. 5

VANCOUVER ISLAND AND COAST.—*Concluded.*

Claim.	Division.	Grantee.	Lot.	Acre.	Acres.
No. 68 Fraction	Vancouver	Britannia Mining and Smelting Co	3945 G. 1	46.06	Dec. 5
No. 85 Fraction	"	" "	3954 G. 1	51.19	Dec. 5
No. 86 Fraction	"	" "	3955 G. 1	48.91	Dec. 5
No. 57	"	" "	4013 G. 1	48.21	Dec. 5
No. 60 Fraction	"	" "	4021 G. 1	48.74	Dec. 5
No. 80	"	" "	4222 G. 1	51.00	Dec. 6
No. 81	"	" "	4223 G. 1	51.59	Dec. 6
No. 119 Fraction	"	" "	4260 G. 1	37.96	Dec. 20
No. 120 Fraction	"	" "	2899 G. 1	47.61	Dec. 20
No. 116	"	" "	2900 G. 1	51.31	Dec. 20
No. 29	"	" "	4373 G. 1	48.66	Dec. 22
Pachena	Victoria	San Juan M. and M. Co	152	12.74	May 14
Pachena Fraction	"	San Juan M. and M. Co	154	6.10	May 14
Pallas Fraction	Vancouver	Britannia Mining and Smelting Co	4160 G. 1	51.41	Jan. 8
Parrot	"	" "	4383 G. 1	51.65	Dec. 27
Pike	"	" "	4370 G. 1	51.65	Dec. 21
Pigeon	"	" "	4381 G. 1	51.61	Dec. 26
Puma	"	" "	4143 G. 1	51.65	Jan. 2
Quail	"	" "	4391 G. 1	51.14	April 20
Rabbit	"	" "	3506 G. 1	49.51	April 19
Raven	"	" "	4380 G. 1	51.28	Dec. 26
Robin	"	" "	4385 G. 1	51.54	Dec. 27
Rook Fraction	"	" "	4388 G. 1	47.12	Dec. 27
Seal	"	" "	4377 G. 1	47.81	Dec. 26
Snimick	Clayoquot	Elizabeth Ann Chesterman	1300	9.44	Mar. 1
Squirrel	Vancouver	Britannia Mining and Smelting Co	3507 G. 1	34.30	Mar. 5
S. Y.	"	Britannia Mining and Smelting Co	4224 G. 1	51.65	April 20
Tally One	Victoria	Charles A. Johnson	519	34.23	July 17
Tally Two	"	Goodwin G. Johnson	520	23.00	July 17
Tally Three	"	Michael J. Gaynor	521	44.20	July 17
Tauri	Vancouver	Britannia Mining and Smelting Co	4153 G. 1	51.65	Dec. 6
Three Jays	Alberni	William Garrett Tanner	524	35.16	Aug. 2
Three Jays No. 2	"	William Garrett Tanner	525	33.50	Aug. 2
Three Jays No. 3	"	John C. Eden	526	50.40	Nov. 13
Thrum-h Fraction	Vancouver	Britannia Mining and Smelting Co	4398 G. 1	51.09	Jan. 3
Tiger Fraction	"	" "	4144 G. 1	50.46	Jan. 3
Trout Fraction	"	" "	4372 G. 1	47.63	Dec. 22
Uranus Fraction	"	" "	4149 G. 1	48.25	Jan. 3
Ursa	"	" "	4155 G. 1	51.65	Jan. 6
Venus Fraction	"	" "	4158 G. 1	46.30	April 20
Victoria	Victoria	San Juan M. and M. Co	153	51.49	May 14
Whale Fraction	Vancouver	Britannia Mining and Smelting Co	4376 G. 1	50.79	Dec. 26
Zulu Fraction	"	Britannia Mining and Smelting Co	4375 G. 1	47.56	April 20

DEPARTMENT OF MINES.

VICTORIA, B.C.

HON. WM. SLOAN, *Minister of Mines.*

R. F. TOLMIE, *Deputy Minister.*

WM. FLEET ROBERTSON, *Provincial Mineralogist and Assayer.*

GEO. WILKINSON, *Chief Inspector of Mines.*

HENRY DEVLIN, *District Inspector*, Nanaimo.

JOHN NEWTON, *District Inspector*, Nanaimo.

ROBERT STRACHAN, *District Inspector*, Fernie.

WM. LANCASTER, *District Inspector*, Fernie.

JAMES MCGREGOR, *District Inspector*, Nelson.

J. H. MCMILLAN, *District Inspector*, Prince Rupert.

H. H. JOHNSTONE, *Temporary Inspector*, Nelson.

D. E. WHITTAKER, *Provincial Analyst and Assistant Assayer.*

J. D. GALLOWAY, *Resident Engineer*, Hazelton.

W. M. BREWER, *Resident Engineer*, Nanaimo.

GEO. A. CLOTHIER, *Resident Engineer*, Prince Rupert.

P. B. FREELAND, *Resident Engineer*, Grand Forks.

A. G. LANGLEY, *Resident Engineer*, Revelstoke.

R. W. THOMSON, *Resident Engineer*, Kamloops.

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	"	"	Louis Dixon.
Liard Mining Division	Telegraph Creek	"	"	
Sub-office	Porter			Chas. H. Smith.
"	McDame Creek			Mike Larsen.
Skeena Mining Division	Prince Rupert	J. H. McMullin	J. H. McMullin	
Sub-office	Alice Arm			Telka Carney.
"	Kitimat			Geo. L. Anderson.
"	Port Simpson			J. R. C. Deane.
"	Copper City			P. R. Skinner.
"	Terrace			T. J. Kirkpatrick.
"	Stewart (Portland Canal)			P. S. Jack.
"	Anyox			E. H. T. Hyde.
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			Brynild Brynildsen.
Queen Charlotte Min'g D.	Queen Charlotte	J. H. McMullin	John L. Barge.	
Sub-office	Jedway			Isaac Thompson.
"	Masset			C. Harrison.
"	Lockeport			William Morgan.
Omineca Mining Division	Hazelton	Stephen H. Hoskins	Jas. E. Kirby	
Sub-office	Fort Grahame			Wm. Fox.
"	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			T. J. Kirkpatrick.
"	New Hazelton			L. B. Warner.

GOLD COMMISSIONERS AND MINING RECORDERS—*Continued.*

Mining Divisions.	Location of Office.	Gold Commissioner.	Mining Recorder.	Sub-Recorder.
Omineca M.D.—*Con.*				
Sub-office	Fort Fraser			J. S. Alexander.
"	Junction Finlay &	Parsnip rivers.		Thos. A. Perry.
"	Pacific			T. H. McCubbin.
"	Smithers			Walter Noel.
"	Burns Lake			R. C. Macdonald.
"	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)		John A. McDougall
"	Pouce Coupe			G. J. Duncan.
Cariboo Mining Division	Barkerville	C. W. Grain		
Sub-office	Quesnel			E. C. Lunn.
"	Fort George			T. W. Herne.
"	McBride			F. F. O'Halloran.
Quesnel Mining Division	150-Mile House	C. W. Grain	R. M. McCusty	
Sub-office	Quesnel	(at Barkerville)		E. C. Lunn.
"	Quesnel Forks			Grant Grinder.
"	Barkerville			C. W. Grain.
Clinton Mining Division	Clinton	Geo. Milburn		
Lillooet "	Lillooet	John Dunlop	John Dunlop	
Kamloops Mining Division	Kamloops	E. Fisher	L. S. Brown	
Sub-office	Chu Chua			George Fennell.
"	Vavenby			Hyde Finley.
"	Albas			C. O. Sjouquist.
Ashcroft Mining Division	Ashcroft	E. Fisher (at Kam.)	H. P. Christie	
Sub-office	Lytton			Thos. Somerville.
Nicola Mining Division	Nicola	E. Fisher (at Kam.)	J. A. Murchison	
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	W. R. Dewdney	
Sub-office	Vernon			H. F. Wilmot.
"	Rock Creek			Jas. Kerr.
"	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	John Bulman	G. E. Sanborn	
Windermere "	Wilmer	" (at Golden)	E. M. Sandilands	
Fort Steele Mining Div.	Cranbrook	N. S. A. Wallinger.	H. S. Clark	
Sub-office	Steele			Joseph Walsh.
"	Fernie			Ronald Hewat.
"	Moyie			W. H. Laird.
"				
Ainsworth Mining Div	Kaslo	R. J. Stenson	A. McQueen	Wm. J. Green.
Sub-office	Howser			W. Simpson.
"	Trout Lake			Oscar Jacobson.
"	Crawford Bay			Thos. W. Lytle.
"	Poplar			Arthur G. Johnston.

GOLD COMMISSIONERS AND MINING RECORDERS—*Concluded.*

Mining Division.	Location of Office.	Gold Commissioner.	Mining Recorder.	Sub-Recorder.
Slocan Mining Division	New Denver	R. J. Stenson	Angus McInnes	
Sub-office	Sandon	(at Kaslo)		W. J. Parham.
Slocan City Mining Div.	Slocan	R. J. Stenson	Thos. McNeish	
Trout Lake Mining Div.	Trout Lake	"	Oscar Jacobson	
Nelson Mining Division	Nelson	John Cartmel	S. S. Jarvis	
Sub-office	Creston			R. Lamont.
"	Ymir			Geo. Leece.
"	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	A. Johnson	J. Lee	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	S. McB. Smith	S. McB. Smith	
Sub-office	Ladysmith			John Stewart.
"	Alert Bay			Ernest H. Robinson
"	Vananda			Leonard Raper.
"	Quathiaski Cove			S. Marshall.
"	Granite Bay			Henry Twidle.
"	Campbell River			T. W. Hanson.
Alberni Mining Division	Alberni	J. E. Hooson	J. E. Hooson	
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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Subject.

PROVINCE OF BRITISH COLUMBIA

SPECIAL REPORTS

ON

COAL-MINE EXPLOSIONS

APPENDIX

TO THE

REPORT OF MINISTER OF MINES

FOR THE YEAR 1918

PRINTED BY
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VICTORIA, B.C.:
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1918.

Explosions at No. 3 Mine, Coal Creek

APRIL 5TH, 1917

卐

SPECIAL REPORTS BY

GEORGE WILKINSON, - - - - Chief Inspector of Mines
THOMAS GRAHAM, - - - - late Chief Inspector of Mines
JAMES ASHWORTH, - - - - - Consulting Engineer

NOTE.—Each of these three Reports was accompanied by blue-prints taken from tracings of the company's mine-plans, to which certain notes had been added. As these three sets of prints were practically similar, only one set has been reproduced, and this applies to all three Reports.

EXPLOSION AT No. 3 MINE, COAL CREEK COLLIERY.

REPORT BY GEORGE WILKINSON, CHIEF INSPECTOR OF MINES.

I have the honour to submit the following report on the explosion which occurred on April 5th, 1917, in the No. 3 mine of the Coal Creek Colliery, operated by the Crow's Nest Pass Coal Company:—

Upon instructions from the Honourable the Minister of Mines, I left Victoria for Fernie on April 7th, 1917; leaving Victoria by 2 p.m. boat for Vancouver, arriving at Vancouver 7 p.m.; left Vancouver by Great Northern Railway via Settle, Spokane, and Wrexford, arriving at Fernie 10 a.m. Monday, April 9th.

Upon arrival at Fernie I visited the offices of the Crow's Nest Pass Coal Company in company with James Ashworth, who was appointed by the Honourable the Minister of Mines to investigate and report upon the explosion. At the office we met W. R. Wilson, general manager of the Crow's Nest Pass Coal Company, who kindly showed us the progress that had been made up to date with the recovery-work, marking the same upon a blue-print.

After consulting with Mr. Wilson I proceeded to Coal Creek and visited the mines and further checked up the progress of the recovery-work. I then consulted with Thomas Graham and Inspectors Strachan, Williams, and O'Brien about the future plan of operations on the recovery-work.

HISTORY OF RECOVERY-WORK.

Over four days having elapsed since the explosion had occurred, the following description of the work which had been done during that time is taken from the evidence of the witnesses at the inquest, and especially that of the mine manager, Mr. Caufield: Having been notified about the explosion about 10.20 p.m. on April 5th, Mr. Caufield hastened to the mine entrance and inquired as to the condition of the fan, receiving the reply from the fan engineer that it seemed to be carrying a heavy load and the water-gauge had fallen; the natural conclusion was that some of the separation doors had been destroyed. Inspection showed that those between Nos. 2 and 3 mines were all right, two being shut and the third being open; closing this, the party returned to the outside, and after ordering material in the shape of boards, nails, etc., to be brought forward, the party proceeded down No. 3 slope, the main haulage and intake airway.

About 50 feet inside the mine entrance they found the body of the pumpman, H. Melarky; leaving instructions for the body to be taken out, the party proceeded farther and found the separation doors between No. 3 mine intake and return blown out. These were rebuilt tempo-

rarily, and 500 feet farther a small fire was encountered in a crosscut to the left of the slope. After extinguishing this with water, two more small fires were discovered and extinguished in the same manner.

About this time Inspector of Mines T. H. Williams and John Biggs, overman of the No. 3 mine, arrived from Fernie, and they headed another exploration party, which travelled the parallel slope or travelling-way. Farther down the slope the separation doors leading to the pipe-lines were found to be destroyed, and it was necessary to erect a temporary stopping at this point.

In the meantime the other party headed by Inspector Williams had reached the foot of the slope and found three men, F. Benezeth, P. Gormly, and J. Machin. Benezeth, who was a miner, was from No. 2 room off No. 6 incline; Gormly was employed as conductor on the trips on the Main level; and Machin's regular employment was as a driver, but he was acting as rope-rider on the Main slope to the surface that afternoon. Benezeth was alive when found and was hurried out to the surface for medical attention, but succumbed four hours later without having regained consciousness.

Leaving the slope and proceeding in the level, the party encountered another fire, which had gained considerable headway, but after considerable work they were able to extinguish it. They then proceeded farther in when they were notified that another fire had been discovered in the crosscut inside of that in which the previous fire had been extinguished; therefore the party retreated and after considerable trouble got two other fires extinguished. About 1,600 feet from the foot of the slope the first big cave of rock was encountered, and, as it was evident that it would take some time to get over this, it was decided to arrange shifts so that the work could be carried forward as fast as possible. Arrangements were made for thirty men to work on each shift; included in this number were five officials who were acquainted with the workings.

By Monday, April 9th, the work had proceeded as far as No. 4 incline; stoppings had been erected to direct the air up No. 4 incline. There were no workmen up No. 4 incline, but it was not deemed advisable to work the rescue parties along the Main level with this large body of gas in this district in such a position that it might be forced out on the men by caves.

Very little progress was being made, and to take advantage of the large barrier pillar between the Main level and No. 1 room off No. 4 incline, and save the erection of about sixteen stoppings between the Main and counter levels, another stopping was built at the foot of No. 4 incline, which practically turned all the air coming into the mine into the No. 4 incline district. When this was completed, as it would take some time to clear out the gas from this district, the workmen were called off the inside work and sent to improve the temporary stoppings and secure the roof along the level at points where it was caved and over which it was difficult to travel.

During the day the body of the locomotive-driver was found at a point a little inside of the inside charging-station. He had been on the way in with an empty trip of cars when the explosion caught him, and, besides having several burns on his face and head, he was caught beneath a cave of rock which covered the entire trip of eighteen cars and the locomotive.

Tuesday, April 10th. The writer visited the mine with the party and made a thorough examination of all the accessible parts. Personnel of party: James Ashworth; Thos. Graham; B. Caufield, manager of Coal Creek Colliery; Chas. Graham, manager of Michel Colliery; William Shaw, Inspector of Mines, Blairmore, Alberta; and Mine Inspectors Wilkinson, Williams, O'Brien, and Strachan, of the British Columbia staff, and Dudley Michel, Instructor in First-aid and Mine-rescue Work. The party were able to proceed to Nos. 3 and 4 inclines, but when at No. 2 stall off No. 4 incline were stopped by gas, the upper portion of these works being full. This proved that the air-current was not strong enough to overcome the resistance set up in the Nos. 4, 5, and 6 inclines, and it seemed impossible to move the gas in these places; and as this body of gas was going to be a standing menace to all operations being conducted inside, as the air was passing it before going inside, and any disturbance in the shape of a cave would force it out on the rescue party, it was the writer's opinion and the opinion of the party that the system of ventilation should be reversed, and this body of gas be put on the return side of the workmen instead of the intake; therefore it was decided after consultation to withdraw to the outside of the overcast on the level and make a break-through in it and reverse the air, so that the fresh air would travel along the counter-level inside of No. 4 incline and from there to No. 5 incline; both the Main and counter levels could be used for an intake, allowing the return air to go up No. 6 incline, down No. 5 incline, the crosscut to the rooms on No. 4 incline, and

after circulating around that district returning out the Main level and up Draper's slope and on to the fan.

This change requiring some time, on Wednesday, April 11th, the writer visited No. 1 East mine, where the "bumps" took place on November 7th and 8th, 1916; the personnel of the party being Thos. Graham; David Martin, overman of No. 1 East mine; and Inspectors Wilkinson, Williams, and Strachan.

Thursday, April 12th. Again visited No. 3 mine. Personnel of party: Thos. Graham, B. Caufield, Chas. Graham, Wm. Shaw, Inspectors Wilkinson, Williams, O'Brien, and Strachan, and Dudley Michel. After the change made in the ventilation on Tuesday we were able to penetrate into No. 6 incline district, getting into Nos. 1, 2, 3, and 4 rooms; in No. 2 room we could not get to within several feet of the face owing to gas, but had no difficulty in getting to the face of the others. During the night the bodies of W. R. Puckey, fireboss; William Bird and H. Falip, miners from No. 6 incline; W. Silverwood and T. Checkley, miners in a crosscut being driven from the level to No. 1 room off No. 6 incline, were found on the siding at the foot of No. 5 incline; all of these men were severely burned and had received other injuries also. The men in No. 1 room off No. 6 incline were also recovered during the night—viz., B. Gioconazzi and J. Falip; one of the two men out of No. 2 room off No. 6 incline, as stated before, was found at the foot of the slope, and up to date the body of his partner has not been recovered.

In No. 3 room the bodies of F. and J. Smith, father and son, were found by the above-mentioned party when examining the face of this room; they were found at the face and had evidently been at work when the explosion occurred, as J. Smith, from injuries received on his forehead, seemed to have been dashed against the face of the room; F. Smith was lying near by under some loose timber.

Owing to gas being present the party was unable to inspect the faces of Nos. 5 and 6 inclines.

Friday, April 13th. Personnel of party: James Ashworth, Thomas Graham, Chas. Graham, B. Caufield, Inspectors Wilkinson, Williams, O'Brien, and Strachan, and Dudley Michel. The party penetrated No. 5 room off No. 6 incline, 20 feet towards the face of No. 5 incline, No. 6 incline, and down No. 5 incline to crosscut of No. 5 incline to No. 1 room off No. 4 incline. During the night the bodies of J. Atkinson and H. Haydock were recovered from No. 5 room; they were found close to the face, both covered with rock. The bodies of J. Bossette and W. G. Clarke were also recovered from No. 5 incline, both being found back from the face down towards the crosscut, where they seemed to have been changing a car; both of these bodies were badly burned and crushed. The bodies of Ed. Coates and J. Campbell were found in the crosscut off No. 6 incline, both of them being buried with rock; the crosscut was caved, said cave extending right across No. 6 incline.

Saturday, April 14th. All lamps brought out of the mine were examined in the presence of the following: James Ashworth, Thomas Graham, George Wilkinson, T. H. Williams, George O'Brien, Chas. Graham, Robert Strachan, Robert Johnstone, electrician Crow's Nest Pass Coal Company, and Albert Fawcett, lampman at Coal Creek Colliery. A list showing condition of lamps is appended.

Monday, April 16th. The party visited return airways and old workings at the head of Draper's slope. Personnel of party: James Ashworth, Inspectors Wilkinson and Williams, Firebosses Jas. Bushell and Frank Lauder. The purpose of this examination was to determine what evidence there was of the explosion in the old workings or to find out if it had originated there. The examination showed there was no evidence of force in the old workings; the party then proceeded to the fan-drift, measured the air-current, and followed down the pipe-line road paralleling the Main No. 3 slope. The evidence showed the stoppings were all blown in from the slope, and James Bushell, the fireboss, stated the separation doors at the foot of the slope were blown in and up the slope near by a pillar-length.

Tuesday, April 17th. The party visited No. 6 incline district and got in the face of No. 5 incline. The bodies of John Monks and J. Stelliga were found in No. 4 room off No. 6 incline, 30 feet back from the face under a heavy cave. This completed the list of men working in this district, except the miner from No. 2 room, whose partner was found alive at the foot of the slope.

All work was then concentrated on reaching the face of the Main and counter levels; with this object in view a stopping was erected outside of No. 5 incline to drive the air down into

the counter-level and along to the face of the Main level and back and up No. 6 incline, and from there through No. 5 incline to No. 4. There being a swamp on the counter-level, it became necessary to build a bridge to allow of travelling the counter.

The counter-level was not heavily caved at this point, except at the foot of the crosscuts, until we reached the crosscut opposite the room or crosscut being driven from the Main level to room No. 1 off 6 incline. At this point it seemed an impossibility to get any farther; however, desperate attempts were made in various ways to penetrate farther by trying to get over or under the cave, and by taking a small slice of coal off the rib alongside of the cave. After four days of futile work it was decided in the interests of safety to abandon the advance work.

With this end in view a consultation was called, and it was decided to form a party containing members of all parties concerned to thoroughly examine the area explored and decide on future action; therefore W. R. Wilson, general manager of the Crow's Nest Pass Coal Company, and Thomas France, secretary of the local Gladstone Union, and William Hunter, president of the local Gladstone Union, joined the party.

On April 18th this party entered the mine and made thorough examination, and returned to the mine office for consultation, with the result that the following was drafted out and signed by all parties concerned:—

"NOTICE.

"COAL CREEK, April 18th, 1917.

"After making an examination of all the existing conditions of the Main level and Main parallel level in No. 3 mine, between the foot of the slope parting and to heavy clod falls in both Main level and counter-level, which we found at points about 600 feet on the inside of No. 6 incline, we are of the opinion that the only safe and practical method of recovering the bodies yet entombed between No. 6 parting and the faces of the Main levels is to push the cleaning-up of main tunnels from the outer end, where the main haulage is available, concentrating all labour through this more safe method until the bodies are all recovered.

"(Signed.) GEORGE WILKINSON. WILLIAM HUNTER.
"THOS. GRAHAM. CHAS. GRAHAM.
"ROBERT STRACHAN. B. CAUFIELD.
"T. H. WILLIAMS. JAMES ASHWORTH.
"GEORGE O'BRIEN. W. R. WILSON."
"THOMAS FRANCE.

SHORT DESCRIPTION OF NO. 3 MINE.

No. 3 slopes are driven due east approximately 1,500 feet; at the foot of the slopes a pair of levels are driven on the strike of the seam for approximately 8,500 feet. Nos. 1, 2, 3, and 4 inclines are turned from these levels at a point 4,500 feet distant from the bottom of the slope. The inclines are driven on a bearing of S. 45° W. for a distance of approximately 2,000 feet. Off these inclines six rooms are driven, in sets of three, for approximately 1,000 feet. At a distance of approximately 5,700 feet from the bottom of the slope, Nos. 5 and 6 inclines are driven on a bearing of due west for a distance of 700 feet and rooms turned off in sets of three. The first three are in a distance of approximately 200 feet, and two of the second set are turned away and in about 50 feet. Inside of Nos. 5 and 6 inclines a distance of 500 feet two rooms are turned away from the level and are up about 75 feet. The faces of the levels are about 800 feet inside of these two rooms.

The levels are driven 10 feet wide, with 50 to 60 feet of pillars between. The rooms are driven 18 feet wide, with 60-foot centres, and a pillar of 150 feet is left between each set of rooms.

The seam averages about 5½ feet in thickness; brushing of about 4 feet is taken up to make height. There is a band of coal in the brushing which runs from nothing to 4 feet.

The ventilation of the mine is produced by a Wilson fan, size 8 x 16 feet, driven by rope-drive from a steam-engine 16 x 18 inches geared 5 to 8, running at a speed of approximately 35 revolutions a minute with a water-gauge of 3½ inches. A spare engine is kept ready for use.

THE APPARENT CONDITION OF THE MINE BEFORE THE EXPLOSION.

To give this, the following reports are appended:—

(*a.*) Firebosses' daily reports from March 1st, 1917, to date of explosion.

(*b.*) Overman's daily reports from March 1st, 1917, to date of explosion.

(*c.*) Gas Committee reports for January, February, and March, 1917.
(*d.*) Inspector of Mines' reports for Janauary, February, and March, 1917.
(*e.*) Samples of mine-air taken in No. 3 mine, Coal Creek.
(*f.*) Air-measurements taken by Inspectors of Mines.

COPY OF FIREBOSSES' REPORTS ON NO. 3 MINE, COAL CREEK COLLIERY, FROM MARCH 1ST TO APRIL 5TH, 1917.

Date: March 1st. Time: 7 a.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas; all places clear and in a safe condition.

W. R. PUCKEY; J. B.; J. MCCOURT.

Date: March 1st. Time: 3 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in a safe condition.

J. THOMPSON; J. B.; W. R. PUCKEY.

Date: March 1st. Time: 11 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found same free from explosive gas and in a safe condition.

J. MCCOURT; J. B.; J. THOMPSON.

Date: March 2nd. Time: 7 a.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas; all places clear and in a safe condition.

W. R. PUCKEY; J. B.; J. MCCOURT.

Date: March 2nd. Time: 3 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in a safe condition. A small cap of gas in return air from level round to counter-level.

J. THOMPSON; J. B.; W. R. PUCKEY.

Date: March 2nd. Time: 11 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found same free from explosive gas and in safe condition. A small cap of gas in return air from Main level round to counter-level.

J. MCCOURT; J. B.; J. THOMPSON.

Date: March 3rd. Time: 7 a.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in a safe condition. A small cap of gas from Main level round to counter-level in return air.

W. R. PUCKEY; J. B.; J. MCCOURT.

Date: March 3rd. Time: 3 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in a safe condition. A small cap of gas in return air from Main level round to counter-level.

J. B.; W. R. PUCKEY.

Date: March 3rd. Time: 3 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: All persons being out of the mine and no shift coming on, I have securely fenced off entrances.

J. B.; W. R. PUCKEY.

Date: March 4th. Time: 8.15 p.m.
Barometer: 26 inches. Thermometer: 32° Fahr.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have removed fences to examine main roads. Fan started 7 p.m.

J. B.; W. R. PUCKEY.

Date: March 4th. Time: 11 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in a safe condition. A small cap of gas in return air from Main level round to counter-level.

J. MCCOURT; J. B.; W. R. PUCKEY.

Date: March 5th. Time: 7 a.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from Main level round to counter-level; all other places clear and in a safe condition.

J. THOMPSON; J. B.; J. MCCOURT.

Date: March 5th. Time: 3 p.m.
Roof and sides: Safe. Ventilation: Good.
Barometer: 25.9 inches. Thermometer: 42° Fahr.
Remarks: I have examined this mine and found a small cap of gas in return air from Main level to counter-level; all other places clear and in safe condition.

W. R. PUCKEY; J. B.; J. THOMPSON.

Date: March 5th. Time: 11 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in a safe condition. A small cap of gas in air from Main level round to counter-level.

J. McCOURT; J. B.; W. R. PUCKEY.

Date: March 6th. Time: 7 a.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from Main level to counter-level; all other places clear and in a safe condition.

J. B.; J. McCOURT.

Date: March 6th. Time: 3 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas. A small cap of gas in return air from Main level round to counter-level; all other places clear and in a safe condition.

W. R. PUCKEY; J. B.; J. THOMPSON.

Date: March 6th. Time: 11 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in a safe condition. A small cap of gas in the return air from Main level round to counter-level.

J. McCOURT; J. B.; W. R. PUCKEY.

Date: March 7th. Time: 7 a.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from Main level round to counter-level; all other places clear and in a safe condition.

J. THOMPSON; J. B.; J. McCOURT.

Date: March 7th. Time: 3 p.m.
Barometer: 26.2 inches. Thermometer: 40° Fahr.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from face of Main level to counter-level; all other places clear and in a safe condition.

W. R. PUCKEY; J. B.; J. THOMPSON.

Date: March 7th. Time: 11 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in a safe condition. A small cap of gas in air from Main level round to counter-level.

J. McCOURT; J. B.; W. R. PUCKEY.

Date: March 8th. Time: 7 a.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from face of Main level round to counter-level; all other places clear and in a safe condition.

J. THOMPSON; J. B.; J. McCOURT.

Date: March 8th. Time: 3 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from face of Main level to counter-level; all other places clear and in safe condition.

W. R. PUCKEY; J. B.; J. THOMPSON.

Date: March 8th. Time: 11 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in a safe condition. A small cap of gas in return air from Main level round to the counter-level.

J. McCOURT; J. B.; W. R. PUCKEY.

Date: March 9th. Time: 7 a.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from face of Main level round to counter-level; all other places clear and in a safe condition.

J. THOMPSON; J. B.; J. McCOURT.

Date: March 9th. Time: 3 p.m.
Barometer: 26.1 inches. Thermometer: 30° Fahr.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from face of Main level to face of counter-level; all other places clear and in a safe condition.

W. R. PUCKEY; J. B.; J. THOMPSON.

Date: March 9th. Time: 11 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in a safe condition. A small cap of gas in return air from Main level round to counter-level.

J. McCOURT; J. B.; W. R. PUCKEY.

Date: March 10th. Time: 7 a.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from face of Main level round to counter-level; all other places clear and in a safe condition.

J. THOMPSON; J. B.; J. McCOURT.

Date: March 10th. Time: 2.30 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas from face of Main level to counter-level; all other places clear and in a safe condition.

W. R. PUCKEY; J. B.; J. THOMPSON.

Date: March 10th. Time: 11 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in a safe condition. A small cap of gas in return air from face of Main level round to counter-level.

J. B.; W. R. PUCKEY.

Date: March 10th. Time: 11 p.m.
Remarks: All persons being out of the mine, I have securely fenced off both entrances.

J. THOMPSON; J. B.; W. R. PUCKEY.

Date: March 11th. Time: 5.50 p.m.
Remarks: Removed fences to examine main roads to pumps and mine.

J. B.; J. THOMPSON.

Date: March 11th. Time: 10 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and main roads to pumps and found same free from explosive gas and in a safe condition.

J. McCOURT; J. B.; J. THOMPSON.

Date: March 12th. Time: 7 a.m.
Barometer: 26.1 inches. Temperature: 22° Fahr.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas; all places clear and in a safe condition.

W. R. PUCKEY; J. McCOURT.

Date: March 12th. Time: 2.45 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in a safe condition. A small cap of gas in return air from Main level round to counter-level.

J. THOMPSON; J. B.; W. R. PUCKEY.

Date: March 12th. Time: 11 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found same free from explosive gas and in a safe condition. A small cap of gas in return air from face of Main level round to counter-level.

J. McCOURT; J. B.; J. THOMPSON.

Date: March 13th. Time: 7 a.m.
Barometer: 26.1 inches. Temperature: 22° Fahr.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from Main level round to counter-level; all other places clear and in a safe condition.

W. R. PUCKEY; J. B.; J. McCOURT.

Date: March 13th. Time: 2.45 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in a safe condition. A small cap of gas in return air from Main level round to counter-level.

J. THOMPSON; J. B.; W. R. PUCKEY.

Date: March 13th. Time: 10.15 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from face of Main level round to counter-level; all other places clear and in safe condition.

J. McCOURT; J. B.; J. THOMPSON.

Date: March 14th. Time: 7 a.m.
Barometer: 26.1 inches. Temperature: 18° Fahr.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in a safe condition. A small cap of gas in return air from Main level round to counter-level.

W. R. PUCKEY; J. B.; J. McCOURT.

Date: March 14th. Time: 3 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in a safe condition. A small cap of gas in return air from Main level round to counter-level.

J. THOMPSON; J. B.; W. R. PUCKEY.

Date: March 14th. Time: 10.50 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from face of Main level to counter-level; all other places clear and in safe condition.

J. McCOURT; J. B.; J. THOMPSON.

Date: March 15th. Time: 7 a.m.
Barometer: 26.2 inches. Temperature: 12° Fahr.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from Main level to counter-level; all other places clear and in a safe condition.

W. R. PUCKEY; J. B.; J. McCOURT.

Date: March 15th. Time: 3 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it clear from explosive gas and in a safe condition. A small cap of gas in return air from Main level round to counter-level.

J. THOMPSON; J. B.; W. R. PUCKEY.

Date: March 15th. Time: 10.50 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from face of Main level to counter-level; all other places clear and in safe condition.

J. McCOURT; J. B.; J. THOMPSON.

Date: March 16th. Time: 7 a.m.
Barometer: 26.3 inches. Temperature: 12° Fahr.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from Main level round to counter-level; all other places clear and in a safe condition.

W. R. PUCKEY; J. B.; J. McCOURT.

Date: March 16th. Time: 3 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from Main level round to counter-level; all other places clear and in a safe condition.

J. THOMPSON; J. B.; W. R. PUCKEY.

Date: March 16th. Time: 11 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a cap of gas in return air from face of Main level to counter-level; all other places clear and in safe condition.

J. McCOURT; J. B.; J. THOMPSON.

Date: March 17th. Time: 7 a.m.
Barometer: 26.4 inches. Temperature: 18° Fahr.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from face of Main level round to counter-level; all other places clear and in a safe condition.

W. R. PUCKEY; J. B.; J. McCOURT.

Date: March 17th. Time: 3 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a little gas in return air from Main level to counter-level; all other places clear and in a safe condition.

J. THOMPSON; J. B.; W. R. PUCKEY.

Date: March 17th. Time: 10.20 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a cap of gas in return air from Main level to counter-level; all other places clear and in safe condition.

W. R. PUCKEY; J. B.; J. THOMPSON.

Date: March 17th. Time: 10.20 p.m.
Remarks: All men being out of mine, I fenced off both entrances to same.

W. R. PUCKEY; J. B.; J. THOMPSON.

Date: March 18th. Time: 5.30 p.m.
Barometer: 26.1 inches. Thermometer: 34° Fahr.
Remarks: I have removed fences to examine main roads to pump.

J. B.; W. R. PUCKEY.

Date: March 18th. Time: 7.30 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined the main roads leading to the pumps and found them free from explosive gas and in a safe condition.

J. B.; W. R. PUCKEY.

Date: March 18th. Time: 10.30 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in a safe condition. A small cap of gas in return air from Main level round to counter-level.

J. MCCOURT; J. B.; W. R. PUCKEY.

Date: March 19th. Time: 7 a.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in face of Main level round to counter-level; all other places clear and in safe condition.

J. THOMPSON; J. B.; J. MCCOURT.

Date: March 19th. Time: 3 p.m.
Barometer: 26.1 inches. Temperature: 34° Fahr.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas from face of Main level to counter-level; all other places clear and in safe condition.

W. R. PUCKEY; J. B.; J. THOMPSON.

Date: March 19th. Time: 11 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in a safe condition. A small cap of gas in return air from Main level to counter-level.

J. MCCOURT; J. B.; W. R. PUCKEY.

Date: March 20th. Time: 7 a.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas from face of Main level round to counter-level; all other places clear and in a safe condition.

J. THOMPSON; J. B.; J. MCCOURT.

Date: March 20th. Time: 3 p.m.
Barometer: 26 inches. Thermometer: 36° Fahr.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from Main level round to counter-level; all other places clear and in safe condition.

W. R. PUCKEY; J. B.; J. THOMPSON.

Date: March 20th. Time: 11 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in a safe condition. A small cap of gas in return air from Main level round to counter-level.

J. MCCOURT; J. B.; W. R. PUCKEY.

Date: March 21st. Time: 7 a.m.
Barometer: 25.9 inches. Thermometer: 38° Fahr.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from face of Main level round to counter-level; all other places clear and in a safe condition.

J. THOMPSON; J. B.; J. MCCOURT.

Date: March 21st. Time: 3 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a cap of gas in face of Main level round to counter-level; all other places clear and in a safe condition.

W. R. PUCKEY; J. THOMPSON.

Date: March 21st. Time: 11 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in face of Main level round to counter-level; all other places clear and in a safe condition.

J. MCCOURT; J. B.; W. R. PUCKEY.

Date: March 22nd. Time: 7 a.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from face of Main level round to counter-level; all other places clear and in safe condition.

J. THOMPSON; J. B.; J. MCCOURT.

Date: March 22nd. Time: 3 p.m.
Barometer: 25.9 inches. Temperature: 38° Fahr.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a cap of gas from face of Main level round to counter-level; all other places clear and in safe condition.

W. R. PUCKEY; J. B.; J. THOMPSON.

Date: March 22nd. Time: 11 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from the face of Main level round to counter-level; all other places clear and in a safe condition.

J. MCCOURT; J. B.; W. R. PUCKEY.

Date: March 23rd. Time: 7 a.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from face of Main level round to counter-level; all other places clear and in safe condition.

J. THOMPSON; J. B.; J. MCCOURT.

Date: March 23rd. Time: 3 p.m.
Barometer: 25.6 inches. Temperature: 34° Fahr.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas from face of Main level round to counter-level; all other places clear and in safe condition.

W. R. PUCKEY; J. B.; J. THOMPSON.

Date: March 23rd. Time: 10.30 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from Main level round to counter-level; all other places clear and in a safe condition.

J. MCCOURT; J. B.; W. R. PUCKEY.

Date: March 24th. Time: 7 a.m.
Roof and sides: Safe, except a small cave on main road. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from face of Main level round to counter-level; all other places clear and in a safe condition.

J. THOMPSON; J. B.; J. MCCOURT.

Date: March 24th. Time: 3 p.m.
Barometer: 25.8 inches. Temperature: 34° Fahr.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a cap of gas from face of Main level round to counter-level; all other places clear and in safe condition.

W. R. PUCKEY; J. B.; J. THOMPSON.

Date: March 24th. Time: 10.30 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in air from Main level round to counter-level; all other places clear and in a safe condition.

J. THOMPSON; J. B.; W. R. PUCKEY.

Date: March 24th. Time: 11 p.m.
Remarks: All persons being out of the mine, I have securely fenced off both entrances.

J. THOMPSON; J. B.; W. R. PUCKEY.

Date: March 25th. Time: 6 p.m.
Remarks: Removed fences to examine mine and main roads to pumps.

J. B.; J. THOMPSON.

Date: March 25th. Time: 10 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found same free from explosive gas and in safe condition.

J. MCCOURT; J. B.; J. THOMPSON.

Date: March 26th. Time: 7 a.m.
Barometer: 26.3 inches. Thermometer: 10° Fahr.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from face of Main level round to counter-level; all other places clear and in a safe condition.

W. R. PUCKEY; J. B.; J. MCCOURT.

Date: March 26th. Time: 3 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in a safe condition. A small cap of gas in return air from Main level round to counter-level.

J. THOMPSON; J. B.; W. R. PUCKEY.

Date: March 26th. Time: 11 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a cap of gas from face of Main level round to counter-level; all other places clear and in a safe condition.

J. MCCOURT; J. B.; J. THOMPSON.

Date: March 27th. Time: 7 a.m.
Barometer: 26.1 inches. Thermometer: 28° Fahr.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in the return air from face of Main level round to counter-level; all other places clear and in a safe condition.

W. R. PUCKEY; J. B.; J. MCCOURT.

Date: March 27th. Time: 3 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from face of Main level round to counter-level; all other places clear and in a safe condition.

J. THOMPSON; J. B.; W. R. PUCKEY.

Date: March 27th. Time: 11 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas from face of Main level round to counter-level; all other places clear and in safe condition.

J. MCCOURT; J. B.; J. THOMPSON.

Date: March 28th. Time: 7 a.m.
Barometer: 26.1 inches. Thermometer: 22° Fahr.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from face of Main level round to counter-level; all other places clear and in a safe condition.

W. R. PUCKEY; J. B.; J. MCCOURT.

Date: March 28th. Time: 3 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from face of Main level round to counter-level; all other places clear and in a safe condition.

J. THOMPSON; J. B.; W. R. PUCKEY.

Date: March 28th. Time: 11 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a cap of gas in return air from face of Main level round to counter-level; all other places clear and in safe condition.

J. MCCOURT; J. B.; J. THOMPSON.

Date: March 29th. Time: 7 a.m.
Barometer: 25.9 inches. Temperature: 32° Fahr.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas from face of Main level round to counter-level in return air; all other places clear and in a safe condition.

W. R. PUCKEY; J. B.; J. MCCOURT.

Date: March 29th. Time: 3 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas from face of Main level round to counter-level in return air; all other places clear and in a safe condition.

J. THOMPSON; J. B.; W. R. PUCKEY.

Date: March 29th. Time: 10.30 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from face of Main level round to counter-level; all other places clear and in safe condition.

J. MCCOURT; J. B.; J. THOMPSON.

Date: March 30th. Time: 7 a.m.
Barometer: 25.9 inches. Thermometer: 22° Fahr.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in the return air from face of Main level round to counter-level; all other places clear and in a safe condition.

W. R. PUCKEY; J. B.; J. MCCOURT.

Date: March 30th. Time: 3 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in the return air from face of Main level round to counter-level; all other places clear and in a safe condition.

J. THOMPSON; J. B.; W. R. PUCKEY.

Date: March 30th. Time: 10.30 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from face of Main level round to counter-level; all other places clear and in a safe condition.

J. MCCOURT; J. B.; J. THOMPSON.

Date: March 31st. Time: 7 a.m.
Barometer: 26 inches. Temperature: 24° Fahr.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in the return air from face of Main level round to counter-level; all other places clear and in a safe condition.

W. R. PUCKEY; J. B.; J. MCCOURT.

Date: March 31st. Time: 3 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in the return air from face of Main level round to counter-level; all other places clear and in a safe condition.

J. THOMPSON; J. B.; W. R. PUCKEY.

Date: March 31st. Time: 3.20 p.m.
Remarks: All men being out of the mine, I securely fenced off both entrances.

W. R. PUCKEY; J. B.; J. THOMPSON.

Date: April 1st. Time: 6 p.m.
Remarks: I have removed fences to examine main roads to pumps.

J. B.; W. R. PUCKEY.

Date: April 1st. Time: 7.30 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined main roads and found them free from explosive gas and in a safe condition.

J. B.; W. R. PUCKEY.

Date: April 1st. Time: 10 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in a safe condition.

J. MCCOURT; J. B.; W. R. PUCKEY.

Date: April 2nd. Time: 7 a.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas; all places clear and in a safe condition.

J. THOMPSON; J. B.; J. MCCOURT.

Date: April 2nd. Time: 2.50 p.m.
Barometer: 26.1 inches. Thermometer: 42° Fahr.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found same free from explosive gas and in a safe condition.

W. R. PUCKEY; J. B.; J. THOMPSON.

Date: April 2nd. Time: 11 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in a safe working condition.

J. MCCOURT; J. B.; W. R. PUCKEY.

Date: April 3rd. Time: 7 a.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas; all places clear and in a safe condition.

J. THOMPSON; J. B.; J. MCCOURT.

Date: April 3rd. Time: 2.45 p.m.
Barometer: 26.3 inches. Thermometer: 42° Fahr.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free form explosive gas and in a safe condition.

W. R. PUCKEY; J. B.; J. THOMPSON.

Date: April 3rd. Time: 10.30 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in a safe condition.

J. MCCOURT; J. B.; W. R. PUCKEY.

Date: April 4th. Time: 7 a.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in a safe condition.

J. B.; J. MCCOURT.

Date: April 4th. Time: 3 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from face of Main level round to counter-level; all other places clear and in safe condition.

W. R. PUCKEY; J. B.; J. THOMPSON.

Date: April 4th. Time: 11 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a little gas in crosscut off counter-level; all other places clear and in a safe condition.

J. MCCOURT; J. B.; W. R. PUCKEY.

Date: April 5th. Time: 7 a.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a little gas in crosscut off counter-level; all other places clear and in a safe condition.

J. THOMPSON; J. B.; J. MCCOURT.

Date: April 5th. Time: 3 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from face of crosscut to face of counter-level; all other places clear and in safe condition.

W. R. PUCKEY; J. B.; J. THOMPSON.

OVERMAN'S REPORTS ON NO. 3 MINE, COAL CREEK COLLIERY, FROM MARCH 1ST UNTIL APRIL 5TH, 1917.

March 1st, 1917. I have examined No. 3 mine and found same free from explosive gas and in a safe condition. Firebosses report No. 3 mine as stated above. Number of men in mine, 53.

J. BIGGS.

March 2nd, 1917. I have examined No. 3 mine and found same free from explosive gas and in safe condition. Firebosses report No. 3 mine as stated above. Number of men in mine, 100.

J. BIGGS.

March 3rd, 1917. I have examined No. 3 mine and found same free from explosive gas and in safe condition. Firebosses report No. 3 mine as stated above. Number of men in mine, 103.

J. BIGGS.

March 4th, 1917. Sunday, mine idle. The mine was fenced off from 3 p.m. on Saturday until 7 p.m. on Sunday. Afternoon-shift fireboss reports No. 3 mine free from explosive gas and in safe condition. Number of men in mine, 4.

J. BIGGS.

March 5th, 1917. I have examined No. 3 mine and found same free from explosive gas and in safe condition. Firebosses report No. 3 mine as stated above. Number of men in mine, 62.

J. BIGGS.

March 6th, 1917. I have examined No. 3 mine and found same free from explosive gas and in safe condition. Firebosses report No. 3 mine as stated above. There is a small cap of gas in the return airway. Number of men in mine, 97.

J. BIGGS.

March 7th, 1917. I have examined No. 3 mine and found same free from explosive gas and in safe condition. Firebosses report No. 3 mine as stated above. Number of men in mine, 97.

J. BIGGS.

March 8th, 1917. I have examined No. 3 mine and found same free from explosive gas and in safe condition. There is a small cap of gas in the air on the return airway. Firebosses report No. 3 mine as stated above. Number of men in mine, 97.

J. BIGGS.

March 9th, 1917. I have examined No. 3 mine and found same free from explosive gas and in safe condition. The Inspector made his usual examination and found the above-mentioned conditions. Firebosses report No. 3 mine as stated above. Number of men in mine, 100.

J. BIGGS.

March 10th, 1917. I have examined No. 3 mine and found same free from explosive gas and in safe condition. Firebosses report No. 3 mine as stated above. Number of men in mine, 99.

J. BIGGS.

March 11th, 1917. Sunday, mine idle. The mine was fenced off from 11 p.m. on Saturday until 5.30 p.m. on Sunday. Afternoon-shift fireboss reports No. 3 mine free from explosive gas and in safe condition. Number of men in mine, 4.

J. BIGGS.

March 12th, 1917. I have examined No. 3 mine and found same free from explosive gas and in safe condition. Firebosses report No. 3 mine as stated above. Number of men in mine, 95.

J. BIGGS.

March 13th, 1917. I have examined No. 3 mine and found same free from explosive gas and in safe condition. Firebosses report No. 3 mine as stated above. Number of men in mine, 101.

J. BIGGS.

March 14th, 1917. I have examined No. 3 mine and found same free from explosive gas and in safe condition. Firebosses report No. 3 mine as stated above. Number of men in mine, 29.

J. BIGGS.

March 15th, 1917. I have examined No. 3 mine and found same free from explosive gas and in safe condition. Firebosses report No. 3 mine as stated above. Number of men in mine, 100.

J. BIGGS.

March 16th, 1917. I have examined No. 3 mine and found same free from explosive gas and in safe condition. Firebosses report No. 3 mine as stated above. Number of men in mine, 100.

J. BIGGS.

March 17th, 1917. I have examined No. 3 mine and found a little gas in crosscut off counter-level; other places clear and in safe condition. Firebosses report No. 3 mine free from explosive gas and in safe condition. Number of men in mine, 98.

J. BIGGS.

March 18th, 1917. Sunday, mine idle. The mine was fenced off from 11 p.m. on Saturday until 5.30 p.m. on Sunday. Afternoon-shift fireboss reports No. 3 mine free from explosive gas and in safe condition. Number of men in mine, 8.

J. BIGGS.

March 19th, 1917. I have examined No. 3 mine and found same free from explosive gas and in safe condition. Firebosses report No. 3 mine as stated above. Number of men in mine, 58.

J. BIGGS.

March 20th, 1917. I have examined No. 3 mine and found same free from explosive gas and in safe condition. Firebosses report No. 3 mine as stated above. Number of men in mine, 95.

J. BIGGS.

March 21st, 1917. I have examined No. 3 mine and found same free from explosive gas and in safe condition. Firebosses report No. 3 mine as stated above. Number of men in mine, 98.

J. BIGGS.

March 22nd, 1917. I have examined No. 3 mine and found same free from explosive gas and in safe condition. There is a small cap of gas in return airway. Firebosses report No. 3 mine as stated above. Number of men in mine, 96.

J. BIGGS.

March 23rd, 1917. I have examined No. 3 mine and found same free from explosive gas and in safe condition. Firebosses report No. 3 mine as stated above. Number of men in mine, 99.

J. BIGGS.

March 24th, 1917. I have examined the main roads of No. 3 mine and found same in safe condition. Firebosses report No. 3 mine free from explosive gas and in safe condition. Number of men in mine, 97.

J. BIGGS.

March 25th, 1917. Sunday, mine idle. The mine was fenced off from 11 p.m. on Saturday until 5.30 p.m. on Sunday. Afternoon-shift fireboss reports No. 3 mine free from explosive gas and in safe condition. Number of men in mine, 4.

J. BIGGS.

March 26th, 1917. I have examined No. 3 mine and found same free from explosive gas and in safe condition. Firebosses report No. 3 mine as stated above. Number of men in mine, 64.

J. BIGGS.

March 27th, 1917. I have examined No. 3 mine and found same free from explosive gas and in safe condition. Firebosses report No. 3 mine as stated above. Number of men in mine, 91.

J. BIGGS.

March 28th, 1917. I have examined No. 3 mine and found same free from explosive gas and in safe condition. Firebosses report No. 3 mine as stated above. Number of men in mine, 91.

J. BIGGS.

March 29th, 1917. I have examined No. 3 mine and found same free from explosive gas and in safe condition. Firebosses report No. 3 mine as stated above. Number of men in mine, 91.

J. BIGGS.

March 30th, 1917. I have examined No. 3 mine and found same free from explosive gas and in safe condition. Firebosses report No. 3 mine as stated above. Number of men in mine, 51.

J. BIGGS.

March 31st, 1917. I have examined No. 3 mine and found same free from explosive gas and in safe condition. Firebosses report No. 3 mine as stated above. Number of men in mine, 92.

J. BIGGS.

April 1st, 1917. Sunday, mine idle. The mine was fenced off from 3.30 p.m. on Saturday until 6 p.m. on Sunday. Afternoon-shift fireboss reports No. 3 mine free from explosive gas and in safe condition. Number of men in mine, 4.

J. BIGGS.

April 2nd, 1917. I have examined the main roads and found same in safe condition. Firebosses report No. 3 mine free from explosive gas and in safe condition. Number of men in mine, 30.

J. BIGGS.

April 3rd, 1917. I have examined No. 3 mine and found same free from explosive gas and in same condition. Firebosses report No. 3 mine as stated above. Number of men in mine, 81.

J. BIGGS.

April 4th, 1917. I have examined No. 3 mine and found same free from explosive gas and in safe condition. Firebosses report No. 3 mine as stated above. Number of men in mine, 90.

J. BIGGS.

April 5th, 1917. I have examined No. 3 mine and found same free from explosive gas and in safe condition. The Inspector made his usual examination of the mine to-day and found the above-mentioned conditions. Afternoon- and night-shift firebosses report a little gas in crosscut off counter-level; day-shift fireboss reports all clear. Number of men in mine, 94.

J. BIGGS.

REPORTS OF GAS COMMITTEE OF NO. 3 MINE, COAL CREEK COLLIERY, FOR THE MONTHS OF JANUARY, FEBRUARY, AND MARCH, 1917.

January 6th, 1917.

We, the undersigned, have this day examined the whole of No. 3 mine and find gas in 5 incline. All other places clear of explosive gas. Timber, roof, and sides good.

(Signed.) WM. BIRD.
JNO. CHARNOCK.

February 17th, 1917.

We, the undersigned, have this day examined the whole of No. 3 mine and find a small cap of gas in 3 room off 4 incline, also gas in crosscut off South slope, same fenced off. Timber, roof, and sides good.

(Signed.) WM. BIRD.
JNO. CHARNOCK.

March 17th, 1917.

We, the undersigned, have this day examined the whole of No. 3 mine and find gas in crosscut off counter. All other places clear. Timber, roof, and sides good.

(Signed.) WM. BIRD.
JNO. CHARNOCK.

INSPECTORS OF MINES' REPORTS FOR JANUARY, FEBRUARY, AND MARCH, 1917.

I hereby give notice that I have this day examined the underground workings of that part of the Crow's Nest Pass Coal Company's Colliery known as Coal Creek No 3 mine, and find the following conditions to prevail therein:—

Part of mine examined: Mine. Ventilation: Good.

Explosive gas: None. Small cap of gas in the last places on the air and in the return airway.

Roadways: Good. Timbering: Good.

Remarks: I measured 32,000 cubic feet of air a minute for the use of forty-four men and eight horses.

Dated at Coal Creek, B.C., this 9th day of January, 1917.

T. H. WILLIAMS,
Inspector of Mines.

I hereby give notice that I have this day examined the underground workings of that part of the Crow's Nest Pass Coal Company's Colliery known as Coal Creek No 3 mine, and find the following conditions to prevail therein:—

Part of mine examined: All the mine. Ventilation: Poor at the face of the South level, but generally good throughout the rest of the mine.

Explosive gas: Face of South level, crosscut off South level, and counter to South level. These three places were fenced off and the men withdrawn.

Roadways: Good, but the South level haulage-road is dusty in places. Timbering: Good.

Remarks: I measured 35,000 cubic feet of air a minute on the main intake for the use of forty-three men and eight horses. This quantity is divided into two shifts: South level split, 25,500 cubic feet a minute for forty men and eight horses; and for the Slope split I measured 6,000 cubic feet a minute for three men and one horse.

Dated at Coal Creek, B.C., this 8th day of February, 1917.

GEORGE O'BRIEN,
Inspector of Mines.

I hereby give notice that I have this day examined the underground workings of that part of the Crow's Nest Pass Coal Company's Colliery known as Coal Creek No 3 mine, and find the following conditions to prevail therein:—

Part of mine examined: Mine. Ventilation: Good.

Explosive gas: None.

Roadways: Good. Timbering: Good.

Remarks: I measured 35,000 cubic feet of air a minute for the use of forty-three men and seven horses. There is a small cap of gas in the Main level and counter.

Dated at Coal Creek, B.C., this 9th day of March, 1917.

T. H. WILLIAMS,
Inspector of Mines.

I hereby give notice that I have this day examined the underground workings of that part of the Crow's Nest Pass Coal Company's Colliery known as Coal Creek No 3 mine, and find the following conditions to prevail therein:—

Part of mine examined: Mine. Ventilation: Good.

Explosive gas: None. There was half-inch cap in the Main level, counter-level, and crosscut off it.

Roadways: Good. Timbering: Good.

Remarks: I measured 29,250 cubic feet of air a minute for the use of forty-three men and seven horses.

Dated at Coal Creek, B.C., this 5th day of April, 1917.

T. H. WILLIAMS,
Inspector of Mines.

MINE-AIR SAMPLES TAKEN IN NO. 3 MINE, COAL CREEK COLLIERY, MARCH 23RD, 1917.

Sample No. 90, taken by T. H. Williams on South level, 150 feet on the return side of the last working-place:—

Chemical Analysis.	Per Cent.	Technical Analysis.	Per Cent.
Carbon dioxide	0.38	Air	94.94
Oxygen	19.87	Fire-damp	3.43
Methane	3.43	Black-damp	1.63
Nitrogen	76.32		

Sample No. 91, taken by T. H. Williams on the Main return, 100 feet from the fan:—

Chemical Analysis.	Per Cent.	Technical Analysis.	Per Cent.
Carbon dioxide	0.34	Air	95.94
Oxygen	20.08	Fire-damp	1.28
Methane	1.28	Black-damp	2.78
Nitrogen	78.30		

Sample No. 92, taken by T. H. Williams on the Main level, about 500 feet from the face, but did not include the three last places on the air:—

Chemical Analysis.	Per Cent.	Technical Analysis.	Per Cent.
Carbon dioxide	0.23	Air	96.66
Oxygen	20.23	Fire-damp	1.99
Methane	1.99	Black-damp	1.35
Nitrogen	77.55		

Average of eight samples taken when mine was working:—

	Per Cent.		Per Cent.
CO_2	0.14	CH_4	1.77
O	20.44	N	77.69

Average of seven samples taken when mine was idle:—

	Per Cent.		Per Cent.
CO_2	0.11	CH_4	1.38
O	20.53	N	77.97

CONDITION OF MINE AFTER EXPLOSION.

The mine was in a badly wrecked condition after reaching a point along the level 1,000 feet from the bottom of the slope; outside from this point the mine was not very much damaged. There are several long and extensive caves along the Main and counter levels, also up the inclines and in the places. It will take a long time to reopen the mine.

The following is from a detailed examination of the mine: Proceeding down the slope from the entrance very little damage is found; some of the stoppings were blown out and separation doors injured. Slight caves of rock had occurred here and there, but were of no consequence, until the first large cave was encountered 1,000 feet along the Main level. This cave extended for about 400 feet; proceeding about 300 feet farther, another cave is encountered which extends for about 700 feet. About 600 feet farther on, another cave is encountered which is practically continuous to the large cave on the level which stopped operations on the advance recovery-work; this is a distance of approximately 3,600 feet. All the inclines and working-places are caved more or less the whole distance.

A detailed examination of the working-places as far as examined showed the following conditions:—

Room No. 1 off No. 6 Incline.—Heavily caved to within a few feet of the face. Coal very soft at face; no signs of coking; large deposits of soot and dust. The men were not working in this place, but were driving a crosscut up to No. 2 room. Two crosscuts had been driven from this room to No. 2 room. Line of force in this room was in from incline and up inside crosscut into No. 2 room.

Crosscut off No. 1 Room.—Heavily caved to within a few feet of the face. Coal hard; no signs of coking deposits of soot and dust.

Room No. 2 off No. 6 Incline.—Heavily caved to within a few feet of the face. Rock nearly 70 feet long in one piece; could not quite reach the face of this room. No signs of coking as far as was reached. Line of force right up this crosscut and out of No. 3 room.

Room No. 3 off No. 6 Incline.—Timbers all blown out by force of explosion, but not much rock fallen. A little sign of coking in this place. The bodies of J. and F. Smith, father and son, were found in this place at the face. They had evidently been working when the explosion occurred. This room was about 15 feet past the last crosscut from No. 2 room and had not suffered much damage at the face from the force of the explosion. The force from the explosion had come up the crosscut from the room below and had gone outwards.

Room No. 4 off No. 6 Incline.—Very heavily caved to within a few feet of the face. Coal very soft at the face; small signs of coking. The bodies of J. Stelliga and J. Monks were found 30 feet back from the face under a cave. These men had apparently finished work for the shift and were in the act of putting their tools away. A tool-rack was found just at this point.

Room No. 5 off No. 6 Incline.—Very heavily caved to within a few feet of the face. Coal very soft; no coking; small deposits of soot. The bodies of H. Haydock and Jos. Atkinson were found right at the face—Atkinson on the right side of the room and Haydock on the left. Shovel found right at the face looks as if they had been caught while working at the face.

No. 6 Incline.—Coal hard at the face. Timbers knocked out, but place not caved. Not much signs of force, more compression; no coking; small deposits of soot. Incline face is 50 feet above crosscut in course of being driven to No. 5 incline. The men from this place, William Bird and H. Falip, were found at the foot of No. 5 incline and had evidently finished work and were on their way out.

Crosscut to Right off No. 6 Incline.—Heavily caved to within 5 feet of the face; no coking; small deposits of soot. The bodies of J. Campbell and Ed. Coates were found in this place. Campbell was found 10 feet from the face and 6 feet from the low rib, lying with his head pointing to the top rib. Coates was found leaning over a car at the face, with cave of rock on top of him, as if he had been in the act of loading a car. The crosscut is in 20 feet; coal 5½ feet high, with a brushing of 3 feet.

Last Break-through from No. 6 to No. 5 Incline.—Evidence of coking on timbers in this crosscut. Empty car found at corner of crosscut at point on No. 5 incline. This car had been broken by confliction of forces; one end had been driven upward to the face of the incline, and the other end outward and down the crosscut. The body of W. G. Clarke was found 10 feet from the car up the incline lying on his back, head pointing down. The body of J. Bossetti was found a little farther up, with his head pointing towards the face.

No. 5 Incline.—Face of this place was found in a normal condition, with the exception of timber knocked out by force of the explosion; no coking; deposits of soot. This was the only place in the mine where there was any conflicting lines of force of the explosion. This can be accounted for by the fact of the incline being driven ahead of the rooms forming a cul-de-sac. The force coming up the rooms and No. 6 incline had partly split, and part broke through the crosscuts into No. 5 incline and direct to No. 4 incline district. The other part reached the face and made a swirling movement and came back down No. 5 incline to the last break-through to No. 4 incline district. These working-places were all that were accessible; the places yet to be explored are the Main and counter levels and crosscut between them, and room No. 1 off the Main level. These places are inside of the heavy caves which stopped the exploration-work.

LINES OF FORCE FROM EXPLOSIVE BLAST.

All lines of force point from the level outwards, the blast coming out of the Main level, split at the foot of No. 6 incline, part going up No. 6 incline; the part split again at room No. 1 off No. 6 incline, part of which went up the incline and part into No. 1 room, up crosscut and into No. 2 room, up crosscut to No. 3 room, out of No. 3 room, and going again on No. 6 incline into Nos. 4 and 5 rooms and No. 6 incline; part of this force broke the stoppings between Nos. 5 and 6 inclines and passed direct through to No. 4 incline district; the other part that went into Nos. 5 and 6 inclines made conflicting lines of force, but eventually joined up with the forces going into No. 4 incline district. Nos. 5 and 6 inclines and rooms Nos. 4 and 5 being practically blind ends or cul-de-sac, conflicting lines of force could be expected at this point. The forces going through No. 4 incline district came back on the Main level and were outwards from that point. All lines of force on the counter-level were outward, going up crosscuts at some places on to the Main level.

DEDUCTIONS AS TO INITIAL POINT OF EXPLOSION.

The lines of force as found in the mine seem to indicate without any doubt that the point of origin was somewhere inside of No. 6 incline. Inside of this point there are yet four working-places to be explored and twelve bodies to be recovered. As to where inside of this point the explosion originated it is premature as yet to decide; but, personally, I am inclined to think there was a primary explosion of fire-damp within this area which was propagated through the mine by the agency of coal-dust.

A short review of the conditions existing inside of this point will also support this theory. From March 1st, 1917, to 3 p.m. April 5th, the day of the explosion, there were ninety-six fire-bosses' reports entered in the book, and on eighty of these gas was reported. This was reported mostly as a cap of gas in return air from face of level to face of counter-level. From evidence brought out by witnesses at the inquest it was proved this was from ½- to ¾-inch gas-cap. This practically means that there was almost continuous from March 1st to April 5th from 2 to 2½ per cent. of methane in the current of air passing through the Main and counter levels. This is also supported by the Gas Committee report of March 17th, 1917; they report finding gas in crosscut of counter-level.

Inspector Williams's report that morning states he found a ½-inch gas-cap in Main level, counter-level, and crosscut off it. Inspector Williams's report of March 9th also states he found a small cap of gas in the Main level and counter-level.

Inspector O'Brien's report on February 8th states the ventilation poor at the face of the South level, and he found explosive gas in the faces of South level crosscut off South level and counter South level; and again on January 9th Inspector Williams reports that small cap of gas in the last places on the return air and in the return air, which is the same level.

Taking the analysis of the air samples from this mine taken on March 23rd, 1917: Sample taken 150 feet on the return side of last working-place contained 3.43 per cent. of methane; quantity passing, 13,000 cubic feet a minute. Sample taken 500 feet from face of Main level contained 1.99 per cent. methane; quantity passing, 17,600 cubic feet a minute. Sample taken 100 feet from fan contained 1.28 per cent. of methane; quantity passing, 53,000 cubic feet a minute. An average of eight samples taken from this mine when working showed 1.77 per cent. of methane in the current passing, and the mine was giving off 3,669 cubic feet of methane to the ton of coal mined.

Again, an average of seven samples taken when the mine was idle showed 1.38 per cent. of methane in the current passing. From this it will be seen the mine was a gassy one, and the weakest place in the ventilation was the face of the Main and counter levels and crosscut of the same.

We have conditions under which explosive gas has been found at the face of the levels as given in Inspector O'Brien's report. Referring again to the samples of gas taken on March 23rd, the one taken 150 feet on the return side of the last working-place showed 3.43 per cent.; when we consider that methane becomes inflammable at 5.5 per cent., this is getting near the danger-line.

Mr. Williams stated in his evidence at the inquest that this sample was taken under abnormal conditions, as there had been a curtain broken down; but, apart from this, we have the current of 17,600, which is the intake to these levels, on the same date, containing 1.99 per cent. of methane. From the evidence taken at the inquest on the condition of the mine the shift preceding the explosion, witness No. 5, Joseph Lane, who worked in the Main level, swore that on the morning of April 5th, when he went into his place, there was a ½-inch gas-cap in it, and this gradually increased to ¾ inch at the end of the shift; he also stated that this was no unusual condition since the double shift was put on. (The double shift was put on to place the men thrown out of work by the "bump" in No. 1 East mine last November.) He also admitted that Inspector O'Brien had withdrawn him owing to there being a 1-inch cap of gas in the air. Lane, who is an old experienced miner, has worked for many years as fireboss, also holding a second-class certificate of competency, did not report this condition either to the fireboss or any of the officials, although he claimed the condition was worse when he left the place and after the fireboss had made his inspection.

R. Doodson, bratticeman, claimed he went into the Main level that morning and found a small cap of gas about ½ inch, and in an hour had reduced it below ½ inch by fixing the brattice.

J. McCourt, fireboss on the night shift, gave evidence that he found a small cap of gas in the crosscut off the counter-level, which he reported.

John Biggs, overman of No. 3 mine, testified he had held a second-class Certificate for eight years, had worked in No. 3 mine for seven years and ten months, and was overman for the past two years and five months. On the 5th instant he found the conditions very good; had found gas in one part of the mine varying to ½-inch cap. Did not consider it a dusty mine, and had never had occasion to withhold the men for dangerous conditions. His opinion was that something out of the ordinary happened, as there was only the usual quantity of dust and gas present on the 5th. They had only small "bumps" in this mine. Replying to Mr. Lane's statement about the gas-cap increasing from ½ to ¾ inches, he claimed that he visited that place on the afternoon and examined for gas and only found ½-inch gas-cap. He admitted he did not report caps of gas until it was suggested by Inspector Williams that he should do so.

Replying to Chief Inspector Wilkinson, he said a broken lamp had been found in the mine several weeks ago and miners had been found with matches in their possession.

Jos. Thompson, fireboss on day shift of No. 3 mine, was on duty on the morning of explosion; had nineteen years' experience as miner; held third-class certificate of competency for eight years; had been fireboss in No. 3 mine for past six months. He thought the general conditions

in the mine that day were fairly good. Was in Main level about 1.30 p.m. that day and did not consider conditions were any worse than they had been during the day; had found a small cap of explosive gas near the roof. He considered everything was in normal condition when he left the mine that day.

B. Caufield, manager, Coal Creek Colliery, had twenty-seven years' experience as a miner. Holds first-class certificate of competency for British Columbia for past seven years; has been three years manager at Coal Creek; testified that he generally found the conditions in No. 3 mine good, and had received no complaints as to conditions there. He considered it to be a fairly good mine; considered the mine dusty, not in what would be considered sufficiently to propagate an explosion-wave, and considered it would require a blown-out shot or a primary explosion of gas to cause flame to start a dust-explosion. There had been no blasting in this mine since December, 1914. His opinion was that a primary explosion of gas must have started the explosion.

The conditions had changed in the levels lately: more timber had to be put in, and afterwards renewed, showing the roof and sides to be more tender; some faults of a minor nature had also been encountered lately in the Main and counter levels.

Replying to Mr. Ashworth, he gave his opinion that an open light, either from a broken lamp or some other source, would be sufficient to cause an explosion; he also stated that gas is given off from the working-places very freely; also feeders from the floor.

After inspecting the mine and listening to the evidence at the inquest, and reviewing the facts obtainable, I am of the opinion that a primary explosion of gas inside of No. 6 incline was the initial cause of the explosion, and that it was propagated through the mine by coal-dust.

From the facts we have the Main and counter levels showing from 2 to 2½ per cent. of fire-damp almost continuously. Lane swears that conditions got worse towards the end of the morning shift the day of the explosion. We have the afternoon shift following on in quick succession; the production of coal goes on, so does the generation of gas, and it would be safe to assume that conditions were still worse at the end of the afternoon shift than what they were at the end of the morning shift; more especially would this be so when the brushing is generally taken up on the afternoon shift, and it has been stated that more gas is given off from the bottom. One might take it from this that conditions were getting near the danger-line by 11 p.m. of the second shift, and it would only need some derangement of the ventilation or some increase of gas given off to give explosive conditions in the Main and counter levels and crosscut off the same. Added to this, there is the dust created by the breaking of the coal at the face and the loading of the cars; this is further carried on by the running of cars and trips.

In the Third Report of Explosion in Mines Committee, page 9, they say that when coal-dust of sufficient fineness was present only 2½ per cent. of fire-damp was necessary to form an explosive mixture, and the richness of coal-dust or its greater inflammability influences the rapidity and consequent violence of an explosion of dust and gas mixtures.

In the Main level of the mine, at the farthest point reached, attention was drawn to a slight upheaval of the floor; this was between two caves, and Manager Caufield mentioned in his evidence that it may indicate some unusual disturbance at this point and would be likely to give off an extra amount of gas, which would naturally increase the percentage which was already in the air travelling.

Until the level is cleared up it would be premature to give any decision as to what might have happened inside of No. 6 incline.

CAUSE OF IGNITION.

The usual causes assigned to mine explosions are as follows:—

1. Ignition by naked light.
2. Blasting.
3. Blown-out shots.
4. Electricity.
5. Large caves caused sparking from the hard rocks.
6. Sparks from pick striking sulphur-balls or hard rock.
7. Broken or defective safety-lamp.
8. Safety-lamp becoming overheated and dirty and in a condition to pass flame.
9. Matches.

In reviewing the probable cause of ignition we can eliminate several of the factors mentioned above.

No. 1. No naked lights were used in this mine.

Nos. 2 and 3. There has been no blasting in this mine since December, 1914.

No. 4 can also be eliminated; the electricity in the mine was what was used in signalling on the slope haulage, and this is too remote to be considered.

No. 5. There were large caves in the mine, but as far as examined they seemed to be a product of the explosion.

No. 6. While explosions may have occurred from this source, it seems a remote chance and one that would be hard to accept until all other causes had been eliminated.

In my opinion the case narrows down to safety-lamps or matches. So far there has been no matches found on any of the bodies recovered, but there are yet twelve bodies to be recovered from the district where it seems the explosion originated, so this question cannot be settled until these bodies are recovered.

The same applies to a question of a defective or broken safety-lamp, and at the best it is very hard to determine after an explosion whether a lamp has been broken after or before an explosion.

On the question of ignition, it would be premature to give any decision until all the bodies and lamps have been found in the area inside of No. 6 incline.

In connection with what has already been said, it may here be stated that in actual experiment with a gauze safety-lamp it was found that, while it would not cause an external explosion in 4.5 per cent. of fire-damp when the air was moving at a velocity of 370 feet a minute and was free from dust, it passed the flame and caused an explosion in ten seconds where only the ordinary amount of dust was floating in the air.

Conditions like the above could easily occur in a few minutes in the levels of No. 3 mine, Coal Creek Colliery.

CONDITION OF SAFETY-LAMPS FOUND.

Lamp No. 1343.—Wm. Silverwood, found at bottom of No. 5 incline on siding. Lamp in good condition, except a small indentation in shield and outer gauze.

Lamp No. 1392.—Wm. Checkley, found at bottom of No. 5 incline on siding. Lamp in good condition, shows signs of heat.

Lamp No. 27.—Wm. Puckey, fireboss, found at bottom of No. 5 incline on siding. Slight indentation in both gauzes, caused by blow on shield; glass, gauze-ring, and gauzes in good condition. *Inside gauze brighter than outside, being a newer gauze.*

Lamp No. 1345.—Henry Falop. Glass gauzes and ring in good condition; slight indentation on outer gauze and shield.

Lamp No. 1302.—Wm. Bird, found at bottom of No. 5 incline on siding. Slight indentation in gauzes and shield; glass, rings, and gauze-ring in good condition.

Lamp No. 1310.—James Smith, found at face of No. 3 room off No. 6 incline. Gauzes in good condition and clean; glass and gauze-ring in good condition. (Wick in lamp knocked down.)

Lamp No. 1316.—Frank Smith, found at face of No. 3 room off No. 6 incline. Gauzes in good condition and clean; glass and gauze-ring in good condition; slight indentation near top of gauze (wick in lamp knocked down); coking on shield of lamp; evidence of heat on both gauzes.

Lamp No. 1367.—John Monks, found in room No. 4 off No. 6 incline, 50 feet from face. Gauzes in good condition, except slight indentation in them; shield indented, causing above condition on gauzes; glass and gauze-ring in good condition, but bottom gauze-ring very uneven on surface.

Lamp No. 1321.—F. Benezeth, found at bottom of slope. Gauzes in good condition; evidence of gas burning in gauze; slight indentation in outer gauze near the top; glass and lower gauze-ring in good condition. *This man worked in No. 2 room off No. 6 incline.*

Lamp No. 1366.—G. Giacomazzi, found at the bottom of the slope; body not found. Lamp blown to pieces; glass and bottom gauze missing; top part of lamp torn away from bottom.

Lamp No. 1388.—J. Atkinson, found in No. 5 room off No. 6 incline. Top part of lamp found only; shield badly broken.

Lamp (No Number); Maker's No. 578,875.—J. Machin, found at bottom of slope. Lamp in good condition; inner gauze shows evidence of heat; bottom gauze-ring has uneven surface.

Lamp No. 1318.—F. Puillandre, found at bottom of Main slope. This man worked in the Main level; his body has not yet been found. Lamp unbroken; gauzes in good condition; glass, rings, and lower gauze-ring in good condition.

Lamp No. 618.—P. Gormley, found at bottom off Main slope with body. Glass broken; gauzes in good condition, except slight indentation on outer gauze; bottom gauze-ring a little uneven on surface.

Lamp No. 3440.—J. Machin, found on top of Main slope. Gauzes in good condition, but outside one very dirty; glass in good condition; bottom gauze-ring in good condition.

Lamp No. 1313.—Hugh Melarky. Lamp all smashed to pieces.

Lamp No. 2556.—Lamp found in pasture at mule-barn; lamp broken; gauzes found all punctured, presumably by caulks on horse-shoes. No record of this lamp given out at lamp-house.

The lamps broken seem to all have been broken by the force of the explosion. Lamp No. 1321 shows evidence of gas burning in the gauzes; this would indicate that there had been gas in No. 2 room during that shift, and that may have been the reason Benezeth was on his way out so early.

Lamp No. 1392, of Wm. Checkley, and No. 1316, of F. Smith, also show signs of heat, but this may have been from the flame of the explosion, as the dust on the shield was coked.

VENTILATION OF THE MINE.

The Inspector's measurement of the air-current on April 5th shows 53,000 cubic feet passing in the fan-drift. Taking the measurements of March 23rd, 1917, at the various places, we have 29,250 cubic feet at a point 100 feet inside of the South slope, 17,160 cubic feet 500 feet from the face of the level, and 13,000 cubic feet in the return from the last working-face. Assuming that some of the total quantity of the 53,000 cubic feet at the fan is used for the outside split, we will take the quantity on the inside of the South slope as being the amount going in for the working-faces. Then 13,000 cubic feet from 29,250 cubic feet gives us a leakage of 16,250 cubic feet or 55.5 per cent.

The mine is not ventilated according to the best mining practice considering the conditions met with. The split for the working-places is on too long a drag and the air is coursed the wrong way. The air is taken in and coursed up through the Nos. 1, 2, 3, and 4 incline districts, then into Nos. 5 and 6 inclines, and around the rooms off No. 6 incline and into the Main levels. There is a heavy drag on the air through friction and a subsequent loss in quantity.

There is an enormous leakage as shown by previous figures. While the system of ventilation was within the "Coal-mines Regulation Act," it was not as good as it could have been made, and in the writer's opinion an error was made in not providing a separate split for the level places where there was so large a generation of gas.

Thirteen thousand cubic feet as measured going through the levels would have been adequate providing it had been fresh air, but from analysis shown it contained 1.99 per cent. methane before it reached the levels.

ATMOSPHERIC CONDITIONS.

There was no unusual disturbance in the atmospheric condition that would have any bearing on the explosion. The barometer readings for six days prior to the explosion are as follows: 26.1, 25.9, 25.9, 26, 26.1, and 26.3 inches; these readings are taken from the fireboss report-book.

REPORTS OF OFFICIALS.

These reports are made in a way that do not give the true conditions; there seems to be an inclination merely to report a cap of gas. No information is given as to the size of cap, and whether it is increasing or decreasing or at any time eliminated. Again, one fireboss will report a small cap of gas; another will report free from explosive gas.

The morning-shift firebosses' report on April 5th states: "I have examined this mine and find a small cap of gas in return air from face of crosscut to face of counter-level; all other places clear and in safe condition." He does not report any cap in the Main level, although he admitted, when giving evidence, there was a ½-inch cap, and we have Overman Biggs's testimony there was ½ inch; also Inspector Williams and Lane, the miner in the place, says there was ¾ inch. It seems strange the morning-shift fireboss did not report a cap in the level. From this it would seem that we cannot depend on the firebosses' reports as to giving the true conditions.

Coming to the overman's report, while the firebosses' reports show gas-caps practically all the month of March, he only reports a small cap four times. Even on April 5th, when Overman Biggs admitted that there was a ½-inch gas-cap in the Main level, he does not report it, but instead he reports: "I have examined No. 3 mine and found same free from explosive gas and in safe condition. The Inspector made his usual examination of the mine to-day and found the above-mentioned conditions." He does not state in the report that his fireboss found a ½-inch cap of gas in the return from the crosscut to the face of the counter-level. Therefore it seems that, so far as conveying information to the manager as to the state of the mine, the overman's report is worse than useless, as it tends to mislead him. It also seems very strange that, while the overman found a ½-inch gas-cap in the air in the level, he does not report it, and also correct the firebosses' report.

It seems to the writer that it would be better to record all gas-caps found, as to their length, and keep track of them until eliminated, and state as to whether they are just in thin stratums along the roof or whether the whole current is charged. The same should apply in cases of explosive gas, the quantity should be stated; from this it would be able to tell the true condition of affairs.

TESTING OF LAMPS.

Rule 10, "Coal-mines Regulation Act, 1911," provides for every safety lamp in use to be tested in an explosive mixture of gas and air at least once every week. This was done at the Crowsnest Pass mines, but in the opinion of the writer lamps should be tested every time they go into these mines, under the conditions they are working. The same rule also provides that every lamp shall be submitted to a mechanical air test whenever assembled after being taken apart. I did not see any mechanical air test in use at these mines. It would therefore seem that for five days every week the only test the lamps were put to was the firebosses' test.

DUST.

Considerable discussion arose at the inquest as to whether this mine was dusty or not. From personal observations of the writer, he would class it as a dusty mine. There was a system of watering being done in this mine, but it was inadequate against the amount of dust being made. Rule 13, "Coal-mines Regulation Act," exempts this mine from any treatment of the coal-dust, as no explosives are used and safety-lamps only are in use.

CONCLUDING REMARKS AND SUGGESTIONS.

A good deal of comment was made at the inquest on the amount of gas in the current that the men were allowed to work in, and the question arose as to what was termed the dangerous condition referred to in General Rule 8, "Coal-mines Regulation Act, 1911." This rule reads: "If at any time it is found by the person for the time being in charge of the mine or any part thereof that by reason of noxious gases prevailing in such mine or such part thereof, or of any cause whatever, the mine or said part is dangerous, every workman shall be withdrawn from the mine or such part thereof as is so found dangerous."

This rule practically leaves it to the person for the time being in charge to determine what is the dangerous condition. There is such a variation of opinion on this that no two persons will hardly agree. This matter was discussed for years in Great Britain by the different authorities, and was finally settled by inserting in the "Coal-mines Regulation Act, 1911," the following: "For the purpose of this section, a place shall be deemed dangerous if the percentage of inflammable gas in the general body of air in that place is found to be two and a half or upwards, or, if situate in a part of a mine worked with naked lights, one and one-quarter or upwards."

If a workman discovers the presence of inflammable gas in his working-place, he shall immediately withdraw therefrom and inform the fireman, examiner, or deputy.

The writer would suggest that some standard percentage of gas in the current be set for the British Columbia mines on the withdrawal of workmen.

In reviewing the cause and extent of mine explosions, there are three essential factors which enter into an explosion:—

First: There has to be an explosive mixture of gas, or of gas and dust.

Second: There has to be a means of ignition.

Third: There has to be sufficient quantity of gas, or of dust, to propagate it through the workings of the mine.

To deal with these factors and prevent as far as possible these explosions, the following should be done:—

First: Large volumes of air at moderate velocities should be circulated through the mines to keep them clear of gas, sufficiently that it would be impossible to find a trace of gas in the air-currents with a safety-lamp. This air should be well conducted to the working-places to prevent small accumulations in cavities at the faces. If dust is being made at the faces, this should be thoroughly allayed by means of water; the faces should be kept in a thoroughly saturated condition. Splitting of the air-current as often as possible should be resorted to, so that the gases given off in the district would not be carried into another.

Second: To prevent as far as possible ignition in the event of explosive conditions occurring. All means of ignition should be removed. In places or mines where danger is suspected no blasting should be allowed; no matches or material for striking a light should be allowed. If gauze safety-lamps are used, they should be tested in an explosive mixture daily before they are allowed in the mine. If the coal is friable and makes a large amount of dust, some approved form of electric lamp should be used for the actual working operations, and a gauze safety-lamp kept in the place for testing purposes only.

Third: Provision should be made that, if an explosion should occur, every means should be used to try and localize it.

The writer would suggest that all working-places where a large amount of dust is made should be efficiently watered to allay the dust, if not naturally damp. All haulage-roads, if not naturally damp, should be stone-dusted. At the entrance to each district stone-dust barriers should be erected to prevent the propagation of the explosion. In all leading places where gas is being generated, or in any places where danger from gas is suspected, stone-dust barriers or some other means of neutralizing should be adopted, so that in the event of a primary explosion occurring it would be stopped in its initial stages. If stone-dust barriers had been erected in the Main levels of the No. 3 mine, inside of No. 6 incline and also in Nos. 5 and 6 inclines, and the haulage-road had been stone-dusted, in all probability the explosion would have been confined to the area inside of No. 6 incline, with a consequent saving of human life and property.

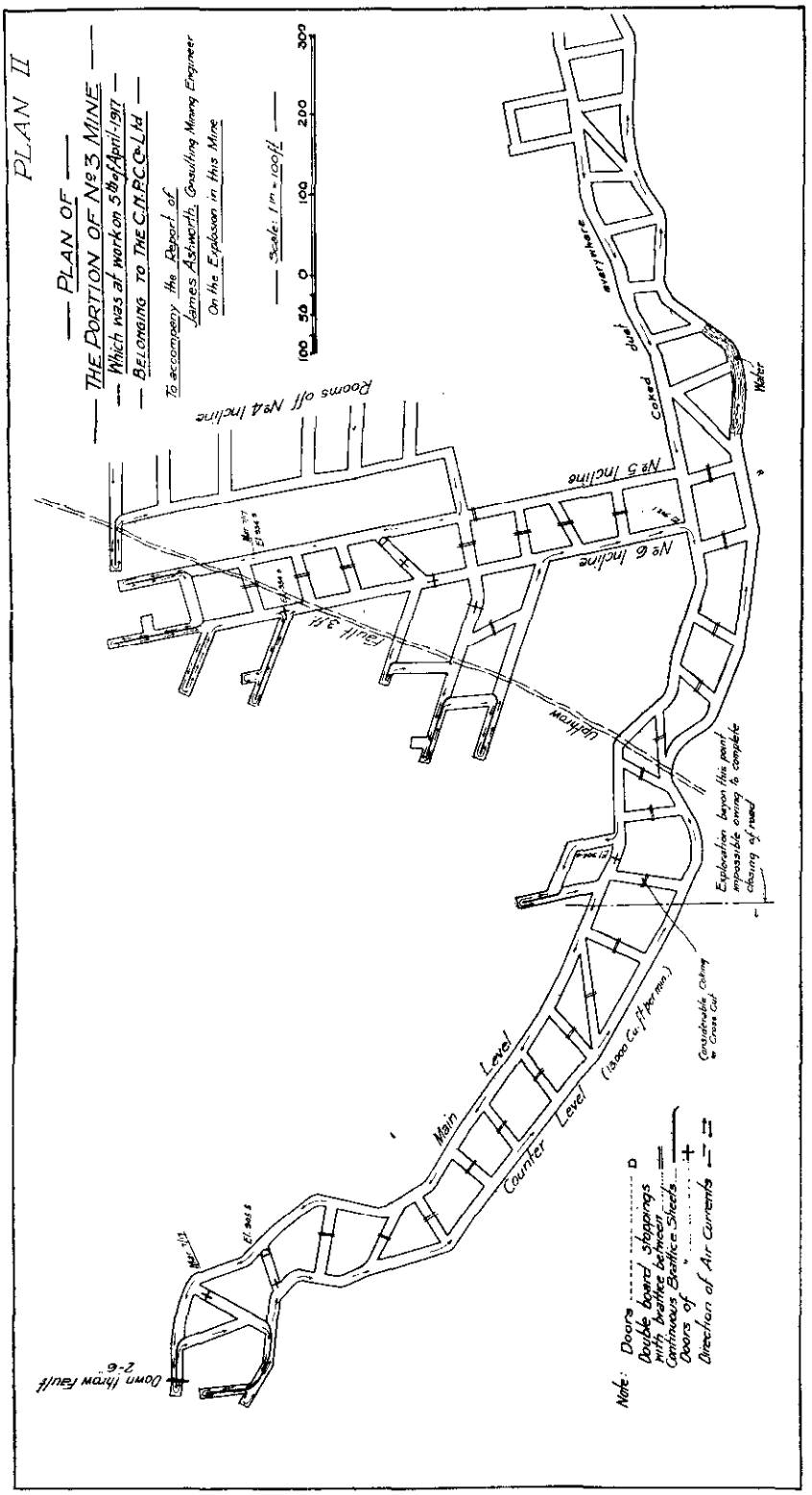
It is the writer's opinion that in all advance headings of gaseous mines frequent safety-zones should be erected to prevent the spreading of any local explosions that might occur.

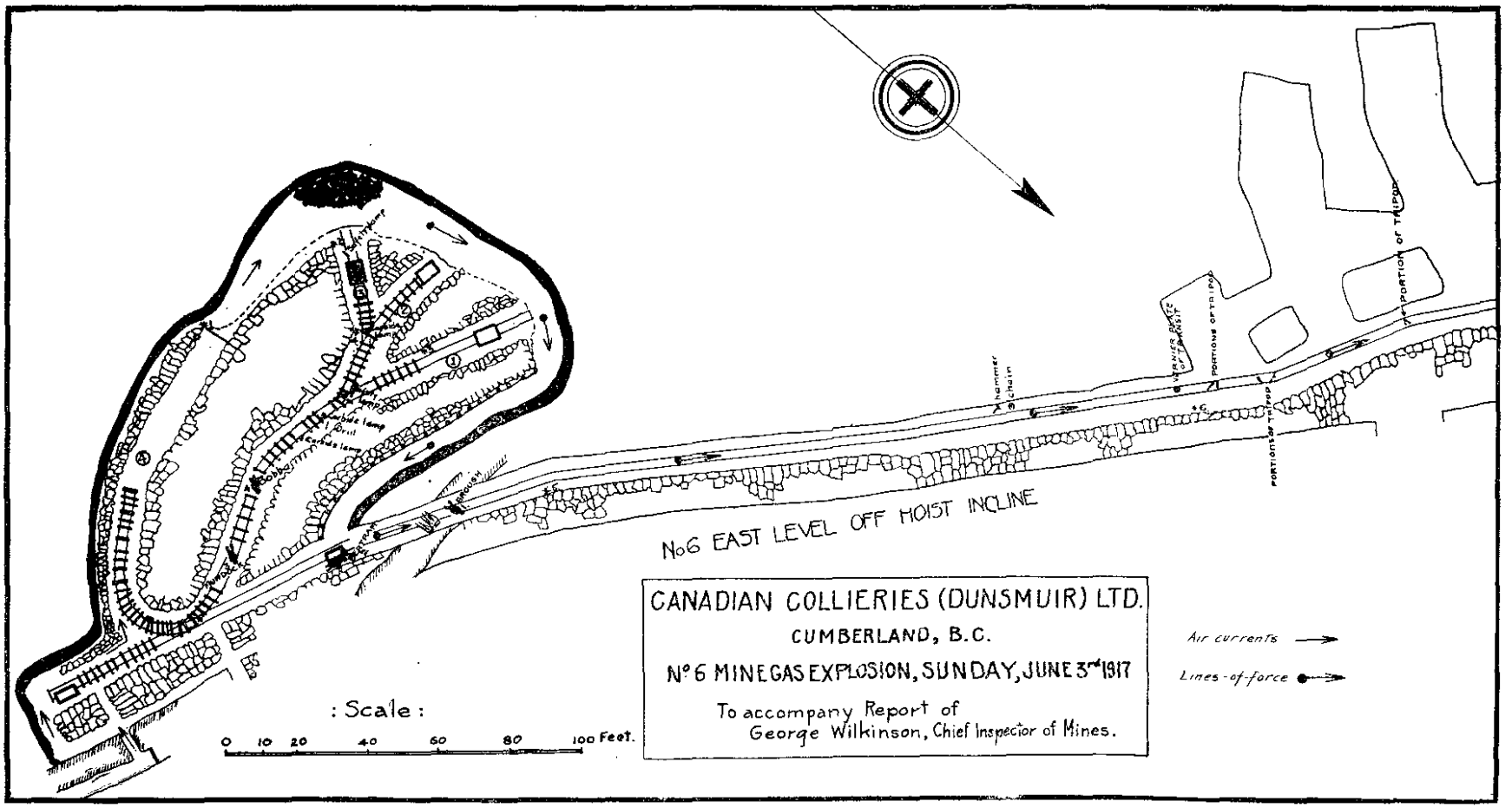
In reviewing the mine explosions occurring in the past, we find them getting more violent in our modern well-ventilated mines.

It is seldom we hear of a case of individual burning to a man in the present day. In the writer's opinion we do not have far to look for a reason. Years ago the writer remembers when there used to be lots of cases of individual burning of some miner; it would generally be a case of some miner lighting some gas in his place and getting burned, and that would be the extent of the explosion. Natural safety-zones were kept in the early days by insufficient ventilation, and when a local explosion did occur it died out for lack of oxygen. In the early days when the mines were using naked lights it was no uncommon thing for gas to be lighted up several times daily, and it would just be a local flash and then go out. What would be the result now if a local explosion occurred in most of the mines? It would spread over all the mine. There must be some reason. In recent years in mines the whole tendency has been improvement in ventilation, without paying sufficient attention to other factors which play just as important a part. Mines that use safety-lamps and do not use explosives are exempt from treating coal-dust.

A mine with a normal percentage of dust in suspension in the air, in the event of a primary explosion of gas, is just as dangerous as a mine full of gas; more especially is this so in well-ventilated mines where there is a plentiful supply of oxygen, where the flame from the explosion distils the carbon from the dust, forming CO, which is combustible and transmits the flame of the explosion through the workings of the mine.

Appended to this report is a plan of No. 3 mine, showing positions of bodies found and general lines of explosive blast and direction of ventilating-current.


PLAN II
PLAN OF
THE PORTION OF No 3 MINE
Which was at work on 5th of April 1917
Belonging to THE C.N.P.C. Co. Ltd
To accompany the Report of
James Ashworth, Consulting Mining Engineer
On the Explosion in this Mine
Scale: 1 in = 100 ft
100 50 0 100 200 300
Rooms off No 4 Inclines
No 5 Incline
No 6 Incline
Level 3 ft
Upthrow
Coked dust everywhere
Water
Explosion beyond this point impossible owing to complete closing of road
Main Level
Counter Level
(1300 Cu ft per min.)
Down throw fault 2-6
Note: Doors
Double board stoppings with leather between
Continuous leather Sheets
Doors of "
Direction of Air Currents



CANADIAN COLLIERIES (DUNSMUIR) LTD.

CUMBERLAND, B.C.

N° 6 MINE GAS EXPLOSION, SUNDAY, JUNE 3rd 1917

To accompany Report of
George Wilkinson, Chief Inspector of Mines.

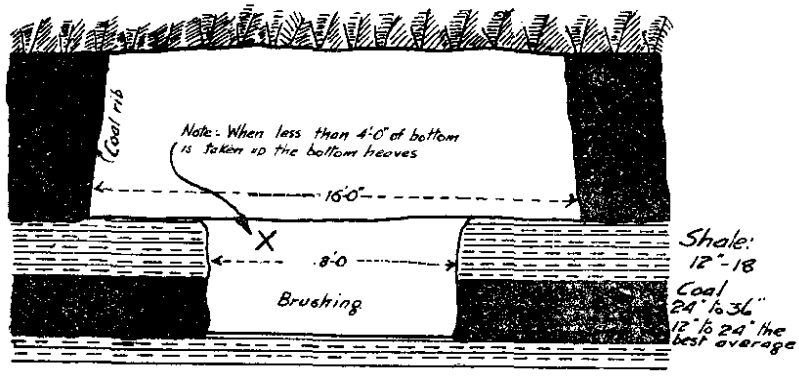
SECTIONS

— OF —

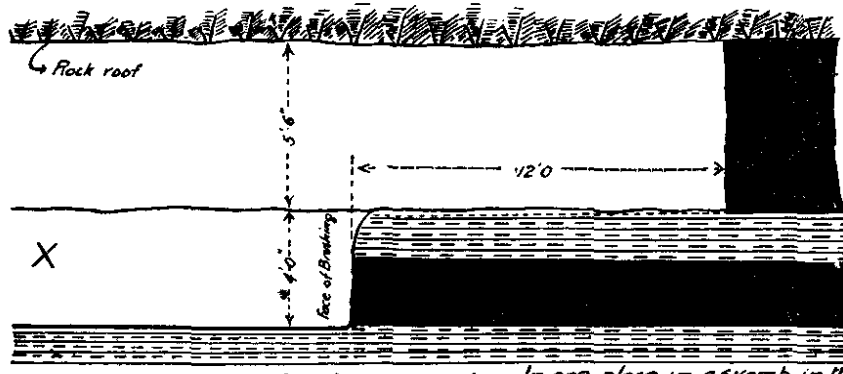
Nº 6 INCLINE Nº 3 MINE

COAL CREEK

Scale:- 1"-4'0"

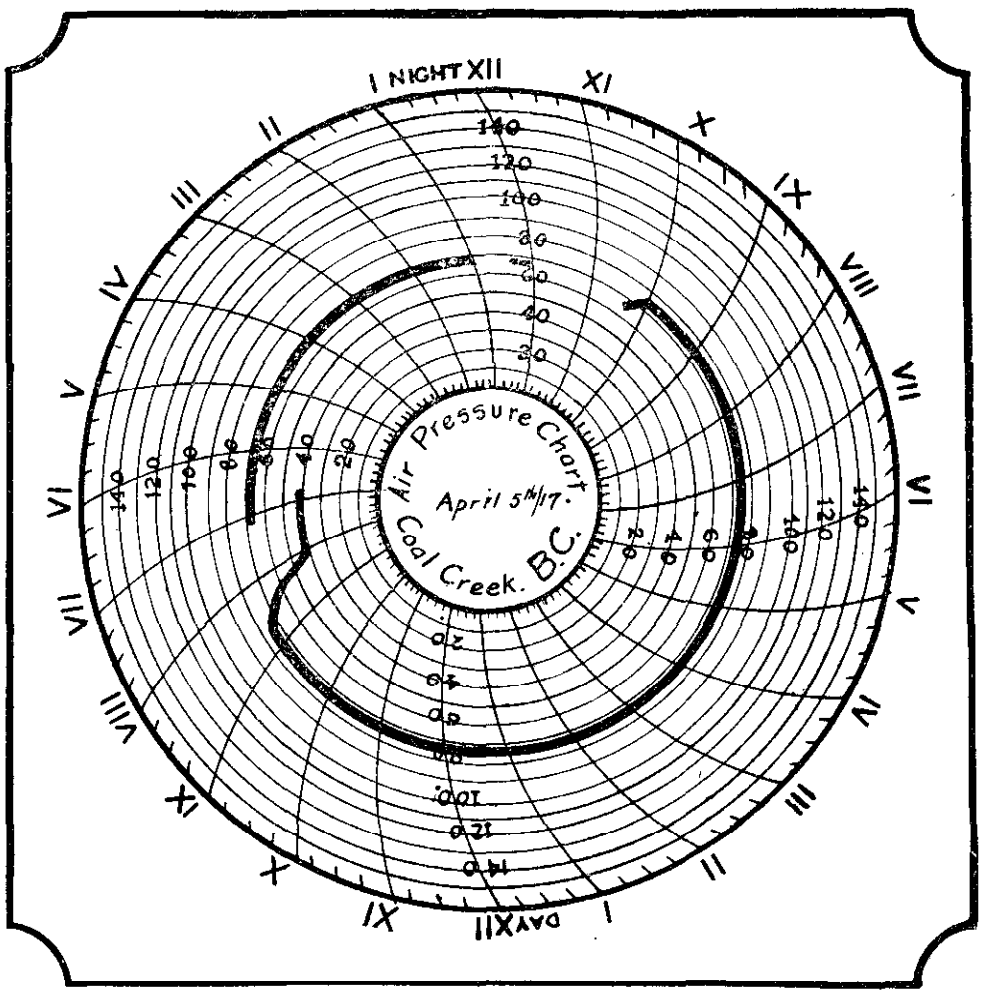


CROSS SECTION



LONGITUDINAL SECTION

In one place in a swamp in the 1-23-9 inclines the bottom coal is 6ft thick


NIGHT XII
DAY XII
Air Pressure Chart
April 5th/17.
Coal Creek. B.C.

EXPLOSION AT No. 3 MINE, COAL CREEK COLLIERY.

REPORT BY THOMAS GRAHAM (LATE CHIEF INSPECTOR OF MINES).

On or about 10.10 p.m., April 5th, 1917, a disastrous explosion occurred in No. 3 mine of the Coal Creek Colliery, situated at Coal Creek, B.C., and owned and operated by the Crow's Nest Pass Coal Company, Limited. The explosion caused the death of thirty-four persons, this being the total number in the mine at the time of the explosion.

A telegram from T. H. Williams, Inspector of Mines, Fernie, stating that an explosion had occurred at No. 3 mine, reached me at 11.30 p.m. that night. Having that day severed my connection as Chief Inspector of Mines to the Department, to accept a position with the Canadian Collieries (Dunsmuir), Limited, I communicated the contents of telegram to you via long-distance telephone at Nanaimo, B.C.

Through you permission was obtained from H. S. Fleming and J. M. Savage, managing director and general manager, respectively, of the Canadian Collieries (Dunsmuir), Limited, for my leave of absence, and under telephonic instructions, confirmed by your letter of April 7th, I proceeded to Coal Creek as your representative until the arrival of the new Chief Inspector of Mines, and to remain as long as my successor deemed my services necessary.

In company with Dudley Michell, First-aid Instructor to the Department, I left Victoria on the afternoon of the following day, and reached Fernie on the evening of the 8th, being joined en route by Robert Strachan, Inspector of Mines, Merritt, B.C.

SITUATION OF COLLIERY.

The Coal Creek Colliery is situated on Coal creek, a tributary of the Elk river, and lies about five miles east of Fernie. The colliery is served by the Morrissey, Fernie & Michel Railway, which makes connections with the Canadian Pacific Railway and the Great Northern Railway at Fernie.

The mines are opened at a point on Coal creek where the coal-seams in their eastward pitch reach the level of the creek, the strike of the seam being approximately at right angles to the valley; the openings consist of drifts in the seams, starting on each side of the valley. At the point of opening the valley of Coal creek is about 1,000 feet in width, aand is spanned with a steel tipple to which the coal from the various mines on each side of the valley is conveyed for preparation and loading. The mountains on each side of the creek rise to a height of 2,500 feet.

Nos. 2 and 3 mines are opened on the same seam, the mine-mouths converging from a common point at the south end of the tipple and at tipple level, No. 2 mine being on the strike, whilst No. 3 follows the dip by slope; the seam worked is locally known as No. 2 seam and in the geological series is the lower of the seams now worked at this colliery.

These two mines were opened about 1898 and were, practically speaking, one mine, as connections were made at many points. The system of operation was an irregular pillar and stall, the pillars being much too small for the future extensive operations needed to reach the main field, in view of the expected heavy cover, which reaches 2,600 feet at one mile from the mine portal.

No. 2 mine was the scene of a disastrous explosion on May 22nd, 1902, in which 128 lives were lost. This explosion devastated the No. 1 South levels off the slope in No. 3 mine, and the only persons saved from either mine were those operating on the North levels off No. 3 mine.

In 1907 and 1908, through irregular modes of operation, No. 2 mine was subject to a series of disastrous "bumps" accompanied with loss of life, and the Department of Mines at that time placed a restrictive prohibitory measure on the area so affected. Following the placing of the proscribed area in No. 2 mine, new levels were started off No. 2 mine to the westward and off No. 3 slope to the eastward to reach the inby portions of the field lying to the south and beyond the proscribed area. Levels were started off No. 3 slope, 1,600 feet from the portal, and were known as No. 2 South, a barrier pillar being left to the westward between these and the restricted area, and that portion of the old No. 2 and No. 3 workings lying outby the proscribed area was used as a return airway for No. 3 mine, and during the last few years a line of heavy stoppings were erected between this area used for return purposes and the old proscribed area. To the dip of No. 2 South level off No. 3 mine an attempt to operate by the long-wall advancing method was tried, but after spasmodic attempts was finally abandoned, and this area is now filled with water.

Two Main levels were finally pushed as feelers into the field, following the contour of the seam, and off these four inclines were pushed to the south-west, leaving a large barrier pillar outby and adjacent to the most southerly portion of the proscribed area of No. 2 mine. A few stalls were turned off No. 4 incline and paralleling the levels. One thousand feet beyond No. 4 incline two more inclines were started, running due west, and known as No. 5 and No. 6, whilst the levels projected some 1,200 or 1,300 feet beyond. The operations at the time of the explosion were confined to the Main levels, Nos. 5 and 6 inclines, and five stalls off No. 6 incline.

In 1911 a new mine known as No. 1 East was opened on what is locally known as No. 1 seam, lying in the series 150 feet vertical above Nos. 2 and 3 mines. This mine was projected to operate over the same area formerly worked by Nos. 2 and 3, and in view of experience gained in No. 2 through irregular modes of operation and excessive extraction on the first operations, this mine was planned to overcome such defects; the plans were rigidly adhered to and only 25 per cent. of the coal was recovered on first operations. (*See* plan of mine, Minister of Mines' Report, 1915.)

The mine was steadily developed, and in the fall of 1916 was producing 1,500 tons a day, the line of the old proscribed area underlying in No. 2 mine had been passed, and whilst the coal was more or less disturbed in the area, and some difficulty had been met in maintaining some roadways, a general impression prevailed that the mode of operation had been successful in overcoming the "bump" troubles. This impression was completely upset by the great "bump" of November, 1916, which devastated No. 1 East mine, shaking the surrounding country like an earthquake and completely destroying all that portion of the mine lying inby a line running east and west near No. 10 East level. This phenomena, together with the problems due to excessive emanations of gas from the field, was made the subject of a special examination and report by George S. Rice, Chief Mining Engineer to the United States Bureau of Mines, a copy of which is in your hands.

No. 3 mine, as already stated, is opened by a slope, the South levels leaving this some 1,600 feet from the portal; the levels follow the contour and extend from the slope about 7,000 feet. Haulage on the slope was by direct rope, and on the level from the slope to No. 1 incline by compressed-air locomotives, the inside gathering being by animal haulage.

The seam as worked in No. 3 mine is a high-grade bituminous coal from 5 to 5.5 feet in thickness, the floor being rather soft carbonaceous shale; the roof is strong hard sandy shale. The coal is friable, powdering finely and containing much gas; it is rather easily mined, especially when worked on the face-planes, but even on the butts it is mined without the use of explosives. A sample taken from the face of No. 2 incline in December, 1916, by Dudley Michell, of the British Columbia Mines Department, under direction of George S. Rice, and analysed by A. Fieldner, Chemist at the Laboratories of the United States Bureau of Mines, Pittsburgh, Pa., gave the following contents (*see* Report of G. S. Rice, Coal Creek "Bumps"):—

Proximate Analysis of Air-dried Coal.—Moisture, 0.55; volatile, 28.52; fixed carbon, 63.83; ash, 7.10; sulphur, 0.54; B.T.U., 14,319. From Memoir No. 59, Canadian Geological Survey.

Proximate Analysis of Air-dried Coal, No. 2 Mine.—Moisture, 1.3; volatile, 26.3; fixed carbon, 64.7; ash, 9; sulphur, 0.5; B.T.U., 13,820.

MINE PRODUCTION.

The mine was producing from 250 to 300 tons a day of two eight-hour shifts, and about thirty-four to thirty-six men a shift. A few men worked on the third shift brushing roadways.

VENTILATION.

The mine was ventilated by a Wilson fan, belt-driven, and was operated as an exhausting unit producing 50,000 cubic feet a minute, with a water gauge of 3½ inches.

REPORTS ON MINE.

Inspectors' Reports.

Crow's Nest Pass Coal Company: Colliery known as Coal Creek No. 3.
Part of mine examined: Mine. Ventilation: Good.
Explosive gas: None. Small cap of gas in the last places on the air and in the return air.
Roadways: Good. Timbering: Good.
Remarks: I measured 32,000 cubic feet of air a minute for the use of forty-four men and eight horses.
Dated at Coal Creek, B.C., this 9th day of January, 1917.

(Signed.) T. H. WILLIAMS,
Inspector of Mines.

Crow's Nest Pass Coal Company: Colliery known as Coal Creek No. 3.
Part of mine examined: All the mine.
Ventilation: Poor at the face of the South level, but generally good throughout the rest of the mine.
Explosive gas: Face of South level, crosscut off South level, and counter of South level. These three places were fenced off and the men withdrawn.
Roadways: Good, but the South level haulage-road is dusty in places. Timbering: Good.
Remarks: I measured 35,000 cubic feet of air a minute on the main intake for the use of forty-three men and eight horses. This quantity is divided into two splits: South level split, 25,500 cubic feet a minute for forty men and eight horses, and for the Slope split I measured 6,000 cubic feet for three men and one horse.
Dated at Coal Creek, B.C., this 8th day of February, 1917.

(Signed.) GEORGE O'BRIEN,
Inspector of Mines.

Crow's Nest Pass Coal Company: Colliery known as Coal Creek No. 3.
Part of mine examined: Mine. Ventilation: Good.
Explosive gas: None. Roadways: Good. Timbering: Good.
Remarks: I measured 35,000 cubic feet of air a minute for the use of forty-three men and seven horses. There is a small cap of gas in the Main level and counter.
Dated at Coal Creek, B.C., this 9th day of March, 1917.

(Signed.) T. H. WILLIAMS,
Inspector of Mines.

Crow's Nest Pass Coal Company: Colliery known as Coal Creek No. 3.
Part of mine examined: Mine. Ventilation: Good.
Explosive gas: None. There is a ½-inch cap in the Main level, counter-level, and crosscut off it.
Roadways: Good. Timbering: Good.
Remarks: I measured 29,250 cubic feet of air a minute for the use of forty-three men and seven horses.
Dated at Coal Creek, B.C., this 5th day of April, 1917.

(Signed.) T. H. WILLIAMS,
Inspector of Mines.

Reports of Gas Committee of No 3 Mine, Coal Creek Colliery.

Mine: No. 3. Date: January 6th, 1917.
We, the undersigned, have this day examined the whole of No. 3 mine and find gas in No. 5 incline. All other places clear of explosive gas. Timber, roof, and sides: Good.

(Signed.) WM. BIRD; JNO. CHARNOCK.

Mine: No. 3. Date: February 17th, 1917.
We, the undersigned, have this day examined the whole of No. 3 mine and find a small cap of gas in No. 3 room off No. 4 incline, also gas in crosscut off South slope, same fenced off. Timber, roof, and sides: Good.

(Signed.) WM. BIRD; JNO. CHARNOCK.

Mine: No. 3. Date: March 17th, 1917.
We, the undersigned, have this day examined the whole of No. 3 mine and find gas in crosscut off counter. All other places clear. Timber, roof, and sides: Good.

(Signed.) WM. BIRD; JNO. CHARNOCK.

Reports of Overman from April 1st to 5th, 1917.

April 1st, 1917.

Sunday, mine idle. The mine was fenced off from 3.30 p.m. on Saturday until 6 p.m. on Sunday. Afternoon-shift firebosses report No. 3 mine free from explosive gas and in safe condition. Total men in mine, 4.

(Signed.) J. BIGGS.

April 2nd, 1917.

I have examined the main roads and found same in safe condition. Firebosses report No. 3 mine free from explosive gas and in safe condition. Total men in mine, 30.

(Signed.) J. BIGGS.

April 3rd, 1917.

I have examined No. 3 mine and found same free from explosive gas and in safe condition. Firebosses report No. 3 mine as stated above. Total men in mine, 81.

(Signed.) J. BIGGS.

April 4th, 1917.

I have examined No. 3 mine and found same free from explosive gas and in safe condition. Firebosses report No. 3 mine as stated above. Total men in mine, 90.

(Signed.) J. BIGGS.

April 5th, 1917.

I have examined No. 3 mine and found same free from explosive gas and in safe condition. The Inspector made his usual examination of the mine to-day and found the above-mentioned conditions. Afternoon- and night-shift firebosses report a little gas in crosscut off counter-level. Day-shift firebosses report all clear. Total men in mine, 94.

(Signed.) J. BIGGS.

Report of Firebosses from April 1st to 5th, 1917.

Mine: No. 3. Coal Creek Colliery.
District: Entrances. Date: April 1st. Time: 6 p.m.
Remarks: I have removed fences to examine main roads to pumps.

(Signed.) J. B.; W. R. PUCKEY.

Mine: No. 3, Coal Creek Colliery.
District: Main Roads. Date: April 1st. Time: 7.30 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined main roads and found them free from explosive gas and in safe condition.

(Signed.) J. B.; W. R. PUCKEY.

Mine: No. 3, Coal Creek Colliery.
District: Mine roads. Date: April 1st, 1917. Time: 10 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in safe condition.

(Signed.) J. B.; J. MCCOURT; W. R. PUCKEY.

Mine: No. 3, Coal Creek Colliery.
District: Mine. Date: April 2nd, 1917. Time: 7 a.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas; all places clear and in safe condition.

(Signed.) J. B.; J. THOMPSON; J. MCCOURT.

Mine: No. 3, Coal Creek Colliery.
District: Mine. Date: April 2nd, 1917. Time: 2.50 p.m.
Roof and sides: Safe. Ventilation: Good.
Barometer: 26.1. Thermometer: 42° Fahr.

(Signed.) J. B.; W. R. PUCKEY; J. THOMPSON.

Mine: No. 3, Coal Creek Colliery.
District: Mine. Date: April 2nd, 1917. Time: 11 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in safe condition.

(Signed.) J. B.; J. MCCOURT; W. R. PUCKEY.

Mine: No. 3, Coal Creek Colliery.
District: Mine. Date: April 3rd, 1917. Time: 7 a.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas; all places clear and in a safe condition.

(Signed.) J. B.; J. THOMPSON; J. MCCOURT.

Mine: No. 3, Coal Creek Colliery.
District: Mine. Date: April 3rd, 1917. Time: 2.45 p.m.
Roof and sides: Safe. Ventilation: Good.
Barometer: 26.3 inches. Thermometer: 42° Fahr.
Remarks: I have examined this mine and found it free from explosive gas and in safe condition.

(Signed.) J. B.; W. R. PUCKEY; J. THOMPSON.

Mine: No. 3, Coal Creek Colliery.
District: Mine. Date: April 3rd, 1917. Time: 10.30 a.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in a safe condition.

(Signed.) J. B.; J. MCCOURT.

Mine: No. 3, Coal Creek Colliery.
District: Mine. Date: April 4th, 1917. Time: 7 a.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found it free from explosive gas and in safe condition.

(Signed.) J. B.; J. McCOURT.

Mine: No. 3, Coal Creek Colliery.
District: Mine. Date: April 4th, 1917. Time: 3 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from face of Main level round to counter-level; all other places in safe condition.

(Signed.) J. B.; W. R. PUCKEY; J. THOMPSON.

Mine: No. 3, Coal Creek Colliery.
District: Mine. Date: April 4th, 1917. Time: 11 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a little gas in crosscut off counter-level; all other places clear and in a safe condition.

(Signed.) J. B.; J. McCOURT; W. R. PUCKEY.

Mine: No. 3, Coal Creek Colliery.
District: Mine. Date: April 5th, 1917. Time: 7 a.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a little gas in crosscut off counter-level; all other places clear and in safe condition.

(Signed.) J. B.; J. THOMPSON; J. McCOURT.

Mine: No. 3, Coal Creek Colliery.
District: Mine. Date: April 5th, 1917. Time: 3 p.m.
Roof and sides: Safe. Ventilation: Good.
Remarks: I have examined this mine and found a small cap of gas in return air from face of crosscut to face of counter-level; all other places clear and in safe condition.

(Signed.) W. R. PUCKEY; J. THOMPSON.

The ventilation was well conducted to the faces. The mine is classed as one of the most gaseous known, giving off large volumes of gas at all times. A series of mine-air samples taken over a period of time ranging from November, 1915, to March, 1917, and comprising some sixteen samples, show the mine ventilation to be carrying off 3,500 cubic feet of methane a ton of coal produced.

The emanation of gas from the face is not a constant quantity, but varies from time to time, coming in surges, necessitating the temporary retirement of the workmen from the face for a period after the occurrence of these surges, to allow time for clearance of the gas by the air-current.

The following are samples of air analysis taken from the Coal Creek mines. For complete set of samples *see* Chief Inspector's Report, 1916, in Minister of Mines' Report for that year.

November 18th, 1915.

SAMPLES OF AIR ANALYSIS.

Mine Working.

Sample No. 17, taken by T. H. Williams at No. 3 mine, Coal Creek, South Level district, 100 feet on return side of last working-place. Safety-lamp showed a ½-inch cap.

Chemical Analysis.	Per Cent.	Technical Analysis.	Per Cent.
Carbon dioxide	0.22	Air	96.03
Oxygen	20.10	Fire-damp	2.46
Methane	2.46	Black-damp	1.51
Nitrogen	77.22		

February 23rd, 1916.

Mine Idle.

Sample No. 31, taken by T. H. Williams at No. 3 mine, Coal Creek, South Level district, 200 feet on return side of last working-place. Safety-lamp showed a ½-inch cap.

Chemical Analysis.	Per Cent.	Technical Analysis.	Per Cent.
Carbon dioxide	0.15	Air	97.09
Oxygen	20.32	Fire-damp	2.29
Methane	2.29	Black-damp	0.62
Nitrogen	77.24		

February 24th, 1916.

Mine Working.

Sample No. 34, taken by T. H. Williams at No. 3 mine, Coal Creek, South Level district, about 200 feet on return side of last working-place. Safety-lamp showed a 5/8-inch cap.

Chemical Analysis.	Per Cent.	Technical Analysis.	Per Cent.
Carbon dioxide	0.16	Air	96.99
Oxygen	20.30	Fire-damp	2.05
Methane	2.05	Black-damp	0.96
Nitrogen	77.49		

October 4th, 1916.

Mine Working.

Sample No. 71, taken by T. H. Williams at No. 3 mine, Coal Creek, South Level split, 300 feet from last working-place on return side. Safety-lamp showed a 5/8-inch cap.

Chemical Analysis.	Per Cent.	Technical Analysis.	Per Cent.
Carbon dioxide	0.21	Air	96.89
Oxygen	20.28	Fire-damp	2.06
Methane	2.06	Black-damp	1.05
Nitrogen	77.45		

March 23rd, 1917.

Mine Working.

Sample No. 90, taken by T. H. Williams at No. 3 Coal Creek mine, South level, 150 feet on return side of last working-place. Safety-lamp showed a 3/4-inch cap.

Chemical Analysis.	Per Cent.	Technical Analysis.	Per Cent.
Carbon dioxide	0.38	Air	94.94
Oxygen	19.87	Fire-damp	3.43
Methane	3.43	Black-damp	1.63
Nitrogen	76.32		

These large emanations of gas have made necessary the reduction of the number of men working on a split of air, in order to keep the air-current from carrying excessive percentages of gas before reaching the last working-place in the split. The number of men breaking down coal has rarely exceeded twenty or twenty-five, as it has been assumed that the volume of gas given off was in proportion to the quantity of coal broken down.

Recent returns of analyses from the field rather upset this theory, and tend to show that the volume of gas given off is rather in proportion to the area of coal exposed in ribs and faces than in the quantity broken down.

I am informed by Mr. Wilkinson, Chief Inspector of Mines, that a series of mine-air samples collected in the Michel Colliery, after a suspension of operations, due to labour troubles, for over thirty days, show a larger percentage of gas given off, with, in some instances, an increase of quantity of ventilation in circulation in the mine.

OLD NO. 3, MICHEL COLLIERY.

In one instance a volume of 85,000 cubic feet a minute has been circulating in the mine continuously and no coal has been broken down for a period of thirty-four days, and yet the entire current was carrying 1.55 per cent. of methane, an increase of $^{7}/_{100}$ of 1 per cent. above that given off when mine was working.

Comparative Tests of the Outflow of Gas at Coal Creek Colliery, taken when the Mines were Working, also when Idle.

Date.	Mine.	District or Split.	Per Cent. of CH_4.	Quantity of Air.	Remarks.
March 21, 1917	B	Main return	1.13	37,000	Working.
May 2, "	"	"	0.77	42,300	Idle 26 days.
March 21, "	"	Incline and left side of slope	2.15	12,000	Working.
May 2, "	"	Ditto	0.44	12,000	Idle 26 days.
March 21, "	"	Right side of slope	0.86	8,000	Working.
May 2, "	"	"	1.14	8,000	Idle 26 days.
March 21, "	No. 1 North	Main return	0.28	33,000	Working.
May 2, "	"	"	0.18	35,000	Idle 27 days.
March 21, "	No. 1 South	"	2.44	27,000	Working.
May 3, "	"	"	1.56	24,000	Idle 26 days.
Oct. 3, 1916	No. 2	"	0.98	21,000	Working.
May 2, 1917	"	"	0.72	42,000	Idle 26 days.
March 23, "	No. 1 East	No. 18 room	2.78	24,800	Working.
May 3, "	"	"	1.50	18,400	Idle 27 days.
Nov. 2, 1916	"	Main return	1.72	160,000	Working.
May 3, 1917	"	"	0.99	136,000	Idle 27 days.
		Michel Colliery.			
March 7, 1917	Old No. 3	Main return	1.48	80,000	Mine working.
April 4, "	"	"	1.48	80,000	Idle 96 hours.
May 3, "	"	"	1.55	85,000	" 34 days.
April 4, "	"	No. 3 Slope	1.63	28,000	" 96 hours.
May 3, "	"	"	1.53	32,000	" 34 days.
March 9, "	No. 3 East	No. 6 East	0.78	46,200	Working.
April 4, "	"	"	0.79	42,000	Idle 100 hours.
May 4, "	"	"	0.76	48,000	" 35 days.
March 9, "	"	Main return	0.83	91,000	Working.
April 4, "	"	"	0.90	94,500	Idle 100 hours.
May 4, "	"	"	0.87	91,000	" 35 days.

The explosion in No. 3 mine, Coal Creek, on April 5th was the most destructive that in my long experience I have ever seen. The mine had a splendid roof and in many instances no timber supports were necessary in the main roadways, and it was confidently expected that recovery-work would only be retarded by the time necessary to restore ventilation. On the contrary, however, the greater proportion of the mine roadways were heavily caved; in many instances these caves were from 1,000 to 1,200 feet in length, and it would seem as if the pressures set up by the explosion were wave-like in motion, having extremes of high pressure to points of low pressure amounting to vacuums. That the intense pressures entered the crevices in the roof strata, and then the sudden release of pressure caused the extremely heavy caving, seems possible. The extent of this caving is shown by colour on the plan submitted with this report, and from a point about 500 feet inby the slopes are almost continuous to the face.

The initial cause is hard to determine, as an examination of the mine discloses that the lines of force came from the two advance Main levels, but owing to excessive caving these were completely blocked, and the faces have so far not been reached, and may possibly not be reached before the latter end of the present year. It would therefore be impossible to make any definite statement as to the point of origin or the initial cause, as it could only be mere supposition. As no explosives were used in the mine or colliery, we can eliminate the "blown-out-shot" theory, and therefore must assume an ignition of gas from some cause; the explosion in general as propagated throughout the mine was, however, undoubtedly supported by coal-dust.

As to whether the gas ignition was due to a defective or overheated lamp or a quantity of gas given off by one of the frequent surges, thrown into atmosphere by a "bump" or blow-out and a lamp-failure, can only be a matter of mere conjecture at this time. I, however, believe

that the point of ignition was on the two Main levels at some point inby that reached by the exploration parties, and was carried from this point throughout the entire mine by coal-dust.

The difficulties encountered by the rescue parties were many and serious, and many times hope of being able to reach the inner workings was almost given up. There were a number of fires encountered, some of them being of alarming proportions, and in many cases roadways had to be constructed through caves, with little opportunity to dispose of the debris, except passing it back from one to another over distances running into hundreds of feet.

The work accomplished, under the circumstances and in the time taken, speaks volumes for every man engaged in the hazardous work, and especially to those responsible for the organization of the same.

Despite the fact that the outer 500 feet of No. 2 South level and the 1,600 feet of the slope were wet, and contained little to support the explosion, considerable velocity must have existed even to the mine-mouth.

The body of Hugh Malarky, pumpman, was found about 25 feet inside the portal; this body had been thrown with much violence against the timbers, and a safety-lamp, supposed to have been issued to this man, was several days afterwards found in the mule pasture 1,000 feet from the mine-mouth.

Three bodies were found at the intersection of No. 2 South level and the slope, one of which, No. 2, F. Benezeth, showed signs of life, but he died shortly afterwards. With the exception of this one victim, it is my opinion that all the others were instantly killed.

On Monday, April 9th, 1917, or four days after the explosion, the party reached the Nos. 1 and 2 inclines; these were explored that afternoon, but difficulty was found in reaching the inner inclines Nos. 5 and 6, owing to the rooms between Nos. 4 and 5 inclines being heavily and completely caved. There being a lack of ventilation to keep the Nos. 1, 2, 3, and 4 inclines clear and progress farther into the mine, it was decided to return to the overcast, some 2,000 feet outby, and take the overcast out, converting the counter or lower level into an intake to No. 4 incline; from this point to utilize the chain pillar to the west of the level between Nos. 4 and 5 inclines and save building stoppings in all the crosscuts between the two levels over the distance. This placed Nos. 1, 2, 3, and 4 on the return instead of on the intake air.

Tuesday, April 10th. Five bodies were found on the parting outside No. 5 incline; all of these bodies were badly burned.

Wednesday, April 11th. The face of No. 1 room off No. 6 incline was reached and the bodies of the miners were found at the face. No lamps were found; these are believed to be under cap-rock which was down close to the face. The face of this room was square and the room heavily caved.

The bodies of the men who worked in No. 2 room were found at the foot of the slope; this room was heavily caved.

No. 3 Room.—Here the bodies of Frank and James Smith, father and son respectively, were found; both bodies were badly burned and were close up to the face. The room was caved to within a few feet of the face; there was a slight trace of coking on the floor. The face-line was square and the coal sounded loose on face.

No. 4 Room.—This room and crosscut were heavily caved, and on the upper rib, about midway between the incline and crosscut, the clothes, dinner-pails, and tools of the workmen were found. The bodies were afterwards found near this place, but under a cave.

No. 5 Room.—Heavily caved near the face; the bodies were found under the tail of the cave at face. The face was square and coal loose, but no evidence of coke was found.

No. 6 Incline was not caved above the last crosscut, but all timbers were blown out. The workmen from this room were found amongst those found at the parting outside No. 5 incline. A blue-print showing plan and section of this place accompanies report. The sketch-plan shows the mode of brushing in the main haulage-roads.

In a crosscut off this incline, leading to No. 5 incline, the bodies of Campbell and Coates were found; both bodies were under a cave.

No. 5 Incline.—This place was not caved above the crosscut; two bodies were found near a car at the last crosscut; the car was badly broken and showed counter-currents; both bodies were badly broken. Coke was found on the timbers in this crosscut just out by car. A series of samples of dust were taken in the mine, and an analysis showed much alteration in all samples except Nos. 3 and 5.

The following show the analyses as made by the Provincial Mineralogist:—

	Moisture.	Volatile Matter.	Fixed Carbon.	Ash.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
No. 1	1.6	11.3	75.3	11.8
No. 2	1.1	13.6	62.8	22.5
No. 3	1.8	12.5	75.9	9.8
No. 4	0.8	16.4	66.8	16.0
No. 5	0.9	16.7	79.3	3.1
No. 6	1.2	14.4	70.7	13.7
No. 7	1.3	11.4	61.4	25.9

Sample No. 1.—Off timber just below crosscut, opposite last break-through on first incline.
Sample No. 2.—Off timber at edge of last crosscut on No. 1 incline.
Sample No. 3.—Off timber in crosscut between Nos. 1 and 2 rooms, No. 4 incline.
Sample No. 4.—Off upper bench of No. 6 incline, opposite No. 2 room.
Sample No. 5.—Off lower rib of Main level, last crosscut at barrier pillar.
Sample No. 6.—Off timber at last crosscut, No. 2 room, No. 6 incline.
Sample No. 7.—Off timber at last crosscut (through) between Nos. 5 and 6 inclines.

Proximate analyses of samples taken from the same places were made by the Crow's Nest Pass Coal Company, the results of which are also given, together with analyses of dust samples taken from safety-lamps recovered in the mine.

The Crow's Nest Pass Coal Co., Ltd. (May 2nd, 1917.)—Samples of Coal-dust taken from No. 3 Mine.

(Submitted by D. Michell.)

Analysis No.	Description.	Moisture.	Vol. Comb. Matter.	Fixed Carbon.	Ash.	Sulphur.	Remarks.
April 10		Per Cent.	Per Cent.	Per Cent.	Per Cent.		
02344	Sample No. 2. Coked dust taken about 300 feet from Main slope on South level at a point about opposite to where fire was burning in crosscut	0.65	17.38	69.81	12.16	....	....
02345	Sample No. 3. Dust from timber lying across roadway about 200 feet in from South slope	0.60	24.68	59.12	15.60	....	....
02347	Sample No. 5. Dust taken from end of sixth car on parting; this car was off track	1.11	20.82	69.17	8.90	....	....
02346	Sample No. 4. Dust taken from rib of coal at same point as No. 3	1.30	23.83	63.65	11.22	....	....
02348	Sample No. 6. Dust taken from prop standing on lower side of roadway on Main level between Nos. 3 and 4 inclines	0.90	20.31	69.62	9.17	....	....
April 9.							
02349	Sample No. 1. From timber just below crosscut opposite break-through on No. 1 incline	1.00	12.53	74.43	12.04	....	....
02350	Sample No. 2. Taken in No. 1 incline at edge of last crosscut (on timber)	0.68	15.62	60.85	22.85	....	....
02351	Sample No. 3, Taken from timber in crosscut between Nos. 1 and 2 rooms off No. 4 incline	1.06	13.78	75.42	9.74	....	....
April 11.							
02352	Sample No. 7. Taken from lower rib opposite left crosscut before barrier pillar on Main level	0.60	17.93	75.83	5.64	....	....

Dust Samples taken from Safety-lamps recovered after Explosion in No. 3 Mine.

(Submitted by D. Michell for Proximate Analysis.)

Analysis No.	Description.	Moisture.	Vol. Comb. Matter.	Fixed Carbon.	Ash.	Sulphur.	Remarks
		Per Cent.	Per Cent.	Per Cent.	Per Cent.		
02353...	Lamp No. 1345.....	0.74	20.36	59.79	19.11	....	....
02356...	" 1321.....	0.86	22.04	62.03	15.07	....	....
02357...	" ?	0.64	23.18	60.48	15.70	....	....
02358...	" 27.....	0.68	20.23	64.70	14.39	....	....
02359...	" 1302.....	21.86		59.36	18.78	....	....
02360...	" 1392.....	24.88		58.32	16.80	....	....
02361...	" 3440.....	24.92		61.22	13.86	....	....
02362...	" 1367.....	21.30		58.40	20.30	....	....

NOTE.—Samples taken from lamps Nos. 1318, 1343, and 1316 are too small for proximate analysis.

Sample of Coal-dust taken from Upper Bench opposite No. 2 Room, No. 6 Incline, No. 3 Mine.

Analysis No.	Description.	Moisture.	Vol. Comb. Matter.	Fixed Carbon.	Ash.	Sulphur.	Remarks.
		Per Cent.		Per Cent.	Per Cent.		
02363...	....	20.40		67.60	12.00	....	....

Average Analysis of Coal from No. 3 Mine.

Analysis No.	Description.	Moisture.	Vol. Comb. Matter.	Fixed Carbon.	Ash.	Sulphur.	Remarks.
		Per Cent.	Per Cent.	Per Cent.	Per Cent.		
....	....	0.50	21.50	69.00	9.00	....	....

Lamps were examined in the lamp-room in the presence of James Ashworth, George Wilkinson, Robert Strachan, T. H. Williams, George O'Brien, Charles Graham, Albert Fawcett, Robert Johnstone, and Thomas Graham.

The dust samples shown in the above analyses were taken from the lamps at this time.

Lamp No. 1343.—W. Silverwood, lamp found near foot of No. 5 incline. Gauzes and lower ventilating-ring clear and sound; bonnet broken by outside influence. Found under a cave.

Lamp No. 1392.—T. Checkley, lamp found under cave at foot of No. 5 incline. Ring and gauze in good shape; very little dust on lamp.

Lamp No. 27.—Thos. Puckey, fireboss, lamp found under cave at foot of No. 5 incline. Lower ventilating-ring, gauzes, and glass in good condition.

Lamp No. 1345.—Henry Falip, lamp found under cave at foot of No. 5 incline. Lower ventilating-ring, gauzes, and glass in good shape; shield injured by cave.

Lamp No. 1302.—William Bird, found under cave at foot of No. 5 incline. Lower ventilating-ring, gauzes, and glass in good shape; shield slightly dented.

Lamp No. 1310.—James Smith, found at face of No. 3 room off No. 6. Lower ventilating-ring, gauzes, and glass in good shape; inner gauze very clean.

Lamp No. 1316.—Frank Smith, same place as lamp No. 1310. Lower ventilating-ring, gauzes, and glass in good shape.

Lamp No. 1367.—John Monks, room No. 4 off No. 6 incline. Lamp found 50 feet from face; shield dented and coke on shield; lower ventilating-ring, gauzes, and glass clear and in good shape.

Lamp No. 1321.—F. Benezeth, miner, No. 2 room off No. 6 incline. Body and lamp found at foot of Main slope; lower ventilating-ring much blocked with dust; glass very dirty; inner gauze shows evidence of gas having burned in the lamp; outer gauze clear.

Lamp No. 1366.—Govi Giacomazzi, miner, No. 2 room off No. 6 incline. Body and lamp found at foot of slope; no glass in lamp; top off the lamp; only the outer gauze found; slight evidence of heating on this gauze.

Lamp No. 1388.—J. Atkinson. Body found in No. 5 room off No. 6 incline; only shield of lamp found.

Lamp with no working number, supposed to be the rope-rider's lamp, found at bottom of slope. One standard and lock-guard gone; lower ventilating-ring dirty. Maker's number of lamp, 578875.

Lamp No. 1318.—Frank Pullandre, lamp found at bottom of Main slope. Glass clean; gauzes in good shape; lower ventilating-ring dirty.

Lamp No. 618.—Found bottom of Main slope. Glass broken and one standard missing; gauzes all right.

Lamp No. 3440.—J. Machim, rope-rider. Supposed to be a spare lamp and was found at the top of the slope. Body of Machim found at the bottom of the slope; glass all right; outer gauze very muddy.

Lamp No. 1313.—Hugh Malarky, pumpman. Found lamp much broken; picked up in pieces.

Lamp No. 2556.—Found in pasture 1,000 feet from the mouth of slope; holes in gauzes, due to caulks on horse's shoes and done in mule pasture.

The operation of this field presents many difficulties; in its short history it has been the scene of many serious disasters, accompanied by a heavy toll of human life and much serious damage to property.

Many unjust criticisms have been hurled at the various managements and at the Government Inspection Service because of these serious accidents, with little knowledge on the part of the critics as to the serious problems that this field presents, problems that are peculiar to this field alone, and which, to be overcome, must be the subject of systematic research covering a period of years.

The great gas blow-outs of the Morrissey Colliery, 1904 to 1908, the earth-rocking "bumps" at the Coal Creek Colliery, 1908 to 1916, and the almost unbelievable quantities of gas given off daily through the ventilating-fans present difficulties that must be made the subject of systematic scientific research, if this, the most valuable coalfield in western America, is to be successfully operated.

The problems presented have exhausted the best efforts of those who have been in charge of the operations, and this fact prompted the recommendation of the writer, following the great "bumps" of November, 1916, for the appointment of some eminent engineer to make an impartial and independent report upon the field.

The Department was fortunate in obtaining the services of George S. Rice, Chief Engineer of the United States Bureau of Mines, for this work. Mr. Rice's very able report, which is in your hands, conveys to you some idea of the many problems that the future operations of the field contain, and makes recommendations that should have the most earnest consideration of the Government.

The economic value of the field is one of the great assets of our Province, and it is destined to play a very important part in future development of the great mineral wealth we all firmly believe our Province to contain; in short, the successful operation of this great coalfield is necessary to the successful development of our great mineral wealth, and justifies any expenditure that may be made with a view to making possible the recovery of the great coal-deposits with a minimum of risk to the lives of those employed.

The facilities for carrying out research-work with our coals, afforded Mr. Rice through his connection with the United States Bureau of Mines, at their well-equipped laboratories at Pittsburgh, Pa., enabled him to obtain valuable information on the gas contents of the Crowsnest Pass coals which otherwise might have remained unknown for some time. I here refer to the experiments carried out by A. C. Fieldner, Chemist to the Bureau of Mines, and described in the report of Mr. Rice (*see* pages 15 to 18). In these experiments the coal was ground in an evacuated, revolving steel tube-mill for a period of two hours, and after which 90 per cent. of the coal passed through a 200-mesh screen; the mill was then connected to a Mercury pump

and evacuated, the gas collected, measured, and analysed. The results were most astonishing, and showed that 100 grammes of Crowsnest coal gave off 163.6 cubic centimetres of methane plus ethane, whilst 100 grammes of Pittsburgh coal gave off 9.1 cubic centimetres of methane plus ethane. Of the 163.6 cubic centimetres of gas given off by the Crowsnest Pass coal, 126 c.c. was ethane, whilst the ethane content of the 9.1 c.c. of gas contained in the Pittsburgh coal was 2.5 c.c. Former analyses of gas samples collected in the field had failed to show any ethane content, notwithstanding that duplicate samples had been collected by the British Columbia Inspection Service, one sample being sent to the Mines Department at Ottawa and the other sample to the United States Bureau of Mines at Pittsburgh, Pa., with the request that special attention be given to the possibility of ethane being contained in the gas. It would therefore appear that the breaking-down of the molecular structure of the coal has much to do with the gas emanations.

The friability of Crowsnest coals is conducive to easy crushing, and the grinding induced by the heavy overlying strata on the supporting pillars, as well as that produced in mining haulage, movement of animals and men, must be releasing daily a large volume of the lighter gases into the mine atmosphere.

When we consider that the inflammability of ethane is so much lower than that of methane, we have an additional danger present in this already dangerous field; the range of inflammability of ethane being from 2.5 to 5, whilst that of methane is 5.5 to 14.5.

These facts make highly necessary the appointment of a commission on research, along lines laid down in the report of Mr. Rice, and should take up the study of the geology of the field in relation to earth-movements. The chemistry of the coal and gas contents should be the subject of the most careful investigation and research, and last, but not least, a systematic and careful study of modes of operation in the field, with a view to obtaining the maximum tonnage yield with the minimum risk to those engaged in the production of the coal. The latter problem is one that must necessarily mean much experimenting, and will consequently cover a period of many years; but it is highly essential to the future of the field, and much care should be exercised in the choice of the mining engineer and operating man recommended as part of the commission.

I have been more or less associated with the field since 1902, and during that period I have always felt and advocated that the only successful mode of operating the seam known as No. 2, and which is identical with the seam worked in No. 3, where the recent explosion occurred, is by the long-wall method; the height of coal, 5 to 5.5 feet, is well adapted to this system. Further, I believe that the long-wall operation of this seam, if carefully carried out from the outcrop, would, as evidenced by the operations conducted in this seam at No. 9 mine on the north side of the valley at Coal creek, tend to break the overlying stratas in a series of slices to the surface, and such breaks would act as outlets for the great volumes of gas contained in the various seams overlying the No. 2 seam.

It will be contended that the operation of the No. 2 seam, which lies below several other seams in the field, would destroy these overlying seams and render their future recovery impossible.

I am of the opinion that the extraction of the No. 2 seam, which lies 150 feet below the seam known as No. 1, or that being operated in the No. 1 East mine at Coal creek, would, if properly conducted and properly extracted, in no way seriously injure the No. 1 seam, or in any way add to the difficulties or cost of operation. I base this opinion on the conditions found in No. 1 East mine, operating in the Upper seam, when working over what is known as the proscribed area in the Lower or No. 2 seam. Here, it is true, there was evidence of a crushed zone near that portion of the field affected in this restricted area, but the method of extraction of the Lower or No. 2 seam, directly under this section, was so irregular in its mode that it was highly conducive to bringing on a squeeze or creep, and again there is the possibility referred to in my report on the "bumps" of November, 1916, of a naturally weak or shear zone in the mountain at this point.

All things considered, I am fully convinced that a well-conducted long-wall system in the No. 2 seam would be the means of obtaining a greater extraction of coal from a given area, a more uniform subsidence with a greater area of support for the overburden, break the overburden so that a reoccurrence of the great "bumps" would be minimized, and through such breaks relieve and drain the overlying seams of their great volumes of gas, rendering their future operation more secure and the general ventilation of the field much easier.

Further, the expanse of face in a long-wall operation would tend to reduce the possibility of heavy outbursts of gas now encountered in the leading places in the present pillar-and-stall mode.

I am further of the opinion that, in view of recent occurrences, gas contained in this field is such in quantity and in pressure, at depths from the face, that it will be found impossible to drive and maintain two or more openings like the present levels into the main body of the field without encountering such outbursts of gas, accompanied by either upheaval of floor or outbursts of fine coal and gas, as to render the operation of the field in this manner impossible.

Much credit should be given W. R. Wilson for his desire to adopt any or all means at his disposal to render the operations safe, and the recent announcements that electric safety-lamps would be used is in keeping with his advanced ideas for the future operations. These lamps should be some assistance in safeguarding the operations, inasmuch as the surges of gas given off at the faces often enveloped the miner in an explosive mixture before he was aware of the presence of the gas, or before he could retreat if aware of the quantity present, and all that stood between the men and a disastrous explosion was the efficiency of flame safety-lamp, a slight defect, an overheating, or an accident to the lamp meant disaster. The introduction of the electric lamp will reduce the number of the flame-lamps in the mine by at least 90 per cent., and will render the chance of ignition from this source in proportion to the number of flame-lamps in use.

Much is being made of the question of a single shift; in the light of the recent mine-air samples, taken after a period of idleness reaching thirty or more days, it seems doubtful if this would be of much benefit.

As already stated, it was deemed at one time that the gas-outflow was in proportion to the amount of coal broken down; it now appears that it is more in proportion to the area of face and ribs exposed. If the latter contention is correct, then the single-shift theory could in no way be a remedy, inasmuch that to obtain a given output of coal per day by a single-shift method would require twice the exposed area necessary for a similar production by the double shift, and consequently a much-enhanced or increased outflow of gas.

In conclusion, I cannot too urgently impress upon you the need for early consideration of the problems in this field.

The management and your inspection force have long carried a serious responsibility, a greater responsibility in the light of recent discoveries than even they realized; and in view of the now general knowledge that the field presents difficulties in greater proportion than any other known coalfield, it is only fair to them that they should be supported and assisted in their work by a commission composed of the ablest men procurable.

I have to thank, for many courtesies shown me, George Wilkinson, Chief Inspector of Mines; Dudley Michell, First-aid Instructor; W. R. Wilson, general manager of the Crow's Nest Pass Coal Company, and his able engineering staff.

SPECIAL REPORT ON EXPLOSION AT No. 3 MINE, COAL CREEK.

BY JAMES ASHWORTH.

On April 8th, in accordance with your telephoned and wired instructions of April 7th, which were as follows: "Confirming my phone message last night, please proceed Fernie and act under instructions which will be sent forward to you there by wire," I left Vancouver at midnight and proceeded direct to Fernie. En route I met your newly appointed Chief Inspector of Mines, George Wilkinson, with whom I was previously acquainted, and we travelled together to Fernie.

On arrival at Fernie we met the funerals of four of the miners, which through some mistake had not been held over until we had had an opportunity to view the bodies. In the afternoon I received your wire and later your confirmatory letter of April 10th, viz.: "I beg to confirm my telegram of yesterday's date, as follows: 'Pursuant to section 73, "Coal-mines Regulation Act," I have appointed you to make a special investigation and report on explosion at No. 3 mine, Coal Creek, on night of 5th instant."

On the afternoon of April 9th I called on W. R. Wilson, the general manager of the Crow's Nest Pass Coal Company, Limited, and communicated your instructions, and also introduced George Wilkinson as your newly appointed Chief Inspector of Mines. In the afternoon we paid a visit to the mine at Coal Creek, and later met Thomas Graham, retiring Chief Inspector of Mines, and the District Inspectors, T. H. Williams (Fernie), George O'Brien (Michel), Robert Strachan (Merrit), and Dudley Michell, of Victoria, First-aid and Mine-rescue Instructor.

Subsequently we met W. Shaw, one of the Albertan Inspectors of Mines, who paid several visits to No. 3 mine.

The No. 3 mine at Coal Creek (*see* Plan 1) is one section of a seam of coal of from 5 to 6 feet thick, which has been operated from the earliest days of the camp. The original entry was, and is still, called No. 2, and was at first ventilated by the fan which now ventilates No. 3 section of the mine; No. 2 section is now ventilated by a separate fan erected in 1911. A third section of this seam of coal, called No. 9, has its entry on the north side of the valley, and is not connected with Nos. 2 and 3 mine-workings underground. Shortly stated, No. 2 mine is working the coal above water adit level, and No. 3 mine the area below.

No. 2 mine is the one in which the disastrous explosion occurred in 1902 and caused the loss of about 130 lives. The place of origin of the 1902 explosion is shown on the accompanying plan—viz., Macdonald's level. Since the 1902 explosion trouble has been experienced from what are known as "bumps" in the central area of the No. 2 mine, which caused several fatal accidents from great upheavals of the floor, falls of roof, and considerable emissions of gas, probably mostly methane. In 1908 a much heavier "bump" than usual occurred, and imprisoned twenty-four men, four of whom lost their lives. After this the major portion of these workings was isolated by a commission sent by the Minister of Mines, and a red line was drawn on the plan, under agreement with the general manager of the Coal Company, that no coal should be wrought within that area, presumably on the conclusion that the pillars in the area wrought under the pillar-and-stall system were too small. Small areas of coal from time to time were worked on a long-wall system, but this system does not seem to have been persisted in sufficiently to demonstrate its effect on this portion of the mine, and it has since remained closed. In parts of Nos. 2, 3, and 9 mines, however, the long-wall system was developed and persistently carried out for some years, but has once more apparently been abandoned.

The Coal Creek mines are superintended by Bernard Caufield, with Overman John Biggs in charge of the No. 3 portion, and William Lancaster, overman over the No. 2 section. W. R. Puckey was the fireboss on duty at the time of the explosion, with J. Thompson on the previous shift and J. McCourt on the night shift. On April 4th J. McCourt reported at 7 a.m.: "I have examined this mine and found it free from explosive gas and in safe condition." On the following shift J. Thompson reported at 3 p.m.: "I have examined this mine and found a small cap of gas in return air from face of Main level round to counter-level; all other places clear and in safe condition." On the 11 p.m. shift W. R. Puckey reported: "I have examined this mine and found a little gas in crosscut off counter-level; all other places clear and in safe condition." On the 7 a.m. shift of April 5th J. Thompson reported: "I have examined this mine and found a small cap of gas in return air from face of crosscut to face of counter-level; all other places clear and in safe condition." This report is countersigned by W. R. Puckey, and therefore shows that he was fully aware of the conditions of the mine.

During the morning shift the District Inspector of Mines, T. H. Williams, made his monthly inspection, and reported as follows:—

"Ventilation: Good. Explosive gas: None. There is ½-inch cap in the Main level, counter-level, and crosscut off it.

"Roadways: Good. Timbering: Good.

"Remarks: I measured 29,250 cubic feet of air a minute for the use of forty-three men and seven horses."

The overman of No. 3 mine, J. Biggs, in his report dated April 5th, says: "I have examined No. 3 mine and found same free from explosive gas and in safe condition. The Inspector made his usual examination of the mine to-day and found the above-mentioned conditions. Afternoon- and night-shift bosses report a little gas in crosscut off counter-level; day-shift fireboss reports all clear. Total men in the mine, 94."

The last examination made by the No. 3 Mine Gas Committee was on March 17th, as follows: "We, the undersigned, have this day examined the whole of No. 3 mine, and find gas in crosscut off counter; all other places clear. Timber, roof, and sides good.—(Signed.) WM. BIRD and JO. CHARNOCK."

On February 8th, 1917, George O'Brien, the Michel District Mines Inspector, took Mr. Williams's duty, and reported on No. 3 mine, Coal Creek, as follows:—

"Ventilation: Poor at the face of the South level, but generally good throughout the rest of the mine.

"Explosive gas: Face of South level, crosscut off South level, and counter to South level. These three places were fenced off and the men withdrawn.

"Roadways: Good, but the South level haulage-road was dusty in places.

"Remarks: I measured 35,000 cubic feet of air a minute on the main intake for the use of forty-three men and eight horses. This quantity is divided into two splits: South level split, 25,500 cubic feet a minute for forty men and eight horses, and for the Slope split I measured 6,000 cubic feet a minute for three men and one horse."

The above quotations from the reports give a good general idea of the ventilation and fire-damp conditions of No. 3 mine at the time of the explosion, and it now remains to ascertain what other conditions may have influenced the explosion.

Immediately before the explosion a trip of empty cars had been lowered down the Main slope, and the hoistman had slackened off the rope to enable the rope-rider to uncouple. The air-locomotive on the main South level, with its trip of empty cars, was on its way inby and probably in motion, and, at a point about 150 feet inside the third charging-station, the air in this level would therefore be in its most dusty condition. It was not customary for the conductor of the trip to go in with the last trip, neither was it unusual for many of the men, when returning from work, to ride out on this last trip. This may have accounted for some of the men being out of their working-places before quitting-time.

The air in the Main level was reported by the District Inspector to be at least 90 per cent. saturated with moisture, and the Main slope wet practically throughout its whole length. The inside length of the level was at times dampened with water which collected in the Main counter-level. The water in the travelling-road down the slope was frozen. No stone dusting was practised.

At the moment of the explosion the miners were preparing to leave their working-places; some were dressing, many had already left their work, and some were nearly out of the mine.

At about 10.20 p.m. the men on the surface were startled by a noise. In the power-house the self-recording dial on the air-compressor showed that the air-line was broken, and one of the engineers on duty saw what appeared to be smoke come out of one of the entries at the other end of the tipple. The hoistman saw the smoke and dust right in front of him, and the weighman on the tipple said that he heard a noise like a trip running away on No. 1 East, saw a big cloud, then a flame and a streak of white vapour. Smoke was very thick on the tipple. He then sent for Mr. Caufield, the superintendent, who was on the spot in about five minutes. Mr. Caufield first gave his attention to the fan which was undamaged, but part of the covering of the shaft was blown off. He then went to the main separation doors between Nos. 2 and 3 mines, found two of them closed and the other partly open. He and a party then went down the slope, and found Malarky's body about 50 feet down. Farther down through the separation doors the

return was blown away; inwards farther down the slope in a crosscut to the left there was a post on fire, and farther inside the crosscut two other posts and boards on fire. The District Inspector, Mr. Williams, and the overman of the mine, Mr. Biggs, then joined the party and went down the travelling-road. The separation doors near the bottom of the slope were found blown out into the return and were replaced by temporary stoppings set up. Farther down the slope one man, Benezeth, was found alive, and two dead men, Gormley (motor conductor) and Machin (the slope rope-rider).

The empty cars in the siding were blown around, and the main air and water pipes were both blown down. Farther along the South level a large fire was discovered in a crosscut where a board stopping was blown inwards towards the return airway. This fire was really three fires and the most dangerous one had to be dug out. Later it was discovered that there was still another fire in the return airway, about 150 feet inside. The first big fall of roof was then found in the Main level, about 1,000 feet inby of the slope. From this point the dangers from fallen roof and gas met with by the exploration party became increasingly difficult, and the advance was systematized by dividing the men into parties of thirty, with five mine officials, and working in six-hour shifts. In this way the exploratory work proceeded from day to day until April 18th, when it was found impossible to get any farther than No. 2 room off the Main level, where both the level and counter-level were completely closed. The Miners' Union was then asked to send representatives to view the situation and consult with the general manager, officials, and Inspectors as to what should be done. At this meeting the decision was unanimous that nothing further could be done at the far end, and that systematic cleaning-up of the mine must be resorted to from the first fall on the level. Two other deputations from the miners were taken in to view the situation before they finally admitted that further exploration for the twelve bodies still unrecovered was impossible. The cleaning-up of the continuous and heavy falls will take a long time, and, therefore, as sufficient evidence appeared to be available to enable the Coroner's jury to arrive at a verdict, the Coroner, Mr. Murray, of Michel, agreed to resume his inquiry on April 19th in the Fernie Court-house at 2.30 in the afternoon. This and the subsequent sittings were not attended by Thomas Graham, the retired Chief Inspector of Mines.

During the day-to-day explorations of No. 3 mine from April 5th to 19th the following bodies and materials were discovered, viz.:—

1. *P. Gormley.*—Very badly burned down to his groin and with many bone fractures; was found wtih his lamp on the Main slope. He was the conductor of South level dinkey.

2. *Fermin Benezeth.*—Lived for three hours; fractured skull, but no evidence of fire on his body. His working-place was room No. 2 off No. 6 incline. His lamp (No. 1321) was a little damaged; the gauzes were very clean and gas had been burning inside.

3. *Hugh Melarky.*—Pumpman. Found near the top of the Main slope; killed by mechanical force and reported unburned, whose lamp (No. 1313) was found smashed outside the entry, and whose second lamp was said to have been found in the horse pasture many hundred feet from the entry.

4. *J. H. Machin.*—Hair burned, neck broken, and other fractures; was found in the siding at the foot of the slope with his arm round a prop. Rope-rider.

G. Giacomazzi.—The partner of Benezeth. His body was not found in the slope, but his lamp (No. 1366) and also his pick were found, the former being smashed up, without inner gauze, and the outer gauze showing signs of having been very hot.

F. Puillandre.—This man's lamp (No. 1318) was also found in the Main slope; the lamp was undamaged, the glass clean inside. His body was not found. He worked at the face of the Main level, and if his body is not subsequently found there, it is probable he had quitted his working-place about three-quarters of an hour before the regular quitting-time.

5. *Albert Barton.*—The driver of the South level air-dinkey; was found on his engine with a heavy timber across his chest. Burns on head and chest; neck broken. Safety-lamp not recovered. Quantity of coal-dust, but no signs of burns in mouth.

6. *William Puckey.*—Fireboss. Found in parting at foot of No. 6 incline. Hair of head and face singed; burned also on the shoulders and chest. Apparently had been seated on the first of a loaded trip of cars, and had partly leaned over with one leg on car, the other on the ground, and head over the shaft of the horse. Coked dust was jammed into the bonnet of his safety-lamp.

7. *Thomas Checkley.*—Head, face, neck, upper chest, and hands burned; burns on *both legs* and several fractures. His working-place was in No. 1 room off the Main level, and he was found with Puckey and three others, with his lamp intact.

8. *Henri Falip.*—Head, hair, face, and neck much burned; chest and abdomen burned; burn on *right leg* and fractures. Lamp No. 1345; inner gauze had been heated. His working-place was No. 6 incline.

9. *William Bird.*—His working-place was also No. 6 incline, and his burns and wounds were similar to those of H. Falip. His lamp (No. 1302) had the shield bruised, also the gauzes, but these were very clean, excepting the ring-gauze below the glass.

10. *William Silverwood.*—Face, head, chest, and abdomen burned; arms and hands and various fractures; burns on *both legs.* Found with the Puckey group and worked in the cut through from No. 1 to No. 2 room off the Main level with T. Checkley. His lamp was No. 1343 and was only slightly damaged.

11. *Jules Falip.*—Was burned on head, face, hair, chest, and arms, and back of thigh; left humerus broken. He was found in his working-place in No. 1 room off No. 6 incline and his safety-lamp was not recovered.

12. *B. Giacomazzi.*—The partner of Jules Falip; was also found in his working-place. He was badly burned down to his left buttock, and fracture of the frontal bone. His safety-lamp was not recovered.

13. *Frank Smith.*—Hair, head, chest, arms, and back burned. Found in his working-place, No. 3 room off No. 6 incline. His lamp (No. 1316) was undamaged with coked dust in shield.

14. *James Smith.*—Was similarly burned to Frank Smith and in the same room. Both had been at work up to the last. Lamp No. 1310; coked dust in shield.

15. *Joseph Atkinson.*—Hair burned off and burned down to the *knees.* Lamp not recovered. His working-place was No. 5 room off No. 6 incline, and his safety-lamp was not recovered.

16. *Giavona Bosetti.*—Working in No. 5 incline. Whole body burned, many fractures, and neck broken. Safety-lamp not recovered.

17. *Joseph Campbell.*—Working in the crosscut between the inclines Nos. 5 and 6. Badly burned on head, face, neck, arms, and back, and both *legs burned.* Safety-lamp not recovered.

18. *Henry Haydock.*—Working in No. 5 room off No. 6 incline. Head, face, neck, arms, and back badly burned. Both the men in this place had been at work up to the time of the disaster. Safety-lamp not recovered.

19. *W. G. Clarke.*—Both legs broken, *legs badly burned,* also arms and head; neck broken; skull fractured, brains scattered. Working at the face of No. 5 incline with J. Bossetti. Safety-lamp not recovered.

20. *Edward Coates.*—Whole body burned; fracture of left shoulder; jaws crushed. Working in the crosscut between inclines with his partner, Campbell. Safety-lamp not recovered.

21. *John Monks.*—Burns on the back, chest, arms, and face, and some cuts. Found in No. 4 room off No. 6 incline. Lamp No. 1367; dent and coke in shield; both gauzes clean.

22. *J. Stelliga.*—Working with Monks. Burns on the breast, face, *right leg,* and arms. No safety-lamp recovered.

This list shows that a recovery of twenty-two out of thirty-four bodies has been made from the mine, and that most, if not all, of the balance will be found inside No. 6 incline under heavy falls. It is most noticeable that only one horse-body out of the seven at work in the mine was found. Not one body recovered from the mine showed any signs of carbon-monoxide poisoning, which fact is certain proof that all the deaths were of an instantaneous character.

The foregoing careful notes on the bodies and safety-lamps recovered from the mine have been made with the object of discovering some indications which would assist in arriving at a conclusive and convincing decision as to what was the originating cause of the disaster. These are supplemented by other evidence. Thus, firstly, that some of the miners had left their working-places before quitting-time; for instance, Benezeth and G. Giacomazzi, who worked in No. 2 room off No. 6 incline, appear to have come out about three-quarters of an hour before quitting-time. Benezeth's body and safety-lamp were found in the Main slope, and Giacomazzi's safety-lamp and pick were also found there, but not his body. Special search has been made for this body, without success, and yet it does not seem credible that he could have escaped alive from the mine. The cleanness and colouring of the gauzes, however, lend some supposition to

the theory that the presence of gas in their working-place had caused them to leave the mine earlier than usual. Secondly, the safety-lamp of F. Puillandre was also found in the Main slope, but no body. This man worked at the face of the South level, where the reports show that there was gas in the ventilating-current before the shift commenced work, and his lamp (No. 1318) was found with the glass clean inside, undamaged, and with very clean gauzes. So far nothing has been found to throw any light on the mystery of the two missing bodies. Thirdly, two other miners inside of No. 6 incline had come out of their working-places — viz., Silverwood and Checkley—who were found in the Main level along with the fireboss, Puckey. The lamp-gauzes did not apparently show any excessive signs of heat. Fourthly, the direction of force shown in the mine was undoubtedly from an originating point somewhere inside of No. 6 incline. Fifthly, at the foot of No. 1 room off the South level some of the exploring party found evidence of the ffoor of the level having been lifted, and this, coupled with the fact that the roof near this point and also inby was fallen to such an extent as to completely close both the Main level and the counter, again leads to the conclusion that there had been a "bump" which caused Silverwood and Checkley to quit work. Evidence was given at the inquest that Silverwood and Checkley's working-place was making gas very freely. Sixthly, it was shown by the evidence that the greatest volume of gas was given off from the floor, and in some instances so freely that care had to be taken, when hanging the check or talley inside the car, that gas did not extinguish the lamp (Lynn). This gassy condition extended to the top of the brushing (*see* section, Plan No. 3).

THE MINE INSIDE OF NO. 6 INCLINE.

From the evidence given at the Coroner's inquest, and other facts already referred to, the reporter has come to the conclusion that the area of No. 3 mine which contains the point of origin of the disaster is inby of No. 6 incline, and at his request the general manager of the Crow's Nest Pass Coal Company, Limited, has had the Plan No. 3 prepared on a larger scale to show more distinctly the conditions as to ventilation.

This plan shows that this part of the mine is a disturbed area, and that the coal-seam does not lie so conformably as in the more outby area. First, there is a downthrow fault of 36 inches, then an area of softer coal, and close to the face another faulting which is an upthrow of 30 inches. The two faults appear to converge in the direction of Nos. 7 and 4 inclines, where in the latter the brushing coal was found to be 8 feet thick.

On the morning shift of April 5th all the rooms were at work, and one of the miners at the face of the Main level, named Lane, who had been a fireboss, said he found a ½-inch cap, and thought it safe to work. He also added that this cap increased towards the end of the shift to ¾ inch, and that he did not report this increase to the fireboss. He thought that ¾ inch represented 3 per cent. of methane or fire-damp. He was at work when Mr. Williams, the Inspector of Mines, passed through the mine in the morning, and also when another Inspector of Mines, G. O'Brien, withdrew all the men out of the counter, the crosscut, and the level on February 8th, 1917, when the cap was about the same size. Mr. O'Brien evidently thought that, as the whole volume of air was charged to this extent with gas, it came within the range of the heading of "Explosive Gas," which is one of the heads under which he has to make a specific report in accordance with section 77 of the "Coal-mines Regulation Act." This report was posted up outside No. 3 mine and was for the information of all employees.

There is no record of any investigation having been made to ascertain from what particular source this extra volume of gas originated, but it is probable that it was within the disturbed area shown on Plan 2.

EXPLOSIVE GAS.

This term as used is a most misleading one, and requires the most serious consideration. It is not found in the "Coal-mines Regulation Act," and there is no history to show how it originated. The Act of Parliament uses the term "inflammable gas," but there is no official definition of that term either. The practical inference has been that where there is no kind of explosive being used a man is safe to continue at work until gas actually explodes in his lamp. Your reporter has on previous inquiries into colliery disasters attempted to ascertain the size of cap which officials and workmen have described as a "small cap," but without any satisfactory result, and therefore he is now of opinion that the time has arrived when this question should

be settled. He is satisfied that either a further explanation of the words "explosive gas" should be enacted, or deleted altogether. A fire-damp or inflammable-gas cap should be stated in parts of an inch, in preference to percentages. One instance of this argument in practical application may be quoted from the No. 3 mine; thus, on the 9th day of March, 1917, Mr. Williams, the Inspector of Mines, in his official report says: "Explosive gas: None"; but under "General remarks" he reports a small cap of gas in the Main level and counter. Two of the firebosses report: "A small cap of gas in return air from face of Main level round to counter-level; all other places clear and in *safe* condition." The other fireboss reports: "I have examined this mine and found it free from *explosive gas* and in safe condition. A small cap of gas in return air from Main level round to counter-level."

This appears to have been the chronic condition of this part of the mine, and the reports are initialled by the overman. The overman, in his report to the manager, says: "I have examined No. 3 mine and found same free from explosive gas and in safe condition. The Inspector made his usual examination and found the above-mentioned conditions. Firebosses report No. 3 mine as stated above."

These quotations show clearly that "explosive gas" is the term to avoid, and that a "small cap of gas" is only worth passing notice.

None of these reports state the origin of the gas which thus charged the whole volume of air at the points named, but the gas must have been in the air before reaching the face of the Main level. Was it from a "blower" within the faulted area?

In a mine like No. 3, which creates a fine and easily ignitable dust from the working of the coal, it may now be asked: What is an *explosive* mixture of air, fire-damp, and coal-dust?

It was stated during the inquest that 1 ton of this coal gave off 3,669 cubic feet of occluded gas; it was also stated that experiments had been made to show what volume of gas was given off whilst the mine was at work and also when not at work. These experiments showed that the return air contained 1.77 per cent. of methane when at work and 1.38 per cent. when not at work, which does not seem to be a very material difference.

With the foregoing facts in mind, it is clear that more safety provision is absolutely necessary, and your reporter would most strongly suggest that the words "explosive gas" and "small caps" be entirely eliminated, and that all reports as to inflammable gases be made in parts of an inch, with a height of cap fixed at which the miners must be withdrawn from the mine, and the special examinations made in accordance with the present "Coal-mines Regulation Act, 1911." For many years an illustrated card issued by the British Home Office Mines Department has been in the hands of the inspectorate of British Columbia and distributed freely "with the compliments of the Minister of Mines," but apparently without any practical result. These cards show the heights of cap produced by 1½, 2, 2½, and 3 per cent. of fire-damp (Figs. 1 to 4), and the accompanying text explains that when a complete cap of 2 per cent., however faint, is discovered on the lowered flame, men should withdraw at once from the working-place and inform the fireman or other official responsible for the ventilation. The card in question is based on tests made with oil as fuel, and therefore it may require some correction for British Columbia mines, which use the benzene or gasolene in safety-lamps in the majority of cases.

Whilst on the subject of safety-lamps, attention may be called to the fact that most of the gas-testing apparatus used throughout the Province is very inefficient, and therefore almost useless as a safeguard against the accidental issuance of a faulty safety-lamp.

STOPPINGS AND DOORS.

The fact was elicited during the inquiry that with a volume of air of over 53,000 cubic feet at the fan-shaft, only 13,000 was found at the far end of the levels, thus showing a leakage of 40,000 cubic feet. This calls for serious attention to the class of air stopping generally used, which is usually made of boards, but sometimes it is of rock and dirt. It seems highly desirable that the stoppings on main roads should be of a more permanent character, so as to prevent an excessive leakage of air.

As regards doors, one door and a canvas sheet will satisfy the provisions of the 1911 Act of Parliament, but the inefficiency of this arrangement was demonstrated at the Reserve Mine explosion, and your reporter strongly suggests that at least two doors should be made compulsory, and not left to the opinion of the Chief Inspector of Mines.

THE QUANTITY OF AIR PER MAN.

Your reporter would suggest a revision of this rule of the present Act of Parliament, as it is obvious that the conditions in a mine which is only just commencing to work a coal-seam are entirely different to those of a mine which is a mile or more from the entry, as in the case of No. 3 mine at Coal Creek.

NUMBER OF MEN IN EACH SPLIT OF AIR.

In view of the gaseous character of the coal-seams of the Crowsnest Pass coalfield, your reporter would suggest that thirty-five men be the limit in each split of air, instead of seventy as in the present Act of Parliament.

THE LOCALIZATION OF AN EXPLOSION.

For a great many years the opinion was almost universal that the watering of the roadways of a mine or wet zones was capable of controlling the extension of an explosion, but this contention has now been practically abandoned, and has given place to stone-dusting. It has not yet been proved that in a case like No. 3 mine at Coal Creek it would have effected any saving of life. There is not a doubt in your reporter's mind that the principal factor in the explosion in No. 3 mine was fire-damp, which, after its own ignition and that of the floating coal-dust, swept through the working-places where neither water nor stone-dust could be practically applied. If stone-dust had been applied on the main South level, there would, however, have been a probability that less damage would have been done to the mine roadways and the men in the slope might have escaped alive. Under similar conditions I should strongly advise that stone-dusting should be adopted on the main haulage-ways where they are not naturally wet as in No. 3 slope.

THE METHODS OF EXTRACTING COAL.

Your reporter would also suggest to you that the mode of extracting or working a coal-seam should be taken into consideration as having a very great influence on the safety of the mine and of the persons employed. Thus, in the past history of the No. 3 mine, all the disasters have occurred whilst the pillar-and-stall system was in vogue, but neither serious "bumps" nor outbursts of gas have occurred whilst the long-wall system of work was practised. This immunity from disaster is doubtless mainly due to three factors: Firstly, that long-wall faces are much more easily ventilated and require less brattice-cloth than the pillar-and-stall method; secondly, there is a less area of the mine open for an equal output; and, thirdly, that gases in the floor and roof are given off with more regularity and much less liability to "bumps."

THE CORONER'S INQUEST.

Some little friction arose in the early stages, but this was settled by the appointment of C. C. Murray, the Coroner of the Michel District, and a fresh jury, who viewed an exhumed body and immediately proceeded to take evidence on April 19th, and continued doing so until the 24th of that month, when the jury announced that they had heard sufficient evidence to come to a decision. They later brought in their verdict, viz.: "That John Monks, *et al.* came to their death at Coal Creek on April 5th, and hereby find that those men met their death by an explosion the first cause of which is unknown to us by the evidence adduced. We, however, would recommend from the evidence received that the single shift would, if practicable, be a great factor in preventing an explosion such as this."

By the courtesy of the Coroner your special investigator was permitted to question the witnesses, and obtain much of the information which is embodied in this his report.

The Coroner further invited all and sundry to bring out any facts which affected the deaths of the thirty-four men killed.

The Crow's Nest Pass Coal Company, Limited, was represented by the general manager, W. R. Wilson; their solicitor, Sherwood Herchmer; and many of the officials. Your inspectorate staff was represented by George Wilkinson, Chief, and W. R. Williams, George O'Brien, and Robert Strachan, District Inspectors. The Miners' Union was represented by T. France, secretary, Mr. Biggs, and Mr. O'Neil, solicitor.

The inquest was resumed on the above date as a consequence of the representations made to the Coroner by myself and your Chief Inspector of Mines that it was impossible to recover

any more bodies for a considerable time; that there was, we thought, sufficient evidence available to enable the jury to come to a conclusion; and later, as a matter of fact, they announced that they were prepared to consider their verdict, whilst Mr. Caufield, the superintendent, was still on the witness stand.

CONCLUSION.

The evidence produced to the jury was brought up as closely as possible to the seat of the origin of the explosion (*see* Plan No. 3), where both the Main level and counter were completely blocked up by fallen roof. The indications were, however, so unmistakable as to the direction of force that every one was convinced that the point of origin was inby of No. 6 incline.

The very dangerous condition which was proved to have existed, particularly at the face of the Main level, the counter, and especially in the crosscut where the coal was soft and producing gas freely, point to this part of the mine as the point of origin.

Now as to the cause: Your special investigator has come to the conclusion, from his personal experimental work on safety-lamps when exposed to mixtures of fire-damp and coal-dust in low velocities of a ventilation-current, that this disastrous explosion was originated by an overheated safety-lamp igniting and exploding the surrounding fire-damp and fine coal-dust. When considering the safety of a safety-lamp, it must not be lost sight of that coal-dust is so finely divided that it will pass through the meshes of a safety-lamp gauze, and also that every such particle of dust contains its own volume of explosive gas. Such dust is therefore as dangerous as fire-damp under conditions similar to those which were probably present when ignition took place. The other possibility is that a loaded car may have been off the track, and that a safety-lamp was broken whilst replacing it; but this is not such a likely occurrence as the former suggestion.

Finally, the most important lesson taught by this explosion is that a maximum height of fire-damp cap must be fixed to compel the miners to withdraw, or be withdrawn, from the mine or part of the mine, and a permissible height of cap must also be fixed for those places where permissible explosives are in use.

In the course of the inquiry it transpired that many of the "certificated" miners never tested for gas when entering their working-places, and never during the shift, and therefore it seems desirable that the firebosses during their rounds of inspection should compel the miners to make tests for fire-damp whilst they are present. Some miner's eyes are diseased and incapable of seeing a dangerous cap on the flame of a safety-lamp.

EXPLOSION AT No. 6 MINE, CUMBERLAND.

REPORT BY GEO. WILKINSON, CHIEF INSPECTOR OF MINES.

I have the honour to submit the following report on the explosion which occurred on June 3rd, 1917, in the No. 6 mine, Comox Colliery, operated by the Canadian Collieries (Dunsmuir), Limited, resulting in the loss of four lives:—

Upon receipt of a telephone message from Mr. Fagan, chief accountant of the Canadian Collieries (Dunsmuir), Limited, about 2 p.m., Sunday afternoon, June 3rd, 1917, to the effect that there had been an explosion in No. 6 mine at Cumberland and that several men were known to be killed, I immediately prepared to leave for Cumberland by automobile, arriving there about 10.30 p.m.

Upon arrival there I was informed that the explosion had been local and only a very small amount of damage had been done, although it had resulted in an unfortunate loss of four lives. All the bodies had been taken out when I arrived there and all other work suspended until morning.

On Monday morning I visited the scene of the accident, accompanied by Henry Devlin, Inspector of Mines for Cumberland District; Dudley Michell, Instructor in First-aid and Mine-rescue Work for the British Columbia Government; Thomas Graham, general superintendent, Canadian Collieries (Dunsmuir), Limited; W. R. Freeman, superintendent of the Comox Colliery; Hugh Sloan, mine manager, No. 6 mine; Thos. Mordy, overman, No. 6 mine; and B. F. Andrews, resident engineer, Canadian Collieries (Dunsmuir), Limited.

SHORT DESCRIPTION OF No. 6 MINE.

No. 6 mine is opened by a shaft 265 feet deep; the workings of this mine consist of pillar-and-stall and long-wall work. Mining in the long-wall section is done by a Sullivan electric coal-cutter, type C.E. 7, alternating current. The average thickness of the coal-seam is about 4 feet, but the coal contains several bands of rock and is of a hard nature, with sandstone roof and floor. Sufficient height is obtained by brushing 3 feet of bottom. On the north side of the shaft a good field of coal has been tapped by driving a rock tunnel through a 50-foot upthrow fault. Mining is done in this district by electric coal-cutter. Pillars are being extracted on the No. 1 incline, west of the shaft, also on the main East levels.

LOCATION OF ACCIDENT.

The explosion occurred in what is known as Fat Sing's machine section, a new piece of long-wall work started inside of a fault on the No. 6 East level off hoist incline; this consists of a long-wall face of approximately 500 feet in length, opened out by four roadways and the level.

THE APPARENT CONDITION OF THE MINE BEFORE THE EXPLOSION.

To give this is appended the following reports:—

(*a.*) Firebosses' daily reports from May 20th to June 3rd, 1917.

(*b.*) Inspectors' reports for March, April, and May, 1917.

(*c.*) Gas Committee reports for March, April, and May, 1917.

TRANSCRIPT OF FIREBOSSES' REPORT-BOOK.

Date: May 20th, 1917. Time: 7 a.m.

I have examined all roadways, doors, and curtains leading to working-places on East and West sides and found same in good order.

(Signed.) DUNCAN THOMPSON; J. B.

Date: May 20th. Time: 2.45 p.m.

I have examined the working-places and roadways of Big Hoist, Hero's, and East Side section and found same in good condition.

(Signed.) JOHN BROWN.

Date: May 20th. Time: 3 p.m.

I have examined all working on the incline and found all clear and in good order.

(Signed.) THOS. RICHARDS.

Date: May 21st. Time: 7 a.m.
Barometer: 29.7. Temperature: 45.
I have examined all working-plaees on East and West sides and found them free from gas and in good order, with the exception of a little gas in slope, Rock Tunnel section.

(Signed.) DUNCAN THOMPSON.

Date: May 21st. Time: 7 a.m.
Barometer: 29.7. Temperature: 45.
I have examined all working-places and roadways on the incline, and found gas in No. 4 stall off East level; the others clear.

(Signed.) THOS. RICHARDS.

Date: May 21st. Time: 2 p.m.
I have examined all working-places and roadways on the incline and found all clear.

(Signed.) THOS. RICHARDS.

Date: May 21st. Time: 3 p.m.
I have examined working-places, Nos. 1 and 2 West, and found them safe and clear of gas. Timbering and ventilation good.

(Signed.) H. LEIGHTON.

Date: May 21st. Time: 3 p.m.
I have examined the working-places and roadways in Rock Tunnel and found all safe and clear, except for a little gas in slope. Timbering and ventilation good.

(Signed.) J. E. SPICER.

Date: May 21st. Time: 3 p.m.
I have examined all working-places in Big Hoist section and found same in good condition and free from gas.

(Signed.) J. BIGGS; F. B.

Date: May 21st. Time: 12 p.m.
I have examined all working-places on incline and Rock Tunnel and found all clear of gas, except a little in slope in Rock Tunnel.

(Signed.) T. LEEMAN.

Date: May 21st. Time: 12 p.m.
I have examined the working-places and roadways in Big Hoist section and found same in good order and free from gas.

(Signed.) F. BOBBA.

Date: May 21st. Time: 12 p.m.
I have examined the working-places and roadways of Nos. 1 and 2 West and found same in good condition and free from gas.

(Signed.) JOHN BROWN.

Date: May 22nd. Time: 7 a.m.
Barometer: 29.7. Temperature: 48.
I have examined all working-places on East and West sides and found them free from gas and in good order, except a little gas in slope road, Rock Tunnel section.

(Signed.) HUGH SLOAN; DUNCAN THOMPSON.

Date: May 22nd. Time: 7 a.m.
Barometer: 29.7. Temperature: 48.
I have examined all working-places and roadways on the incline and found all clear.

(Signed.) THOS. RICHARDS.

Date: May 22nd. Time: 2 p.m.
I have examined all working-places and roadways on the incline and found all clear.

(Signed.) THOS. RICHARDS.

Date: May 22nd. Time: 3 p.m.
I have examined all working-places in Big Hoist section and found same in good condition and free from gas.

(Signed.) J. BIGGS; F. B.

Date: May 22nd. Time: 3 p.m.
I have examined all working-places and roadways in Rock Tunnel. I found a little gas in East slope; all others clear and safe. Timbering and ventilation good.

(Signed.) J. E. SPICER; T.L.

Date: May 22nd. Time: 3 p.m.
I have examined working-places, Nos. 1 and 2 West, and found them safe and clear of gas. Timbering and ventilation good.

(Signed.) H. LEIGHTON; J. B.

Date: May 22nd. Time: 12 p.m.
I have examined all workings on incline, Rock Tunnel, and found a little gas in slope, Rock Tunnel; all other places clear.

(Signed.) T. LEEMAN.

Date: May 22nd. Time: 12 p.m.
I have examined the working-places and roadways in Big Hoist section and found same in good order and clear of gas.

(Signed.) F. BOBBA.

Date: May 22nd. Time: 12 p.m.
I have examined the working-places and roadways of Nos. 1 and 2 West and found same in good condition and free from gas.

(Signed.) HUGH SLOAN; JOHN BROWN.

Date: May 23rd. Time: 7 a.m.
Barometer: 29.6. Temperature: 42.
I have examined all working-places on East and West sides and found them free from gas and in good order, except a little gas in Fat Sing's machine wall, Big Hoist section.

(Signed.) DUNCAN THOMPSON.

Date: May 23rd. Time: 7 a.m.
Barometer: 29.6. Temperature: 42.
I have examined all working-places and roadways on the incline and found all clear.

(Signed.) HUGH SLOAN; THOS. RICHARDS.

Date: May 23rd. Time: 2 p.m.
I have examined all working-places and roadways on the incline and found all clear.

(Signed.) THOS. RICHARDS; T.L.

Date: May 23rd. Time: 3 p.m.
I have examined all working-places in Big Hoist section and found them in good condition and free from gas.

(Signed.) J. BIGGS; F.B.

Date: May 23rd. Time: 3 p.m.
I have examined all working-places and roadways in Rock Tunnel and found a little gas in slope; all others safe and clear.

(Signed.) J. E. SPICER; T.L.

Date: May 23rd. Time: 3 p.m.
I have examined working-places in Nos. 1 and 2 West and found them safe and clear of gas. Miss-shot No. 82; place, Hero section. Timbering and ventilation good.

(Signed.) HY. LEIGHTON; J. B.

Date: May 23rd. Time: 11 p.m.
I have examined the working-places and roadways of Nos. 1 and 2 West and found same in good condition and free from gas.

(Signed.) JOHN BROWN.

Date: May 23rd. Time: 11 p.m.
I have examined all working-places on incline and Rock Tunnel and found a little gas in slope; all other places clear and in good working-order.

(Signed.) T. LEEMAN; HUGH SLOAN.

Date: May 23rd. Time: 11 p.m.
I have examined the working-places and roadways in Big Hoist section and found same in good order and free from gas.

(Signed.) F. BOBBA.

Date: May 24th. Time: 6 a.m.
I have examined roadways, doors, and curtains leading to working-places in Rock Tunnel, also Big Hoist section, and found them in good order.

(Signed.) DUNCAN THOMPSON; HUGH SLOAN; T. M.

Date: May 25th. Time: 7 a.m.
Barometer: 29.5. Temperature: 50.
I have examined all working-places and roadways on East and West sides and found them free from gas and in good order, excepting a little gas in slope roadway, Rock Tunnel section.

(Signed.) DUNCAN THOMPSON.

Date: May 25th. Time: 7 a.m.
I have examined all working-places and the roadways on the incline and found them clear.

(Signed.) THOS. RICHARDS; HUGH SLOAN.

Date: May 25th. Time: 2 p.m.
I have examined all working-places and roadways on the incline and found all clear.

(Signed.) THOS. RICHARDS.

Date: May 25th. Time: 3 p.m.
I have examined working-places and roadways, Nos. 1 and 2 West, and found them safe and clear of gas. Timbering and ventilation good.

(Signed.) HY. LEIGHTON; J. B.

Date: May 25th. Time: 3 p.m.
I have examined the working-places and roadways in Rock Tunnel. I found a little gas in slope; all others clear and safe. Timbering and ventilation good.

(Signed.) J. E. SPICER.

Date: May 25th. Time: 3 p.m.
I have examined all working-places behind Big Hoist and found same in good condition and free from gas.

(Signed.) J. BIGGS; F. B.

Date: May 25th. Time: 12 p.m.
I have examined all workings and roadway, incline and Rock Tunnel, and found a little gas in slope; all other places clear.

(Signed.) T. LEEMAN.

Date: May 25th. Time: 12 p.m.
I have examined the working-places and roadways in Big Hoist section and found same in good order and free from gas.

(Signed.) F. BOBBA.

Date: May 25th. Time: 12 p.m.
I have examined the working-places and roadways of Nos. 1 and 2 West and found same in good condition and free from gas.

(Signed.) JOHN BROWN.

Date: May 26th. Time: 7 a.m.
Barometer: 29.6. Temperature: 50.
I have examined all working-places and roadways on East and West sides and found them free from gas and in good order, except a little gas at face off Fat Sing's machine wall, Big Hoist section.

(Signed.) DUNCAN THOMPSON.

Date: May 26th. Time: 7 a.m.
Barometer: 29.6. Temperature: 50.
I have examined all places and roadways on the incline and found all clear.

(Signed.) THOS. RICHARDS; HUGH SLOAN; T. M.

Date: May 26th. Time: 2 p.m.
I have examined all working-places and roadways on the incline and found all clear.

(Signed.) THOS. RICHARDS.

Date: May 26th. Time: 3 p.m.
I have examined all working-places in Big Hoist section and found same in good order and free from gas.

(Signed.) J. BIGGS; F. B.

Date: May 26th. Time: 3 p.m.
I have examined the working-places and roadways in Rock Tunnel and found a little gas in slope; all others clear and safe. Timbering and ventilation good.

(Signed.) J. E. SPICER.

Date: May 26th. Time: 3 p.m.
I have examined working-places and roadways, Nos. 1 and 2 West, and find them safe and clear of gas. Timbering and ventilation good.

(Signed.) HY. LEIGHTON; F. B.

Date: May 26th. Time: 11 p.m.
I have examined the working-places in Big Hoist section and found same in good order and free from gas. Roadways, timbering, and ventilation good.

(Signed.) F. BOBBA.

Date: May 26th. Time: 11 p.m.
I have examined all working-places, roadways, incline, and Rock Tunnel; found a little gas in the slope; all other places clear.

(Signed.) T. LEEMAN.

Date: May 26th. Time: 11 p.m.
I have examined the working-places and roadways of Nos. 1 and 2 West and found same in good condition and free from gas.

(Signed.) JOHN BROWN.

Date: May 27th. Time: 4 a.m.
I have examined roadways, doors, and curtains on East and West sides and found same in good order, except No. 2 West level door (requires repairing).

(Signed.) DUNCAN THOMPSON; F. B.

Date: May 27th. Time: 2.30 p.m.
I have examined the working-places and roadways in Big Hoist section and Rock Tunnel and found same in good order and free from gas.

(Signed.) F. BOBBA.

Date: May 27th. Time: 3 p.m.
I have examined all workings and roadways on the incline and found all clear.

(Signed.) THOS. RICHARDS.

Date: May 28th. Time: 7 a.m.
Barometer: 29.55. Temperature: 50.
I have examined all working-places and roadways on East and West sides and found them free from gas and in good order, except a little gas in slope roadway, Rock Tunnel section.

(Signed.) DUNCAN THOMPSON; F. B.

Date: May 28th. Time: 7 a.m.
Barometer: 29.55. Temperature: 50.
I have examined all working-places and roadways on the incline and found gas in the East level; the others clear.

(Signed.) THOS. RICHARDS; J. B.

Date: May 28th. Time: 2 p.m.
I have examined all working-places and roadways on the incline and found all clear.

(Signed.) THOS. RICHARDS.

Date: May 28th. Time: 3 p.m.
I have examined all working-places and roadways in Big Hoist section and found same in good order and free from gas. (Miss-shot in Jap's place, Check No. 18.)

(Signed.) F. BOBBA.

Date: May 28th. Time: 3 p.m.
I have examined the working-places and roadways of Nos. 1 and 2 West and found same in good condition and free from gas.

(Signed.) JOHN BROWN.

Date: May 28th. Time: 3 p.m.
I have examined all working-places and roadways in Rock Tunnel. I found a little gas in W. Hutton's face and also in slope; all others safe and clear. Timbering good and ventilation fair.

(Signed.) J. E. SPICER.

Date: May 28th. Time: 12 p.m.
I have examined all working-places on incline and found all clear of gas. Roadway ventilation in good condition.

(Signed.) T. LEEMAN.

Date: May 28th. Time: 12 p.m.
I have examined working-places, Nos. 1 and 2 West and Rock Tunnel, and found them safe and clear of gas, except Rock Tunnel slope. Timbering and ventilation good.

(Signed.) HY. LEIGHTON.

Date: May 28th. Time: 12 p.m.
I have examined all working-places in Big Hoist section and found same in good order and free from gas.

(Signed.) J. BIGGS; T. M.

Date: May 29th. Time: 7 a.m.
Barometer: 29.5. Temperature: 50.
I have examined all working-places and roadways on East and West sides and found them free from gas and in good order, except a little gas at face off Fat Sing's machine wall, Big Hoist section.

(Signed.) DUNCAN THOMPSON; F. B.; T. L.

Date: May 29th. Time: 7 a.m.
Barometer: 29.5. Temperature: 50.
I have examined all working-places and roadways on the incline and found all clear.

(Signed.) THOS. RICHARDS; HUGH SLOAN.

Date: May 29th. Time: 2 p.m.
I have examined all working-places and roadways on the incline and found all clear.

(Signed.) THOS. RICHARDS.

Date: May 29th. Time: 3 p.m.
I have examined all working-places and roadways in Rock Tunnel and found a little gas in slope; all other places clear and in good order.

(Signed.) T. LEEMAN; T. M.

Date: May 29th. Time: 3 p.m.
I have examined the working-places and roadways in Big Hoist section and found same in good order and free from gas.

(Signed.) F. BOBBA.

Date: May 29th. Time: 3 p.m.
I have examined the working-places and roadways of Nos. 1 and 2 West and found same in good condition and free from gas.

(Signed.) JOHN BROWN.

Date: May 29th. Time: 12 p.m.
I have examined all working-places on incline. I found a little gas in No. 4 place in Level Dip section; all others clear and safe. Timbering and ventilation good.

(Signed.) J. E. SPICER.

Date: May 29th. Time: 12 p.m.
I have examined working-places and roadways, Nos. 1 and 2 West and Rock Tunnel, and find them safe and clear of gas, except Rock Tunnel slope. Timbering and ventilation good.

(Signed.) HY. LEIGHTON.

Date: May 29th. Time: 12 p.m.
I have examined all working-places behind Big Hoist and found same in good condition and free from gas.

(Signed.) J. BIGGS.

Date: May 30th. Time: 7 a.m.
Barometer: 29.6. Temperature: 48.
I have examined all working-places and roadways on East and West sides and found them free from gas and in good order, except a little gas in roadway of Rock Tunnel slope.

(Signed.) DUNCAN THOMPSON; J. B.

Date: May 30th. Time: 7 a.m.
Barometer: 29.6. Temperature: 48.
I have examined all working-places and roadways on the incline and found gas in No. 5 stall; the others all clear.

(Signed.) THOS. RICHARDS; T. M.

Date: May 30th. Time: 1 p.m.
I have examined all working-places and roadways on the incline and found gas in No. 5 stall, East level; the others all clear.

(Signed.) THOS. RICHARDS.

Date: May 30th. Time: 3 p.m.
I have examined all working-places in Rock Tunnel and found a little gas in slope; all other places clear. Roadway good; ventilation fair.

(Signed.) T. LEEMAN.

Date: May 30th. Time: 3 p.m.
I have examined the working-places and roadways of Nos. 1 and 2 West and found same in good condition and free from gas.

(Signed.) JOHN BROWN.

Date: May 30th. Time: 3 p.m.
I have examined all working-places and roadways in Big Hoist section and found same in good order and free from gas.

(Signed.) F. BOBBA.

Date: May 30th. Time: 12 p.m.
I have examined the working-places and roadways on incline and found all safe and clear of gas. Timbering good; ventilation good.

(Signed.) J. E. SPICER.

Date: May 30th. Time: 12 p.m.
I have examined all working-places behind Big Hoist and found same in good condition and free from gas.

(Signed.) J. BIGGS.

Date: May 30th. Time: 12 p.m.
I have examined working-places and roadways, Nos. 1 and 2 West and Rock Tunnel, and find them safe and clear of gas, except slope, Rock Tunnel. Timbering good; ventilation fair.

(Signed.) HY. LEIGHTON.

Date: May 31st. Time: 7 a.m.
Barometer: 29.7. Temperature: 50.
I have examined all working-places and roadways and found them free from gas and in good order, except a little gas in Hutton's place and slope roadway.

(Signed.) DUNCAN THOMPSON; F. B.

Date: May 31st. Time: 7 a.m.
Barometer: 29.7. Temperature: 50.
I have examined all working-places and roadways on the incline and found all clear.

(Signed.) THOS. RICHARDS; T. M.

Date: May 31st. Time: 3 p.m.
I have examined the working-places and roadways in Big Hoist section and found same in good order and free from gas.

(Signed.) F. BOBBA.

Date: May 31st. Time: 3 p.m.
I have examined all working-places and roadways on the incline and found all clear.

(Signed.) THOS. RICHARDS.

Date: May 31st. Time: 3 p.m.
I have examined all working-places in Rock Tunnel and found a little gas in slope; all other places clear. Roadway good; ventilation fair.

(Signed.) T. LEEMAN.

Date: May 31st. Time: 3 p.m.
I have examined the working-places and roadways of Nos. 1 and 2 West and found same in good condition and free from gas.

(Signed.) JOHN BROWN.

Date: May 31st. Time: 12 p.m.
I have examined all working-places in Big Hoist section and found same in good condition and free from gas.

(Signed.) J. BIGGS.

Date: May 31st. Time: 12 p.m.
I have examined working-places and roadways, Nos. 1 and 2 West and Rock Tunnel, and find them safe and clear of gas, except Rock Tunnel slope. Ventilation fair; ventilation good.

(Signed.) HY. LEIGHTON.

Date: May 31st. Time: 12 p.m.
I have examined all working-places and roadways on incline and found all safe and clear of gas. Timbering and ventilation good.

(Signed.) J. E. SPICER.

Date: June 1st. Time: 7 a.m.
Barometer: 29.5. Temperature: 50.
I have examined all working-places and roadways and found them free from gas and in good order, except a little gas in Rock Tunnel slope.

(Signed.) DUNCAN THOMPSON; F. B.; T. M.

Date: June 1st. Time: 7 a.m.
Barometer: 29.5. Temperature: 50.
I have examined all working-places and roadways on the incline and found all clear.

(Signed.) THOS. RICHARDS.

Date: June 1st. Time: 3 p.m.
I have examined all working-places and roadways on the incline and found all clear.

(Signed.) THOS. RICHARDS.

Date: June 1st. Time: 3 p.m.
I have examined the working-places and roadways of Nos. 1 and 2 West and found same in good condition and free from gas.

(Signed.) JOHN BROWN; HUGH SLOAN.

Date: June 1st. Time: 3 p.m.
I have examined all working-places in Rock Tunnel and found a little gas in slope; all other places clear. Roadway good; ventilation fair.

(Signed.) T. LEEMAN.

Date: June 1st. Time: 3 p.m.
I have examined the working-places and roadways in Big Hoist section and found same in good order and clear of gas.

(Signed.) F. BOBBA.

Date: June 1st. Time: 12 p.m.
I have examined all working-places in Big Hoist section and found same in good condition and free from gas.

(Signed.) J. BIGGS.

Date: June 1st. Time: 12 p.m.
I have examined all working-places and roadways on incline and found all safe and clear of gas. Timbering and ventilation fair.

(Signed.) J. E. SPICER.

Date: June 1st. Time: 12 p.m.
I have examined working-places and roadways, Nos. 1 and 2 West and Rock Tunnel, and find them safe and clear of gas, except slope, Rock Tunnel. Timbering good; ventilation fair.

(Signed.) HY. LEIGHTON.

Date: June 2nd. Time: 7 a.m.
Barometer: 29.5. Temperature: 50.
I have examined all working-places and roadways and found them free from gas and in good order, except a little gas in slope roadway at face of Brown's level, Rock Tunnel section.

(Signed.) DUNCAN THOMPSON; F. B.; T. L.

Date: June 2nd. Time: 7 a.m.
Barometer: 29.5. Temperature: 50.
I have examined all workings and roadways on the incline and foun d all clear.

(Signed.) THOS. RICHARDS.

Date: June 2nd. Time: 2 p.m.
I have examined all working-places and roadways on the incline and found all clear.

(Signed.) THOS. RICHARDS.

Date: June 2nd. Time: 3 p.m.
I have examined the working-places and roadways in Big Hoist section and found same clear of gas and in good order.

(Signed.) F. BOBBA.

Date: June 2nd. Time: 3 p.m.
I have examined the working-places and roadways of Nos. 1 and 2 West section and found same in good condition and free from gas.

(Signed.) JOHN BROWN.

Date: June 2nd. Time: 3 p.m.
I have examined all working-places in Rock Tunnel and found a little gas in slope; all other places clear. Roadway good; ventilation fair.

(Signed.) T. LEEMAN.

Date: June 2nd. Time: 11 p.m.
I have examined all-working-places on incline and found all safe and clear of gas. Timbering and ventilation good; roadways safe.

(Signed.) J. E. SPICER.

Date: June 2nd. Time: 11 p.m.
I have examined all working-places in Big Hoist section and found same in good order and free from gas.

(Signed.) J. BIGGS.

Date: June 2nd. Time: 11 p.m.
I have examined working-places and roadways, Nos. 1 and 2 West, and find them safe and clear of gas. Timbering and ventilation good.

(Signed.) HY. LEIGHTON.

Date: June 3rd. Time: 4 a.m.
I have examined roadways, doors, and curtains in Big Hoist section, Rock Tunnel, and No. 1 West and found same in good order.

(Signed.) DUNCAN THOMPSON.

Date: June 3rd. Time: 8 a.m.
I have examined all working-places in Rock Tunnel and found a little gas in slope; all other places clear.

(Signed.) T. LEEMAN.

INSPECTORS' REPORTS FOR MARCH, APRIL, AND MAY, 1917.

I hereby give notice that I have this day examined the underground workings of that part of the Canadian Collieries (Dunsmuir), Limited, Colliery known as No. 6 mine, and find the following conditions to prevail therein:—
Part of mine examined: All the mine. Ventilation: Good, showing 43,375 cubic feet of air a minute passing into the mine, divided into three splits.
Explosive gas: Found a small quantity in No. 1 slant off the West level, No. 1 dip; and in No. 2 slant off No. 5 East level.
Roadways: In fair order. Timbering: In fair condition.
Remarks: In No. 1 split there was 14,500 cubic feet of air a minute passing for the use of thirty-one men and three mules. In No. 2 split there was 16,875 cubic feet of air a minute passing for the use of sixty-three men and seven mules. In No. 3 split there was 12,000 cubic feet of air a minute passing for the use of forty-four men and five mules.
Dated at Cumberland, B.C., this 13th day of March, 1917.

HENRY DEVLIN,
Inspector of Mines.

I hereby give notice that I have this day examined the underground workings of that part of the Canadian Collieries (Dunsmuir), Limited, Colliery known as No. 6 mine, and find the following conditions to prevail therein:—
Part of mine examined: All the mine. Ventilation: Good, showing 40,975 cubic feet of air a minute passing into the mine, divided into three splits.
Explosive gas: Found a little issuing from a feeder in the roof in No. 2 level off No. 2 dip.
Roadways: In fair order. Timbering: In fairly good order.
Remarks: In No. 1 split there was 15,000 cubic feet of air a minute passing for the use of thirty-two men and four mules. In No. 2 split there was 15,975 cubic feet of air a minute passing for the use of forty-seven men and eight mules. In No. 3 split there was 10,000 cubic feet of air a minute passing for the use of forty-seven men and five mules.
Dated at Cumberland, B.C., this 11th day of April, 1917.

HENRY DEVLIN,
Inspector of Mines.

I hereby give notice that I have this day examined the underground workings of that part of the Canadian Collieries (Dunsmuir), Limited, Colliery known as No. 6 mine, and find the following conditions to prevail therein:—
Part of mine examined: All the mine. Ventilation: Good, showing 38,850 cubic feet of air a minute passing into the mine, divided into three splits.
Explosive gas: None found. Roadways: In fair order. Timbering: In fairly good condition.
Remarks: In No. 1 split there was 10,500 cubic feet of air a minute passing for the use of sixteen men and three mules. In No. 2 split there was 15,750 cubic feet of air a minute passing for the use of fifty men and seven mules. In No. 3 split there was 12,600 cubic feet of air a minute passing for the use of forty-three men and six mules.
Dated at Cumberland, B.C., this 7th day of May, 1917.

HENRY DEVLIN,
Inspector of Mines.

GAS COMMITTEE REPORTS FOR MARCH, APRIL, AND MAY, 1917.

March 22nd. I have examined all No. 6 mine in accordance with General Rule 37, C.M.R.A., and found all clear of gas, ventilation good, timbering good, and all in safe condition.

NAT BEVIS.

April 17th. I have examined all No. 6 mine of Cumberland in accordance with General Rule 37, C.M.R.A., and found all clear of gas, ventilation good, timbering good, and in general in safe working condition.

NAT BEVIS.

May 17th. I have examined all No. 6 mine in accordance with General Rule 37, C.M.R.A., and found all clear of gas, except a slight cap in dip in Rock Tunnel district, but I do not consider this dangerous. Ventilation good, timbering good, and all in safe working condition.

NAT BEVIS.

CONDITION OF MINE AFTER EXPLOSION.

The mine was practically undamaged; two or three temporary stoppings blown out and a few curtains down was the only damage done; these were repaired in about one hour after the explosion occurred. The surveyor's transit which was standing on the level some distance outside was blown over by the force of the blast and broken.

DETAILED CONDITION AT FACE OF SECTION WHERE ACCIDENT OCCURRED.

No. 1 Roadway.—Coal undercut, but not shot down; signs of coking; timber burnt a little and pitch on timbers burned; on low side of this place was a fault.

No. 2 Roadway.—Coal undercut, but not shot down; signs of coking on coal cuttings from machine-mining.

No. 3 Roadway.—Coal undercut and shot down; no signs of coking; everything at face undisturbed.

No. 4 Roadway.—Conditions same as before explosion.

Face of Level.—Conditions same as before explosion.

LINES OF FORCE OF EXPLOSIVE BLAST.

The lines of force were outward, although very slight; there were small amounts of debris scattered outwards and the parts of the surveyor's transit were blown outwards.

DEDUCTIONS AS TO THE INITIAL POINT OF EXPLOSION.

Conditions found point to the face of No. 3 roadway as being the initial point of the explosion. Apparently there had been a small accumulation of gas along the face at the end of this roadway. The machine had just finished an undercut along the face, and the portion in front of No. 3 roadway had been shot down and the loose coal was still lying there. The balance of the face was undercut and the cuttings thrown back in a heap at the face.

In the writer's opinion there had been a small accumulation of gas along the face at the head of No. 3 roadway and where the coal was shot down. On account of the coal which remained unshot there would be a projection which would hinder the air-current from reaching the portion which was shot down. This small accumulation of gas became ignited and travelled along the face, gathering up the finest of the coal-dust from the machine cuttings, and travelled down the airway on to the level and outwards for a distance of approximately 360 feet, or a distance of about 500 feet altogether from the point of origin. At this point the force had been expended.

At a point about 330 feet from the point of origin the surveyor's transit had been standing, and was knocked over and broken by the force of the blast and scattered a distance of 85 feet. The tool-sack which was lying on the floor, with hammers, etc., in it, was left undisturbed; a stopping was blown out by the concussion a distance of 600 feet from the point of origin. A man working about 1,000 feet away just felt a slight concussion, while another one claims he was knocked over; these men gave the alarm that something was wrong.

CAUSE OF IGNITION.

In the writer's opinion the gas was ignited by the flame of the carbide lamp carried by L. Murdock, who was following close on the heels of the fireboss going into the place. In No. 3 roadway the brushing was 14 feet from the face, and the safety-lamp carried by the fireboss was found 9 feet from the face of the brushing. Eighteen feet from the fireboss's lamp a carbide lamp was found which evidently had been carried by L. Murdock, judging from the position the bodies were found. Twenty feet farther back another safety-lamp was found, and 10 feet from this another carbide lamp was found; these had evidently been carried by Bertram, the chief surveyor in charge of the party. Ten feet outside of the carbide lamp carried by Bertram, another carbide lamp was found; this lamp had evidently been carried by Brough.

The bodies were all found in rotation as the lamps were found. Brough had moved about 120 feet from where he had dropped his lamp; Bertram had moved about 105 feet from where his lamp was found; Murdock had moved 80 feet away from his lamp, and Bobba 77 feet.

From the positions the bodies and lamps were found it would appear that the survey party had gone in this district, accompanied by the fireboss, to have a look around the places prior

to starting to survey. The position in which the lamps of the various members of the survey party were found would also indicate this. We found the fireboss's lamp nearest the face; his body is also nearest the point of ignition. Murdock's body is found next to the fireboss, with approximately the same distance between them as there was when they started to get out after the ignition had taken place. The other two bodies are practically the same, almost the same distance dividing them as there was before the accident. There was a small drill for drilling holes for the station plugs, found at the switch with the safety-lamp and carbide lamp; this had evidently been carried by Bertram. Murdock had evidently gone up the place to give Bertram a preliminary foresight for the station at the switch, and the fireboss had gone in ahead of him to examine the place, and not expecting anything to be in the place had allowed him to come in too close, and the flame from his lamp had come in contact with the outer edge of the accumulation of gas and ignited it. If it had not been for the dust from the machine-cutting it is improbable that the explosion would have extended any farther than the one place. The mine was damp at this point, and, in fact, throughout the whole mine; this accounts for the short distance the explosion travelled. Unfortunately the place had just been machine-cut the previous afternoon, and some of the dust from the cuttings was fine and dry enough to play a part in the explosion, and there is no doubt in my mind but what the dust propagated the explosion from its point of origin to where it stopped. Apart from the small amount of dust made at the face by the machine-cuttings, there was no material in this mine to feed an explosion; this accounts for the short distance the flame travelled.

VENTILATION.

The ventilation of the mine was good; there were 38,850 cubic feet a minute passing into the mine, and for the split where the accident occurred 15,750 cubic feet a minute. The conducting of this to the face might have been better, the pack-walls at the head of the roadways being a little too far back from the face, leaving too large an area, with a consequent reduction in velocity, thereby allowing a thin stratum of gas to accumulate along the roof at the face.

A little gas was reported in this section by D. Thompson, night-shift fireboss, in his reports of 7 a.m., May 23rd, May 27th, and May 29th, 1917. In cross-examination at the inquest this fireboss stated that the gas he reported on these three occasions was found at the highest place, and was not explosive gas, but simply a cap of gas. He also testified that he examined the section where the explosion occurred between 2 a.m. and 3 a.m. on the morning of the explosion and found it absolutely clear. While not being in a position to dispute this statement, a little reasoning will show that this is a strange occurrence.

Work finished on the long-wall face at 9 p.m. the night before the explosion, and from this fireboss's statements had stood for a period of six hours and no gas had accumulated. It is strange that after standing for this period, and remaining clear, gas should have accumulated between the hours of 3 a.m. and 10 a.m. unless some unusual occurrence had taken place on the face, which to all appearances had not.

OFFICIAL REPORTS.

These reports were made regularly and in correct form as far as the actual working-days were concerned, but for Sundays they are open for criticism.

It appears that on Saturday night the fireboss's work was to examine the doors, stoppings, and curtains to see that they were in good order. This left the Saturday night shift without a report for any men that might be coming to work in the mine on Sunday morning. This could have been remedied by sending out a fireboss earlier to have sufficient time to make the examination and report before the men went in the mine. It appears this was not done, Sunday being a small shift on repair-work; the firebosses on the morning shift would go and examine the particular places where these men were going to work, just before the men entered.

Technically this may have fulfilled the provisions of the "Coal-mines Regulation Act," but practically it was a poor system, and I am of the opinion it was a breach of their own special rules, No. 28 of which reads: "The fireboss on night shift shall begin to make his examination for the morning shift within three hours of the time the day shift enters the mine, and have it completed and be at the station to make and sign his report before the day shift enters the mine."

The defence was put up at the inquest by Mr. Mordy, overman at No. 6 mine, that there was no shift coming on duty on Sundays; therefore it was not necessary to have an examination and report made. When cross-examined by the writer he admitted there were twenty-four men at work exclusive of the surveyors, but including five firebosses this made a total of twenty-seven men in the mine; and he also admitted that under the circumstances that morning he would consider an examination necessary. There were plenty officials employed at the mine to carry out all provisions of the "Coal-mines Regulation Act" and special rules, but there seemed a laxity on the part of the manager and overman in not having this done on Sundays when men were working in the mine. It would have been a different matter if there had been no men going out to work in the mine. There might then have been some grounds for the statement that no examination was necessary.

INQUEST.

A Coroner's inquisition was held at Cumberland on June 6th and 7th, 1917, and after taking the evidence of eight witnesses the jury brought in the following verdict:—

"We, the jury empanelled to inquire into the death of George Norris Bertram, Frank Bobba, Lois Murdock, and John D. Brough at No. 6 mine, Cumberland, B.C., Canada, Sunday, 3rd day of June, 1917, are unanimously agreed that the above came to their death by an accidental explosion of gas in the Machine section. We also respectfully recommend that the use of naked lights in No. 6 mine of the Canadian Collieries (Dunsmuir), Limited, be entirely abolished.

"(Signed.) H. V. COLLINS, *Foreman.*
"JOHN PRAIN.
"JAMES E. ASTON.
"EDWARD LONGLAND.
"GEORGE JOHN HARDY.
"JOHN WILLIAMSON.

"JOSEPH SHAW, *Coroner.*"

CONCLUDING REMARKS AND SUGGESTIONS.

The unfortunate loss of life in this case is to be regretted; in no case was the burning severe, or any other serious injuries, death being due to carbon-monoxide poisoning.

The accident was due purely and simply to naked lights. This accident could not have possibly occurred if safety-lamps had been in use. The mine was not gassy, neither was it dusty; it was just about as safe as any mine could be made from a gas and dust standpoint. It would therefore appear that naked lights are not safe in any coal-mine, and I would earnestly recommend that a clause be put in the "Coal-mines Regulation Act" prohibiting the use of naked lights in a coal-mine. This accident in all probability would not have occurred if it had been an ordinary working-day instead of Sunday, because in the event of it being a working-day the fireboss would have been in and examined the face for the oncoming shift within a short period of the men going in, and would have found the accumulation of gas and fenced the place off. Mr. Mordy, the overman of the mine, when cross-examined by the writer at the inquest, stated that when surveyors were going out on Sunday they usually reported to him, and he made arrangements for the examination of the places by the fireboss; and in this case the surveyor told him he would be down at the mine at 7 o'clock and see the fireboss himself, and he informed the surveyor the fireboss could go with them while they were making their survey. This the surveyor had evidently done, as he had been in the district on the other side of the shaft with the fireboss for that district and had completed his survey. He had evidently then gone into the other district and got Bobba, the fireboss, to go with them to examine the place. By an error of judgment on the part of Bobba, he had allowed these men to go in the places with him while he was making his examination, instead of keeping them at a point on the outside of the district until he had done so. Unfortunately he paid the extreme penalty for this error and sacrificed the lives of three men.

There was no lack of officials in the mine to make a thorough examination of the same, as there were five firebosses in the mine with nineteen workmen the morning of the explosion.

Appended to this report is a plan of location of accident, showing position of bodies found and general lines of explosive blast and direction of ventilating-current. Also analysis of samples of dust collected after explosion, and statement of injuries by the doctor.

SAMPLES OF COAL AND COKE TAKEN FROM NO. 6 MINE, CUMBERLAND, ON JUNE 4TH, 1917.

		Moisture.	Volatile Matter.	Fixed Carbon.	Ash.
		Per Cent.	Per Cent.	Per Cent.	Per Cent.
Sample No. 1..	Off end of cog at face of inside (No. 4) road.....	1.2	25.3	42.9	30.6
" 2..	Off prop at head of No. 3 road	1.3	23.6	49.7	25.4
" 3..	Off cog on No. 1 road, 40 feet from face on left side..	1.5	19.5	42.4	36.6
" 4..	Off cog immediately above No. 1 carbide lamp.....	1.8	12.4	33.8	52.0
" 5..	Off (fault) cog 15 feet outside of fault	1.3	18.1	40.1	40.5
" 6..	Off cog at bottom of No. 7 road	1.2	22.3	44.3	32.2

DOCTOR'S CERTIFICATE.

My name is George Kerr McNaughton. I am a duly qualified medical practitioner in and for the Province of British Columbia. I reside at Cumberland.

About 1 p.m. on Sunday, June 3rd, I went down to No. 5 mine in company with T. Graham and Robt. Henderson, and straightway proceeded to that part of the mine where lay the bodies of the deceased, John D. Brough, Lewis Murdock, Frank Bobba, and George Bertram. I briefly examined the bodies in the order named, and in each case was unable to find any signs of life. The bodies were lying prostrate, and I noticed that the faces and hands were superficially burnt and that the covered parts of the bodies were still quite warm.

On Monday afternoon I made a closer examination of the bodies at Mr. Banks's undertaking parlours, and found as follows:—

John D. Brough.—Hair on scalp and eyebrows burnt close to skin; burns of first and second degree of face, scalp, neck, hands, wrists, and both sides of trunk; third degree burn of the nose.

Lewis Murdock.—Hair singed on back and sides of neck, not singed at all on top of head; eyebrows burned close to skin; burns of first and second degree of face, backs of hands, and wrists; first degree burns of upper part of chest.

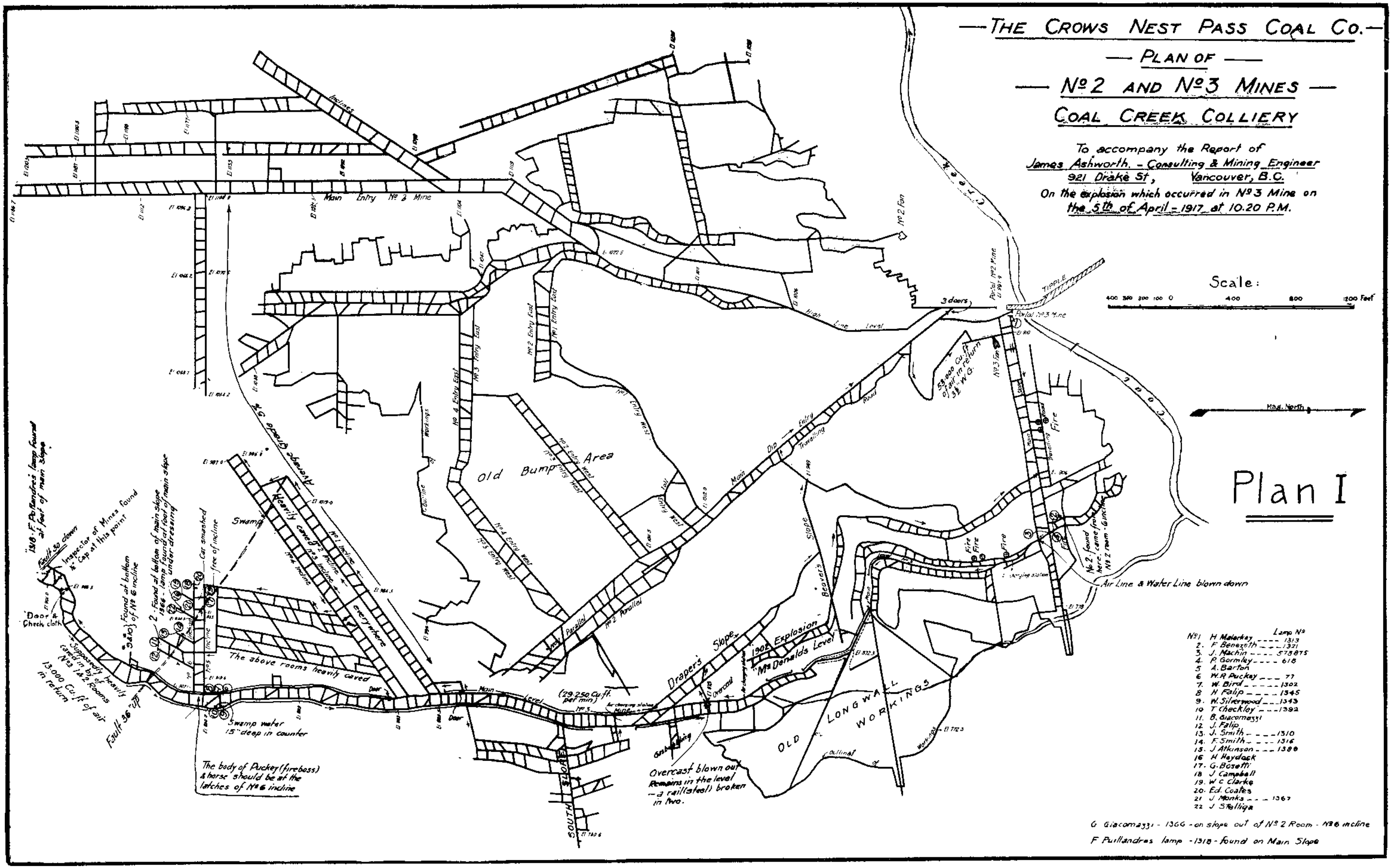
Frank Bobba.—Hair singed all over scalp; eyebrows burned close to skin, but eyelashes only slightly singed; burns of first and second degree of forehead, face, hands, and wrists.

George Bertram.—Hair singed all over scalp; in front half-burned close to skin; eyebrows burned; first and second degree burns of the forehead, face, hands, and wrists, and upper part of both shins.

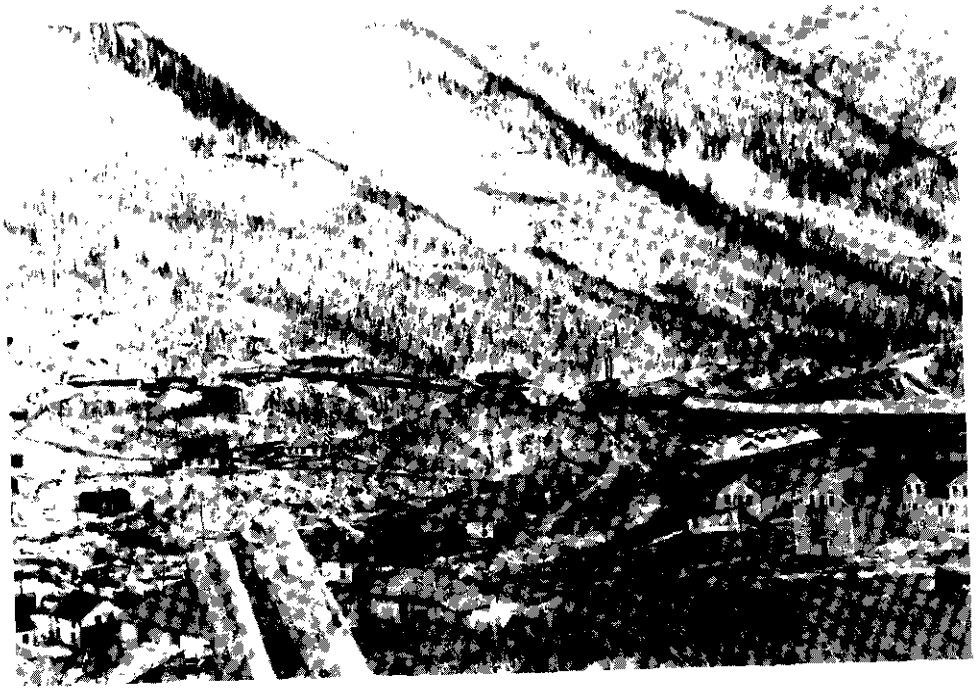
In all cases the superficial layer of skin in the burnt areas was charred and blackened. Where the deep layer of skin was exposed it was a cherry-red colour, and in the different parts of the body the healthy skin assumed a fresh pink colour in contrast to the usual dusky purple.

Apart from the burns there was no evidence of external injury. From the nature of the accident and the examination of the bodies I believe the death of deceased, Brough, Murdock, Bobba, and Bertram, was caused from poisoning by carbon-monoxide gas.

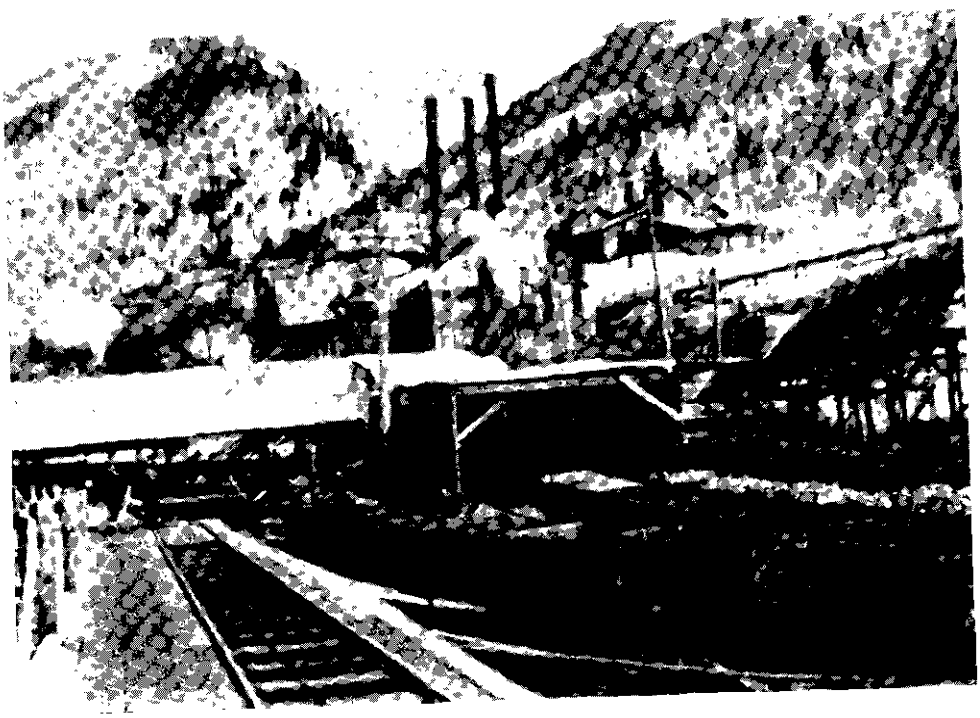
VICTORIA, B.C.:
Printed by WILLIAM H. CULLIN, Printer to the King's Most Excellent Majesty.
1918.



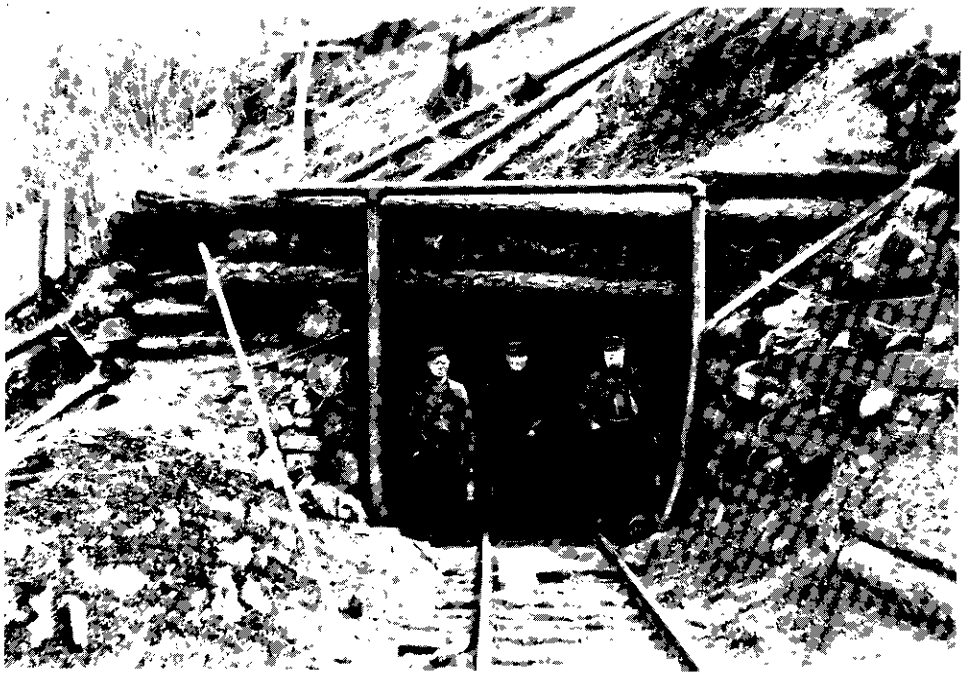
—THE CROWS NEST PASS COAL CO.—
— PLAN OF —
— Nº 2 AND Nº 3 MINES —
COAL CREEK COLLIERY
To accompany the Report of
James Ashworth. - Consulting & Mining Engineer
921 Drake St, Vancouver, B.C.
On the explosion which occurred in Nº 3 Mine on
the 5th of April - 1917 at 10.20 P.M.
Scale:
400 300 200 100 0 400 800 1200 Feet
Mag. North
Plan I
Main Entry Nº 2 Mine
Inclines
No 2 Fan
Creek
High Line Level
3 doors
Portal Nº 2 Mine
TIPPLE
Portal Nº 3 Mine
No 3 Fan
53,000 Cu.ft of air in return 3½" W.G.
Road
Main
Travelling
Fire
No 2 Entry East
No 1 Entry East
No 3 Entry East
No 4 Entry East
No 1 Entry West
No 2 Entry West
No 3 Entry West
No 4 Entry West
No 5 Entry West
Old Bump Area
Main Dip Entry
Travelling Road
Workings
Outline of Workings
Average Grade 5%
No 1 Parallel
No 2 Parallel
Beavers Slope
Draper's Slope
1902 Explosion
"McDonalds Level"
Overcast
Main Level
(29.250 Cu.ft. per min)
No 3 Mine
Door
SOUTH SLOPE
OLD LONGWALL WORKINGS
Overcast blown out
Remains in the level
— a rail (steel) broken in two.
Air Line & Water Line blown down
No 2. found here, came from No 2 room - 6 incline
Heavily caved everywhere
No 1 Incline
No 2 Incline
No 3 Incline
No 4 Incline
Swamp
The above rooms heavily caved
Car smashed
free of incline
Incline
2. Found at bottom of main slope
1366 - lamp found at foot of main slope under dressing
9 & 10 } Found at bottom of Nº 6 incline
1318 - F. Pollandres' lamp found at foot of main slope.
Fault 30 down
Inspector of Mines found his Cap at this point
Door & Check cloth
Supposedly heavily caved in by of Nos 1 & 2 Rooms
13.000 Cu.ft of air in return
Fault 36" up
Swamp water 15" deep in counter
The body of Puckey (fireboss) & horse should be at the latches of Nº 6 incline
Lamp Nº
Nº 1 H Malarkey ---- 1313
2. F Benezeth ---- 1321
3. J. Machin ---- 578875
4. P. Gormley ---- 618
5 A. Barton
6 W.R Puckey ---- 77
7. W. Bird ---- 1302
8 H Falip ---- 1345
9. W. Silverwood ---- 1343
10 T Checkley ---- 1392
11. B. Giacomazzi
12 J. Falip
13. J. Smith ---- 1310
14. F. Smith ---- 1316
15. J Atkinson ---- 1388
16 H Haydock
17. G. Bosetti
18 J Campbell
19. W C Clarke
20. Ed. Coates
21 J Monks ---- 1367
22 J Stelliga
G Giacomazzi - 1366 - on slope out of Nº 2 Room - Nº 6 incline
F Puillandres lamp - 1318 - found on Main Slope



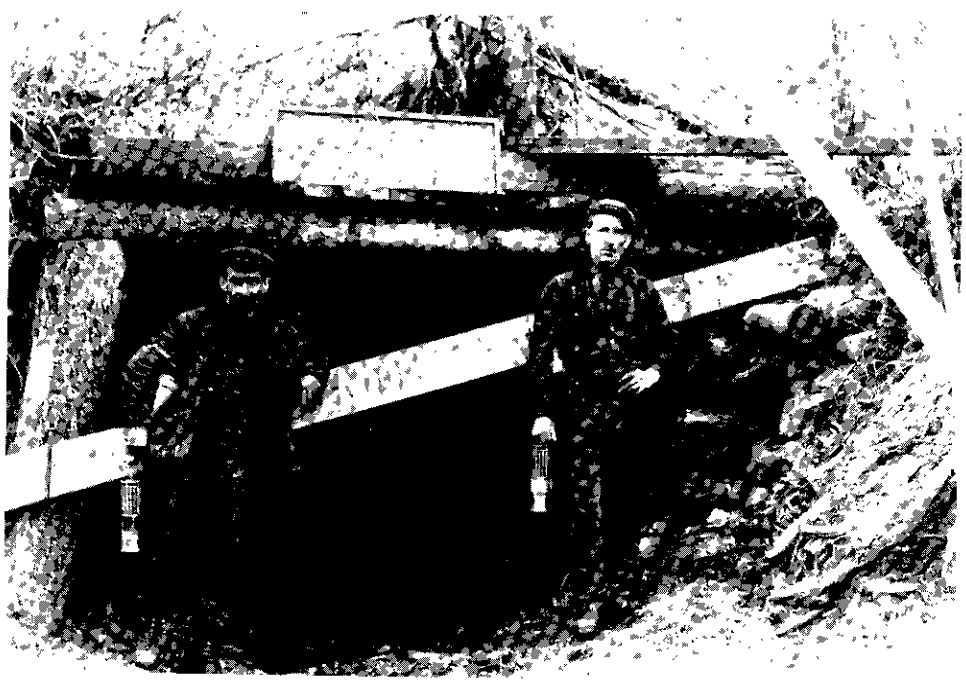
Coal Creek Colliery, South Side.



Entry, No. 3 Mine Slope, from West.



Entry, No. 3 Mine, Coal Creek, after explosion.



Entrance to Travelling-road, No. 3 Mine, Coal Creek.