ANNUAL REPORT

OF THE

MINISTER OF MINES

FOR THE

YEAR ENDING 31ST DECEMBER

1916

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.
1917.

To His Honour FRANK STILLMAN BARNARD,

Lieutenant-Governor of the Province of British Columbia.

MAY IT PLEASE YOUR HONOUR:

The Annual Report of the Provincial Mineralogist upon the Mining Industry of the Province for the year 1916 is herewith respectfully submitted.

WILLIAM SLOAN,

Minister of Mines.

Minister of Mines' Office,

March 31st, 1917.

Della Lake, Alberni Mining Division.

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, 1916.

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

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

I have the honour to be,

Sir,

Your obedient servant,

WILLIAM FLEET ROBERTSON,
Provincial Mineralogist.

Bureau of Mines, Victoria, B.C.,
March 16th, 1917.

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 1916.

Gold, placer	$ 74,620,103
Gold, lode	91,350,784
Silver	41,358,012
Lead	36,415,124
Copper	114,559,364
Zinc	7,212,759
Coal and coke	165,829,315
Building-stone, bricks, etc.	26,697,835
Miscellaneous minerals, etc	517,419
Total	$558,560,715

TABLE II.—PRODUCTION FOR EACH YEAR FROM 1852 TO 1916 (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
Total	$558,560,715

Table III. gives a statement in detail of the quantities and value of the different mineral products for the years 1914, 1915, and 1916. 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 1914, 1915, AND 1916.

	Customary Measure.	1914.		1915.		1916.	
		Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold, placer	Ounces.	.....	$ 565,000	38,500	$ 770,000	29,025	$ 580,500
" lode	"	247,170	5,109,004	250,021	5,167,934	221,932	4,587,334
Silver	"	3,602,180	1,876,736	3,366,506	1,588,991	3,301,923	2,059,739
Lead	Pounds	50,625,048	1,771,877	46,503,590	1,939,200	48,727,516	3,007,462
Copper	"	45,009,699	6,121,319	56,918,405	9,835,500	65,379,364	17,784,494
Zinc	"	7,866,467	346,125	12,982,440	1,460,524	37,168,980	4,043,985
Coal	Tons, 2,240 lb.	1,810,967	6,338,385	1,611,129	5,638,952	2,084,093	7,294,325
Coke	" "	234,577	1,407,462	245,871	1,475,226	267,725	1,606,350
Miscellaneous products	.....	.....	2,852,917	.....	1,571,181	.....	1,326,273
			$26,388,825		$29,447,508		$42,290,462

TABLE IV.

OUTPUT OF MINERAL PRODUCTS BY DISTRICTS AND DIVISIONS.

NAMES.	DIVISIONS.			DISTRICTS.		
	1914.	1915.	1916.	1914.	1915.	1916.
CARIBOO DISTRICT	.....	.....	.....	$ 308,807	$ 885,502	$ 778,157
Cariboo Mining Division	$ 166,500	$ 217,500	$ 162,000	.....	.....	.....
Quesnel "	37,000	86,000	20,000	.....	.....	.....
Omineca "	105,307	582,002	596,157	.....	.....	.....
CASSIAR DISTRICT	.....	.....	.....	2,079,177	4,420,988	7,210,949
EAST KOOTENAY DISTRICT	.....	.....	.....	4,709,672	4,653,836	6,810,926
WEST KOOTENAY DISTRICT	.....	.....	.....	6,311,205	7,308,793	9,101,905
Ainsworth Division	471,534	360,846	754,902	.....	.....	.....
Slocan and Slocan City "	1,780,936	2,455,462	3,761,091	.....	.....	.....
Nelson "	579,563	608,277	619,376	.....	.....	.....
Trail Creek "	3,456,610	3,865,284	3,935,836	.....	.....	.....
Other parts	22,562	18,924	30,700	.....	.....	.....
BOUNDARY-YALE DISTRICT	.....	.....	.....	4,867,029	5,470,689	7,243,560
Osoyoos, Grand Forks & Greenwood Divisions	4,270,744	5,023,635	6,592,991	.....	.....	.....
Similkameen, Nicola, Vernon	533,991	371,733	450,780	.....	.....	.....
Yale, Ashcroft, Kamloops	62,294	75,321	199,789	.....	.....	.....
LILLOOET DISTRICT	.....	.....	.....	38,978	25,643	65,457
COAST DISTRICTS (Nanaimo, Alberni, Clayoquot, Quatsino, Victoria, Vancouver)	.....	.....	.....	8,079,957	6,682,057	11,079,508
				$26,388,825	$ 29,447,508	$42,290,462

TABLE V.

MISCELLANEOUS PRODUCTS AND TOTALS OF PRODUCTION, 1916.

DISTRICT AND DIVISION.	Cement.	Lime and Limestone.	Building-stone.	Riprap.	Crushed Rock.	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															778,157
Cariboo		1,000		1,000	1,000	1,000			4,000		4,000		158,000	162,000	
Quesnel													20,000	20,000	
Omineca				1,000		1,000			2,000		2,000		594,157	596,157	
CASSIAR															7,210,949
Atlin										3,000	3,000		356,066	359,066	
Liard-Stikine Skeena, Portland C Queen Charlotte		26,000	2,000	1,000	1,000	1,500			31,500	13,022	44,522		6,807,361	6,851,883	
EAST KOOTENAY															6,810,926
Fort Steele		500	1,000	1,000	1,000	1,000			4,500		4,500	3,296,702	3,428,993	6,730,195	
Windermere-Golden		500		1,000	1,000	1,000			3,500		3,500		77,231	80,731	
WEST KOOTENAY															9,101,905
Ainsworth		500			500	500			1,500		1,500		753,402	754,902	
Slocan & Slocan City				500	500	500			1,500	2,400	3,900		3,757,191	3,761,091	
Nelson		1,000	1,000	1,000	1,500	1,500		1,000	7,000	4,080	11,080		608,296	619,376	
Trail Creek		2,000	1,000	5,000	10,000	10,000			28,000		28,000		3,907,836	3,935,836	
Other Divisions		500			1,000	1,000			2,500		2,500		28,200	30,700	
BOUNDARY-YALE															7,243,560
Grand Forks Greenwood Osoyoos		53,000		1,000	1,000	1,000		1,000	57,000	1,020	58,020		6,534,971	6,592,991	
Similkameen Nicola Vernon		1,000		1,000	1,000	1,000			4,000		4,000	386,921	59,859	450,780	
Yale Ashcroft Kamloops		1,000		2,000	1,500	1,500		288	6,288		6,288		193,501	199,789	
LILLOOET				1,000	1,000	1,000			3,000	3,198	6,198		59,259	65,457	65,457
COAST DISTRICT	436,459	19,000	162,783	212,231	22,542	35,000	90,277	164,973	1,143,265		1,143,265	5,217,052	4,719,191	11,079,508	11,079,508
	436,459	106,000	167,783	228,731	44,542	58,500	90,277	167,261	1,299,553	26,720	1,326,273	8,900,675	32,063,514	42,290,462	42,290,462

TABLE VI.—PLACER GOLD.

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

YIELD OF PLACER GOLD 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		
						Total	$74,620,103

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	17,391	204,800	9,216	.....	.....	.....	.....	26,547
1888	.....	.....	79,780	75,000	674,500	29,813	.....	.....	.....	.....	104,813
1889	.....	.....	53,192	47,873	165,100	6,498	.....	.....	.....	.....	54,371
1890	.....	.....	70,427	73,948	*Nil.*	*Nil.*	.....	.....	.....	.....	73,948
1891	.....	.....	4,500	4,000	*Nil.*	*Nil.*	.....	.....	.....	.....	4,000
1892	.....	.....	77,160	66,935	808,420	33,064	.....	.....	.....	.....	99,999
1893	1,170	23,404	227,000	195,000	2,135,023	78,996	.....	.....	.....	.....	297,400
1894	6,252	125,014	746,379	470,219	5,662,523	169,875	324,680	16,234	.....	.....	781,342
1895	39,264	785,271	1,496,522	977,229	16,475,464	532,255	952,840	47,642	.....	.....	2,342,397
1896	62,259	1,244,180	3,135,842	2,100,689	24,190,977	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	1,390,617	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	3,446,678	.....	.....	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	5,276,922	.....	.....	15,180,164
1906	224,027	4,630,689	2,900,262	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	265,582	5,282,880	2,631,389	1,321,488	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	958,293	26,872,397	1,069,521	36,927,656	4,571,644	2,634,544	129,092	11,454,063
1912	257,496	5,322,442	3,132,108	1,810,045	44,871,454	1,805,627	51,456,537	8,408,513	5,358,280	316,139	17,662,766
1913	272,254	5,627,490	3,465,856	1,968,606	55,364,677	2,175,832	46,460,305	7,094,489	6,758,768	324,421	17,190,838
1914	247,170	5,109,004	3,602,180	1,876,736	50,625,048	1,771,877	45,009,699	6,121,319	7,866,467	346,125	15,225,061
1915	250,021	5,167,934	3,366,506	1,588,991	46,503,590	1,939,200	56,918,405	9,835,500	12,982,440	1,460,524	19,992,149
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
To'l	4,430,226	91,350;784	73,409,324	41,358,012	886,879,502	36,415,124	717,505,675	114,559,364	85,453,671	7,212 759	290,896,043

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
Total	44,894,609	$145,440,340

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
Total	3,615,465	$20,388,975

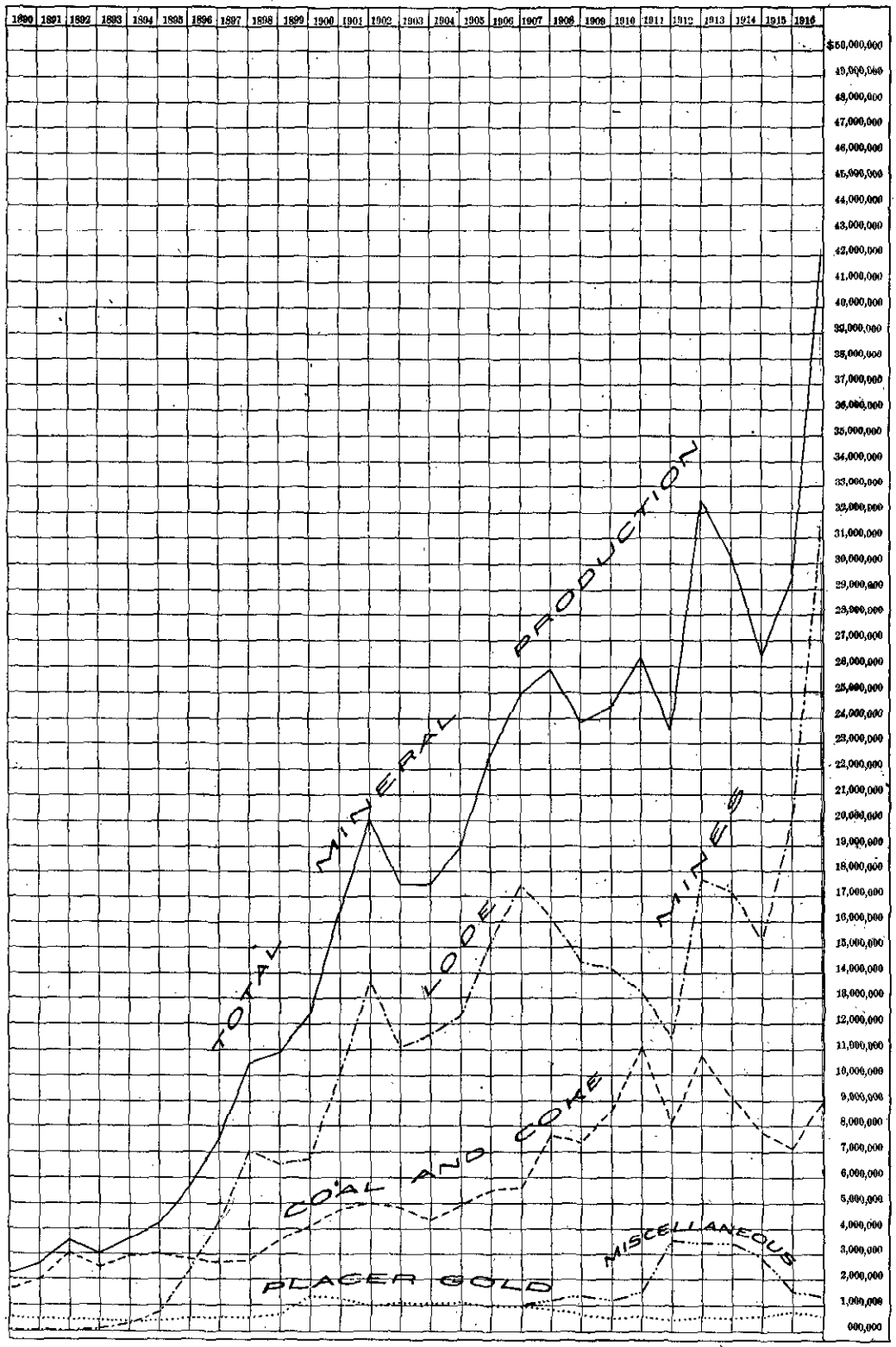
TABLE IX.—PRODUCTION IN DETAIL OF THE

DISTRICT.	YEAR	TONS.	GOLD—PLACER.		GOLD—LODE.		SILVER.	
			Ounces	Value.	Ounces.	Value.	Ounces.	Value.
				$		$		$
Cariboo								
Cariboo Division	1913		6,550	131,000				
	1914		8,250	165,000				
	1915		10,750	215,000				
	1916		**7,900**	**158,000**				
Quesnel "	1913		1,500	30,000				
	1914		1,750	35,000				
	1915		4,250	85,000				
	1916		**1,000**	**20,000**				
Omineca "	1913	353	300	6,000	62	1,281	46,298	26,297
	1914	350	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	**17,762**	**850**	**17,000**	**1,303**	**26,933**	**112,635**	**70,262**
Cassiar								
Atlin Division	1913	310	15,750	315,000	1,355	28,008		
	1914	270	16,100	322,000	1,000	20,670		
	1915	320	18,850	377,000	875	18,086		
	1916	**262**	**16,925**	**338,500**	**736**	**15,213**	**3,054**	**1,905**
Liard, Stikine, Skeena, Queen Charlotte, Portland Canal Divisions.	1913	51	650	13,000	29	599	4,714	2,678
	1914	261,987	1,150	23,000	2,884	59,612	131,509	68,516
	1915	646,391	1,450	29,000	5,034	104,053	175,179	82,684
	1916	**732,380**	**1,100**	**22,000**	**3,806**	**78,670**	**256,802**	**160,193**
East Kootenay								
Fort Steele Division	1913	32,626	100	2,000			362,311	205,793
	1914	36,884	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**
Windermere-Golden	1913	10,000					4,756	2,701
	1914							
	1915	5,556					1,188	561
	1916	**2,183**					**29,178**	**18,201**
West Kootenay								
Ainsworth Division	1913	92,472			25	517	447,015	253,905
	1914	66,441			100	2,067	329,586	171,714
	1915	42,630			121	2,501	289,565	136,675
	1916	**77,841**			**45**	**930**	**321,202**	**200,366**
Slocan and Slocan City	1913	116,206			252	5,209	1,841,226	1,045,816
	1914	104,510			13	269	1,775,975	925,283
	1915	114,292			26	537	1,812,550	855,524
	1916	**123,886**			**64**	**1,323**	**1,480,571**	**923,580**
Nelson Division	1913	79,843	50	1,000	26,324	544,117	129,011	73,278
	1914	57,879			15,298	316,210	150,268	78,290
	1915	23,634	50	1,000	9,233	190,846	9,405	4,439
	1916	**20,695**	**50**	**1,000**	**4,107**	**84,891**	**32,647**	**20,303**
Trail Creek Division	1913	253,870			137,004	2,831,873	109,585	62,244
	1914	297,260			138,568	2,864,201	136,185	70,952
	1915	338,568			142,595	2,947,489	159,584	75,324
	1916	**308,924**			**129,790**	**2,682,759**	**132,080**	**82,391**
Revelstoke, Trout Lake and Lardeau	1913	546	100	2,000	54	1,116	23,397	13,289
	1914	149	100	2,000	8	165	11,295	5,885
	1915	155	100	2,000	15	310	16,740	7,901
	1916	**521**	**50**	**1,000**	**22**	**455**	**22,419**	**13,985**
Boundary-Yale								
(Grand Forks, Greenwood and Osoyoos Divisions.)	1913	1,844,795	50	1,000	101,195	2,091,701	394,048	223,819
	1914	1,093,229	50	1,000	84,908	1,775,048	347,981	181,298
	1915	1,228,724	100	2,000	87,870	1,816,273	273,795	129,231
	1916	**1,343,853**	**50**	**1,000**	**75,628**	**1,563,231**	**280,578**	**175,025**
Similkameen, Nicola, and Vernon Divisions	1913	54	150	3,000	1	20	335	190
	1914	150	150	3,000	35	724	15	8
	1915	225	600	12,000	101	2,088	347	164
	1916	**1,416**	**450**	**9,000**	**32**	**661**	**830**	**518**
Yale, Ashcroft and Kamloops Divisions	1913	557	100	2,000	25	517	126	72
	1914	279	150	3,000	14	289	57	30
	1915	2,134	500	10,000	106	2,191	1,702	803
	1916	**7,414**	**150**	**3,000**	**570**	**11,782**	**4,215**	**2,629**
Lillooet								
Lillooet and Clinton Divisions	1913	840	150	3,000	1,368	28,277	295	168
	1914	120	150	3,000	231	4,775	390	203
	1915	50	400	8,000	31	641	5	2
	1916	**2,400**	**250**	**5,000**	**2,625**	**54,259**		
Coast								
(Nanaimo, Alberni, Clayoquot, Quatsino, New Westminster, Vancouver, and Victoria Divisions.)	1913	231,286	50	1,000	4,560	94,255	102,739	58,356
	1914	256,463	50	1,000	3,908	80,778	91,574	47,710
	1915	225,454	100	2,000	2,490	51,468	66,033	31,168
	1916	**449,982**	**50**	**1,000**	**3,204**	**66,227**	**116,119**	**72,435**
TOTALS	1913	2,663,209	25,500	510,000	272,254	5,627,490	3,465,856	1,968,606
	1914	2,175,971	28,250	565,000	247,170	5,109,004	3,602,180	1,876,736
	1915	2,690,110	38,500	770,000	250,021	5,167,934	3,366,506	1,588,991
	1916	**3,188,865**	**29,025**	**580,500**	**221,932**	**4,587,334**	**3,301,923**	**2,059,739**

METALLIFEROUS MINES, ETC., FOR 1913, 1914, 1915, AND 1916.

LEAD.		COPPER.		ZINC.		TOTALS FOR DIVISIONS.				TOTALS FOR DISTRICTS.
Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	1913.	1914.	1915.	1916.	1916.
	$		$		$	$	$	$	$	$
										772,157
						131,000				
							165,000			
								215,000		
									158,000	
						30,000				
							35,000			
								85,000		
									20,000	
156,862	6,165	1,838	231			40,024				
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	
										7,163,427
						343,008				
							342,670			
								395,086		
7,260	448								356,066	
6,579	259	1,336	204			16,740				
		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	
										3,506,224
18,525,083	728,036					935,829				
24,863,105	870,209						1,127,583			
26,582,050	1,108,472			180,000	20,250			1,370,876		
24,156,143	1,490,817	5,664	1,538	14,340,000	1,614,592				3,428,993	
2,495,355	98,067					100,768				
216,327	9,021			311,719	35,068			44,650		
571,244	35,257	3,400	925	210,000	22,848				77,231	
										9,054,925
9,027,861	354,795			150,680	7,253	616,450				
8,069,525	282,433			280,000	12,320		468,584			
3,436,184	143,289			678,940	76,381			358,846		
7,841,869	494,000			625,971	68,103				753,402	
22,648,766	890,096			6,608,088	317,188	2,258,309				
15,233,910	533,187			7,264,464	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	
1,936,418	76,101	815,126	124,470			818,966				
2,004,436	70,155	586,764	79,800	332,003	14,608		559,063			
967,775	40,356	30,240	5,225	3,127,209	351,811			593,677		
1,240,784	76,582	176,383	47,980	3,470,036	377,540				608,236	
		2,538,661	387,654			3,281,771				
		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	
521,771	20,506					36,911				
128,912	4,512						12,562			
89,041	3,713							13,924		
206,741	12,760								28,200	
										6,788,331
45,982	1,807	28,621,973	4,370,575			6,688,902				
1,678	59	16,428,959	2,234,339				4,171,744			
7,127	297	17,402,662	3,007,180					4,954,981		
14,922	921	17,626,623	4,794,794						6,534,971	
		8,073	1,233			4,443				
							3,732			
		21,701	3,750					18,002		
		182,633	49,680						59,859	
		29,505	4,505			7,094				
		14,525	1,975				5,294			
		295,164	51,004					63,998		
47,380	2,924	635,594	173,166						193,501	
										59,259
						31,445				
							7,978			
								8,643		
									59,259	
										4,719,191
		14,443,793	2,205,567			2,359,178				
		13,070,245	1,777,553				1,907,041			
		9,770,197	1,688,290					1,772,926		
		16,835,265	4,579,529						4,719,191	
55,364,677	2,175,832	46,460,305	7,094,489	6,758,763	324,421	17,700,838				
50,622,048	1,771,877	45,009,699	6,121,319	7,866,467	346,125		15,790,061			
46,503,590	1,939,200	56,918,405	9,835,500	12,982,440	1,460,524			20,762,149		
48,727,516	3,007,462	65,379,364	17,784,494	37,168,980	4,043,985				32,063,514	32,063,514

TABLE X.—Showing Mineral Production of British Columbia.



PROGRESS OF MINING.

The gross value of the mineral production for 1916 was $42,290,462, an increase over that of the year 1915 of $12,842,954, or nearly 44 per cent., and an increase over that of the previous record year 1912 of $9,849,662, or 30.3 per cent. The gross value of the metallic minerals recovered in 1916 was $32,063,514, which represents an increase over last year of $11,301,365, a percentage increase of about 54 per cent. which is certainly a matter for congratulation. It might be further pointed out that the metalliferous output for 1916 was the greatest in the history of mining in the Province, being nearly 76 per cent. greater than the year of 1912.

This increased value of the metalliferous output is due in part to the higher market prices of the metals during the year, and in part to the much larger production of some metals, notably copper and zinc.

The production of copper was 8,460,959 lb. more than the previous record year (1915), or 14.85 per cent., while the zinc-output was three times in quantity that of the previous year.

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

The year 1916 was a record year for mining in British Columbia, all branches of the industry, excepting gold and the building materials, showing increased production over that of the previous year. The uncertainty of war conditions during 1915 was not such a prominent feature in 1916, and steady operations were general throughout the year.

The continued enormous and ever-increasing demand for shells of all kinds for the Allies has continued the great consumption of copper, lead, and zinc, with the result that the market prices of these metals remained at an abnormally high level all year.

During the last half of 1915 the market prices of metals were high, but, as it was thought these prices might drop at any time, the main stimulating effect on mining was only to increase production at the existing mines and did not cause much development of new properties. With, however, the continuation of these high prices and the predictions by many eminent authorities that at least reasonably high metal prices might be expected to continue for some time, the year 1916 saw a great increase of new development.

All over the Province old properties which had been abandoned, or closed, were re-examined and in many instances work commenced and ore shipments made. Along the Coast a number of copper prospects which have lain dormant for years have been taken up under options and work on them started. Capital for these new enterprises is being obtained in Vancouver, Victoria, Spokane, Edmonton, and, of course, from the large moneyed centres of the United States.

Owing to the fact that so many men in the Province have enlisted, the problem of getting sufficient labour has often been serious, and there is no doubt that with ample labour a still larger production would have been made. Prospecting has suffered more than mining, as the prospectors as a class have responded very readily to the recruiting sergeant, with the result that prospecting has been practically at a standstill. Furthermore, the high wages being paid at the mines has retained many who might otherwise have engaged in prospecting during the summer-time. A great need for the future of the mining industry is a large influx of prospectors to the Province, and it may confidently be expected that the free and adventurous life of prospecting will make a strong appeal to many of the returned soldiers.

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. As might be expected, then, with a largely increased production of metalliferous minerals in 1916, there is also an increased output of coal and coke. On the other hand, a stoppage of production of coal and coke immediately curtails the metalliferous production.

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 tht copper-smelters, and these in turn compelled the copper-mines to very much curtail their outputs.

But for these untoward circumstances it is certain that the output for 1916 would have approached the $50,000,000 mark.

A portion of the coal-output is used for domestic purposes and in industrial plants, and a decline in demand for fuel for these purposes partly offset the increase due to increased metalliferous production.

The production of building materials shows a slight decrease as compared with the previous year, which reflects the continued depression in the building trades.

Taken in the aggregate, the mineral production and development in the year 1916 is cause for congratulation at this time, and it may confidently be expected that the future will show a steady increase. The industry is now in a healthy condition and promises well for the future.

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 over 75 cents at the close of the year 1916 proved very beneficial to the silver-lead mines of the Slocan.

The year 1916 saw some important metallurgical developments in British Columbia. The most important of these was the completion and commencement of operations at the electrolytic zinc plant of the Consolidated Company at Trail near the beginning of the year. The plant was operated steadily during the remainder of the year and is now turning out from 25 to 30 tons of spelter a day. The output for 1916 was approximately 15,000,000 lb. In connection with this plant sulphuric acid and hydrofluosilic acid plants were erected.

The commencement of electrolytic copper-deposition process in the Province was also started at Trail during the year. The refinery installed has a capacity of 10 tons of cathode copper a day, and is now being increased to 15 tons a day. In addition to copper produced by the Consolidated Company some blister-copper from the British Columbia Copper Company is also being refined at this plant.

Late in the year the Ladysmith smelter, which has lain idle since 1911, was purchased from the Tyee Copper Company by the Ladysmith Smelting Corporation, Ltd., backed by Ohio capital. It is expected that the smelter will be ready to operate some time in the near future. A general custom smelting business is to be carried on, and in addition the company expects to obtain ore from its own properties.

Several new concentrating plants have been under construction during the year and some of these were completed. Of these the most important were the *Florence* mill at Ainsworth, the *Surprise* mill, Slocan, and the mill at the Surf Inlet property, Princess Royal island.

During the year considerable increases were made in the wage schedule paid to all labour employed in mining. As high metal prices prevailed, this worked no hardship on the operating mines, except in the case of gold-mines. Gold by remaining at a standard price has really declined considerably in value when measured in terms of labour and supplies, so that the gold-mines, by having higher operating expenses and no increase in the value of the finished product, have made lower profits than in former years.

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.

All the large operating companies have had a satisfactory year, and, in addition to ore-extraction, development has been kept well ahead. The Britannia Company brought further milling capacity into operation during the year and is now treating 2,800 tons a day.

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

The tonnage of ore mined in the lode mines of the Province during the past year was greater than that of any previous year. The ore mined amounted to 3,188,865 tons, showing an increase over that of the previous year of 498,755 tons.

The tonnage mined in 1916 was produced by the various districts in about the following proportions: Boundary-Yale, 42.4 per cent.; Cassiar and Omineca, 23.5 per cent.; Coast District, 14.1 per cent.; Rossland, 9.7 per cent.; Slocan, 3.9 per cent.; East Kootenay, 3.2 per cent.; Ainsworth, 2.4 per cent.; Nelson, 0.7 per cent.; all others, 0.1 per cent.

The following table shows the number of mines which shipped ore during the year 1916, 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 1916.

	Tons of Ore shipped.	No. of Mines shipping.	No. of Mines shipping over 100 Tons in 1916.	MEN EMPLOYED IN THESE MINES.		
				Below.	Above.	Total.
CASSIAR DISTRICT:						
Atlin, Stikine, Queen Charlotte, and Portland Canal	2,063	9	3	39	40	79
Skeena	731,079	4	1	316	135	451
CARIBOO DISTRICT:						
Omineca	17,752	7	2	60	52	112
EAST KOOTENAY DISTRICT:						
Fort Steele	98,846	5	3	148	96	244
Windermere-Goldén	2,183	9	5	38	29	67
WEST KOOTENAY DISTRICT:						
Ainsworth	77,841	18	7	197	151	348
Slocan and Slocan City	123,886	34	15	453	288	741
Nelson	20,695	14	11	151	64	215
Trail Creek	308,924	4	4	661	150	811
Revelstoke, Lardeau, and Trout Lake	521	6	1	22	17	39
BOUNDARY-YALE DISTRICT:						
Greenwood, Grand Forks, and Osoyoos	1,343,853	30	15	535	269	804
Similkameen, Nicola, and Vernon	1,416	7	1	16	19	35
Yale, Ashcroft, and Kamloops	7,414	8	2	63	48	111
LILLOOET DISTRICT	2,400	3	3	17	28	45
SOUTHERN COAST DISTRICT	449,992	17	9	560	592	1,152
Total	3,188,865	169	81	3,276	1,978	5,254

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	4	13	17	4	18	22
EAST KOOTENAY		3	3			
AINSWORTH	3	6	9	9	7	16
SLOCAN	9	11	20	32	14	46
NELSON	2	7	9	8	2	10
TRAIL CREEK	1	6	7	4	3	7
REVELSTOKE-LARDEAU	4	1	5	7		7
BOUNDARY	3	11	14	15	12	27
LILLOOET	1	1	2	2	2	4
Total	27	59	86	81	58	139

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 1916, aggregating $558,560,715. From this table it will be seen that coal-mining has produced more than any other separate class of mining, a total of $165,829,315; followed next in importance by copper at $114,559,364, and next in order is lode gold at $91,350,784, with placer gold in fourth place at $74,620,103.

The metal gold, obtained from both placer and lode mining, amounts to a value of $165,970,887, the greatest amount derived from any one mineral, the next important being coal, the total gross value of which, combined with that of coke, is $165,829,315, followed by copper at $114,559,364, silver at $41,358,012, and lead at $36,415,124.

TABLE II. shows the value of the total production of the mines of the Province for each year from 1893 to 1916 (inclusive), during which period the output increased tenfold, and reached a gross production for the year 1916 of $42,290,462, which is $12,842,954 greater than that of the year 1915, and nearly 40 per cent. greater than the previous record year, certainly a matter for congratulation.

The value of the total mineral production of the Province up to the end of 1916 was $558,560,715.

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 $189,500, and a decrease in the output of lode gold of $580,600, making a total decrease of $770,100 in the total production of the metal.

The amount of silver produced this year was 3,301,923 oz., having a gross value of $2,059,739, a decrease in the number of ounces of 64,583, due principally to a decreased ouput in the Slocan and Trail Creek districts which was partially compensated by increases in all the other districts. The value of the silver production in 1916 was, however, $470,748 greater than in 1915, due to the prevailing high market price of silver in 1916.

The table shows an output of lead in 1916 amounting to 48,727,516 lb., valued at $3,007,462, which is an increase over the production of the preceding year of 2,223,926 lb. of lead, and an increase in value of $1,068,262, partly due to the advance in the value of the metal.

The production of copper this year was 65,379,364 lb., valued at $17,784,494, an increase in amount of 8,460,959 lb. or about 14.8 per cent. The value of the product was greater than that of the preceding year by $7,948,994—an increase of slightly over 80 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 for the first time on record the Southern Coast District has the honour of first place on the list, followed, in order of importance, by the West Kootenay, Boundary, Cassiar, and East Kootenay 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 $1,143,265, as shown in Table V.

TABLE V. is a new table introduced four years ago, and is an endeavour to show in some detail the production of those products, such as building materials, previously summarized under "Miscellaneous products," and which amounts this year to $1,326,273. 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 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 1916, and shows a total production of $74,620,103. The output for 1916 was $580,500, a decrease, as compared with the previous year, of about 24.6 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 $290,896,043; 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 1916 was 44,894,609 tons (of 2,240 lb.), worth $145,440,340. Of this, there was produced in 1916 2,084,093 tons valued at $7,294,325, an increase of 472,964 tons in quantity and of $1,655,373 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 1916 was 401,487 tons, from which was made 267,725 tons of coke, having a value of $1,606,350, an increase in amount over the preceding year of 21,854 tons, or about 8.9 per cent., with an increase in value of $131,124. The total value of the ouput of the collieries of the Province in 1916 was $8,900,675.

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 1913, 1914, 1915, and 1916, 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 1916 was 3,188,865 tons, having a gross value of $31,483,014 and, with the placer gold, a total value of $32,063,514.

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

Boundary-Yale District	42.42	per cent. of tonnage.
Trail Creek Mining Division	9.68	„ „
Cassiar and Omineca Districts	23.50	„ „
Southern Coast District	14.12	„ „
Slocan District	3.88	„ „
Ainsworth Mining Division	2.44	„ „
Nelson Mining Division	0.65	„ „
East Kootenay District	3.16	„ „
Other Divisions	0.15	„ „
	100.00	

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

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

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

It will be seen that, although coal-mining has been a constantly increasing industry during this whole period of twenty-six years, lode-mining did not begin practically, until 1894, since when it has risen with remarkable rapidity, though not without interruption, until it reached, in 1906, the $17,500,000 line. The total mineral production in 1910 reached the $26,000,000 line, and in 1912 it reached the $32,000,000 line, while this year it is above the $42,000,000 line.

GOLD.

Placer Gold.

The production of placer gold during the past year was worth about $580,500 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 1915, of $189,500, chiefly due to a drier season than usual in the Atlin and Cariboo Districts.

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.

Although this year shows a decreased output as compared with 1915, it is, nevertheless, greater than that of any other year since 1908.

In hydraulic mining it has been pretty well demonstrated that the gold-output is in direct proportion to the number of days in which water was available for piping; the snowfall of the winter of 1915-16 was unusually light, and, as this is the principal source of the water-supply, it was anticipated that the quantity of water available for hydraulicking would fall short of the usual quota; hence there was little hope for even a normal production of placer gold during the season of 1916.

In the Barkerville section of the Cariboo District the larger hydraulic companies made a smaller output than usual, due to an insufficient supply of water; this is also true of the Quesnel and Quesnel Forks sections, which report much smaller amounts of gold recovered than has been the rule for some years past.

Complete news has been received from the Omineca District, where considerable work has been going on, most of which, however, was of a preparatory nature, and it is not expected that any great output was made this year, probably not more than about $17,000 all told.

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

In the Liard-Stikine District the Boulder Creek Hydraulic Mining Company had a successful season, taking out about $17,000 from its ground on Thibert creek. Ball and Finn and Mitchell Bros., working in the same vicinity, made small outputs.

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

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

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

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 better output than for some years past.

Gold from Lode-mining.

The value of the gold produced from lode-mining in the Province during the year 1916 was $4,587,334, a decrease, as compared with the previous year, of $580,600, or about 11.23 per cent. This smaller production of lode gold is due to a decreased tonnage of ore mined in the Rossland District and to slightly lower values in the gold contents of the Boundary ores.

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

The only large stamp-mill in operation in the Province is at the *Nickel Plate* mine at Hedley, in the Osoyoos Mining Division, which, this past year, milled some 73,500 tons of ore having a

value of over $700,000. 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 *Engineer* mine, Atlin, which operated during the year.

The following are the values of the gold product of the three most important camps; Rossland, $2,682,759; Boundary, $1,563,231; and Nelson, $84,891. Nearly 80 per cent. of the gold production of the Province is obtained from the smelting of copper-bearing ores, the remainder mainly from stamp-milling.

The gold production of the various districts is approximately as follows:—

	Oz.
Rossland	129,790
Boundary	76,230
Nelson	4,107
Skeena	3,806
Coast	3,204
Omineca	1,303
All others	3,492

The production in the Rossland District shows a decrease of 12,805 oz. as compared with 1915, which is accounted by a decrease in the tonnage shipped.

The Boundary District shows a decrease of 11,640 oz., as compared with 1915. The Granby Company's mines show a decrease of about 7,800 oz., but the British Columbia Copper Company shows a considerable increase; while the *Jewel* and the *Union* show decreases.

The *Nickel Plate* production was less than the previous year by nearly 8,000 oz. The other properties in this district only contribute small amounts. The *Carmi* did not operate, and little was done by the *Dividend-Lake View*.

A reduction of about 5,000 oz. occurred in the Nelson District, or over 50 per cent. This decrease is mainly due to a falling-off in the production of the *Mother Lode* mine on Sheep creek, where the cyanide-mill was not operated owing to the exhaustion of the developed ore reserves at the mine. The mine is at present closed and the future plans of the company are not known. The *Granite* mine made an increased production.

The *Queen* mine, on Sheep creek, made a smaller output than the previous year, but it is said that development-work on the lower levels is proving satisfactory in showing the continuation of the ore-shoots.

The production of gold from the Skeena District is practically all from the *Hidden Creek* mine, at Anyox. The tonnage mined at this property was greater, but the gold content was somewhat lower, than in 1915.

The Coast production shows an increase, due to increased tonnage 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 last year. The ore is a high-grade copper ore, carrying low gold and silver values.

SILVER.

The total amount of silver produced in the Province during the year 1916 was 3,301,923 oz., valued at $2,059,739, a decrease in amount, as compared with the previous year, of 64,583 oz.; but, owing to the increase in the market value of this metal, the value of the silver-output in 1916 was $470,748 greater than in 1915.

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 three years, which were:—

1913	59.8 cents an oz.
1914	54.8 "
1915	49.7 "
1916	65.7 "

The market price steadily improved, starting at 56.8 cents in January and reaching 75.765 cents in December, 1916.

The increase in the price of silver was due to the large amounts being required by Great Britain, France, and Russia for coinage.

The Slocan District—including the Ainsworth, Slocan, Slocan City, and Trout Lake Mining Divisions—produced about 55 per cent. of the total Provincial output of silver this year, and the Fort Steele Mining Division about 15.4 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	1,480,571 oz. silver	= 44.83	per cent. of total.
Fort Steele M.D. produced	509,693 „	15.43	„
Ainsworth „	321,202 „	9.73	„
Boundary „	285,623 „	8.65	„
Skeena „	256,802 „	7.77	„
Trail Creek „	132,080 „	4.00	„
Omineca „	112,635 „	3.41	„
Coast „	116,119 „	3.52	„
Nelson „	32,547 „	0.99	„
Trout Lake-Revelstoke M.D. produced	22,419 „	0.68	„
All others produced	32,232 „	0.99	„
	3,301,923	100.00	

LEAD.

The lead production of the Province for the year 1916 was 48,727,516 lb. of lead having a market value of $3,007,462, showing, as compared with the previous year, an increase in amount of 2,223,926 lb. of lead, or 4.72 per cent.; but owing to the increase in the market value of this metal, the value of the lead-output in 1916 was $1,068,262 greater than in 1915.

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 1916 was considerably higher than for the previous year, being 6.858 cents a pound as compared with 4.6 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	24,156,143 lb. lead	= 49.57	per cent. of total.
Slocan „	14,415,645 „	29.58	„
Ainsworth „	7,841,869 „	16.09	„
Nelson „	1,240,784 „	2.55	„
Omineca „	224,451 „	0.46	„
All others „	848,624 „	1.75	„
	48,727,516	100.00	

COPPER.

The amount of copper produced by smelting in the Province in 1916 was 65,379,364 lb. fine copper, valued at the average New York market price for copper at $17,784,494. These figures represent the amount of copper actually recovered, as nearly as it is possible to ascertain; the amount of copper really in the ores mined would be approximately 25 per cent. greater. This is the largest copper-output in the history of the Province.

As compared with the year 1915, these figures show an increased production in amount of 8,460,959 lb., or about 14.86 per cent. and in value the increase is $7,948,994, or 55.3 per cent.

The amount of copper produced during the year 1916 is the largest in the history of copper-mining in the Province; the highest previous production, made in 1912, was 51,456,537 lb., valued at $8,408,513.

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

Owing to this heavy demand for war purposes, principally for brass to be used in shells, the market price of copper increased steadily during the year. The year opened with copper at about 22.5 cents a pound in the New York market, and at the end of December it was 29 cents; the average price for the year was 27.202 cents, as compared with an average price of 17.275 cents in 1915. This higher market value of the metal assisted materially in raising the value of the copper produced, thereby greatly stimulating production.

The large increase in quantity of copper produced this year is due to a greatly increased production from the Coast District of some 7,000,000 lb., largely from the *Britannia* mine, while the Granby Company's *Hidden Creek* mine, at Anyox, on Observatory inlet, increased its production by about 2,000,000 lb. The output from the *Rocher Déboulé* mine, in the Omineca Division, was rather less than last year. The Trail Creek Mining Division and the Boundary District made very nearly the same production as last year; the output from Kamloops was greater, chiefly due to increased production from the *Iron Mask*.

The big mine and smelter of the Granby Company at Anyox were operated continuously throughout the year, and the tonnage treated was nearly 2,300 tons a day. The reserves of good-grade ore at this mine are very considerable and are given in the annual report of the company for the fiscal year ended June 30th, 1916, as amounting to 9,416,385 tons, with an average copper content of 2.37 per cent.; in addition to which there is practically an equal tonnage of lower-grade ore. The Granby Company this year produced from its mines in Skeena and Boundary 57.6 per cent. of the Province's copper production.

Another important producer of copper in the northern portion of the Province is the *Rocher Déboulé* mine, near Hazelton. After developing for a couple of years this property commenced shipping in June, 1915, and has produced steadily since that time.

In the Boundary District the Granby Company's mines at Phoenix and smelter at Grand Forks were operated to nearly full capacity, but the output was curtailed during the latter part of the year owing to shortage of coke. Operations at this plant were characterized by the handling of a large amount of material low in copper and highly siliceous which had not previously been classed as ore. This was rendered possible by the high price of copper.

The British Columbia Copper Company, which operates the *Mother Lode* mine at Deadwood and a smelter at Greenwood, was, in former years, another large producer of copper in the Boundary District. During the past year this company's production has again increased very materially; a production of about 3,376,000 lb. of copper being made, chiefly by the *Mother Lode* mine. The company's smelter was operated steadily throughout the year, although also affected somewhat by the coke shortage.

The *Britannia* mine had a very successful year, the tonnage of ore mined and milled being about 400,000 tons, containing 18,000,000 lb. copper, 98,000 oz. silver, and 800 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 1915; the most important producer is again the *Marble Bay*.

More small shipments of copper ore were made from Vancouver island and along the Coast than in 1915. 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 1916, it is likely that a considerable increase of production will take place in 1917.

The only production of copper in the Nelson Division was from the *Eureka* mine, but the reopening of the old *Silver King* mine about the end of the year may assist copper production from this Division in 1917.

The following table shows the production of the various districts for the years 1913, 1914, 1915, and 1916:—

	1913. Lb.	1914. Lb.	1915. Lb.	1916. Lb.	1916. Per Cent.
Boundary District	28,621,973	16,428,959	17,402,662	17,626,623	26.97
Rossland District	2,538,661	3,779,830	4,651,681	4,200,745	6.42
Coast, Omineca & Cassiar Districts,	14,446,967	24,199,621	34,516,957	42,547,332	65.08
Yale-Kamloops District	37,578	14,525	295,164	819,227	1.25
Nelson and other Districts	815,126	586,764	51,941	185,437	0.28
	46,460,305	45,009,699	56,918,405	65,379,364	100.00

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

Boundary, 0.655 per cent.; Coast, Omineca, and Cassiar, 1.77 per cent.; and Rossland, 0.68 per cent.

Copper-mining is now the most important form of mining in the Province, and this year it more than equalled in value the entire total value of the other lode minerals produced, and was double the value of the coal and coke production. It forms 55.5 per cent. of the total value of metalliferous mines and 42.5 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 most important metallurgical development in connection with copper-mining during the year 1916 was the establishment of a copper-refinery at the Trail smelter. Until this year all copper produced in the Province was shipped to Eastern points as blister-copper and there refined, but with a start at refining having been made, it may be expected that an increasing amount of the copper-output will be refined in the Province.

The plant at Trail has a capacity of 12 tons of refined copper a day, but is being increased to 17 tons a day; it treats blister-copper from the Trail smelter and part of the blister-copper produced at the Greenwood smelter of the British Columbia Copper Company.

The smelting plant at Ladysmith owned by the Tyee Copper Company, which has lain idle since 1911, was sold near the end of the year, and will be operated by a new company, the Ladysmith Smelting Corporation, Limited. It is said that the purchasers intend to enlarge the smelter, equip it with converters, and possibly to erect a copper-refinery to refine the blister-copper produced.

ZINC.

The total quantity of zinc produced in 1916 was 37,168,980 lb., valued at $4,043,985, 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 1915, of 24,186,540 lb., or 53.6 per cent., in amount, and of $2,583,461, or 56.5 per cent., in value.

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

The former highest recorded productions were in 1909, when 8,500,000 lb. of zinc was produced, worth $400,000; in 1914, when the production was $7,866,467 lb., valued at $346,125; and in 1915, with 12,982,440 lb., valued at $1,460,524.

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

The price of spelter in the New York market averaged for the year 1913, 5.65 cents a pound; for the year 1914 it averaged 5.21 cents; for the year 1915 it averaged 13.23 cents; while the average for 1916 was 12.804 cents.

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

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

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

Of the total output of 37,168,980 lb., 17,854,357 lb. came from the Slocan District, 3,470,036 lb. from Nelson Division, 625,971 lb. from Ainsworth Division, and 14,950,000 lb. from East Kootenay.

The largest producer in the Province was the *Sullivan*, in East Kootenay, which is credited with 14,840,000 lb., followed by the *Standard*, in Slocan Division, with 9,530,000 lb., while the *Lucky Jim*, in Slocan, produced 3,833,000 lb.; the *H.B.*, in Nelson Division, 3,470,000 lb.; the Galena M. and M. Company, in Slocan Division, 2,473,000 lb.; and the *Slocan Star*, 1,334,000 lb.

An important event during the year was the commencement, in the spring, of the production of refined zinc at the new electrolytic zinc plant at the Trail smelter. This plant, which has a capacity of 25 tons a day of refined zinc, uses a new process which takes in the raw ore and turns out refined zinc. This is the first time that zinc ore has ever been refined in a commercial plant in British Columbia, and therefore adds a new industry to those which centre around mining. The plant was designed and built to treat ore from the Consolidated Company's *Sullivan* mine, but towards the end of the year some zinc concentrate was bought from the *Lucky Jim* mine and treated.

For the first time a production of zinc was made from the Omineca Division. This came from the *Silver Standard* mine, and was hand-sorted ore averaging about 40 per cent. zinc and 60 oz. silver.

OTHER MINERALS.

Iron Ore. No iron ore has been actually shipped during the past year, but some development and prospecting has again begun, stimulated by the demand for iron and steel which has been emphasized by the war having monopolized all the usual outside sources of supply, while the high freight rates have only made the lack of local production more pronounced.

The consequent strong agitation in favour of a local iron-smelting plant and the hope that such may materialize in the near future has led the owners of iron claims adjacent to the Coast to expect a market for their ores.

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."

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

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

Considerable interest has been manifested during the past year in regard to iron-deposits generally, and a bulletin on the subject has been issued and is found elsewhere in this Report under the subdivision Coast District.

Platinum. A small quantity of crude placer platinum has been recovered on the Tulameen river, in the Similkameen District, estimated at about $1,700 in value. This was obtained from placer-gold workings being carried on, and the results are considered encouraging.

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

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

Molybdenum.

Considerable interest has been evinced during the past year in molybdenite deposits, owing to the high price of this mineral, caused by demands for war purposes. This mineral, which is a sulphide of molybdenum, is used in the manufacture of special high-grade steel for guns. The actual output of molybdenite during the year was about 12 tons, estimated to be worth $20,570. A shipment was made from the *Molly* group, on Lost creek, in the Nelson Mining Division; this shipment amounted to 24 tons of ore and contained by assay about 12 per cent. of molybdenite. Some development-work was done on the property and it is now understood to be under lease and bond to the Orillia Molybdenite Company, which intends to erect a small concentrator. The market requirements are such that a molybdenite ore must be concentrated up to 85 or 90 per cent. molybdenite (MoS_2) before it is marketable. The Lost Creek property has several thousand tons of from 2 to 4 per cent. ore, so that, with a suitable mill, a small production could be maintained

Another property, on Alice arm, in the Skeena Mining Division, controlled by J. D. Ross, of Seattle, is reported to have a large showing of molybdenite and is described elsewhere in this report under "Alice Arm District." A mill was erected on the property 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; 9 tons of ore (16 per cent.) was shipped from Lillooet and 2 tons of 30-per-cent. ore from Keremeos.

Molybdenite ore, concentrated so as to contain 85 to 90 per cent. of that mineral, is now worth about $2,000 a ton.

The urgent demand for war purposes for antimony and molybdenum caused the Dominion Government Munitions Resources Commission to detail two ex-members of the Geological Survey, W. F. Ferrier and J. C. Gwillim, to spend the best part of the season in British Columbia in search of any available ores of these metals.

It has not yet been learned what success attended these efforts as far as antimony is concerned, though a small shipment was made from Three Forks. The drop in the price of the metal from 40 cents to 12 to 14 cents later in the season discouraged production.

As regards molybdenite ores, Mr. Gwillim reports that he has secured the following shipments:—

Molly mine	15 to 20 tons	ore running about 12 per cent. MoS_2.
Index mine, Texas creek..	9 tons	ore running about 16 per cent. MoS_2.
Alice arm	383 tons	ore running about 2 per cent. MoS_2.
Keremeos	2 tons	ore running about 30 per cent. MoS_2.

It is understood that these ores were shipped to Ottawa and there concentrated in the Government mill up to the required commercial grade of about 85 per cent. MoS_2, for which payment was made at the rate of approximately $20 a unit, less a nominal charge for concentrating.

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

Antimony.

Antimony is another metal which greatly advanced in price owing to demands for war purposes. Its principal use in war material is to harden the lead bullets used in shrapnel. The average price in January, 1916, was 42.55 cents a pound, and in December 14.59 cents. Increased production, especially in China, has brought the price to a more normal point.

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-Alturas* property, situated on a fork of Carpenter creek, in the Slocan Mining Division; this ore carried from 50 to 60 per cent. antimony.

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

Magnesite.

A deposit of hydromagnesite near the town of Atlin was worked to some extent this year by Armstrong and Morrison, of Vancouver. It is known that a few hundred tons was produced, but details regarding the shipment have

not yet been received. This occurrence of magnesite was fully described by the Provincial Mineralogist in the Minister of Mines' Report for 1904, and later in much greater detail by G. A. Young in the Summary Report of Geological Survey, 1915.

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

Magnesium Sulphate.

A deposit of magnesium sulphate near Kruger mountain, Osoyoos Division, occurs in a flat depression known as Spotted lake, which is a partially dried-up lake containing alternate circles of water and dry places. The magnesium sulphate occurs as a layer all over the lake-bottom, covering a considerable area and said to be of exceptional purity; the thickness of the deposit has not been definitely ascertained. Three hundred tons was extracted and shipped to New York in 1915, where a market at a good price was obtained. The material is used in the drug trade. The nearest town to the deposit is Oroville, Washington, U.S.A., which is distant about six miles.

About 75 tons of talc was shipped from Lillooet this past year.

COAL.

The gross production of coal in 1916 was 2,485,580 long tons, of which 401,487 tons was made into coke, leaving the net production at 2,084,093 tons. These figures show an increase, as compared with 1915, of 513,000 tons gross and of 472,964 tons net. The quantity of coke made was 267,725 tons, which is an increase of about 21,854 tons as compared with 1915. For purposes of comparison the following table is shown:—

	1911.	1912.	1913.	1914.	1915.	1916.
Coal, gross.....tons, 2,240 lb.	2,297,718	3,025,709	2,570,760	2,166,428	1,972,580	2,485,580
Less made into coke "	104,656	396,905	433,277	355,461	361,451	401,487
Coal, net..... "	2,193,062	2,628,804	2,137,483	1,810,967	1,611,129	2,084,093
Coke made..... "	66,005	264,333	286,045	234,577	245,871	267,725

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

	1913.	1914.	1915.	1916.
Vancouver Island mines.....tons, 2,240 lb.	973,493	1,072,314	1,020,942	1,492,761
Nicola and Similkameen mines..... "	265,542	138,931	99,066	110,549
Crowsnest mines..... "	1,331,725	955,183	852,572	882,270
Total quantity of coal mined..... "	2,570,760	2,166,428	1,972,580	2,485,580
Less made into coke..... "	433,277	355,461	361,451	401,487
Net quantity of coal produced..... "	2,137,483	1,810,967	1,611,129	2,084,093

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

	1913.	1914.	1915.	1916.
Vancouver Island collieries.....tons, 2,240 lb.	*Nil*	*Nil*	5,450	27,604
Nicola and Similkameen collieries... "	*Nil*	*Nil*	*Nil*	*Nil*
Crowsnest District collieries..... "	286,045	234,577	240,421	240,121
Total coke production.. ... "	286,045	234,577	245,871	267,725

As will be seen from the above figures, the net coal production this year is 472,964 tons more than it was in 1915, and greater than it has been since 1913.

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 fall 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 1916 was 267,725 tons (2,240 lb.), which is 21,854 tons greater than the preceding year, and, with the exception of the year 1913, is greater than any year since 1905.

The high market price of the metals, particularly copper, kept the copper-smelting plants, both of the Interior and the Coast, running to nearly full capacity, or as the coke-supply would permit.

Of this gross coke production, 240,121 tons was made by the Crow's Nest Pass Coal Company in East Kootenay, and the remaining 27,604 tons was made by the Canadian Collieries at Comox, V.I.

COLLIERIES OF COAST DISTRICT.

The Collieries of the Coast District, which includes those on Vancouver island and in the Nicola-Princeton fields, mined 1,603,310 tons of coal in 1916, while 18,238 tons was taken from stock, making 1,621,548 tons distributed from these collieries in 1916. This amount was distributed thus:—

Sold as coal in Canada	782,733	tons.
Sold as coal in United States	450,926	„
Sold as coal in other countries	6,166	„
Total sold as coal	1,239,825	tons.
Used under companies' boilers, etc.	135,037	„
Used in making coke	49,496	„
Lost in washing, etc.	197,190	„
	1,621,548	„
Minus coal taken from stock	18,238	„
Gross output	1,603,310	„

The total coal sales of the Coast collieries for the year show, as compared with the sales of the previous year, an increase of 368,219 tons, equivalent to over 42 per cent.

The consumption of coal sold in that part of British Columbia served by the Vancouver Island collieries shows this year an increase of 189,817 tons, or about 38 per cent. from the preceding year; the amount exported to the United States was 183,930 tons greater, and 6,166 tons of coal was exported to other countries.

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

This company produced in 1916 some 27,604 tons (2,240 lb.) of coke, of which 26,043 tons was sold in Canada, and 1,561 tons was added to stock.

On Vancouver Island, five companies produced coal this year—the Canadian Collieries, Limited, the Western Fuel Company, the Pacific Coast Coal Mines, the Vancouver-Nanaimo Coal Company, and the Nanoose Colliery; the majority of these companies each operate two, or more, collieries. The combined gross output of the Island collieries was 1,492,761 tons.

In the Nicola and Princeton coal-fields of the Coast District, the Middlesboro Colliery Company produced 49,005 tons of coal; the Princeton Colliery, 29,458 tons; the Inland Coal and Coke Syndicate (formerly Coal Hill Syndicate), 31,295 tons; the Pacific Coast Colliery Company, 453 tons; and the Merritt Collieries, Limited, 338 tons.

The total output of this portion of the sub-district was 110,549 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 813,250 tons; and the Corbin Coke and Coal Company, which made an output of 69,020 tons; making a gross output for the district for 1916 of 882,270 tons of coal. The Hosmer Mines, Limited, did not operate.

In addition to the coal mined 41 tons was taken from stock, making the amount of coal distributed from the collieries 882,311 tons.

Of this gross tonnage 351,991 tons was used in the manufacture of coke, of which there was produced 240,121 tons (2,240 lb.).

The coke sold this year amounted to 241,790 tons, of which 1,669 tons was taken from stock.

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

Sold as coal in Canada	75,319	tons.
Sold as coal in United States	386,953	„
Total sold as coal	462,272	tons.
Used by the companies in making coke	351,991	„
Used by the companies under boilers, etc.	68,048	„
	882,311	„
Minus coal taken from stock	41	„
Gross output	822,270	„

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, 83.4 per cent. of the gross output, their respective production representing 32.7 per cent., 28.4 per cent., and 22.3 per cent. of such total.

Of the other collieries: In the Coast District, on Vancouver island the Pacific Coast Coal Mines, Limited, produced 153,112 tons, and the Vancouver-Nanaimo Coal Company 78,443 tons; and in the Nicola Valley section of the district, the Middlesboro Colliery Company mined 49,005 tons, the Inland Coal and Coke Company 31,295 tons, the Princeton Coal and Land Company 29,458 tons, and the Pacific Coast Syndicate some 453 tons of coal.

In the East Kootenay District, in addition to the Crow's Nest Pass Coal Company, which produced 813,250 tons, the Corbin Coal and Coke Company produced 69,020 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 55 per cent. of the total coal-output.

The gross output of the collieries of the Province for the past year was, as already stated, 2,485,580 tons, and some 18,279 tons of coal was taken from stock, making the gross amount of coal distributed 2,503,859 tons.

Of this gross amount, there was sold for consumption in Canada, 858,052 tons; sold for consumption in the United States, 837,879 tons; sold in other countries, 6,166 tons; making the total coal sales for the year 1,702,097 tons of 2,240 lb.

In addition to the coal sold, there was used in the manufacture of coke 401,487 tons, and used under companies' boilers, etc., 203,085 tons; while 197,190 tons was lost in washing and screening.

The coke sales of the Province for the past year amounted to 267,833 tons, of which 108 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.	782,733	75,319	858,052
" export to United States ..... "	450,926	386,953	837,879
" export to other countries ..... "	6,166	.....	6,166
Total coal sales	1,239,825	462,272	1,702,097
COKE.			
Sold for consumption in Canada ..... tons, 2,240 lb.	26,043	207,413	233,456
" export to United States ..... "	.....	34,377	34,377
" export to other countries ..... "	.....	.....	.....
Total coke sales	26,043	241,790	267,833

BUILDING MATERIALS.

The production of building materials in 1916 was slightly less than in the preceding year, being $1,299,553 as compared with $1,571,181. 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 $1,250,000 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, except that during the last two years a considerable amount of rough building-stone, in the shape of rough granite blocks, has been used in the construction of the Government piers at the Outer Wharf, Victoria.

The outputs of sand and gravel, of brick, pottery, and cement are all slightly less than in 1915, but the decrease is not serious. The output of fire, face, and lime-silica brick shows an increase, due to a 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.," has been changed this 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.

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 $156,000, 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 3,600 M., amounting in value to $36,194; 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 nearly twice as great in 1916 as in the previous year, and is partly accounted for by the fact that the company supplied a lot of the brick products going into the construction of the electrolytic zinc-refinery at Trail. 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 about $164,000.

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 1916 as in the previous year. The Port Haney Brick Company, besides manufacturing common brick, also makes drain-pipe, partition-blocks, etc., but only a comparatively small output is made owing to lack of demand for such products.

Lime. The manufacture of lime is conducted in a small way at a large number of points in the Province, but only on the Coast has any attempt been made at more extensive operations. In the neighbourhood of Victoria, on Esquimalt harbour three kilns are in operation, and there are kilns on Saanich arm. On Texada island—in addition to the old plant at Marble bay—a new and extensive plant was erected at Blubber bay a few years ago. The limestone being used is of exceptional purity, but is 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 $106,000, as compared with $112,142 in 1915. Production of lime on the southern coast was lessened, but $24,000 worth of limestone was quarried in Skeena Division for use as flux at the Anyox smelter of the Granby Company.

The Consolidated Mining and Smelting Company quarried its customary yearly amount of limestone at the Fife quarries for use as flux in the furnaces at the Trail smelter. The amount produced in 1916 was 103,282 tons, valued at $51,641.

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 $436,459, which compares with $464,690 worth produced in 1915. The cement plant which was started near Princeton and operated for a few months was closed in 1913 and has never resumed operations.

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; and John D. Galloway, M.Sc., Assistant Provincial Mineralogist; while H. Nation nominally continues as general office assistant, but he went to the war in August, 1914, and his place has been temporarily filled.

During the season of 1916 the Bureau was allowed the temporary assistance in the field of a private practising mining engineer, W. M. Brewer, M.E., who was engaged to make examinations of and report on the mineral properties on Vancouver island and some of the adjacent islands, with particular reference to the iron-deposits thereon, on which a special bulletin (No. 3, 1917) has been issued, while his reports on the other mineral claims are included in the general reports of the districts in which they are situated.

J. H. Turnbull, Professor of Mining in the University of British Columbia, was engaged by the Department, and was occupied in field-work for two months making an examination of the Alice Arm district of the Skeena Mining Division, and his report thereon is included in the report on that Division.

Robert Musgrave, a mining engineer, was engaged for some of the summer months examining mining properties in various parts of the Province, most of his time being occupied in reporting on requests for Government assistance under the "Mines Development Act, 1916."

Provincial Mineralogist.

After the Report for the preceding year had been issued, the Provincial Mineralogist, with assistants, in May and December, held examinations at Victoria of candidates for Certificates of Competency as Assayers, each of which lasted a week. During the season of 1916 the greater part of the time of the Provincial Mineralogist was occupied in attending to work in connection with the publication of reports, and the superintending of the parties in the field, and to the routine work of the Bureau, necessitated by the continued absence for the entire year, on military duties, of his assistant, Harold Nation, which demanded his continual presence in the office, so that he was able personally to undertake but little field-work.

In September he made a short trip into the Lillooet Mining Division, examining mining properties and reporting thereon. For the first three weeks of December he was engaged in assisting the Chief Inspector in investigating the so-called "bumps" in the mines of the Crow's Nest Pass Coal Company at Fernie.

Assistant Provincial Mineralogist.

The Assistant Mineralogist, during the first half of the year, was engaged in the routine office-work, the preparation of the reports on his field-work of the previous field season, and assisting in the statistical work and compilation of the Annual Report. His field-work of the season was carried out in the Omineca, Bella Coola, Nanaimo, and Clinton Mining Divisions, leaving Victoria June 25th and returning November 15th, so that over four months was spent in field-work.

The entire month of July was spent in the Hazelton-Telkwa district of the Omineca Mining Division, and during that time practically all of the more important properties were examined, besides a number of prospects. The report on this work was published as Bulletin No. 2, 1917, in February of 1917, and with some corrections and changes is reprinted under the heading of "Omineca Division" in this Annual Report.

After looking over the existing mines and claims in the Hazelton-Telkwa district, the main part of the season's work commenced, which consisted of a trip from Houston, on the Grand Trunk Pacific Railway, southwards to the Chilcotin country. The object of the trip was partly to explore the contact of the Coast range with the older rocks on the east following southwards from the line of the Northern Transcontinental, and also to get information about some hæmatite iron-ore showings in the north-western end of the Chilcotin country.

On leaving Houston, the party proceeded to Owen lake, where some silver-lead-zinc claims have been staked; then on to Sibola mountain, where gold-quartz showings attracted a little attention two years ago. Sweeny mountain is near Sibola mountain, and on this some promising silver-lead showings have been staked.

From Sweeny mountain an old trail known as the Bonthrone trail was followed south to the western end of Ootsa lake.

The Forestry Service boat at Ootsa Lake, which is equipped with an Evinrude motor, was kindly loaned to the writer to make a trip on the big interior lakes. Ootsa lake was traversed to its head; thence up the Tahtsa river to where the Whitesail river joins it, and then up this river to Whitesail lake and on to the head of the lake. A portage of one mile and a half separating Whitesail lake from Eutsuk lake was made and all the upper end of Eutsuk lake was examined. The return was made by the same route, the total distance travelled being some 250 miles.

Arriving back at Ootsa Lake, the pack-train was again brought into use, and with a fresh outfit of supplies the Bella Coola trail was taken.

From Bella Coola the party went up the valley and out to Klinaklini, following the telegraph-line. On the headwaters of the Klinaklini river a deposit of hæmatite was examined.

From Klinaklini the trail was taken to Tatla lake and then on to Tatlayoko lake. A gold property was examined at the southern end of the lake, on which work was done a few years ago.

From this point the trail was taken to Alexis Creek, and here the party was disbanded. The writer and his assistant returned to the Coast via Ashcroft and Canadian Pacific Railway.

In all, about 700 miles were covered with the horses and pack outfit, in addition to 250 miles of lake work.

The report on this work will be found under its proper heading in this Annual Report.

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 1916 there were made by the staff in the Government Assay Office 2,555 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	$ 464 00
Fees for assaying	171 00
Fees for melting and assaying gold-dust and bullion	49 50
Fees for assayers' examinations	150 00
Total cash receipts	$ 834 50

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

Attorney-General's Department	$ 620 00
Agriculture Department	110 00
Board of Health	230 00
Treasury Department	124 50
Other departments	55 00
	$1,139 50
Value of work done outside of Department work	$2,074 00

The value of gold melted during the year 1916 was $25,823 in 47 lots, as against $37,972 in 80 lots in 1915.

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 1916 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 June 12th and the following days. Two candidates came up for examination, and obtained the required number of marks; the Board recommended that Certificates be granted them. One candidate applied for exemption under section 2, subsection (2), of the Act, but failed to qualify.

Another examination was held at the Government Laboratory, Victoria, on December 22nd. Three candidates came up for examination, and obtained the required number of marks, 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 five candidates.

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

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

Under section 2, subsection (1).

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.
Bishop, Walter.....Grand Forks.
Buchanan, James.....Trail.
Buehman, A. C.....Trail.
Campbell, Colin.....New Denver.
Carmichael, Norman.....Clifton, Arizona.
Church, George B .....
Cobeldick, W. M.....Scotland.
Collinson, H.....Cobham, Eng.
Comrie, George H.....Alice Arm.
Craufurd, A. J. F.....Rossland.
Crerar, George .....
Cruickshank, G .....Trail.
Day, Athelstan.....Dawson.
Dedolph, Ed.....Nelson.
Dockrill, Walter R.....Chemainus.
Dunn, G. W. .....Rossland.
Farquhar, J. B. .....Vancouver.
Fingland, John J.....Kaslo.
Grosvenor, F. E.....Vancouver.
Hamilton, Wm. J.....Anyox.
Hannay, W. H .....Rossland.
Hart, P. E.....
Hawkins, Francis ..... Silverton.
Hawes, F. B.....Vancouver.
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.)....Victoria.
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, Alex. C.....Vancouver.
Morgan, Richard.....Trail.

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

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

Under section 2, subsection (2).

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

Under section 2, subsection (3).

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

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

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

CARIBOO DISTRICT.

CARIBOO MINING DIVISION.

REPORT BY C. W. GRAIN, GOLD COMMISSIONER.

I have the honour to submit herewith my report on the progress of the mining industry in the Cariboo Mining Division for the year ending December 31st, 1916.

The season just past has certainly been the quietest that the Cariboo District has seen for a long time; fewer of the old-time properties having been worked, practically no new work started, comparatively few leases applied for, and very few new claims recorded. This has naturally somewhat reduced the revenue of this office and the other mining offices in this district.

I do not consider this state of quietness will in any way be of a permanent nature; it is caused simply by the financial depression prevailing more or less over the whole of the Dominion, created by the present war.

It must also be borne in mind that, in these days of war, capitalists have been somewhat diffident with regard to mining, as there have been so many other fields of investment opened up to them. Apparently, if capital has in any way been attracted to mining, it has been mining other than placer-mining, which is the style of mining chiefly carried on in this district.

However, apparently it has not been only the lack of capital that has been felt in the district during the past season, but it appears that the actual mining population has been considerably reduced; this is clearly shown by the number of free miners' certificates issued, the number this year being very much smaller than previous years—another war condition; as many men who in past years did a certain amount of prospecting or worked claims in a small way have either enlisted in the Canadian Forces or have left the district to fill positions left vacant by those that have enlisted in other parts of the Province. These conditions have not only had the effect of materially reducing the actual revenue usually derived from the mining industry in these parts, but have also had the effect of considerably reducing the amount of the output of placer gold during the past season, and thus making it appear that this district is practically not worked as regards mining.

However, it becomes more and more evident as time goes on that this Division is no longer the country for the small man or properties worked in a small way. It is a country very expensive to live and work in and a country with but a short mining season; that is, for hydraulicking. A small outfit has not sufficient time in the open season to move the required amount of ground to pay expenses; whereas if the same property was worked with a very much larger plant and a slightly larger staff, it would make very satisfactory returns. There are many properties in this district which, if opened up on a somewhat larger scale, might yet be turned into good paying mines.

The weather conditions of the past season were not very good for hydraulic mining; there was an extremely light snowfall—in fact, only about half of the usual fall, a little over 10 feet; luckily this quantity melted very gradually and a fairly good head of water was obtained, which was augmented by a plentiful supply of rain during the summer. However, the fall months were very dry, and thus there was practically no fall run to amount to anything.

The more important properties worked in the vicinity of Barkerville were the three mines owned by John Hopp, with reference to which Mr. Hopp has kindly handed in the following report:—

"I beg to submit the following report for this season's operations of my hydraulic-mining properties in this Mining Division:—

"The very light snowfall in this part of the Province and the late spring shortened the season very materially; however, later rains gave a much better supply of water than was expected for the spring run, and we obtained a better general average value a cubic yard than ever before. After the spring clean-up, however, there was practically no more rain during the entire balance of the season, and the ground was too dry to even get the water stored in the reservoirs through the ditches to the mines without serious loss from seepage and evaporation.

"*Lowhee.*—After the spring clean-up a considerable amount of work was carried out in this mine. The main pipe-line of 30, 22, and 18 inches diameter and penstock 14 x 18 x 12 feet deep was moved up-stream; a vast amount of work was done in connection with repairs and improvements to the Ella Lake dam and the ditches in connection therewith. The mine is now in excellent condition for commencing new season's work.

"*Stouts Gulch.*—The pit in this mine was extended over the summit and down Lowhee creek as far as possible. In order to operate the mine next season, considerable improvements and alterations had to be made. The entire plant was moved farther down Stouts gulch; two 40-foot flumes and No. 6 giants extended on branches to the main pipe-line of 22, 18, and 16 inches diameter to open pits, one on each side of the old workings and capable of covering a large area along the benches of Stouts gulch, which benches carry good values.

"*Mosquito Creek.*—The work at this mine was badly handicapped by shortage of water; considerable development-work was done, extending the ditches and adding a No. 2 plant in addition to the No. 4 plant now in use; this was found to be a great advantage.

"In addition to the work done on the above mines, a company has been doing considerable Keystone drill testing work for me on adjoining ground on Williams creek and Willow river for dredging purposes. If satisfactory values are found, they propose building a dredge, of the larger type now used in California and other dredging fields, and which I confidently look forward to being accomplished here in the near future."

On upper Antler creek the Houser Bros. with a small staff did considerable work on the two leases owned by them, and although they did fairly well, they did not do as well as they expected, as they are not yet in a really well-defined channel; therefore this winter they intend to do considerable sinking and drifting so as to definitely locate the channel.

On Shepherd creek, near Eight-mile lake, Robert Rees worked on the leases owned by him with paying results, and it would appear that he owns ground that is very rich in spots, but which is hard to work by the hydraulic method, as he has but a very poor water-supply and is practically without dump.

On Slough creek the *Point* mine, owned by Loo Gee Wing, of Vancouver, and ably managed by Joseph Wendle, was worked as conservatively as heretofore, with the usual steady and paying returns.

On Lightning creek the Lightning Creek Hydraulic Mining Company, an English company, worked its property with a very much smaller staff than usual. I have been unable to obtain any particulars as to the results. This company has now installed two hydraulic elevators, which I understand are now working satisfactorily.

On Chisholm creek the Cariboo-Chisholm Creek Mining Company did a considerable amount of work during the past year, and I have to thank J. A. Macpherson, the manager, for kindly sending in the following report:—

"During last March we completed the high benches of the east side of Chisholm creek by sinking a shaft and drifting out and crosscutting the channel to the outside rim. The ground was 40 feet deep, the channel 14 feet wide on bottom, and the outside rim 20 feet high. The values were too low for drifting, but sufficient for hydraulicking; however, the ground is at too high a level for our present supply of water. A feature of the channel is that it runs towards the Devil's canyon, therefore being directly opposite in direction to Chisholm creek.

"At the commencement of the hydraulic season we put in 1,200 feet of pipe-line and began prospecting the surface gravels lying on the clay of the present creek-bed. During the season we laid a sluice of thirty-five boxes on a 4½-per-cent. grade, and from this point ran an open-cut for 600 feet through the clay where we broke into the surface gravels; continuing this open-cut, we completely crosscut them. These surface gravels are 740 feet wide and average about 25 feet in depth, and contain good values in heavy gold. The conditions for hydraulicking, such as sluice-grade, dump, material to be moved, and available pressure, are very favourable, and the only thing that could hinder very profitable returns from hydraulicking these gravels would be insufficient water. The combined waters of Chisholm, Davis, and Jawbone creeks would assure successful operations.

"During the latter part of November we finished driving the drain-tunnel to tap the deep ground on the west bench; the tunnel is 1,011 feet long, the latter part being in rock. The rock-work was done under contract by McHardie & McDonald, and very satisfactory work and

progress was made by them; although the rock was not very favourable for fast progress, the contractors drove by hand-work as high as 100 feet a month. We are now preparing to bore from the surface and drive a 6-inch casing to tap the drain-tunnel."

On Perkins gulch Felker & Sparkes did considerable new work on the leases owned by them, piping when water was available, with, however, I understand, not such good results as last year.

As far as I can gather, no work of any sort was carried on on the property of the Lightning Gold Gravels and Drainage Company at Wingdam during the season; such was also the case with the old Waverly Company's property on Grouse creek.

QUARTZ-MINING.

With regard to quartz-mining, there has been a slight activity in this branch of mining this year in this immediate vicinity, on Proserpine mountain, south-east of Barkerville. In the old days a vast amount of work was done in connection with quartz on this same mountain, but in those days of high rates on everything it was impossible to work quartz, unless it was very rich indeed.

This year a new ledge was discovered on the Grouse Creek side of the mountain by Elmer Armstrong, and a number of claims were staked and a certain amount of work done. I understand that the result of the assays made has been very encouraging; the claims have been visited by two different experts, but, as far as I can gather, they and the owners have failed to come to any agreement as regards purchase, the stumbling-block appearing to be the amount and time of the first cash payment. It would appear that there has hardly been enough work done as yet to support the owners in their stipulation for a large cash payment.

From applications for mineral and placer claims sent in for record by the Deputy Mining Recorder at Fort George and from the number of certificates of work issued, it would appear that there has been considerable activity in mining in that vicinity.

J. A. Wade, of Prince George, has kindly sent me a short report bearing on the work done in the neighbourhood of Government and Hixon creeks, which is as follows:—

"On the Cameron and Ewing leases on Government creek a large amount of prospecting and some development-work was carried on all year, five men being employed. I understand that this property has been bonded.

"A number of quartz locations were made in the vicinity of Government, Buckley, and Hixon creeks, but very little work was done, except by S. D. Gillis and Company, who drove one tunnel of 150 feet and are now engaged on another farther down the creek. They found a stringer of very high-grade ore. Their claims adjoin those of the Quesnel Quartz Mining Company. Morice Davis, on behalf of Edgar Bloomfield, is now on the ground preparing to go ahead with work on the Hixon Creek leases.

"Pedley & Smith worked all year on their quartz claims on Terry creek, and certainly have some fine samples.

"Echternach & Caulfield are now down about 40 feet on their claim about five miles east of here.

"A number of men worked at placer on Ah Bau creek and took out fair wages.

"I look for quite a little boom in mining as soon as the Pacific Great Eastern Railway gets steel laid through this country."

In closing, I would mention that work has recently been resumed on the scheelite-deposits on Hardscrabble creek, about twelve miles north-west of Barkerville. Considerable work was done on this property a number of years ago; but the property has been more or less tied up for a considerable time, owing to the failure of the various parties interested to agree as to the best methods of working same, or whether it was even worth working at all. Various options have been given at different times, which would appear to have been binding on the giver, but in nowise binding on the recipient as regards opening up the property.

John A. Macpherson, of Van Winkle, one of the co-owners, has now taken the matter in hand, and has great hopes of being able to interest Toronto capital in the undertaking. Mr. Macpherson sends me the following in connection therewith:—

"I anticipated making out a full report on the Hardscrabble scheelite-deposits, but failed to get around to it; however, the main facts are as follows:—

"The property was repaired and put in first-class shape last September. It will be thoroughly examined and further development-work will be done on it this winter with the idea of opening up the property.

"An analysis of practically pure scheelite from Hardscrabble is as follows: WO_3, 73.68 per cent.; MoO_3, 0.66 per cent.; CaO, 20 per cent.

"The zone containing at least 10 per cent. tungstic acid is 12 and possibly 15 feet wide. A concentration of the Hardscrabble ore can be obtained containing 70 per cent. tungstic acid.

"The ore so far developed occurs under two distinct conditions—as an associate mineral with iron pyrites and galena in small quartz veins and in vuggs in the country-rock, sometimes quite pure and at other times mixed with a little quartz. There are other important minerals associated with the scheelite."

I would mention in connection with this property that Professor T. L. Walker, of Toronto University, acting under instructions received from the Department of Mines at Ottawa, inspected this property in 1908, and I consider that it would not be out of place to quote portions of his report thereon:—

"In 1904, W. C. Fry, while mining a placer claim on Hardscrabble creek, a tributary of Willow river, about ten miles north-west of Barkerville, had great difficulty owing to the appearance in the sluices of a heavy white mineral which some had called barite or heavy-spar. It was so heavy that a current sufficient to wash it away carried the gold off also. Austin J. R. Atkin was the first to recognize this mineral as scheelite. Later, in drifting in connection with placer-mining, a shoulder of the bed-rock was cut and the mineral was discovered in-place. Knowing the value of the scheelite, the ground was staked as a mineral claim (carrying rights to operate in the hard bed-rock). At the time of my visit—August, 1908—the mine was idle, but from those interested I learned that a shaft had been sunk about 30 feet in the rock, and, drifting along the scheelite-zone, had been carried about 50 or 60 feet.

"The deposit as revealed by the underground working appears to constitute a zone from 3 to 8 feet wide, following the north-west-south-east strike of the country-rock, which is here much metamorphosed to a mica-schist. Angus Macpherson, who had charge of the underground work, informs me that masses of practically pure scheelite were found, at times 50 lb. in weight.

"The scheelite is coarsely crystalline, pink to brown where fresh, but buff to cream in colour where weathered on the surface as found in the gravels. Along with the scheelite I observed, on examining the ore-pile, small quantities of canary tungstite, and from some of the operators I learned that wolframite had been reported. Besides these tungsten ores and the two main gangue minerals, quartz and ferruginous calcite, pyrite and galena occur in small proportions.

"It would be very difficult to form a correct estimate of the proportion of scheelite contained in the zone of tungsten-bearing rock. Mr. Macpherson considers, as a result of assays made, that the whole belt carries about 8 per cent. of tungstic acid. The 2 or 3 tons of ore which I saw were probably much richer, but, as far as I am aware, no satisfactory assay sample has been taken with a view to determining the richness of the belt as a whole, and since no ore has been milled or concentrated, such estimates may be very far from assays based on systematic sampling or concentrating.

"The results of an analysis of a sample of practically pure scheelite from Hardscrabble are as follows: WO_3, 73.68 per cent.; MoO_3, 0.66 per cent.; CaO, 20 per cent.

"This mine is easily accessible, being reached by a good bridle-trail and winter road. The mine is but a little above the level of Willow river. Hardscrabble creek flows within a few hundred feet of the shaft-house, and would probably supply sufficient water for hoisting and milling. The high values of scheelite concentrates should make it possible to ship to Ashcroft even with the present long haul and high freight."

Barkerville is about 280 miles from Ashcroft by wagon-road, and, at the time Professor Walker made the above report, there was no railway nearer than Ashcroft, and all freight carried from the railway to Barkerville cost in the neighbourhood of $140 a ton. There is now a railway at Prince George and a steamer from Quesnel to Prince George, and thus the only hauling by freight-wagon would be the sixty miles between Barkerville and Quesnel. The value of scheelite concentrates has increased enormously since Professor Walker made his report, the present price being somewhere about $17 a unit.

Hydraulicking on Otter Creek, Atlin.

OFFICE STATISTICS—CARIBOO MINING DIVISION.

Free miners' certificates (individual)	270
Free miners' certificates (company)	7
Free miners' certificates (special)	1
Placer claims recorded	5
Placer claims rerecorded	32
Mineral claims recorded	110
Certificates of work issued	42
Placer leases granted	21
Leaves of absence	21
Conveyances and other documents recorded	57

Revenue.

Mining receipts	$ 7,756 45
Free miners' certificates	1,399 60
Leaves of absence	52 50
Water rights revenue	2,089 75
Firearms licences	172 50
Miscellaneous receipts	56 00
Total	$11,526 80

QUESNEL MINING DIVISION.

REPORT BY ARTHUR SAMPSON, MINING RECORDER.

I have the honour to submit herewith my report on mining operations in the Quesnel Mining Division of the Cariboo District for the year ending December 31st, 1916.

The mining industry is still handicapped by the lack of cheap transportation, and development-work is in consequence retarded.

In the Keithley section, Mining Lease 1460 (locally known as the *Kitchener* mine), operated by Harrison & Worth, and situated about one mile up the creek from Keithley Ranch, on the old Keithley Creek channel, has been the most active and obtained the best results of any of the mines reported on in this Mining Division.

Work was commenced by the present owners on this property in the fall of 1914, when a tunnel of 24 feet was run and bed-rock was struck, which gave the exceedingly good prospects of $3 to the pan. The tunnel was found, however, to have been driven at too high a level, and another drive was run into the hill some 3 feet lower, work being carried on the balance of that winter.

In the spring of 1915 a short ditch was run from Four-mile creek to enable dirt to be treated by sluicing, and the balance of the summer was spent in prospecting the ground; in the fall a crew of fourteen men was put to work, and two miles of ditch and 2,500 feet of fluming constructed, giving a sufficient head of water to run a dump-box; on account of the extreme cold weather work ceased until the spring of this year, when a small crew of six men was employed and a further drive of 200 feet into the hill made, with crosscuts from the main drive, with prospects of the most encouraging nature; the claim, being some 130 feet above the present creek, has an excellent dump.

Clark & Walton were also in this section, and did considerable work near the old *Luce* claim.

Prospecting by other miners has been carried on in the various creeks in this vicinity, but without much result.

In the Quesnel Forks section no extensive work would appear to have been carried on during the past season.

In the Harpers Camp section a certain amount of work of a preliminary nature has been done on the claims controlled by the International Dredging and Exploration Company.

In lode-mining, development-work is still being pursued in the Timothy mountain and Vavenby sections.

OFFICE STATISTICS—QUESNEL MINING DIVISION.

Free miners' certificates	117
Mineral claims recorded	30
Certificates of work	38
Placer claims recorded	11
Placer claims rerecorded	11

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, 1916.

The output of gold reported for the year 1916 was a little less than for the preceding year. Various causes may be assigned for this decrease, but two or three factors were more particularly responsible, and these were practically unavoidable under existing circumstances. Those were, first and most important, shortage of water, and another was scarcity of labour.

Shortage of water will continue to be embarrassing until efficient reservoirs or other methods of conservation have been installed upon the principal creeks and streams. This season's experience was disconcerting, for, although we had a heavier snowfall than usual last winter, the ground was so thirsty in the spring and early summer that the water from the melting snow and glaciers disappeared without causing any flood, or even abnormally high water in the creeks, and those who were particularly interested in it were astonished at its unusually early and rapid disappearance.

The scarcity of labour was contributed to by at least two unusual factors, one being the number of men—some of them old-timers—who left the district, either singly or in contingents with a recruiting officer, to enlist for active service abroad, and the other was the fact (alleged, at any rate) that some men who were considered undesirable and were turned back at the International Boundary conveyed the impression, as widely as possible, that labourers were not wanted in the camp.

As a result of the consequent scarcity of labour and shortage of water some operators closed down about midsummer, and others struggled along under a heavy handicap as long as they could, but the results were, naturally, rather discouraging.

Another deterrent factor was the enormously increased cost of powder and high explosives, which hitherto have been freely used to assist and increase the effect and execution of water used under pressure, but this season operators were disposed to curtail or dispense with the use of powder wherever possible, being content to confine their operations to a smaller area, if by so doing the relative cost of operation was reduced.

The general result was an increased output on three creeks and a more or less decreased production upon the others throughout the district. I may say, however, that if all operators had made the returns requested and incumbent upon them in compliance with statutory requirements, the reported output would probably have exceeded that of 1915.

McKEE CREEK.

The Delta Gold Mining Company, under the management of George Adams, operated for about the same length of time and with about the same number of men as last year, and with about the same average yield a square foot of bed-rock uncovered, but for certain reasons the output was not quite up to that of 1915.

A considerable amount of dead-work was performed, however, in preparation for next season's operations, when the results are confidently expected to be much more satisfactory.

There was a force of from eleven to twenty-three men employed, with an average of eighteen, and they operated from May 1st to October 21st.

PINE CREEK.

The Columbian Mines Company, representing the North Columbia Gold Mining Company, the Pine Creek Power Company, Limited, and the Atlin Consolidated Mining Company, under the management of Paul W. Greyer, with a force of about forty-four men, commenced operations on April 15th and closed down on October 28th. They report having moved about 100,000 cubic

yards of gravel in one set of pits and over 121,000 cubic yards in the other (opposite sides of the creek) with very satisfactory results. They were operating for about two weeks less time than in 1915 and moved about 100,000 cubic yards of gravel less than in the previous season, and yet the output was proportionately better than that of the year before, indicating better "pay" in the gravel handled.

On the Pine Creek Flume Company's holdings no hydraulic mining was carried on, but a number of drifting outfits operated throughout the year with apparently satisfactory results.

Several outfits are drifting along the creek this winter. The aggregate output from the creek was a little less than for 1915.

SPRUCE CREEK.

On the Spruce Creek Power Company's leases from eight to ten men were drifting throughout the year with fairly satisfactory results.

On the *Gladstone* lease James McCloskey had six men prospecting on "lay" propositions, but with indifferent results.

In the creek-bed J. R. Clay continued his resluicing operations with the same satisfactory results as heretofore. There was nothing worth mentioning being done by other holders in that locality.

On the *Peterborough* lease and adjacent ground H. O. Morse has been drifting throughout the year and finding good "pay" most of the time. He employed an average of six men.

On the next section above the *Peterborough* Otto Miller and partners and Smith, Conroy & Carlson have been drifting with very satisfactory results, and appear to have ground upon which they may continue to do so for years. Foley & McPherson are also operating in this section.

On the *Lovell* group, comprising the *Poker*, *Joker*, *Croker*, and *Olalla* leases, owned by Isaac Matthews, from thirty to sixty men have been employed drifting pretty continuously until about the close of navigation, when nearly all of those operations were suspended for the winter. Some very rich ground was encountered during those operations and the results should have been gratifying to the owner. A few men are drifting there this winter.

Extensive development has been prosecuted on *Discovery* claim by J. M. Ruffner, and the indications are that in the very near future a considerable area in that vicinity will be the scene of active development on a more elaborate scale than usual in this camp.

There has been some development-work carried on at other points along the creek up to and beyond Blue Canyon, but for lack of water the results were not very remunerative—at any rate, they have not been formally reported.

This was again the banner creek of the district, and the aggregate output reported was nearly $400 in excess of that of 1915. From the present outlook this may be expected to continue for years to come.

BIRCH CREEK.

On Birch creek the scarcity of water was more keenly felt than on most streams, and in consequence the output fell considerably short of that of former seasons. The "pay" appears to lie under a heavy bank in the section now being operated and a good supply of water is necessary to remove the overburden.

A sad catastrophe occurred on this creek near the end of the season. An old-timer on this creek, Frank Charlebois, was caught by an overhanging bank and smothered. He was the victim of his own temerity, for he had been warned against the danger from that bank and his method of operation, by the Gold Commissioner and others, months previously.

From five to ten people were employed on this creek and operations covered the period from April to the end of October.

BOULDER CREEK.

On Boulder creek from twenty to thirty men were employed during the summer in both open and drift mining, and the results were satisfactory while the good water lasted, but the scarcity of water was painful to the operators, some of whom closed down, while others struggled along as best they could throughout the season.

One operator, J. H. Black, increased the utility of the available supply of water by building three small reservoirs, by which he and the other operators profited, and without which he, at any rate, must have closed down by midsummer.

There are several outfits drifting on the creek this winter.

Notwithstanding the shortage of water, the output exceeded that of 1915 by over $4,000.

The construction of more efficient reservoirs for next season's operations is contemplated and better results may be expected.

RUBY CREEK.

On Ruby creek T. M. Daulton, as manager of the Placers Gold Mines Company, with a force of from eight to twenty men and an average of fourteen, commenced operations on April 24th and continued until October 24th. Shortage of water and scarcity of labour hampered his operations to such an extent that the output was materially reduced from that of 1915, but no appreciable difference in values was noted.

Some very rich gravel has been encountered by drifting and a number of men are drifting there this winter. Better water and results are anticipated next season.

WRIGHT CREEK.

Nothing worth mentioning was done on Wright creek this season, the men who were operating there having enlisted for service overseas.

OTTER CREEK.

On Otter creek J. E. Moran, with a force of from four to six men, again operated on upper Otter creek, but was worsted for lack of sufficient water. There is gold there in considerable quantities, but the problem is the conserving of sufficient water to work it profitably; he intends continuing next season.

On lower Otter creek the Mines d'Otter Creek, under the management of Henry Maluin and W. H. Brethour, had a force of men drifting on the syndicate ground last spring, and commenced hydraulic operations about the end of May and continued until October 15th. Bed-rock was encountered with the sluice about August 1st and very good "pay" found thereon. This syndicate has been for a number of years working down to bed-rock, and it is very gratifying that good "pay" should be found thereon when reached.

A very satisfactory clean-up was secured during the latter part of the operating season. A number of men are drifting there this winter and reports of the results are very satisfactory indeed.

O'DONNEL RIVER.

O'Donnel river was disappointing this season and the aggregate output less than that of last year. The O'Donnel Placers Company, under the direct superintendence of J. Frank Breeze and the general management of Paul W. Greyer, employed twelve men there throughout the season and moved a large quantity of gravel by hydraulic methods, but a large portion of the ground thus worked had been previously "drifted" out, and the greater part of the values having been thus recovered left poor "pay" for the hydraulic operator, but they claim to have gotten through the worked-out portion and to expect good returns for next season.

Nothing worth mentioning was done by any one else on this stream during this season.

OTHER CREEKS.

Very little was done on Wilson creek and practically nothing on Burdette or Davenport creeks.

One or more men on each were prospecting on Graham, Volcanic, Cracker, Horse, Hemlock, Lincoln, Bull, Fox, and Rob Roy creeks, and while I have no definite reports of results from any of them, I find that all of the men so engaged have been encouraged to continue their researches.

Cracker creek, which lies a little to the north of Ruby creek and is tributary to Surprise lake in the same manner, is likely to be the scene of active development next season, as a working option and bond has recently been acquired by some Americans upon certain leases located thereon, and they will doubtless commence operations as soon as climatic conditions will

permit. This creek heads up on the west side of Surprise lake, near the heads of Ruby, Boulder, Birch, and Volcanic creeks, and appears to be in similar formation, and the general impression appears to be that it may prove similarly rich in auriferous gravel when bed-rock is reached. That there is gold on the creek has already been demonstrated.

A number of leases have recently been located on Rob Roy creek, which is tributary to Sucker river, which in turn is tributary to Teslin lake, and, if granted, I expect the locators will undertake systematic development next season with a view to the installation of an hydraulic plant thereon; reports generally indicate the existence of ideal conditions for that method of operation.

There are drifting operations this winter on Pine, Spruce, Boulder, Ruby, Otter, O'Donnel, and Volcanic creeks, and the output from some of them is very good.

There are from seventy-five to a hundred men engaged in such work throughout the district.

MINERAL CLAIMS.

There was more attention paid to quartz properties throughout the district during the past season than for some years previous, and development or prospect work under options to purchase was undertaken upon several properties, particularly on Taku arm, but nothing seems to have come of it, as the assignment of any of the properties to the option-holders has not been reported and the options appear to have been abandoned.

It does not appear as if sufficient work had been done in any one instance to warrant any declaration for or against the property, so that in that respect they appear to remain practically as they were.

A considerable force of men was employed upon the *Engineer* mine during the summer and a few men are doing prospect and development there this winter, but I have had no report from the owner or manager as to output, development, or anything else of that nature, so am not in position to report progress. It is asserted, however, that the mine appears to improve in values and volume as depth is attained.

It is also known that experts of various groups of capitalists have visited and examined the property from time to time, and that negotiations for the acquisition of the property by some of those groups have been under consideration by the owner for some time, but any actual transfer or sale has not yet been reported here.

On the other quartz properties around Atlin lake and Taku arm considerable development has been performed by some owners and assessment-work has been pretty generally attended to, but nothing in particular has been reported. Some new locations have been recorded, and some owners, notably the Laverdiere Bros., who have copper and gold-copper properties on Atlin lake, are continuing their development-work throughout the winter.

On the *Silver Queen* and *Ruby Silver* property at Pavey, Lake Bennett, development-work has been in progress throughout the year, but no report, or reply to the request for one, has been obtained, so that I am unable to report progress.

In the Rainy Hollow section some development-work was performed upon the properties of the Kennedy-Burnham-Conway Syndicate, particularly upon the *Maid of Erin* claim. Mining engineers visited that district during the summer, with the result that the property of the above-mentioned syndicate has been bonded to a group of capitalists represented by Colonel W. L. Stevenson, of Skagway, and, according to the terms of the bond, active development will be undertaken as soon as climatic conditions will permit of it. The consideration involves a sum of over $500,000.

Should the development contemplated above disclose what the parties interested anticipate, it will mean the commencement of great activity in that section, for the mineralized area already covered by locations in that vicinity is large.

Nothing has been done in the way of developing the coal-deposits in this district during the past year.

Some shipments of hydromagnesite were made during the season, but nothing indicating active and permanent development has been undertaken so far as I have been advised.

Although the aggregate output of the district has not been as large as in some years in the past, I think it will compare favourably with that of other districts throughout the Province from the *per capita* standpoint, as the number actually engaged in its production was comparatively small.

There was a slight falling-off in revenue collected which would not have been so if various operators and residents in the district had fulfilled their obligations.

Following is a statistical report of work done and revenue collected at this record office during the year 1916:—

OFFICE STATISTICS—ATLIN MINING DIVISION.

Free miners' certificates (individual)	438
Free miners' certificates (company)	6
Placer records	6
Placer rerecords (representing 261 claims)	244
Leases located	20
Leases issued	4
Leaves of absence (representing 155 claims)	31
Filings	3
Bills of sale (placer)	20
Bills of sale (hydraulic)	35
Bills of sale (mineral)	24
Mineral records	85
Certificates of work	148
Filings	5
Certificates of improvements (recorded)	10
Certificates of improvements (advertised, not yet issued)	4
Crown grants issued	9
Gold reported (individuals)	$145,530 00
Gold reported (companies)	162,212 00
Total	$307,742 00
Royalty paid (individuals)	2,196 40
Royalty paid (companies)	4,396 50
Total	$ 6,592 90

Revenue.

Land revenue	$ 8 00
Water revenue (rentals)	1,017 20
Free miners' certificates (individual)	2,060 00
Free miners' certificates (company)	550 00
Mining receipts (lease rentals)	2,630 00
Mining receipts (lease deposits)	400 00
Mining receipts (other sources)	1,812 15
Licences (liquor)	640 00
Licences (trade)	200 00
Licences ("Game Act")	307 50
Fines and forfeitures	238 00
Probate duty	16 40
Sale of Government property (wood)	97 50
"Marriage Act"	30 00
Law-stamps	13 50
"Taxation Act"—	
Real-property tax	3,153 20
Personal-property tax	13 50
Wild-land tax	23 55
Income-tax	16 75
Mineral-tax	6,592 90
Acreage-tax	1,010 75
Interest	14 65
"Motor-traffic Regulation Act"	90 00
Miscellaneous receipts	8 25

STIKINE AND LIARD MINING DIVISIONS.

REPORT OF H. W. DODD, GOLD COMMISSIONER.

I have the honour to submit the annual report on mining operations in the Stikine and Liard Mining Divisions of Cassiar District for the year ending December 31st, 1916.

The office revenue shows a slight increase and mining activity an improvement over 1915. Owing to the unusually dry summer, a scarcity of water hindered operations to some extent.

THIBERT CREEK.

The season's work by the Dease Creek Syndicate Hydraulic Company, with a force of sixteen men, was largely taken up in finishing ground which it was unable to complete in 1915 for lack of water; the returns, however, were very satisfactory. As the company intends to operate on a much larger scale next season, piping was closed two weeks earlier than usual in order to make changes in the plant, the wrecking of which occupied three weeks, this being necessary in order to remove to the new pits; the balance of this work will be completed during the winter months, so that full advantage can be taken the coming season in piping during the early spring freshets.

DELOIRE, MOSQUITO, DEASE, AND MCDAME CREEKS.

On Deloire creek very little work was in progress on the Mitchell leases. Levels were taken for the installation of improved machinery, which is intended to operate the coming season.

On Mosquito creek some prospecting was done by Adsit & Hankin with fair results, and one lease was applied for.

On Dease creek Hanimann & Ruepp, after doing considerable dead-work in the way of new sluices and other changes, uncovered about 1,300 square feet of bed-rock, off which a fair clean-up was made.

On McDame creek Amos Godfrey, representing the Princess May Hydraulic Company, secured some good properties, on which the old Rosella Creek hydraulic plant is to be placed the coming winter, so that everything will be in readiness for operations in the early spring.

QUARTZ-MINING.

Iskut River.—On the *Red Bluff* group of five claims, with the exception of 27 feet of tunnel, the work has been confined to open-cuts, showing good prospects in gold and copper; these claims are owned by F. E. Bronson and associates, of Wrangell, who already hold nine Crown-granted claims in the same vicinity, and on which assessment-work is fully kept up.

Eight new locations were staked and recorded on Gold creek, a branch of the Iskut, by R. Howard and party, from Wrangell, but owing to the lateness of the season no assay returns have been received; this is also a gold and copper prospect.

Unuk River.—Assessment-work, merely, has been done on these claims.

Grand Rapids.—The Stikine Mining Company had ten men at work during the season developing its properties, the *Stikine Nos. 1, 2, 3.* No. 3 tunnel was driven 200 feet through good showings of silver-lead-zinc ore; the work, however, closed in August owing to some change in the company, but it is to be expected that work will be resumed in the spring.

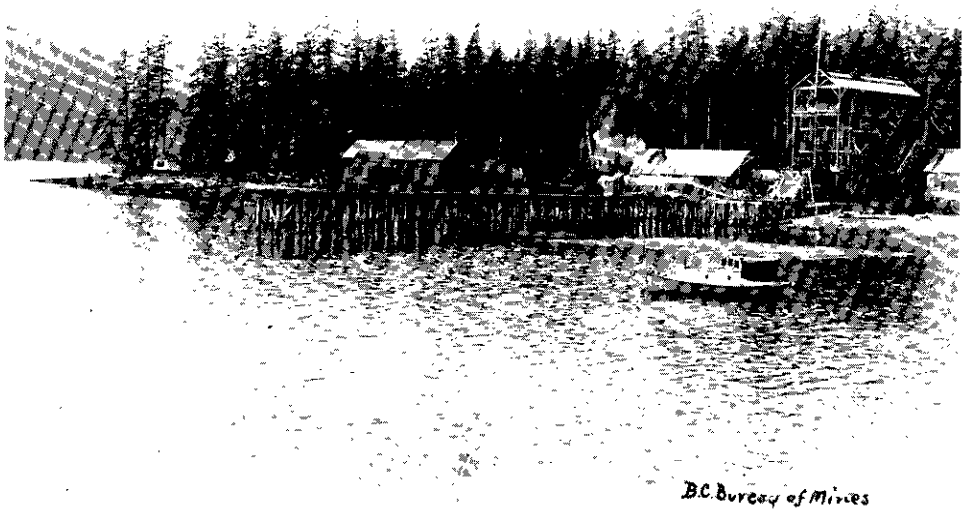
On the *Jay Bird Nos. 1, 2,* held by Julian & Jackson, a good pack-trail has been constructed and suitable cabins erected for future work.

On the *Sour Dough*, held by Byrer & McShane, a 40-foot open-cut was made, with a good showing of silver-lead.

Clearwater.—On the *August* and *Mountain Goat* (gold-copper), owned by Lewis Kirk, assessment only was carried on.

Four-mile Creek.—On this creek, eight miles below Telegraph Creek, Guy V. Carson, of Wrangell, had five men at work all summer on the *Glenora* group. A 22-foot open-cut, 12 x 12, was run, exposing good showings in copper-gold; a good pack-trail was constructed with an easy grade from the Stikine river to the property, a distance of five miles; it is expected that considerable development will be done on this property the coming season.

In conclusion, I may say that, from indications, the year 1917 will see more mining activity in the district than for some time past; with this in view, the Hudson's Bay Company is placing



Maple Bay, Portland Canal, Granby Consol. M. S. & P. Co.

Swamp Point, Portland Canal, Granby Consol. M. S. & P. Co.

a 30-ton power-boat on the river, making weekly trips all season, beginning the middle of May, from Wrangell to Telegraph Creek, so that river transportation, on which so much depended in the past, will be assured.

OFFICE STATISTICS—STIKINE AND LIARD MINING DIVISIONS.

Revenue collected from free miners' certificates	$ 579 50
Revenue collected from mining receipts	1,737 35
Revenue collected from other sources	2,809 70
Total	$5,126 55

SKEENA DISTRICT.

SKEENA AND BELLA COOLA MINING DIVISIONS.

BY J. H. MCMULLIN, GOLD COMMISSIONER.

I have the honour, as Gold Commissioner, to submit the annual report of mining operations in the Skeena and Bella Coola Mining Divisions for the year ending December 31st, 1916.

The past year has seen a great revival of mining interest in the Skeena Mining Division, more especially in the Coast district. Two important discoveries were made on Porcher island by resident pre-emptors who had no previous mining or prospecting experience. One of these properties is now under option to the Belmont Canadian Mines, Limited, operating at Surf inlet, Princess Royal island, and a company has been formed to develop the other group. An item of interest included in this report is the report of A. C. Garde, B.Sc., M.E., on the *Bald Mountain* group, Porcher island.

Considerable activity has taken place in the Alice Arm district, over 400 claims having been recorded during the past year, and the prospects for the coming year appear to be very bright from a development point of view.

COAST DISTRICT.

The Belmont Canadian Mines, Limited, owners of the *Surf Inlet* group of mineral claims on Princess Royal island, have carried on development-work continuously during the year with a large force of men. A subsidiary company, the Surf Inlet Power Company, Limited, has finished the construction of the dam at the outlet of Cougar lake and an hydro-electric plant is being installed.

The Drum Lummon Copper Mines, Limited, are the owners of a group of claims situated about one mile back from the beach at Miskatla bay, on Douglas channel. A considerable amount of drifting has been done and this property appears to be a very promising one. The ore carries gold, silver, and copper and the average values are good.

The *Bolton* group of six claims is situated at Klekane inlet and are under option to the Granby Consolidated Mining, Smelting, and Power Company, Limited. This property was located in 1911 and considerable development-work has been done. The ore is copper-gold.

The British Columbia Pyrites Company, Limited, owners of a group of five Crown-granted claims, situated on the Ecstall river, a tributary of the Skeena, has bonded the property to the Lewisohn Bros., of New York. Considerable development-work was done on this property in 1901-2. The ore is an iron sulphide carrying a small proportion of copper pyrites. A shipment was made to the Victoria Chemical Works in the fall of 1901 which carried 45 per cent. of sulphur. This ore is especially adapted for the manufacture of sulphuric acid.

The *Wild Goose* group, consisting of four claims, situated on Gibson island, are under bond to the Granby Consolidated Mining, Smelting, and Power Company, Limited. A force of eleven men is employed; a shaft has been sunk for a depth of 50 feet and drifting is being carried on from that depth. The ore is averaging from 3 to 4 per cent. copper with small gold values.

The *Patterson-Gillett* group of claims is situated on the Belle range of mountains, near Surf point, Porcher island, and was located in March and April of 1916. This property is under option to the Belmont Canadian Mines, Limited. The ore is a pyrrhotite and iron pyrite carrying gold in a crystalline quartz, and is similar to the Surf Inlet property which is being operated by this company. It is the intention of the company to sink a shaft on the property; considerable surface work has been done, twenty men being employed.

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Bald Mountain Group.

The following is from a report by A. C. Garde, mining engineer, of Prince Rupert: "This property is situated in the Bald Mountain range, in the northern part of Porcher island, at elevations ranging from 100 to 1,000 feet above the harbour known as Jap inlet. This inlet is considered to be one of the safest and best-sheltered harbours in northern British Columbia, with deep water and good anchorage. From Jap inlet the mining camp and workings can be conveniently reached over a two-mile trail with an easy grade. The distance by water to Prince Rupert is less than twenty miles. The *Bald Mountain* group comprises thirty-two mineral claims, or a total of approximately 1,600 acres of mineral-bearing land, all of which claims adjoin.

"Broadly speaking, the formation of Porcher island (as well as Gibson island) is on a grand scale and consists of wide bands of metamorphic rocks derived from old sedimentaries, which may have been deposited during the Palæozoic age, and underlie a considerable portion of the same. These rocks, originally, were mostly argillaceous, siliceous, and calcareous sediments, but have been intensely altered by subsequent intrusions of granodioritic dykes. On Porcher island the contact between the granites and the metamorphic rocks can be traced on the surface without any difficulty.

"The contacts are of great economic importance from an ore-producing point of view, as it is generally close to these that lenticular bodies of copper sulphides have been developed and are found in fissure-like zones or bands. Several ore-zones have been discovered in the mineralized belt, which, in my opinion, is more than 1,000 feet wide and several miles long. The individual bands all follow the same strike, N. 60° W., in parallel systems, tilted by the same forces and dipping in a north-easterly direction at a maximum angle of 70 degrees from the horizontal.

"The minerals, which in this manner have replaced a portion of the original rock, consist principally of copper and iron sulphides, such as chalcopyrite, pyrrhotite, and pyrite. With these a small percentage of bornite, sphalerite, and molybdenite are associated.

"In the early spring of 1916 a discovery of copper ore was made on the *Young Bull* claim. The first sample, taken on the 12-inch pay-streak, assayed by G. G. West, gave as follows: Gold, 0.04 oz. a ton; silver, 1 oz. a ton; copper, 4 per cent.

"This discovery was of sufficient importance to encourage development-work, and a shaft was sunk on the showing and continued to depth of approximately 25 feet.

"The result of this work was satisfactory in every respect. The ore-body, which only measured 1 foot on the surface, gradually increased in width and value, and at the present time shows 4 feet, with the following values: Gold, 0.05 oz. a ton; silver, 0.8 oz. a ton; copper, 6.2 per cent.

"During excavation approximately 20 tons of ore was taken out of the shaft and placed on the dump, averaging over 3 per cent. in copper and $1.50 in gold and silver to the ton, while selected samples will assay three and four times as much.

"While the above work was going on, other croppings on the same band were explored by means of several open-cuts, and on the *Lord Kitchener* claim and the *Entente Cordiale* claim ore-showings equal to those on the aforementioned claim have during this season been uncovered.

"By systematic prospecting the ore-zone of this particular band has thus been proved on the surface for nearly a mile, and the indications for developing a large body of commercial ore are very good indeed.

"A second band, parallel to the first, and approximately 100 feet closer to the granite-contact mentioned and indicated on the general map, has also been located on the *Entente Cordiale* claim, and a considerable body of chalcopyrite and quartz uncovered, averaging for several feet as follows: Gold, 0.05 oz. a ton; silver, 0.2 oz. a ton; copper, 3.5 per cent.

"A tunnel was started 75 feet below this showing and is now being driven in for the purpose of crosscutting same. At the time of this writing the face of the tunnel promises well for future development-work. Numerous other cuts have been put in on the different claims, and invariably, where surface work has been attempted on the property within the ore-zone, it has always met with success. Copper has been found in many places, and sometimes far apart, indicating that ore of economic value may be distributed over an area 1,000 feet wide and 6,000 feet long.

"In working on the property this past summer, no attempts have been made to develop any ore-bodies in particular. The policy has been to demonstrate the possibilities of the property by doing a limited amount of work in several places instead of considerable work in one place. Surface work is still being carried out on the property, but the intention is, during the coming season, to put down a series of diamon-drill holes at selected points and continue these as far as the granite-contact. I have every reason for believing that this work, if properly directed, will prove the property in depth.

"Climatic conditions at this point will readily permit work to be carried on all the year round, and, generally speaking, the economic conditions for mining are good. The facilities are so advantageous that it will be possible to handle even low-grade ores on a large scale at a profit."

OBSERVATORY INLET.

ALICE ARM.

The Molybdenum Mining and Reduction Company, Limited, owns a group of twenty-three claims, situated on the west side of Alice arm, about three miles below the head of the arm. Several hundred feet of tunnelling and a considerable area of surface work have been done. The ore carries a percentage of molybdenite.

The company, early in the spring, erected a concentrating plant with a view to shipping molybdenite concentrates, but the plant did not prove a success. I am informed, however, that the company is improving the plant and hopes to have the concentrator working in the near future.

The Dolly Varden Mines Company has furnished the following report through the manager, R. B. McGinnis, M.E.:—

"At the *Dolly Varden* property we operated a diamond-drill for the season, drilling about 4,000 feet; also drifted about 800 feet in various tunnels as well as commencing several raises. On the surface several new buildings were erected for camp purposes; also a compressor-house and a compressor and engine, track, pipe, four machine-drills, cars, sawmill, and drill-house were brought in and installed. A horse-trail was built from the head of Alice arm to the property, a distance of eighteen miles, and at the arm a wharf and warehouse were built.

"At the *Wolf* property two diamond-drills were operated for the entire season, drilling about 6,000 feet, and a small amount of underground development was done, together with numerous cuts and pits. A horse-trail from the *Dolly Varden* to the *Wolf* property, a distance of about two miles, was partly constructed."

A number of properties in this district have been bonded during the year; development-work has been carried on on some of the properties during the winter, and the coming season should see this camp in a very flourishing condition.

GRANBY BAY.

The *Hidden Creek* mines and 2,000-ton copper-smelter of the Granby Consolidated Mining, Smelting, and Power Company, Limited, were operated continuously throughout the year, and a larger output was made than in any previous year. The tonnage treated was 730,956 tons, containing 3,633 oz. gold, 238,051 oz. silver, and 23,890,896 lb. copper.

Under the subdivision of the Annual Report entitled "Boundary District" will be found lengthy quotations from the annual report of the Granby Company for the fiscal year ended June 30th, 1916. Much information is given there about the operations at Anyox as well as in the Boundary District, and the balance-sheet showing the financial condition of the company, which is most satisfactory, is included.

BELLA COOLA MINING DIVISION.

A number of new locations were made during the year in this Division, which shows a revival of interest, and I am informed that active development-work will be commenced on some of these locations early in the season.

OFFICE STATISTICS—SKEENA AND BELLA COOLA MINING DIVISIONS.

Free miners' certificates (individual)	642
Free miners' certificates (company)	7
Free miners' certificates (special)	5
Mineral claims recorded	669
Certificates of work issued	637
Bills of sale, etc., recorded	162
Filings	58
Certificates of improvement recorded	195

Revenue.

Free miners' certificates	$3,407 00
Mining receipts, general	4,494 55
Total	$7,901 55

ALICE ARM DISTRICT.

REPORT BY J. M. TURNBULL, MINING ENGINEER.

Under instructions from the Provincial Mineralogist, I spent two months, from July 14th to September 11th, 1916, examining properties in the Alice Arm district. The area covered included most of the watersheds of the Kitsault and Illiance rivers and of Lime and Roundy creeks, all of which flow into Alice Arm inlet near its head. Some sixty properties were inspected.

Several Coast steamers make calls at Alice Arm, which may also be reached by daily launch from Anyox. There is an excellent hotel at Alice Arm, which may be made headquarters for successive trips up the above creeks and rivers. Horses may be taken up the main Kitsault and Illiance trails; the other trails are not suitable for horses and must be travelled on foot.

The attached sketch-map shows the rivers, creeks, and trails, with topographic and geological notes, and the locations of the properties mentioned, including practically all of any known importance up to September, 1916. My detailed report, which follows, is respectfully submitted.

GENERAL CONCLUSIONS.

In general the Alice Arm district is a very promising one from a mineral point of view and bids fair to become an important producer.

The possibilities may be grouped under four general heads, each associated with geological features and rocks, which are a great aid in prospecting, and enable the district to be roughly divided into areas in which certain kinds of ore may be searched for, each kind occurring probably only in its own particular area. These heads are as follows:—

Head No. 1. Comparatively large bodies of quartz in fairly definite veins, carrying values chiefly in silver, which are essentially milling-ores. These are associated with and occur in a rock which is chiefly andesite, possibly diabase in part. The promising part of the andesite at present appears to be as follows: Beginning at Homestead creek, eighteen miles up the Kitsault river, flanking the river on the west side in a band not over one mile from the river at any point, as far north as Trout creek, and opposite on the east side of the river for the same distance, and beyond Trout creek. The andesite extends an unknown distance to the east or north-east, also up to the Kitsault glacier, indicating a possible large extension of the favourable area, which is largely unprospected yet. Much of the surface is covered with wash and timber in the latter area, in which prospectors should closely examine any humps and ridges, shooting into any brown-stained rock or quartz exposures they may find.

Combination mountain and the headwaters of Black Bear creek are also in andesite, which seems to be separated from the Kitsault andesite by a band of sedimentary rocks. This area may extend an unknown distance to the west, but as far as seen, where clearly exposed above timber-line, no signs of mineralization were observed in it.

In the angle between the Illiance and Kitsault rivers a small area of andesite is indicated on the map. It can hardly be large, but might be worth a little further prospecting, as referred to in the description of Casey's property.

At the head of the Tchitin river an area of diabase occurs which may have some connection with the Kitsault andesites, which it resembles. This shows some mineralization of more or less similar type, but is badly mashed up, and is seriously handicapped by its situation in regard to transportation. (*See* description of *Left Over* claim.)

The andesite appears to be from present knowledge the most important area from an economic standpoint. It contains the partly developed mines *Dolly Varden* and *Wolf* and a number of promising prospects of similar type. A considerable production of silver is practically assured already, and the prospects for the future at present seem excellent. The chief production will probably be from rather large ore-bodies of medium to low grade in silver.

Head No. 2. Copper ores, with more or less gold and silver. These are less developed, less known or understood, and less definite in form and occurrence than the deposits under Head No. 1. The main belt in which these occur is narrow, perhaps less than a mile wide, extending from Evindsen creek north-west to the Kitsault glacier,

paralleling the Kitsault river on the west side and about one mile distant from it. South of Evindsen creek it is not distinctly evident for about three miles, and may be partly interrupted by the andesite area. About the mouth of Miner creek there are showings on both sides of the Kitsault river, where the belt may cross. South of Miner creek, if it be continuous, it is probably on the east side of the Kitsault river, but no showings are reported for about nine miles, possibly in part accounted for by inadequate prospecting or else lack of mineralization. On the North-east branch of the Kitsault river, south of the mouth of Washout creek, copper-showings are staked on both sides of the river. The belt should cross the Illiance river about Casey creek or higher, but was not distinguished with certainty along the Illiance trail.

The formation in which the ore occurs is a dark-grey rock which, north of Evindsen creek, on the whole seems to be igneous in origin, sufficiently altered in places to effervesce with acid, cut by later dykes of similar composition. On the *Red Bluff* it is tufaceous sandstone, which may really be a different belt. It is flanked on the east side, in places at least, by a band of slate of narrow width, and on the west side, south of the West fork, by andesite, but near the Kitsault glacier sedimentaries occur on the west side, including limestone. The structure was not worked out, but there appears to be a break at Evindsen creek, and it is probably older than the andesite. The formation was not observed outside of the area above outlined.

The characteristic mineralization is a disseminated pyrite accompanied with a certain amount of chalcopyrite. The latter occurs in places in concentrated form as bunches of some size, but not of much continuity, as far as can be seen from the little work done; no large amounts of quartz are usual. Good gold values occur with some of the better chalcopyrite-showings, as on the *Red Point* and *Vanguard*. A noticeable feature is the apparent constancy of small gold values, from 40 cents to $1 usually, regardless of the copper content.

Where the zone is cut into, as in bluffs and creek-canyons, it weathers a deep red, making very conspicuous red outcrops, which are several hundred feet wide in places. These are well seen on Black Bear, Copper, and Gash creeks, on the *Combination* claim, and to some extent in the red hills near the Kitsault glacier. The one on the *Red Bluff* claim can be seen from the beach at Alice Arm, some miles away. The red is, however, rather a surface staining and does not extend to any depth, the grey rock showing when the rock is broken.

Outside of the chalcopyrite bunches, which might be partly or wholly hand-sorted when mined, the mineralization is disseminated, and would indicate bodies of ore, which would be concentrated if they exist of sufficient value and quantity to justify mining operations.

It is difficult to forecast the commercial possibilities of these deposits with any confidence. The points in their favour are chiefly their great extent, the number of good surface showings, the constancy of small gold values, and their concentrating nature. The points against them are the lack of continuity of the showings, the average thinness of mineralization, the relatively large percentage of pyrite compared to chalcopyrite in the disseminated portions, and the results of diamond-drilling on the *Red Point*, which are described under that property. Three holes were driven in the base of a red bluff, with good surface showings on top. The cores show a little finely disseminated pyrite, with specks of chalcopyrite all through, but no pay-ore. Gold values averaging about 60 cents a ton were obtained. The holes were about 200 feet deep.

On the whole, development of a typical property of this class appears to be warranted in view of the large possibilities. In any case there will probably be a small tonnage produced from the rich concentrated bunches, of which the *Vanguard* shows perhaps the best example, when transportation is available.

Head No. 3. Small quartz veins of the fissure type, containing sometimes high silver values in small erratic shoots. The characteristic mineralization is pyrite, blende, galena, grey-copper, and ruby-silver, etc., in a quartz gangue. These occur in the argillite or slate formation, which extends six or seven miles up the west side of the Kitsault river to a depth of three miles, and surrounds Alice Arm town, with a radius of three to four miles, including most of Lime creek and the lower part of the Illiance river. The deposits surrounding the head of the Illiance river may be broadly included, though they occur in a schistose rock of tufaceous origin, and the characteristic mineralization is somewhat different.

In general these deposits promise chiefly to yield a small and erratic production of high-grade silver, hand-sorted smelting-ore. Little development-work has been done on any of these, which are mostly only surface showings, and the Illiance section may furnish some exceptions, but is at present handicapped by difficult conditions of transportation.

There was not observed any distinct secondary enrichment, and the mineralization suggests that the ore is primary on the whole, but the little development done rather indicates better values on the surface. There is no conclusive proof, either way, available.

Head No. 4. Molybdenite-deposits. These occur in the slate area at moderate distances from the granite contact, in connection with large tongues of granite, and associated with numerous diorite dykes. The characteristic mineralization is quartz in well-defined veins or seams, in which molybdenite occurs chiefly as thin films, with local variations.

Only one of these is of any commercial importance at present—namely, the property of the Molybdenite Mining and Reduction Company, which is described in detail later. They are of considerable geological interest, and there is no apparent reason why others may not be found near the granite-contact in the slate area west of Alice Arm town, and in the Lime and Roundy Creek sections.

TOPOGRAPHY.

The various rivers and creeks are predominantly gorge or canyon like, with narrow valleys, from which the slopes rise at angles of 30 to 40 degrees to a general elevation over 3,000 feet, above which there is a general tendency to flatten. The slopes generally culminate in peaks and ridges, with elevations of 5,000 feet or more, associated with numerous small glaciers. There is no flat area of any extent in the district.

TIMBER.

Timber-line is at about 3,500 feet. Up to 3,000 feet above sea-level the country is generally covered with a dense forest-growth and much underbrush, which makes prospecting difficult. There is an ample supply of good timber for mining operations.

CLIMATE.

The climate is cool and very wet. There is a heavy snowfall in winter, varying from a maximum of, say, 12 feet at the beach to 20 feet or more at higher elevations. Snow lies on the ground for five to eight months, according to elevation. Many of the surface showings cannot be seen to advantage until July or August. For general prospecting and examination there is not much use going to Alice Arm until June or later. The district is near enough to the general Coast to escape long periods of very cold weather as a rule.

POWER.

No large water-powers occur in the district, but many of the tributary creeks have a considerable volume and rapid fall, so that a number of small water-powers could be developed under fairly high heads without having to carry the water for great distances. The flow is very variable, and, as the ground is mostly saturated with water, the creeks rapidly become raging torrents after a heavy rain, and rapidly shrink again in dry weather. No winter measurements seem to be available at present.

TRANSPORTATION.

Transportation at present is entirely by trails. Owing to the swampy nature of the soil, most of the side-trails are soft-bottomed and could only be made fit for pack-horses at considerable cost, as by planking or corduroying. The Dolly Varden Mines Company has put in a main trail up the Kitsault river, which is wide and mostly on water-grade. This is passable by pack-horses as far as the *Dolly Varden* mine, and will be continued to the *Wolf* mine, a total distance of twenty-one miles. It is expected that a narrow-gauge railway will be constructed over this distance in 1917. The Illiance main trail is good enough to take pack-horses over, but is too soft for much work after the first ten miles. It includes fords over the Kitsault river and Illiance River delta, which can be avoided by starting from Silver City. The branch trail up the North-east Kitsault river is passable for horses for four miles, nearly to the *San Diego* property. The trail to the *Mohawk* from Silver City is a graded trail, needing some repairs. The other trails are foot-trails, steep in places, following foot-logs, etc., and in some cases indistinct. Those shown on the map can mostly be followed without much trouble. The Tchitin River trail can be followed on foot to the Nass valley, but is rather indefinite in places.

Large vessels can land at Riel's camp, Silver City wharf, and the Dolly Varden Mining Company's wharf. The head of Alice arm is filled with material brought down by the rivers, forming tide-flats. As the tide rises as much as 24 feet, there is no chance of making a deep-water wharf close to Alice Arm town or along the end of the arm, though small boats can be brought into the town at high tide.

The only mechanical transport in the district at present is an aerial tramway 4,000 feet long from the mine to the mill of the Molybdenum Mining and Reduction Company at Riel's camp, on Alice arm.

Any property within a radius of three or four miles of Alice Arm town could be served by an aerial tramway to tide-water. The railway mentioned will serve the upper Kitsault river. A railway up the Illiance is feasible, but would require heavy side-hill construction and rock-work, and would have grades of 3 or 4 per cent. at least. The tonnage possibilities make such a scheme look rather remote at present.

SAMPLING.

No attempt was made to systematically sample the showings visited. In most cases the work done was insufficient to make average sampling of any practical value, other than to determine the general character of the ore, which was usually determinable with sufficient accuracy by inspection, combined with the results of available assays. The time required to carry out general sampling would have prevented covering the district completely in the time available.

GEOLOGY.

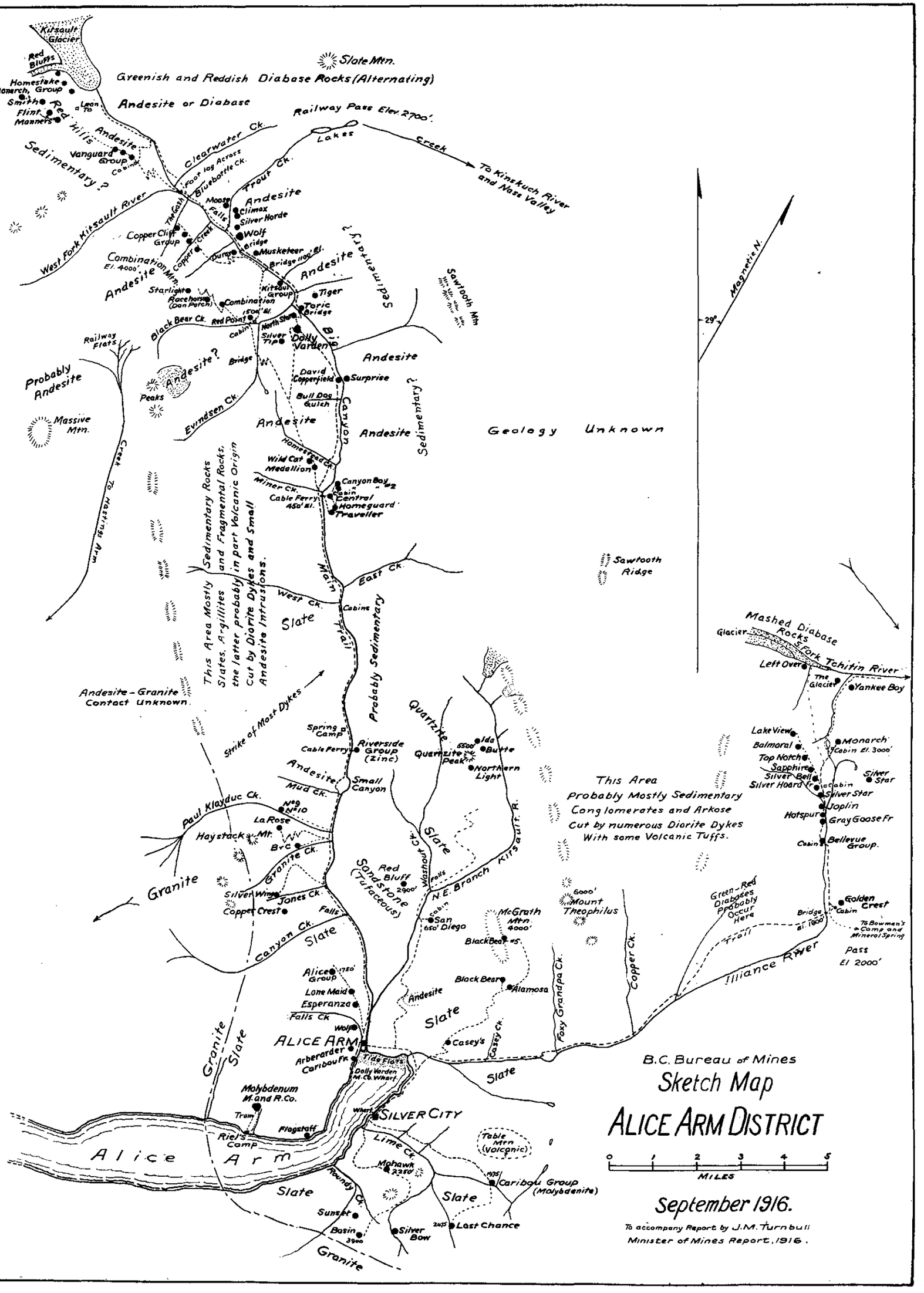
No attempt was made to work out the geology in detail. The following remarks are based on observation made in connection with inspection of properties while travelling along the trails and on occasional broad views from high points reached.

The Alice Arm mineralized area lies wholly on the eastern side of the great Coast Range granite, or granodiorite, batholith. The contact with the granite crosses Alice Arm inlet about four miles from its head, considerably west of Riel's camp. In a northerly direction its course is roughly parallel with the Kitsault river, about three miles to the west of the river, for a distance of eight or ten miles, north of which it is not yet determined, but appears to swing more to the west. South of the inlet the contact seems to swing to the east to about the head of Lime creek.

In the southern portion of the area the rocks are predominantly shallow-water sedimentaries, roughly in the following order: From the contact eastward, slates or argillites, tufaceous sandstones, quartzite, coarse reddish conglomerates with finer beds, and, finally, at the head of the Illiance river, volcanic tuffs. The whole has been intruded by a great number of dark-grey dykes, which seem to resemble the diorite dykes of the Portland Canal area, and have a general tendency to strike in a north-easterly direction. Other intrusive rocks occur in places, and the percentage of such rocks is very considerable. In the northern portion of the area intrusive rocks seem to largely predominate, and the sedimentary portions are either mere remnants or have been covered up by igneous flows in part. Between the two portions a kind of mixed zone seems to occur, which was not followed, except along the bottom of the Kitsault valley, and shows a variety of rocks, slates, intrusives, and mixed rocks, which may be in part volcanic, either tufaceous, breccia-like, or full of inclusions. It is notable that no mineral occurrences have been found in this intermediate zone.

The sedimentary series seems to have a general strike to the north-west, more or less parallel to the granite-contact, and a general considerable dip to the north-east, with great local variations. As a whole, schistose-structure is not conspicuous to any degree, showing that the rocks have not been subjected to extreme pressure, but that considerable disturbance and faulting has taken place is shown by considerable folding and faulting and the presence of the great number of dykes and intrusions mentioned, as well as by numerous mineral veins. Two small cold springs occur, one on the *Red Bluff* property, four miles north of Alice arm, and the other at Bowman's camp, east of the upper Illiance river. The former has been reported on by McConnell, of the Canadian Geological Survey.

With the exception of moraines at the ends of retreating glaciers, glacial deposits on the surface were not observed.


Kitsault Glacier
Red Bluffs
Homestake Monarch Group
Smith
Flint
Manners
Red Hills
Lean To
Slate Mtn.
Greenish and Reddish Diabase Rocks (Alternating)
Andesite or Diabase
Railway Pass Elev. 2700'
Lakes
Creek
To Kinskuch River and Nass Valley
Andesite
Sedimentary ?
Vanguard Group
Cabin
Clearwater Ck.
Foot log Across
Bluebottle Ck.
Trout Ck.
The Gash
Moose Falls
Climax
Silver Horde
Wolf
Copper Cliff Group
Copper Creek
Durnin
Ridge
Musketeer
Bridge 1100' El.
West Fork Kitsault River
Combination Mtn.
El. 4000'
Andesite
Sedimentary ?
Starlight
Racehorse (Dan Patch)
Combination
1500' El.
Kitsault Group
Tiger
Toric
Bridge
Sawtooth Mtn
Magnetic N.
29°
Black Bear Ck.
Red Point
Cabin
North Star
Silver Tip
Dolly Varden
Railway Flats
Probably Andesite
Andesite ?
Bridge
David Copperfield
Surprise
Bull Dog Gulch
Peaks
Evindsen Ck.
Canyon
Andesite
Sedimentary ?
Geology Unknown
Massive Mtn.
Homestead Ck.
Wild Cat
Medallion
Canyon Boy
Cabin
Central
Homeguard
Traveller
Miner Ck.
Cable Ferry
450' El.
Creek To Hoskyns Arm
Sedimentary Rocks and Fragmental Rocks, Slates, Argillites the latter probably in part Volcanic Origin Cut by Diorite Dykes and Small Andesite Intrusions.
Main
East Ck.
West Ck.
Cabins
Slate
Trail
Sawtooth Ridge
Mashed Diabase Rocks
Glacier
S. Fork Tchitin River
Left Over
The Glacier
Yankee Boy
Andesite - Granite Contact Unknown.
Strike of Most Dykes
Probably Sedimentary
Quartzite
Spring Camp
Cable Ferry
Riverside Group (Zinc)
Ida
Butte
6500'
Quartzite Peak
Northern Light
Andesite
Small Canyon
Mud Ck.
Paul Klayduc Ck.
No 9
No 10
La Rose
Haystack Mt.
B v C
Granite Ck.
Granite
Silver Wings
Jones Ck.
Copper Crest
Falls
Canyon Ck.
Slate
Red Sandstone (Tufaceous)
2900'
Washout Ck.
Falls
N.E. Branch Kitsault R.
Slate
Cabin
San
650' Diego
McGrath Mtn 4000'
Black Bear #5
6000' Mount Theophilus
This Area Probably Mostly Sedimentary Conglomerates and Arkose Cut by numerous Diorite Dykes With some Volcanic Tuffs.
Green-Red Diabases Probably Occur Here
Lake View
Balmoral
Top Notch
Sapphire
Silver Bell
Silver Hoard Fr
Cabin
Monarch
Cabin El. 3000'
Silver Star
Silver Star
Joplin
Hotspur
Gray Goose Fr
Cabin
Bellevue Group.
Golden Crest
Cabin
Bridge
El. 1900'
To Bowman's Camp and Mineral Spring
Trail
Pass
El. 2000'
Illiance River
Alice Group
1750'
Lone Maid
Esperanza
Falls Ck
Wolf
ALICE ARM
Arberarder
Caribou Fr
Tide Flats
Dolly Varden M. Co. Wharf
Black Bear
Alamosa
Andesite
Slate
Casey's
Casey Ck.
Foxy Grandpa Ck.
Copper Ck.
Granite
Slate
Molybdenum M. and R. Co.
Tram
Flagstaff
Riel's Camp
SILVER CITY
Wharf
Table Mtn (Volcanic)
Alice Arm
Lime Ck.
Mohawk 2350'
1975
Caribou Group (Molybdenite)
Roundy Ck.
Slate
Slate
Sunset
Basin
3900
Silver Bow
2475
Last Chance
Granite
B.C. Bureau of Mines
Sketch Map
ALICE ARM DISTRICT
0 1 2 3 4 5
MILES
September 1916.
To accompany Report by J.M. Turnbull
Minister of Mines Report, 1916.

The river and creek valleys are generally narrow, often canyon-like, with very steep side-slopes up to 3,000 feet elevation, above which the slopes tend to round off, resulting in a large area of generally rounded summits, intersected by creek and river valleys and by lines of sharp peaks 4,000 to 6,000 feet high, the latter usually flanked by small glaciers, from which most of the creeks take their rise. The main Kitsault valley is more or less open, though narrow and somewhat U-shaped, except through the Big canyon, which is very sharply cut, forming a narrow gorge through which the river boils. The canyon cannot be traversed along the bottom owing to the precipitous sides in many places. It extends from Miner creek to the bridge above Evindsen creek, and is in marked contrast to the rest of the Kitsault valley. It suggests that the andesite through which it is cut is a comparatively recent flow or intrusion. The main tributary creeks are mostly steep in their upper parts and flatten near the mouths, so that while one or two resemble hanging valleys, the latter are at least not typical. Few of the creeks in the district seem to head in typical basins. The Illiance valley is canyon-like in its east-west portion. Its north-south portion is more open and U-shaped, and its appearance suggests glacial scooping-out. North of Alice Arm town the valley is wide for a couple of miles and appears to be a portion of the inlet, now filled by river detritus.

The slate, or, more correctly, argillite rock, is composed mostly of rather hard, smooth blocky beds, varying from a very fine black to a coarser grey texture and colour. These sometimes alternate in thin or thick beds when the bedding is distinctly seen. Slaty cleavage is seldom distinctly developed, but occasionally occurs in thin beds, with cleavage at 45 degrees to the bedding-planes, sandwiched in between blocky beds which show no cleavage. Near its northern and eastern margins cleavage is more common and the dip seems to be generally steeper. In general it is more or less folded, sometimes broken or faulted, with a general dip to the north-east. It is cut by numerous dykes, with a general north-east strike and more or less vertical dip. A few of these dykes are interbedded, and in one or two observed instances these were fine-grained and dark, resembling the slate so closely that they could only be distinguished by the fact that at some point they turned and cut the bedding. A 40-foot dyke is shown in a road-cut at Alice Arm town. This is composed of white or grey feldspar, with lath-like crystals of hornblende, and at a short distance has a granitic appearance. Coarser phenocrysts are developed near the border on one side. The adjoining slate shows very slight alteration. The dyke contains a few small grains of iron sulphide. Some of the finer-grained grey dykes show a similar appearance under the pocket-lens, and are probably similar.

Three wide tongues of granite cut the argillites, described under Molybdenum Mining and Reduction Company, *Caribou* (molybdenite), and *Silver Wing* properties, in each case associated with mineral deposition.

The slate area includes or underlies the town of Alice Arm, extending west to the granite and south to the head of Lime creek, east of Lime creek to an unknown distance, the lower four or five miles of the Illiance river, and the area between the Kitsault river and the granite-contact as far north as Mud creek, and in part still farther north to West creek. It also occurs in part up the North-east Kitsault, beyond Washout creek, into the base of Quartzite peak. North of Evindsen creek isolated patches occur in the andesite area. On the north-east slope of Combination mountain a band 200 feet wide occurs, striking north-west, and forming the foot-wall of the *Copper Cliff* showings; this seems to have considerable longitudinal extension, and, in line with it, north of the West fork, a large anticline is visible with a slate core or centre, arched over by what may be andesite. This was only seen from a distance, but may indicate that the andesite is a flow overlying and covering some sedimentary area. East of the Kitsault river the slates seem to flank the river, more or less corresponding to the distribution on the west side, but their extent to the east is unknown. Slate mountain, near the north end of the map, is probably not slate, but alternating flows of greenish and reddish diabases or andesites. It was not closely approached.

Mineralization in the slates is that described under Heads Nos. 3 and 4—that is, molybdenite; and quartz veins, with erratic high-grade bunches of silver ore. The granite tongue in the slates at the head of Jones creek resembles the tongue on the property of the Molybdenum Mining and Reduction Company, and suggests the possibility of finding other molybdenite-deposits of similar nature in the Jones Creek section.

The sandstone formation lies generally to the north-east of the main slate area, but seems narrower and less definite. It occurs on the *San Diego* and *Red Bluff* properties, four miles up

the North-east branch of the Kitsault river. On the *Red Bluff* it is classed as tufaceous sandstone by Mr. McConnell, of the Geological Survey. It resembles the interbedded grey coarse beds of the slates to some extent, and slate occurs to the east of it again in the south-west slope of Quartzite peak. It was not definitely observed to cross the Illiance river. To the north a similar rock was observed on the *Riverside* group. Again on the *Homeguard* and *Wild Cat* properties, about Miner creek on the Kitsault river, similar rock seems to form the country, whence it either strikes west to the head of Evindsen creek or is interrupted by the andesite area. On the *Red Point*, *Copper Cliff*, and other groups, west of the Kitsault river and extending up to the glacier, similar rock is observed. On the *Red Point* it rather resembles an altered igneous rock, supported by a thin section, made for the Dolly Varden Mines Company, whereby it is classed as a diorite. As there is much igneous intrusion in the formation in the form of dykes, etc., and its field relation suggests a sedimentary origin as a whole, the real nature of the formation requires more detailed study to have it classified with certainty.

It is characterized by the development of surface oxidation in places where it is mineralized and where conditions are favourable, such as precipitous bluffs and canyon-walls. This surface oxidation shows as a dark-red stain, which is conspicuous, but of no great depth, and usually merely a surface stain. This occurs on the *Red Bluff*, *Red Point*, *Combination*, *Copper Cliff*, and less definitely on the red hills near the Kitsault glacier. It does not seem to occur outside of the narrow belt, or interrupted belt, above indicated.

The characteristic mineralization is pyritization, with slight chalcopyrite. In places excellent exposures of good-grade chalcopyrite ore are shown up, in irregular shapes, associated with good gold and silver values. The pyritization seems to be generally associated with small gold values, regardless of the copper content.

The most conspicuous of the chalcopyrite-showings is on the *Vanguard* group, near the glacier, where the rock, however, seems to be more related to the andesite, and the mineralization includes some minerals more characteristic of the andesite, as barite. It may here represent a transition or contact area on the west edge of the andesite, as may also the *Ouray*, which lies three miles to the south-east.

Except for these possible contact properties, the sandstone-belt includes the properties referred to under Head No. 2—that is, all the properties of prospective copper value, except the *Golden Crest*, on the Illiance.

The quartzite formation forms the upper part of the mountain near the head of the North-east Kitsault, which I have called Quartzite peak, for lack of a local name. It is here probably over 1,000 feet thick. It is also exposed on the head of the North fork of Lime creek with a thickness of several hundred feet, east of the granite intrusion which contains the molybdenite. It was not observed in the Illiance valley, where it might occur covered up on the trail, nor elsewhere in the area examined. It is characteristically very fine-grained and flinty, very hard, and of a light-brown colour. As far as known, it is practically barren of important mineralization, though it contains some small quartz veins, with trifling amounts of zinc-blende, galena, and possibly molybdenite. Cutting the quartzite are a few granite dykes, which in places are siliceous, passing into what look like quartz veins. One of these conspicuously shows on the peak, extending down its bare eastern side for 1,500 feet or more. These suggest that the main granite may underlie this area.

Some thirty claims were staked during the summer on quartz stringers, etc., and on brown weathered patches on Quartzite peak, some of which were examined, as the *Ida*, *Butte*, and *Northern Light*, but as they all seem almost hopelessly unpromising they are not described in detail in the descriptive portion of the report.

East of the upper North-east Kitsault river the ridge which culminates in Mount Theophilus is generally brown weathering, resembling at a distance the ridge west of the upper Illiance river, which is in part coarse conglomerate and also brown weathering. Between these ridges was unexplored, except where the Illiance trail crosses, quantities of the green-red diabase (or andesitic) float were observed. As this diabase occurs at the head of the South fork of the Tchitin river and in Slate mountain, west of the upper Kitsault river, it is evidently extensively developed. At the head of the Tchitin it is badly twisted up or mashed. It may be similar to green-red diabases referred to in reports of the Geological Survey as occurring in the Atlin district, much farther north.

The coarse conglomerate referred to occurs on the west side of the upper Illiance river. Only the eastern edge of the formation was seen. It seems to lie west of the known mineral showings of the Illiance and is not known to be mineralized. It is exceedingly coarse in places, with some narrow bands of dark-red slates. The boulders consist of a variety of rocks, mostly igneous, with red-slate material as a cement.

The schist or volcanic-tuff formation occurs at the head of the Illiance river. The western contact seems to lie a short distance west of the line of claims shown on the map west of the river. If it crosses the Tchitin river it must be east of the *Yankee Boy* claim, which seems to lie in the Tchitin diabase. Its eastern and southern extensions are not known. The tuff is decidedly schistose, to a degree not observed elsewhere in the district. It resembles a fine conglomerate at first sight, and has possibly been reworked or transported by water after its first deposition. It is traversed by numerous dykes, similar generally to those on the Kitsault, but which have a general strike somewhat west of true north. These seem to become stronger towards the south, and on the *Golden Crest* claim there is a width of some 400 feet, which may all be intrusive and somewhat differently mineralized from the other claims, being copper-bearing, with characteristic chalcopyrite.

The mineralized veins travel with the schist or cut it at a narrow angle, with steep dips. They are usually narrow and lenticular, with local wide bunches and some intersections. They seem to be numerous, and in the absence of important development-work are somewhat difficult to interpret. The characteristic mineralization is galena, zinc-blende, copper-glance, or grey-copper, with little pyrite, in a gangue of white to yellow spar, probably calcite with some feldspathic material, and some quartz in minor quantities. Copper seems to be in larger proportion to the north. On the *Joplin* and claims near by mineralization occurs in a gangue consisting of what appears to be a brecciated and highly altered igneous rock, with serpentine or chlorite, possibly originally of dyke origin and in one case 30 feet wide. The chief values appear to be in silver, and the shoots irregular and bunchy. Very high assays have been obtained, say up to 1,000 oz. silver a ton, in places.

The best ore seems to occur in general on the surface, and there is a possibility that secondary enrichment has taken place to shallow depths in considerable degree. Lack of development prevents drawing very definite conclusions, as only a few shallow tunnels and some surface stripping are available for observation.

These deposits are referred to under Head No. 3, though they are distinct in character from the regular slate veins.

The andesite formation is at present the most important economically, and contains the deposits of mineral referred to under Head No. 1. As shown in the big Kitsault canyon and elsewhere, it is generally a light green in colour and rather fine in grain, but distinctly crystalline. It also occurs as a rather dark-red variety. It is probable that the area represents several distinct flows similar to and perhaps identical with the green-red diabases. Distinct contacts of the two varieties were observed, also each variety containing inclusions of the other. In the *Dolly Varden* mine the vein appears in a contact of the two, in places, but not everywhere. Specimens of the green variety sometimes show a reddish or purplish mottling, which may be due to local alteration or in part to small inclusions. This appearance is rather characteristic. Where the solid rock is surface-weathered it often shows a light-greyish or yellowish furry appearance on the surface.

The veins appear to be siliceous replacements along fissures or fissure-zones, the outcrops appearing as massive quartz or sometimes as brown-stained exposures, which must be shot into to expose their real character. This should be noted by prospectors. They usually project above the surface to some extent, sometimes forming considerable humps or ridges. Any brown-stained humps in this area should be shot into to determine whether they are silicified below.

In distribution the andesite occupies the valley of the main Kitsault river, from Homestead, possibly from Miner creek, up to and beyond Trout creek, and probably up to the Kitsault glacier. It forms the walls of the Big canyon. Outside of the valley its distribution is unknown definitely. A line from the *Red Point* to the head of Homestead creek may mark one part of the boundary, and the area west of this line is only classed as andesite doubtfully. The summit of Combination mountain, which is rounded, consists of andesite. Standing on the summit, a large area of country can be seen, much of which is bare along the ridges, but to the south and west, where one would expect to see granite, there is no change in the general appearance of

the formation. At a distance, however, the granite and the andesite resemble each other sufficiently to make it doubtful how far the andesite extends in these directions. The western and southern extension of the andesite is therefore possibly great, but not known. In all the bare exposed rock thus seen no quartz ledges or other veins showed sufficiently to be visible at a distance with field-glasses, and the area looks generally barren, as does the summit of Combination mountain itself.

Around the headwaters of Trout creek the country is timber-covered, and no idea could be formed of the extent of the andesite in this direction without actually traversing the area.

North of Trout creek and east of the Kitsault glacier, Slate mountain from a distance is made up of a series of nearly horizontal layers of green and red rock, which looks barren from a distance and seems to resemble the green-red Tchitin diabases. As the andesite also seems to occur more or less in alternate green and red flows, it is possible that it is identical with the diabases, in which case the andesite area would be extensive to the north-east. In any case the drainage area of Trout creek seems worthy of careful prospecting, and possibly the area to the north of it.

The characteristic mineralization is as described for the *Dolly Varden* mine—quartz with pyrite, accompanied by smaller quantities of more valuable minerals, galena, ruby-silver, native silver, etc. The ore is essentially milling in character and the outcrops found have been often large; widths of 50 to 80 feet are known, and late reports state that an outcrop 150 feet wide has been found on the *Moose* claim, north of Trout creek. It is notable that these so far seem to be confined to a limited elevation above the valley-floor, which may be partly due to lack of sufficient prospecting. Barite is a common mineral in some of the veins, but does not seem to be associated with the best values, as far as observed.

Extending south from the *Red Point* mine and west of the *Dolly Varden*, red shaly outcrops were noted, in places full of coarse fragments of other rock. This may extend southwards across Homestead creek, cutting off the andesite. The summit of the ridge forming the east side of the Kitsault canyon, south of Trout creek, does not look like andesite from a distance, and is reported to have red shales, which may cut off the andesite on the east. The gorge-like nature of the big canyon suggests that it is the result of rapid erosion and that the andesite may be a relatively recent intrusion.

Prospecting in this district is difficult. The season is short. The ground is much covered up, making much digging necessary to uncover anything in many cases. Travel is slow and laborious. A geological investigation to delimit the andesite area would therefore be of great assistance, enabling the prospector to confine himself to areas of promise, and would be well justified in view of the large size and economic importance of the possibilities.

The outlying andesite areas farther south, noted on the map, are relatively small, and not yet shown to be of economic importance.

No attempt was made to work out in detail the geological age and sequence of the different formations. In general the argillite series seems to be the oldest formation, covering the south-west corner of the district, and lying against the main granite area, which forms its south and west boundaries. Following eastward, it generally dips to the north-east, and appears to underlie the coarse conglomerates and tuffs of the upper Illiance, possibly separated therefrom by diabases. Northward a belt of fragmental and mixed rocks seem to separate it more or less from the Kitsault andesite.

There is a general similarity to the rocks of the Portland Canal district, to the north-west, as described by R. G. McConnell in Memoir 32, Geological Survey, but the mineralization and occurrence is sufficiently different to make a direct comparison impossible, and the district must be judged on its own merits.

Esperanza Group.

This group consists of three claims—*I Chance It*, *Aldebaran*, and *Black Bear*—owned by Salinas Bros. *et al.*, and situated on the west side of the Kitsault river, about half a mile north of Alice Arm townsite. The vein is a fissure in the black slate, or argillites, which here lie in comparatively flat bedding, and blocky layers, with little cleavage. The vein strike is roughly north by west, and the dip is easterly, 45 degrees or more, with the slope of the hill. A number of small diorite dykes, standing nearly vertically and striking north-easterly, cut across the vein and the slates. They also send off branches in places between the slate-beds. The vein shows a strong tendency to jump or fault along the bedding-planes, making it difficult to follow, and variable in dip.

The mineralization consists largely of quartz, with small amounts of galena, pyrite, grey-copper, and ruby-silver. The values are chiefly in silver, with a little gold, and are high in small irregular shoots; 100 tons of ore shipped gave returns of 213.4 oz. silver, 0.29 oz. gold, and a little copper, representing a hand-sorted product, the percentage of waste being undetermined.

The workings are on the *Aldebaran* claim in three separate places, which are supposed to all be on the same vein. Absence of intermediate workings and the heavy timber, vegetation, and soil which cover the surface of the claims make it impossible to prove or disprove this statement at present. A description of the workings is as follows:—

Main Workings.—At an elevation of 520 feet a crosscut tunnel 15 feet long cuts the vein. From here a drift runs south on the vein for 80 feet, and a raise has been driven 50 feet, also on the vein. From the first 40 feet of the drift, and from the vein raise, ore was extracted, amounting to 30 or 40 tons, which is piled in the sorting-shed. Specimens containing ruby-silver can readily be obtained from this pile; there is, however, much waste, and it will yet have to be sorted. The last 40 feet of the drift has been run in the foot-wall, with the quartz showing along one side. The vein has only been broken through at the face, where the width is about 4 inches and looks barren, apparently the end of the ore-shoot. Whether this 40 feet, thus stripped, will prove to contain much ore remains to be seen. As far as one can judge by inspection, it looks rather hungry, but may be better-looking when broken into.

The raise shows continuous vein, with small bunches of good-looking ore, for 40 feet. In the last 10 feet the vein pinches and turns flat, turning to run with the bedding. There is nothing to show how far it may do this before turning up again where good ore might again possibly be looked for. The average width in drift and raise would be approximately 10 inches or more.

No stoping has been done above this drift. A stope 80 feet long by 40 feet high, up to the pinch, is the most that could be obtained. As the values occur in bunches in the vein, it is not possible to forecast the result in tons of sorted ore with certainty.

From the 15-foot crosscut another drift runs north for 25 feet, above which a little stoping has been done, which breaks through to the surface in the north end. At the 20-foot point a raise is driven up 25 feet, showing vein quartz up to 18 inches wide, but all barren or nearly so, apparently. From where the stope breaks through, surface stripping on a considerable scale has been done for about 300 feet. From the southern part of this considerable amounts of excellent ore were obtained, and the vein is exposed in widths of a few inches, with slight mineralization, and only a few spots of good ore left to show. At about 75 feet two diorite dykes aggregating 10 feet cut across the vein. Beyond these a tunnel has been driven in about 60 feet, angling back slightly so as to angle through the upper dyke. It starts on a wide bunch of quartz, and near its mouth some stoping was done. The vein rapidly pinches and appears to be running with the bedding here, across its normal strike. Across the dyke, in the face of the tunnel, a peculiar wedge-shaped section of vein quartz 2½ feet wide is exposed, slightly mineralized. This may represent the point where the vein turns up to its normal course again, but work has not been carried far enough to prove this with certainty.

North of this tunnel irregular barren quartz occurs, mixed with dykes and dyke branches, to the north end of the stripping. At the north end of the 300-foot stripping a tunnel has been run in on the vein for over 100 feet, with a raise of 20 feet near the mouth. These workings follow barren white quartz mixed with two small dyke branches near the surface. The quartz reaches a maximum width of 3 feet, narrowing to a stringer near the face of the tunnel. The tunnel has a general westerly course and the vein has here a flat southerly dip, as compared with a northerly course and easterly dip in the lower part of the workings. It is not clear which variation represents the normal course of the vein and which is due to a local roll or bend in the vein, but the latter appears to have been the best ore-producer.

Natural further development would be to sink a winze, say, 10 feet in the 80-foot south drift, first described, followed by a short crosscut from the surface to gain a further depth of not over, say, 25 feet. To go deeper than this by attempting to crosscut from 100 feet lower down the hillside would be unsafe, as a local roll may bring the vein to the surface above the point of starting.

The ore is rich, but occurs in bunches, and the vein is very irregular. Systematic development on a large scale might easily result in failure, and the property seems best adapted to working on a small scale, as by leasing

Showing No. 2.—Some 400 feet south of the main workings, at an elevation of 525 feet, a crosscut tunnel 15 feet long cuts a vein, which has been drifted on in a northerly direction for 30 feet. The dip is about 30 degrees to the west; 12 tons of good ore came from here, having been sorted out and included in the 100-ton shipment previously mentioned.

The vein appears to meet a bedding-plane at an acute angle, forming a lens of ore, with the widest portion at the junction. The lens is 20 feet long, 3½ feet wide in the centre, pinching at both ends. The vein-walls appear to pinch towards the surface. A little ore is still exposed in bunches and is quite zincky, but the best part seems to have been mined out. It might pay to try a little underhand stoping on this lens.

Showing No. 3.—This is 400 feet south of Showing No. 2 and at an elevation of 550 feet. The occurrence is similar in character to No. 2, but the lens is small, with a maximum thickness of 20 inches, and a length not over 5 or 6 feet. This has been followed by a flat incline, or tunnel, for 25 feet. In the face there are only one or two small spots of mineral in the quartz. One assay from the surface gave: Silver, 2,234 oz.; gold, 0.5 oz.; lead, 26.4 per cent.; zinc, 7 per cent.; copper, 2 per cent. There are some 6 tons of sortable ore on the dump.

The formation is hard, blocky, argillite or slate, with a strike N. 60° W. (mag.) and a dip of 25 degrees to the south-west. This applies approximately also to Showing No. 2 and the main workings.

On the *Black Bear* claim, north of the main workings, surface work has exposed a small quartz-outcrop. If there be any connection between the different workings, which follow a general line, it is hidden by the heavy timber, vegetation, and wash, which covers the steep hillside and makes prospecting difficult.

Transportation is over a rather poor and steep trail, which branches off the *Dolly Varden* main trail, and is some 2,000 feet long, rising 500 feet. The main workings are twenty minutes' walk from Alice Arm townsite.

Lone Maid. One Crown-granted claim, adjoining the *Esperanza* group on the north end of the latter. Owned by Mr. Chambers. Near the north end of the claim, at an elevation of 1,100 feet, is a tunnel 25 feet long, running S. 55° W. (mag.). This is on a vein 5 feet in width. The filling consists of quartz veins, with much calcite, up to 18 inches wide, and slate between. Slight amounts of zinc-blende, galena, chalcopyrite, and a little pyrrhotite occur in spots. Near the surface the vein in somewhat oxidized and honeycombed. The whole is rather hungry-looking. The general dip is about 45 degrees to the north-west. The slates dip about 45 degrees to the south-west. On the dump is about 1,000 lb. of good-looking ore. There is nothing worth mentioning left in the tunnel.

Alice Group. Consists of four claims in a square block—the *Alice*, *Silver Ridge*, *Butte*, and *Progress*. Owned by John Strohnbeck *et al.* Situated on the west side of the Kitsault River, about one mile and a half north of Alice Arm. Over 200 feet of tunnelling has been done on this group; also there are several open-cuts. This includes 25 feet of tunnel in Canyon creek on a claim now abandoned. The amount of work reflects credit on the energy of the owners. The claims are in the black argillite or slate area. The work has been done on or in connection with small quartz veins. There is only one ore-showing of any consequence, described as follows:—

At an elevation of 1,750 feet, an open-cut 25 feet long and 15 feet maximum depth, running N. 70° W. (mag.) exposes a small irregular shoot of good ore about 10 feet long, with a maximum width of 6 inches. The ore consists of galena and zinc-blende, with probably some grey-copper, in a gangue of crushed slate and quartz, partly oxidized and decomposed, with little cross-faults.

Parallel to the cut, a few feet to the south, a tunnel has been run in 30 feet, largely in dyke rock with quartz cross-stringers. Near the face a crosscut has been driven 8 feet, cutting what appears to be the vein-fissure a few feet below the open-cut. The fissure is barren in the crosscut, but the formation is quartz-seamed and somewhat decomposed, and the crosscut should be driven a few feet farther to make sure it has really cut the vein.

There is a 3-foot parallel dyke in the open-cut. There is more dyke than slate altogether in the showing, which is much broken up with little fissures and twists. The showing is similar

in general character to the *Esperanza*, and on the same general line, but hardly warrants further development.

Silver Wing. One claim near the head of Jones creek. Owner, Mr. Jones. A second claim, the *Copper Crest*, some distance to the south, was not visited, no definite showings being claimed. The workings are in the gulch of Jones creek, at an elevation of approximately 2,700 feet. The gulch represents a zone of crushing or faulting, running about N. 60° W. (mag.) in the slate formation. A nearly vertical small dyke parallels the creek, outcropping along the south bank. A tunnel 8 feet long crosscuts this, showing quartz stringers near the dyke in the crushed slates. Five little open-cuts, extending up the creek for 75 feet, show a continuation of similar conditions. The quartz contains slight mineralization of galena, zinc-blende, chalcopyrite, and pyrite, with a few specks of a mineral which the owner thought was stephanite. The best assay obtained was $23, across 4 feet, mostly in silver. This last showing was caved in owing to a tree falling from above, and was not seen.

Across the creek, above the upper open-cut, a short tunnel has been driven along the line of fissuring, N. 70° W. This shows a few quartz stringers. Assays from $1 to $4 have been obtained.

The fissure-zone shows some crumpling, and a curved stringer near the mouth of the last tunnel assayed $60 across 10 inches.

About 300 feet above the workings is a band of rock which looks like granite, and is probably an offshoot from the main granite-mass which lies to the west. The band is about 400 feet wide. While nothing of importance has so far been shown up, this area seems to justify some further prospecting.

On the *Copper Crest* the owner states that red-stained rocks occur, which may be similar to the red bluffs found elsewhere in the district, and that pyrite, chalcopyrite, zinc-blende, and galena occur, the last containing $40 in silver. This statement would make it appear that further prospecting is warranted.

B and C. Two claims owned by Chas. Monroe. Situated on north side of Granite creek, at 1,000 feet elevation, half a mile from the main Kitsault River trail. The vein is a 6-inch quartz stringer, with a little calcite, arsenical iron, pyrrhotite, pyrite, zinc-blende, and galena. This is in the slate formation, but is locally fissured and seems to be mixed up with dyke rock. The showing does not appear to be of any particular importance. Work done consists of one open-cut.

La Rose Group. Two claims—*La Rose* and *La Rose No. 1.* Owners, Miles Donald, Joe Wells, and Dr. Kergin. Operated under lease and bond by John Munro. The workings are situated between Granite and Paul Klayduc creeks, nearer the latter, at an elevation of 2,250 feet, about three miles by trail from the Kitsault river, on the west side.

The vein strikes northerly and southerly, with a dip close to vertical. A wide open-cut has been run into the hillside, in a small dry gully, at right angles to the vein, so as to cut a section out of the vein 12 feet long and 8 to 10 feet deep. On the bottom and north end of the section some good ore shows, and there is about 3 tons of good ore on the dump. The ore-shoot appears to be something over 12 feet long, with a maximum width of 1 foot.

The vein contains quartz, with zinc-blende, galena, pyrite, chalcopyrite, and grey-copper in bunches. Assays up to several hundred ounces in silver have been obtained, and some ruby-silver is present in places. The values vary greatly.

From the south side of the cut a tunnel was being driven, and was in 10 feet when inspected, showing the vein to be rather irregular and twisted opposite the dry gully, but not actually faulted to any extent. No ore showed in the tunnel, but later reports state that ore was encountered on further advance.

The formation is mostly fine-grained, grey, and rather hard, probably a fine sandstone belonging to the general slate or argillite area. In the tunnel a reddish weathered rock occurs which resembles the andesites to some extent and may be of dyke origin.

About 1,500 feet north-east of the above, and 500 feet lower, in a cross-gully along a dyke, some 2 to 3 feet of slickensided slate occurs, with quartz stringers, containing slight bunches of pyrite, chalcopyrite, and galena, with zinc-blende, from which an assay of $40 is reported, mostly in copper. There are one or two other showings of still less significance. None of these prove the continuation of the main vein with any fair degree of probability.

The property is not thoroughly prospected yet and may contain other ore-shoots, though there is nothing to indicate that any important tonnage is likely to be found.

No. 9 and No. 10. On the north bank of Paul Klayduc creek, opposite the *La Rose*. Two claims. Owner, Wm. Hanna. These are recent locations, with little work done, and were not visited. The owner reports a ledge 3 to 8 feet wide of slickensided slate, with quartz and pyrite.

Wolf. One claim a short distance up Falls creek, near Alice Arm. Owner, J. E. Stark. Not visited. The owner reports a showing of 6 inches of good ore in the creek, which is hard to see when the creek is high. This is in the slates and of the same type of deposit as the *Esperanza* probably.

Arberarder. One claim. Owner, A. McPhail. Situated about half a mile west of Alice Arm town. This is a recent discovery and was followed by a rush of midnight claim-staking. At 740 feet elevation a little open-cut shows a 30-inch vein, striking north (magnetic) and dipping 65 degrees west, with 4 inches of quartz on the foot-wall and 12 inches on the hanging-wall, and pyritized slate between. The quartz has slaty seams and bunches in small amount, with a little pyrite and chalcopyrite and a little of a dark mineral. The vein is rather well defined and should be worth further prospecting. One hundred and fifty feet to the west is an outcrop showing 12 inches of barren-looking quartz with a well-defined hanging-wall. Strike N. 60° E., dip 70 degrees northerly. If it continues it should intersect the former vein.

Caribou Fr. Group. Three claims. Owners, Geo. R. Naden *et al.* On the beach 1,000 feet south of Alice Arm town. A 70-foot tunnel runs S. 40° W. from near the water on a quartz vein dipping 60 degrees to the south-east. The vein reaches a width of 12 inches, and is strong, but appears barren. Farther south 1,000 lb. of high-grade ore was mined from a stringer near the water.

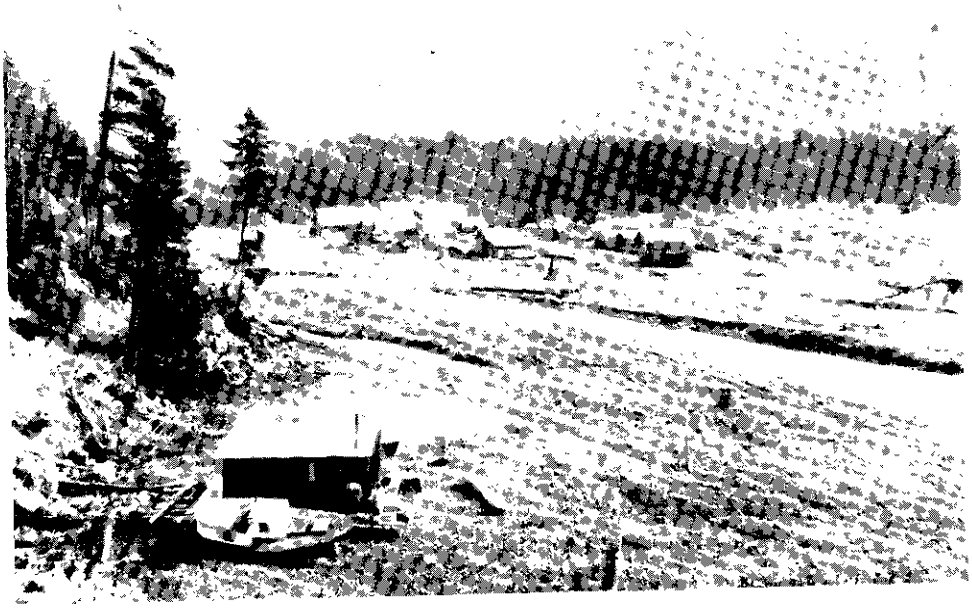
Riverside Group. Six claims—*Riverside No. 1*, *Riverside No. 2*, *Riverside No. 3*, *Riverside No. 4*, *Kitsault No. 1*, and *Kitsault No. 2*. Owners, McPhail & Hoskins. Surrounding these on the north, east, and south are eleven other claims—namely, *Kitsault No. 3*, *Kitsault No. 4*, *Kitsault No. 5*, *Bonanza*, *Bluebell*, *Silver King*, *Mary Ann*, *Poor Boy*, *Blue Grouse*, *Black Bear*, *Mountain Boy*, *Canyon*, and *Jumbo*. The other owners being McDonald, Flynn, Lade, and Crawford. Commonly known as the Zinc property. Situated on the east side of the Kitsault river, about seven miles north of Alice Arm. Most of the ground is unprospected.

On the *Kitsault No. 1* a tunnel has been run in 30 feet from near the river's edge, at an elevation of 250 feet above sea-level. A cable-ferry crosses the river at this point. The tunnel shows very little mineralization in the back and face. It follows a jointing or fissure, which runs N. 25° E. (mag.). The ore-dump is largely covered with waste, but what is visible shows considerable brown zinc-blende, with a little chalcopyrite, galena, and pyrite. The ore is not solid, but would be easily concentrated. The owners state that the best showing was in the bottom of the tunnel, and the ore there averaged about 1 foot in width, with 5 feet in one place about half-way in. The gangue is quartz and calcite, with some brecciated slate.

On the *Riverside No. 2*, at an elevation of 350 feet, a tunnel has been driven in 20 feet, striking and following a fissure-plane which runs S. 65° E., dipping northerly 65 degrees. In the face are some quartz stringers with a little pyrite. Up the steep hillside to the east are several small open-cuts, which show small quartz-lenses, the largest being 3 feet in width. These may represent the continuation of the doubtful vein in the tunnel. An assay of 0.3 oz. gold and 8 oz. silver is reported from one of them, and the vein is reported to have been traced to the top of the mountain.

One or two other small showings were seen, which need not be described. Nothing was seen that suggested a strong or definite vein, nor were any definite igneous dykes noticed, though some of the rock at the zinc tunnel appeared to be doubtfully igneous. The formation is largely a soft grey rock, more or less schistose in places, resembling that on the *San Diego*. Its uniform character and absence of dykes do not seem very promising for any extensive mineralization.

Casey's. Owners, Geo. Casey and W. Shaw, of Prince Rupert. Name not ascertained with certainty, in owner's absence, but probably the *Little Joe* group. Situated a few hundred feet north of the Illiance river near its mouth, two miles from Silver City.



Alice Arm Townsite.

Churn-drill, San Diego Group.

At 460 feet elevation is a surface stripping and a 20-foot incline shaft on a 4-foot vein, striking S. 70° E. (mag.), dip 25 degrees easterly. Near the surface the vein contains an appreciable amount of galena and pyrite, with slaty inclusions, but is rather barren-looking in the bottom. Seventy feet lower a 35-foot tunnel shows 1 foot of solid vein and 4 feet of crushed filling. The surface is covered with wash and small timber, and the formation was not certainly determined. It appears to belong in the slate area. The interesting feature is the gangue, which is largely barite, or heavy-spar, with some quartz. In this feature it resembles some veins in the andesite or silver area of the upper Kitsault river. There is a small exposure of andesite about two miles to the north-west on the North-east Kitsault trail, whose extent is not known.

A closer investigation of Casey's property and the area between it and the andesite might easily be justified, though it might be difficult on account of so much surface covering being present. Judging by comparison, any discovery in this area would probably be made in some hump or ridge which projects above the general level, and would show quartz or brown-stained rock on the outcrop, while the andesite tends to weather with a light-grey furry appearance, dark underneath when broken.

Alamosa. Two claims identified by posts. Owner, Nelson McInnis. *Alamosa No. 1* and *Alamosa No. 2*. Situated on the south-west slope of McGrath mountain, three miles from Silver City. This slope of the mountain has a number of creek gulches running generally south-west. In one of these the slate formation has been crushed and is mineralized with stringers of quartz and calcite, some of which are strong enough to appear like veins for a short distance. Here and there a little zinc-blende occurs, but nowhere in commercial quantity. There is one tunnel 12 feet long and some open-cuts. The claims have been restaked several times, and do not appear at all promising.

Black Bear Group. Eight claims—*Black Bear*, *Black Bear No. 1*, *Black Bear No. 2*, *Black Bear No. 3*, *Black Bear No. 4*, *Black Bear No. 5*, *Lucky Girl*, and *Little Johnny*. Owners, A. E. Dench *et al.* Situated on the south-west slope of McGrath mountain, from 2,000 feet elevation to the top of the mountain. Adjoins the *Alamosa* and very similar in character. On the *Black Bear No. 1* claim, at 2,500 feet elevation, a 42-foot tunnel has been driven, which crosscuts several feet of quartz and calcite stringers near the mouth, and one or two small ones farther in. On the dump is less than ½ ton of ore, which contains some zinc-blende and a little galena.

On the east side of the mountain, at 3,800 feet elevation, is a sharp gully in the precipitous face of the hill. This is the seat of considerable fracturing and contortion, in which open-cuts and natural exposures show quartz stringers, with some bunches of zinc-blende. Nothing of commercial importance or promise was shown. The occurrence is reported as 28 feet wide, no doubt on account of its deceptive appearance. The formation here is coarser and may be a sandstone, as compared with slate, with probably some tufaceous beds on the lower claims. Some other little workings showed similar conditions. The owner reports a high silver assay on the north slope of the mountain on another claim not visited.

Flagstaff. One claim. Owner, M. P. Olsen. On the north shore of Alice arm, two miles and a half from Alice Arm town, in the slate area. No work has been done. Two outcrops show a small barren quartz vein, which appears to be of no value.

Anyox Extension. One claim. Owner, M. P. Olsen, On the north shore of Alice arm, near Way point, seven miles or more from Alice Arm town. This is separated from the Alice Arm district proper by a belt of granite some four miles wide, and belongs to the Anyox area. Some 200 feet from the water, and 50 feet higher, a heavy iron-oxide capping is exposed a few feet in width. A pit sunk on this shows dark dyke rock, with some iron sulphide, from which the capping originated. The dyke was traced to the beach, where it is exposed along with numerous parallel dykes, and no mineralization was found in it. The formation is here strongly metamorphosed into a mica-schist. The contact with the granite is well exposed on the beach, but shows no striking change or mineralization at the immediate contact. The granite, however, contains inclusions of the schist for some distance.

Caribou Group (Molybdenite). Five claims—*Caribou*, *Caribou No. 1*, *Caribou No. 2*, *Caribou No. 3*, and *Caribou No. 4*. Owners, Jos. Wells, Wm. McLean, and Miles Donald. Located on the North fork of Lime creek, about four miles by trail from Silver City. Very little work has been done, but the creek affords a clear cross-section for about 1,500 feet. The camp lean-to is at an elevation of 1,975 feet.

For 500 feet above the camp the creek shows a fine-grained flinty quartzite, resembling that on Quartzite peak, with numerous cross-dykes and a few quartz stringers. For 1,000 feet south of the camp the creek shows granite, with dykes, all running in a general direction west of north. This granite may be a tongue from the main granite, two miles to the south-east, but, as no other section is exposed, its nature is not known. This granite section is cut by an extraordinary number of criss-cross stringers, mostly quartz, but in some cases quartz feldspar or aplite, seldom as wide as 1 foot and mostly a few inches in width. These stringers are mineralized in many and various places with molybdenite in small quantities, mostly in the form of thin seams or films. In a few places a different, and apparently distinct, mineralization of pyrite, chalcopyrite, galena, and zinc-blende occurs in small bunches in the quartz veins.

That the granite has been greatly shattered is shown by the great number of quartz veins, by the numerous included grey dykes, and by crushed bands in the granite. The crushed bands are soft, almost clay-like, and contain molybdenite in places, which has apparently been ground and rubbed into a smooth black paste. Some of the granite is also silicified to some extent and slightly pyritized. One or two little open-cuts have been made in the creek-banks; one of these, 75 feet above the creek, shows yellow molybdate of iron, or molybdic oxide, in small amounts, with a little molybdenite. An open-cut on the flat ground, a few hundred feet north of the creek, shows a quartz vein of larger size than usual, with a little molybdenite. This shows that there is some lateral extension to the deposit.

An assay of $8 in gold and silver is reported from a general sample of "ore" from the creek.

As a whole, the deposit contains too small a percentage of molybdenite to have any commercial value, and there do not seem to be any important local concentrations, though the total amount of contained metal must be large. A little work on one of the crushed zones would be advisable, as they are much altered, and the original content of molybdenite may have been greater than now shows on the surface.

Molybdenite is reported to show on Roundy creek for a width of 150 feet, which is likely to be of similar character.

Some of the dykes near the head of this North fork of Lime creek were very dark and basaltic looking, and Table mountain, a flat-topped mountain to the north, is reported to be basaltic, but was not visited, as being only of geological interest.

Molybdenum Mining and Reduction Co. C. P. Riel, manager. Head office and mill at Riel, B.C., which is situated on the north shore of Alice arm, about four miles from Alice Arm town. The property consists of some twenty-five mineral claims, of which six are surveyed and Crown-granted—namely, the *Blackwell*, *Success*, *Molybdenum*, *Silver Tip*, *Molly No. 1 Fr.*, and *Monarch*. The main work, consisting of some 600 feet of tunnels, is on the *Success* mineral claim.

The mine is connected with the mill by a Leschen 2-bucket aerial tramway 4,075 feet long, with a drop of about 1,100 feet, and a nominal capacity of 100 tons in twenty-four hours. Bunker capacity of 80 tons at the upper and 200 tons at the lower end is provided.

The mill consists of crushing and separating plants in separate buildings. The crushing-plant building is set on the side of a steep bank, and the foundations do not look very solid. The crushing is done dry. The plant consists of a jaw-crusher, followed by coarse rolls, then by fine rolls, connected in series by 2-bucket elevators. The crusher and rolls are on the same level. The fine rolls operate by choke-crushing in closed circuit with a set of gently sloping shaking screens, the final product being 40 mesh. A short trial run showed that the fine screen tended to blind, due to slight moisture and sticky material in the ore probably. A ball or conical mill for fine crushing may prove necessary. The separating plant contains flotation machines, and was not completed, some details remaining to be worked out. The mill appears to be more or less of an experiment, and may require some remodelling before successful operation is attained. Poor results at the start, if they occur, may be more the fault of the mill than of the ore, which appears to have given good results in experimental preliminary tests for concentration.

Power is furnished by two 50-horse-power wood-fired return-tubular boilers, which also operate a 500-cubic-foot air-compressor, from which a pipe-line leads to the mine. The mill has a nominal capacity of 100 tons a day. The mine is equipped with one Denver Dreadnaught and one Sullivan hammer-drills. Owing to a flat portion on the tramway at the top, power is required to start the loaded bucket, which is furnished by a small oil-engine.

The main mine-workings are at an elevation of 1,200 feet, and begin in a gully, along the bed of which bare rock is exposed for over 1,200 feet, the balance of the ground being largely covered with soil and timber, with occasional rock outcrops or humps.

The formation, broadly speaking, is sedimentary, belonging in the slate or argillite area. The ore occurs as a series of quartz veins, with a general strike about north (mag.), and dips to the west varying, but mostly steep. These veins are quite irregular in width along strike and dip, and form rather a zone than a well-defined vein. Mineralization consists mostly of molybdenite in the form of thin seams parallel to the walls, but often curved and crumpled where the veins have been squeezed by pressure, in which case the seams may be ¼ inch thick. The ore tends to break along seams, which gives specimens a deceptively solid appearance.

Paralleling the veins, and between them, are a number of dykes which make up a large percentage of the country-rock near the veins. This general dyke-vein zone continues for about 800 feet north of the mouth of the main working-tunnel, at which point it is cut off by a tongue of granitic rock, mostly moderately coarse feldspar and quartz, which strikes about north-east and has a width of probably several hundred feet. Vein-fissures continue into the granitic rock, but the mineralization seems to change. A 42-foot tunnel, 250 feet above the main tunnel, driven north from the contact with the granitic rock, shows a fissured zone much altered or decomposed, in which small dykes are seen. In this tunnel small lenticular shoots of ore were found, which consisted of quartz with galena, zinc-blende, and pyrite, both coarse and very fine-grained. The best showing was 3 feet wide. Six inches shows in a crosscut near the face in one place. This crosscut shows the fissure-zone to be at least 15 feet wide, and strong, with much gouge on the walls. An assay furnished by the company shows: Silver, 150 oz. a ton; lead, 55 per cent.; zinc, 35 per cent., which seems to total up too much, but shows the general character of the ore. The occurrence does not suggest any important tonnage of this class of ore, though it has possibilities.

The main tunnel follows the zone for a length of 200 feet, attaining a depth of 90 feet. For the first 100 feet it follows a fissure, with little quartz; then follows a quartz-lens for 50 feet; then crosscuts west for 38 feet, from the middle of which a drift continues north for 50 feet to the face, where a crosscut is run 90 feet east. The two crosscuts show rock with large and small quartz veins for a width of 80 feet altogether, with the western or hanging-wall side possibly not reached, while the foot-wall side penetrates over 25 feet of dyke, in which the crosscut ends. The two sides of the crosscuts are not the same, as the quartz-lenses vary in width, sometimes with great rapidity, but the total width of quartz is perhaps nearly half of the 80-foot zone. This quartz is more or less mineralized with molybdenite in fine seams, but the bulk of it is rather barren-looking, and its value appears to me to be very doubtful as a whole, though some streaks may pay to mine.

At 40 feet from the mouth of the main tunnel a drift branches to the east at 45 degrees, which swings nearly parallel to the main tunnel after 50 feet. In the parallel portion a lens of quartz was encountered, which has a width, as shown by a crosscut, of over 12 feet. The quartz in the crosscut looks rather barren, but good ore is stated to be in the bottom of the tunnel. From this drift a raise of 30 feet length reaches the surface, around the upper part of which a small stope has been worked. This shows a width of about 6 feet of good-looking ore, which is said to run over 3 per cent. molybdenite, fully borne out by its appearance. This is the best showing in the mine, and the exposed length is about 20 feet altogether. The drift inside the raise is largely in dyke rock, but would probably encounter more quartz if continued to cut the east crosscut above mentioned.

On the surface, in the gully, several showings of fair ore are exposed naturally. The good ore evidently occurs in small bunches and development will be an expensive item, and a large production of molybdenite does not seem probable, though a close sampling might indicate a more favourable state of affairs than a mere eye inspection would show, and the possibilities extend outside the explored area. The gangue of the ore is occasionally crushed rock, accompanied by quartz. This may be due to original mineralization of the rock, but is more likely

due to the crushing which has taken place to some extent, dragging the molybdenite ore into the rock locally.

One dyke was observed to cut a body of quartz, and showed a porphyritic structure in the centre, with very fine grain at the contacts with the quartz, the latter being apparently unaffected. Some, and perhaps all, of the dykes, which vary in appearance, are therefore later than the ore, though they have themselves been affected by the crushing to some extent. The origin of the ore is therefore not probably from the dykes, but more probably from the granite, and deep-seated, relatively at least. The fact that the surface exposures are better is probably largely accidental or due to limited underground development, which has not extended far enough to prove up the deposit adequately as yet.

As the outcrop of the zone runs downhill to the south, there should be a good chance to get in a lower tunnel as a drift along the mineralized zone, when it becomes desirable.

Last Chance. Two claims—*Last Chance* and *Last Chance No. 1*. Owners, G. R. Naden, Bowers, and Jos. Wells. Situated on the south-facing bank of the Middle fork of Lime creek. At 2,475 feet elevation a tunnel has been run for 20 feet, north-east (mag.), on a 4-foot vein, consisting of quartz in crushed slate. The vein is oxidized on the surface, hardening in the face, but not completely. The quartz contains a little galena, zinc-blende, and pyrite. The tunnel shows some lean carbonates. A picked assay gave: Gold, 1.40 oz.; silver, 14 oz.; lead, 20 per cent. A cut above the tunnel shows a well-defined vein, 5 feet wide. Five assays from the surface are reported to have run $16 to $19 a ton.

The proportion of quartz in the vein is rather small, and the vein looks rather lean and hungry. It does not seem very promising, but is not exposed for any distance, and might be better elsewhere. The formation is slate, containing other small veins or stringers, one of which shows across the creek, which may be the same vein, but smaller. The creek is 100 feet below the tunnel.

Silver Bow. Claim located near the head of Lime creek, Main fork. Elevation, 3,600 feet. Shows some quartz stringers in the slates, which are here schistose and twisted. A stringer or showing of high-grade ore was reported, but could not be found, in the owner's absence. It is said to be Crown-granted and owned by Tom McRostie *et al.*

Basin. This claim or group is owned by G. R. Naden, of Prince Rupert. Situated on the south side of the basin at the head of the Main fork of Lime creek. The workings are at an elevation of about 3,900 feet, well above timber-line. The surface contours are here rounded or convex, while the strike of the vein follows a concave curve, and the dip is nearly vertical, thus the apex forms a vertical curve on the same hillside.

On the two slopes of this curve two short tunnels about 10 feet long have been driven, each on the vein, in nearly opposite directions. They would meet if continued on the vein. There are also two small open-cuts on the vein on the south side of the tunnels. The vein runs from 8 to 30 inches. The mineralization is peculiar to this locality, as far as observed, consisting of bunches of massive pyrrhotite, containing smaller bunches of bright galena, with some zinc-blende and quartz. The vein is small and the percentage of lead is small. It does not appear to be of much importance. Fifty feet below the above tunnels a crosscut has been run to tap the ledge in depth. It was inaccessible, but judging by the dump it was short, and did not get the vein.

The formation is granitic, but appears rather to be a gneissic transition zone between the main granite and the main slates.

Sunset. Situated west of the headwaters of the West branch of Lime creek, near the granite contact. Owner, G. W. Morley. The *Sunset No. 2* (Jos. Hays, owner) and the *Lone Pine* (Al. Cleary, owner) adjoin. The vein appears to be of the fissure type, with some replacement, but not very definitely opened up yet. The workings consist of two open-cuts on a steep north slope at an elevation of about 3,400 feet, near timber-line. The vein runs 25° W. (mag.). The formation on the west side appears gneissic and fine-grained, while the east or foot-wall side seems to be porphyritic, and may be a dyke. The cuts are 60 feet apart near the south end line, adjoining the *Sunset No. 2*. The vein is best exposed in the lower or northern one, where it shows a width of 5 to 6 feet, not fully exposed perhaps. Farther up the hill some obscure siliceous outcrops show, which appear rather bunchy and irregular.

Mineralization is similar to that on the *Basin* claim; that is, massive bunches of pyrrhotite, with some pyrite, galena, and zinc-blende, the galena appearing very fresh and with brilliant lustre when broken. The surface is somewhat oxidized. A picked assay is reported to have given $84 in silver, which shows that the galena is probably silver-bearing. The vein is largely covered by surface wash, and its relations are somewhat obscure. It might contain good ore-shoots, and appears worthy of further development, as it is well placed for adit entry on the vein on a steep slope. It seems to be in the gneissic transition zone between the main slate area and the main granite. It would not cost much to find out something about it with a little tunnelling.

Mohawk Group. Four claims—*Mohawk*, *Mohawk No. 1*, *Mohawk No. 2*, and *Mohawk Fr.* Owners, Alice Arm Mohawk Mines, Limited. Situated on the east slope of Roundy creek, on a small tributary called Mohawk creek, about two or three miles from Silver City by a graded trail a little out of repair. The cabins and main shaft are at an elevation of 2,150 feet above sea.

The vein is narrow and sharply defined, striking east and west (mag.), with a dip 75 to 80 degrees to the north. It is faulted where it crosses the little creek, with a throw of 20 feet or so. The mineralization consists of a very white, clean quartz, containing well-defined black zinc-blende, with a little pyrite. A bunch of high-grade silver ore is reported to have occurred just east of the fault in the creek, which has been removed by a 6-foot shaft and 6-foot tunnel. The dump shows considerable quartz, in which a few specks of ruby-silver were found, and a peculiar tin-white mineral which seems to be galena.

Some fine-grained arsenopyrite was also noticed. An assay of 300 oz. of silver is reported from the good ore. Some 50 feet west of the creek a shaft was sunk, now full of water. It is reported to be 50 feet deep, with an east drift 130 feet long from the bottom, which got no ore, but is supposed to have run off the vein. The dump corroborates the report, showing much brown rock, with a texture-like sandstone, which might be dyke rock possibly, and a small proportion of white barren quartz. The vein on the surface is from 12 to 16 inches wide, and is said to have been traced for 800 feet to the east. The surface is much covered with soil and heavy timber. The property is in the main slate area.

San Diego Group. Eight claims—*San Diego*, *San Jose*, *San Luis*, *San Juan*, *San Mateo*, *San Pedro*, *San Dimas*, and *San Marcos*. Owners, J. E. Price and S. J. Eubank, of Seattle, Wash. Situated on the west slope of McGrath mountain, four miles from Alice Arm. The main work is at an elevation of 900 feet above sea, not far from the North-east Kitsault river. A good trail, passable for horses, leads nearly to the property.

The formation is presumably tufaceous sandstone, with small bands of slate, though in appearance it rather suggests an altered greenstone, containing a certain amount of secondary calcite. It is rather soft and generally light grey in colour, cut by several small dykes.

Most of the work has been done in one place. Several large blasts have broken out a large step-like open-cut in the bottom of a steep little gorge, on each side of which a short tunnel has been driven. The main work has been done with a shot core-drill. The drill is an Ingersoll Rand Calyx drill, 1½-inch core, driven by a 4-horse-power Fairbanks gasolene-engine. This has been run by Mr. Eubank alone, who has made as much as 12 feet in a day's work with it.

The mineralization consists of a general pyritization of the sandstone, accompanied by a varied distribution of chalcopyrite, generally carrying small but surprisingly constant gold values. The total quantity of sulphides is small, as far as observed. The chalcopyrite seems to occur in local concentrations, while the pyritization is more general. The interbanded slates are barren. Some mineralization has been found over a considerable area of the hillside of the above general character, but usually slight. A little arsenical iron was observed in nodules.

The dykes in general run about N. 20° E. (mag.). No definite direction can be stated for the mineralization at present.

The drill-cores have been shipped out and complete records have not apparently been kept. As far as could be obtained, the records are as follows: Hole No. 1, depth 50 feet. Cut two stringers, of which one ran 8.2 per cent. copper. Direction vertical. Hole No. 2, depth 165 feet: 0-12 feet, gold trace, copper 1.7 per cent.; 12-24 feet, gold 0.07 oz., copper 1.9 per cent.; 24-36 feet, gold 0.02 oz., copper 2.8 per cent.; 36-48 feet, gold 0.02 oz., copper 4.14 per cent.

Below 48 feet the hole successively encountered different bands, including 22 feet soft, white, limy material, 5 feet slate, 30 feet grey sandstone rock, ending in 5 feet slate, all of which showed no values of consequence.

Both holes started from the big step-like open cut, which, however, broke out the upper 25 feet of the 50-foot hole.

At the surface, where the deeper hole started, a lens of good chalcopyrite ore was found, which amounted to about 1,000 lb. The good assays of the deep hole are rather surprising, in view of the general nature and appearance of the deposit. It is not known how the cores were sampled, as they were shipped out by Mr. Eubank, who furnished me with the above assays as received by him.

No work has been yet done to show the lateral extent of the above ore, but the result is encouraging enough to warrant putting down more holes with this end in view. As far as surface conditions go, there is ample room for large deposits or ore-bodies in the mineralized area. As it is similar in character to other large showings in the copper-belt, its development would be significant of what might reasonably be expected elsewhere.

At 1,350 feet elevation a small open-cut shows similar formation, which here strongly resembles altered greenstone, and contains a little chalcopyrite and pyritization. In the gully above the drill several dykes cross and the formation is generally the same, somewhat pyritized, with a few spots of chalcopyrite. The steep gulch-walls are somewhat yellow-stained, and in places a bluish-white, watery slime oozes out, which was not identified.

A general sample across 40 feet, 25 feet below the drill, taken by Mr. Eubank, gave $1.20 gold and 0.7 per cent. copper. The grey formation effervesces more or less with acid and is evidently somewhat calcareous, though not to any large extent.

Red Bluff.

Situated on a hill west of the North-east branch of the Kitsault river, across from the *San Diego*, and a little farther, say four to five miles, from Alice Arm. The faint trail crosses the river at an elevation of 500 feet. The upper part of the hill is cut by several steep canyon-like gulches, the walls of which are red-stained over a large area, which is conspicuous and visible from Alice Arm.

At 2,300 feet elevation a 15-foot tunnel passes through the red stain into light-coloured leached-looking rock, somewhat lightly pyritized. In the gully at this point the formation has an apparently crystalline structure between two dykes, though somewhat leached and altered, and may be igneous. At 2,900 feet elevation a 35-foot tunnel has been driven, showing somewhat stronger mineralization, with deeper oxidation along seams. A few pieces of ore on the dump show considerable chalcopyrite, and the rock is pyritized. Some of the oxidized material was panned, with no result in gold. Dykes are numerous, running N. 15° E. In general it resembles the *San Diego*, but the mineralization is generally very slight. The mineral spring is referred to elsewhere in the geological remarks.

No attempt was made to go over the red outcrops in detail. They are precipitous to a large extent and very similar in appearance to the similar red outcrops in the upper Kitsault section, and are evidently due to oxidation on the surface of a pyritized portion of the formation, which portion is unknown in extent, but certainly large, measurable in acres rather than in feet. Copper-stain seems to be generally absent or inconspicuous. Sulphides usually occur immediately below the surface stain, and there is nothing to indicate that the oxidized surface may be underlaid at depth with enriched sulphide ores. Whether or not there are areas of more concentrated mineralization, in size and value sufficient to constitute workable ore-bodies, is not known, and would probably be difficult to determine with certainty by a surface examination. The possibilities may be considered large in size, but rather doubtful in occurrence. The formation is called tufaceous sandstone by McConnell, of the Geological Survey.

Quartzite Peak Area.

On the summit and East side of Quartzite peak, down to the headwaters of the North-east branch of the Kitsault river, some thirty claims were staked during the summer. A number of these were looked over, but nothing was seen which appeared to be of any promise whatever, and most of them will neither be named nor described. On the summit of the peak, or near the summit, certain patches of the quartzite show a brown surface stain, due to small patches of light pyritization, which are accompanied by dykes. These follow the strike of the bedding resembling a line of outcrops, but the brown colour is due to a very slight surface stain, and the amount of pyrite is very small.

On the *Ida* a small flat quartz vein was seen, outcropping along the hillside, quite persistent, varying in width from a few inches to a foot or more. In places it contains a slight mineralization, mostly zinc-blende, with a few specks of galena, sufficient to furnish a few fair-looking specimens.

On the *Butte* a fissured zone 2 or 3 feet wide occurs, which has a vein-like appearance, with a few mineralized spots. Lower down and farther south quartz stringers are numerous in places, apparently phases of a small branching granite dyke. These are pyritized in spots, from which specimens can be obtained.

This area has been blanketed by groups of claims, staked wholesale in blocks of four, mostly by agents. Molybdenite is reported to have been seen in specimens, which is not surprising in connection with the granite dykes, but is unlikely to be of any important significance.

ILLIANCE RIVER SECTION.

The main Illiance trail starts from Silver City, where there is a Government wharf. A branch trail leads into it from Alice Arm. The latter crosses the Kitsault river by a cable-ferry, which consists of a boat attached to a traveller on a cable and is not large enough for horses, which have to ford. It then crosses the Illiance delta, which at high-water times floods it in places. The most certain access is by boat from Alice Arm to Silver City. The main trail is suitable for pack-horses, but gets soft and swampy above the Eleven-mile point. From its source, at 3,000 feet or more elevation, the Illiance flows due south for about four miles, then swings rather abruptly to the west, flowing somewhat south of west for eleven miles to its mouth, where it forms a delta across the tide-flats. The east and west portion of its valley is narrow and canyon-like, the northern portion being wider and more open.

No mineral-deposits of importance seem to have been found along the east-west portion, the main showings being grouped along the north-south portion, and thus widely separated from the other showings in the Alice Arm district.

In the absence of many of the claim-owners, information was difficult to obtain in regard to many of the showings, and some were not discoverable, while others were probably overlooked. but, as the general character of most of them was the same as far as seen, it is not likely that anything of exceptional importance was missed, in view of the number actually visited.

Golden Crest. Owners, Ralph Y. Ingraham *et al.* Situated on the east side of the Illiance river, opposite the Eleven-mile bridge. One hundred feet from the main trail, at an elevation of about 2,000 feet, an open-cut has been made. This exposes the formation for a width, east and west, of 6 to 8 feet. The formation is distinct from the tuffs to the north, and has the texture of an igneous rock, or of a compact sandstone, stained with a variety of light-yellowish and faint-pinkish tints. This is mineralized in the cut, with quartz stringers and with some pyrite and a little chalcopyrite. The largest quartz stringer is about 1 foot wide by 6 or 8 feet long, heavily impregnated with pyrite, and runs north-east.

The formation is said to be 500 feet wide, and an assay is reported from the east side contact which ran 2 per cent. copper, $3.20 gold, and 40 cents silver. This was not seen. It is said to get better when shot into. Some specimens at the cabin showed what seemed to be barite and rhodocrosite in the gangue, reminding one of the upper Kitsault section, while some of the mineral looked like the glance or grey-copper of the upper Illiance. The impression seems to be that the values are chiefly in gold, but the appearance rather suggests copper possibilities, though the amount of copper observed was very small. It is difficult from anything else seen in the district, and seems to warrant a closer investigation after it has been a little more opened up on the surface.

Bellevue Group. Five claims—*Bellevue*, *Bellevue No. 1*, *Bellevue No. 2*, *Bellevue Fr.*, and *Blenheim*. Owners, Dr. Kergin, of Prince Rupert, and J. E. Stark, of Alice Arm. The main trail crosses the group, but the actual showings are down in the canyon and were not seen. Mr. Stark informed me that there were several open-cuts showing ore similar to that on the claims farther north. One of these showed a width of vein of 7 feet, with some galena in it. There are two tunnels, now caved in, 25 feet and 18 feet respectively; the latter showed a 4-foot vein, with from 8 to 14 inches of solid galena in a gangue of spar. The galena assayed $50 a ton. Assays were obtained from some of the upper showings of from 75 to 200 oz. silver. In the canyon there is said to be considerable barite, suggestive of the upper Kitsault.

Grey Goose Fr.

Owner, Harry Phillips. Adjoins the *Bellevue* group on the north of the latter, and lies in the floor of the Illiance valley. The workings are at an elevation of 2,400 feet. The chief work is a tunnel 35 feet long, running west into the base of a low north-and-south ridge. The formation is highly altered and brecciated, containing serpentine and pinkish streaks, which suggest rhodocrosite. There are several north-and-south vertical seams and hard silicified streaks. The whole is light grey in colour and slightly pyritized. No ore is exposed, nor any distinct vein.

Two hundred feet south of the tunnel is an open-cut showing similar formation, with small bunches of pyrite and zinc-blende, with a little galena as well. The total amount of sulphides is small. Fifty feet south of the cut a tunnel is started in rotten schist, which in the face is turning to the grey formation described. It shows considerable heavy pyrite in bunches, with a little zinc-blende and galena in odd specks here and there.

The general formation is somewhat schistose and may represent an altered phase of the tuffs, but seems rather to resemble an altered intrusive rock, possibly analogous to that in the *Golden Crest*, or else a dyke.

A few hundred feet to the west coarse conglomerate outcrops, of a general reddish colour, which appears to continue a long distance to the north, angling somewhat to the west, about parallel to the line along which many of the claims are staked in the valley.

United Metals Co.

This stock company, locally managed by Mr. Calhoun, owns a number of claims in the section, of which three were visited—namely, the *Joplin*, *Silver Star*, and *Silver Hoard*. These occupy an area about one claim north of the *Grey Goose Fr.* On the *Joplin* claim, about 500 feet north of the cabin on the west bank of the river, a surface stripping 10 feet wide runs up the steep bank for a length of 30 feet. This shows considerable surface oxidation, with north-and-south seams, yellow leached rock, with unaltered bands. At the base of the stripping a tunnel has been run in some 25 feet in a westerly direction. The tunnel is in grey altered rock, soft and somewhat schistose and pyritized. At 12 feet in on the south side a bunch of good ore was struck, of which some remains; 300 lb. of this ore is on the dump, which is heavy in zinc-blende, with pyrite and galena. It would run from 10 to 15 per cent. lead. There is also a 5-ton dump of heavily pyritized schist, with small amounts of zinc-blende and galena.

The face of the tunnel is harder and looks silicified. It shows cubes of pyrite. Several seams in the tunnel strike north and south, with a nearly vertical dip. Across the river, 50 feet distant, is a 10-foot dyke, nearly vertical, striking north and south, which is said to be traceable for a long distance, and ore found against it in places.

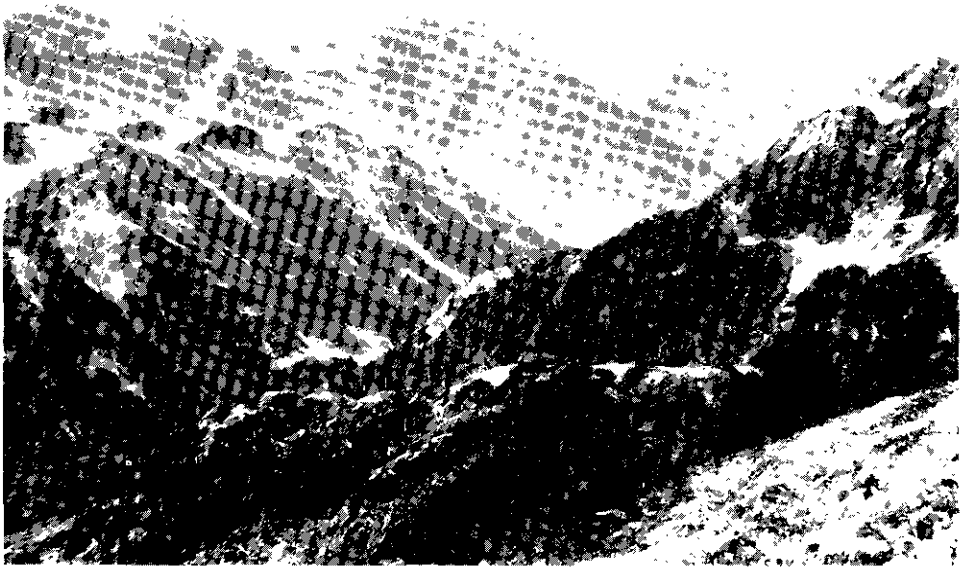
The formation is generally similar to that on the *Grey Goose Fr.* and shows that the altered zone contains ore to a depth of 12 or 15 feet, anyway, though bunchy. The possibility suggests itself that the zone might contain larger ore-bodies in length or in depth. The width of the zone is enough to permit of such bodies attaining considerable size, but there is no proof at present that such bodies do or do not exist, though the general scant mineralization does not make the prospects look very bright.

Just back of the cabin, on the same level nearly as the tunnel—namely, 2,500 feet—is an open-cut showing the leached grey formation pyritized. Fifty feet north is a stripping 30 feet long, in which bunches of galena and zinc-blende occur for a length of 6 to 8 feet; the full width is not exposed, as the stripping runs with the strike.

In the river-canyon, a short distance south of the cabin, is a showing of ore 4 to 16 inches wide, containing galena and blende which is being mined and sacked for shipment. It is said to be high in silver. This must be close to the dyke mentioned.

On the *Silver Star* claim, at an elevation of 2,560 feet, there is a surface stripping on the main trail. This is 20 feet long and shows a leached and pyritized zone, with a few small bunches and stringers of ore. Some fair specimens can be got showing galena and blende, with a mineral which may be specular iron.

At 2,700 feet elevation, north-west from the last showing, there is an open-cut 50 feet long, which shows several small lenses of good ore, of which the largest is 5 feet long by 6 to 8 inches wide in the centre, and by inspection running 10 to 15 per cent. lead and 20 per cent. zinc. The gangue is decomposed tuff rock, with spar (calcite in part) and quartz. The lenses occur in a zone, say, 6 or 8 feet wide.



Divide, Illiance River, looking North.

Table Mountain, Alice Arm District.

On the *Silver Hoard*, near the north line, adjoining the *Silver Bell* property, is a stripping and shallow rock-cut, which shows a lenticular north-and-south outcrop containing good-looking ore. On the west side is 2 feet of spar with rhodocrosite and a copper mineral, probably chalcocite. The remainder, 8 feet wide, consists of rock gangue, with seams of quartz, spar, and chalcocite. The foot-wall is fine-grained and looks like a red shale narrow band. The formation is generally tuff-schist. The exposure as a whole might run from 3 to 5 per cent. copper. A sample across 4 feet is reported to have given 21 per cent. copper, with no gold and silver. The showing seems to have been cut into at the best point and looks like a surface enrichment, which might be blown out with a few shots, though this is not proved. It is probable that there are parallel showings on this claim, judged by indications on the claims to the north.

Silver Bell Group.

Two claims—*Silver Bell* and *Sapphire*. Owners, Jos. Hays, Mrs. McGrath, Moore, and Johnson. Adjoin the *Silver Star* on the north. The formation is schistose tuff, with dykes which both cut and follow the schistosity. The veins are narrow and lenticular in general, following or slightly cutting the schistosity, with very small lenses of ore, which in places is, however, of very high grade. In general the silver value seems to decrease going north. There are probably a number of more or less parallel veins, or long narrow lenses, in the general vein-zone, and further prospecting might considerably increase the number now known. Single exposures seem to pinch out in length, and the next exposure may be in line, or parallel, as the case may be.

At 2,940 feet elevation, a short distance above the McGrath cabin, a surface stripping or cut 125 feet long shows a narrow wavy vein, in which quartz-lenses occur, mineralized in bunches with small amounts of chalcocite and pyrite, and possibly some specular iron. The greatest width is 1 foot, and the ore forms a small percentage of the vein. A picked specimen ran: Copper, 8 per cent.; silver, 1,150 oz.; gold, $38, which would indicate the presence of argentite or some rich silver mineral. The chalcocite is doubtful and may be grey-copper or tetrahedrite, which would explain the silver.

Two hundred feet north and considerably west of the strike of the above, two strippings show parts of a vein, which seems to have a length of over 200 feet; it is cut by a dyke in one place. Near the south end there is an exposure of 6 inches of fine ore in one place. This seems to be a small lenticular ore-shoot. The balance of the work shows the oxidized surface of the vein, and a little ore in a couple of places where it has been slightly broken into. The actual stripping totals over 100 feet out of the 200 foot length. Galena and chalcopyrite were noted in small quantities. The strike is about N. 45° W. (mag.) (N. 16° W. true) and the dip 70 degrees west.

The *Sapphire* claim lies north of the *Silver Bell*. At 3,250 feet elevation on the *Sapphire* there is a line of cuts, on a vein or veins, which show more or less ore in spots, of similar character to the *Silver Bell*. An assay of $167 in silver is reported from one of these. At 3,350 feet elevation there is a stripping 50 feet long by 12 feet or less wide. A considerable bunchy vein-outcrop is here exposed, which seems to be at the junction of at least two veins; ore occurs in it in spots. One assay of $27 in silver and 16 per cent. copper is reported, which represents selected ore. The total of metallic minerals is small, but there is a good deal of quartz and spar in stringers and bunches, while the whole surface of the stripping is more or less iron-stained and red. This side of the valley—in fact, both sides are cut into numerous gullies and ridges, about parallel to the veins, partly of glacial origin possibly, several of which seem to more or less focus about at the above intersection of veins.

A little work on some of the richer spots on this property might be made to pay for itself, even if the sorted ore had to be packed out on horses, and would prove whether or not they have any continuity in depth, a point that is at present in doubt.

Top Notch.

Owner, Mrs. McGrath. Adjoins *Sapphire* on the north. At 3,400 feet elevation there is an open-cut or stripping 40 x 12 feet. At one side is a tunnel, which gains little depth, running 15 feet westerly alongside a dyke. It shows 3 feet of much-oxidized material, red-stained with knots of good ore, of which a small pile lies outside on the surface. The stripping has cross-fissures, one of which cuts off the oxidized vein just beyond the face of the tunnel. Some distance farther north, at 3,430 feet elevation, a cut in a small hump shows 2 feet of vein, with spar, quartz, and a little pyrite, chalcopyrite, chalcocite, azurite, and malachite, not in important quantity.

Balmoral and Lakeview. Two claims—the *Balmoral*, owned by Wm. Bradley, and the *Lakeview*, by Major Christie. Are north extensions of the *Top Notch*. Little work has been done. They were not examined, as the mineralization seemed to have approached the vanishing-point in the *Top Notch*, and no good showings were reported.

Monarch Group. Owners, J. E. Stark and F. E. Juggins. Situated just east of the little lake at the head of the Illiance river. The main workings are 250 feet above the lake; elevation, 3,250 feet. A surface cut has been blasted out in the solid rock to a depth of 2 to 5 feet for a length of 40 feet east and west, apparently across the strike of the vein. For 10 feet in the west half of the cut the mineralization is quite heavy, consisting of pyrite and chalcocite, with a little galena, blende, and chalcopyrite, in a gangue of altered country-rock, partly silicified, quartz, and some spar (calcite in part). The formation is schistose brownish volcanic tuff. The remaining 30 feet of the cut is similar, but much less mineralized. The whole makes rather a fine-looking surface showing. The best 10 feet is said to run 10 per cent. copper, which seems a little high for a good average, but the mineralization is sufficiently irregular to make a good average hard to get. The percentage of chalcocite is enough to ensure a high-grade concentrate, if such ore were found in quantity, at any rate.

Although a number of rock-exposures were searched around this showing, no corresponding outcrops could be found, and it appears to be quite local, though this could not be definitely proved on the ground, as practically no surface work had been done to follow it.

The main exploratory work was done by a man named Hopkins, under option, and consists of a crosscut tunnel some 40 feet below the showing in elevation and 100 feet distant. This was driven in eastward for 140 feet, cutting two or three little north-and-south seams of quartz calcite slightly mineralized. It extends past the line of the surface, showing slightly, and as far as can be judged should have cut the vein. About 15 feet from the face a couple of water seams or fissures were encountered, and near the face a 3-foot dyke was cut through. Both of these in dip and strike correspond fairly well with the surface showing, and in the face and near the seams there is a little silicification with slight mineralization, which most probably represents the vein, though the contrast with the surface showing is rather startling. The dyke was not certainly identified in the east side of the cut, where it might be expected, but may be represented by a silicified greenish exposure of rock where it should show. The tunnel should be driven farther in its present course, to make sure that the vein has not been missed by any flattening of its dip. The surface is more or less oxidized, but not enough to account for so much enrichment unless the heavy glaciation which has probably taken place has removed the oxidized material. As snow lies here 30 feet deep in winter, the ground is normally saturated, and water-level is close to the surface. The great difference between the surface and the tunnel is, however, hard to account for by secondary enrichment alone, and it is quite possible that the tunnel has not yet cut the vein. A few other showings on this property were seen, but were mostly on stringers of little apparent importance. There is a good cabin near the lake, with several bunks.

Left Over. Two claims—*Left Over* and *Left Over No. 2*. Owners, J. E. Stark and F. E. Juggins. Situated on the south side of the South fork of Tchitin river. The vein-outcrop runs up the side of a precipice, which rises above a considerable glacier. The glacier fills the valley at this point. By climbing up to a narrow ledge one can work around and reach the outcrop in one place. The vein here seems to be about 5 feet total width, with sulphides in heavy short bands, or lenses, consisting of galena, chalcopyrite, blende, and pyrite, with quartz and altered rock as gangue. Some grey-copper appears to be present. Eighteen inches of galena occurred in the original showing, in part shot away, which assayed 174 oz. silver and no gold. The quartz-pyrite combination gave 70 oz. silver and $40 in gold. Large boulders of this quartz-pyrite combination are found as float down the valley, with a smooth brown-stained surface. Many of them appear too large to have come from this ledge. Two hundred feet or more higher up above the precipice a large barren-looking quartz-outcrop could be seen, which is said to run south along a ridge-top. The formation seems to be the Tchitin mashed diabases, which are well exposed in the steep rock-walls which rise from the glacier.

The occurrence is an interesting one, and would be worth more development, except for its extremely difficult situation from a transportation point of view. The showings are at an

elevation of 2,700 feet, and the ore would have to be brought out over the Illiance divide, a distance of about seventeen miles or more.

Yankee Boy. Owner, Ralph Y. Ingraham. Situated near the Tchitin river, on the east slope of an unnamed creek which heads at the Illiance divide and flows north into the Tchitin. An open-cut at an elevation of 2,400 feet shows a dyke, alongside of which for 15 or 20 feet is a very slight mineralization. A few specks of galena and trifling amounts of some copper mineral are visible. A little good float seems to have been found below.

UPPER KITSAULT RIVER SECTION.

The most important mineral deposits of the Alice Arm district occur in this section. It includes all the valuable deposits of the andesite-silver type and most of the properties of the copper type. The former is sufficiently developed to assure an important production of silver, on which the building of a railway and mill is expected, while there are several promising undeveloped prospects. The copper properties are less developed, but a small production is probable, while the possibilities of large production, though still indefinite, will probably be considered good enough to warrant further development. In fact, late reports state that two or three of them have been taken up under working-bonds. In the past, transportation difficulties have badly handicapped development. These have been considerably reduced by the building of the Dolly Varden Mines Company's main graded trail, which enables horses to travel up the river for nineteen miles. With the completion of the railroad, development will doubtless proceed at a much more rapid rate. The railway terminus will probably be south of Trout creek. If a good pack-trail were to be built for three or four miles above Trout creek, it would probably assist in the development of the section.

The railway-grade follows the river closely, with a grade of under 1 per cent., nearly to Miner creek, where it rises to avoid the Big canyon, which is impassable near the river-level. Above the Big canyon the river-valley swings considerably to the west, but keeps an easy grade for three or four miles, after which it rises rapidly to the glacier, whence it issues at an elevation of about 2,800 feet.

Practically all the important showings and properties were visited. One or two could not be seen for snow, and one or two new discoveries were made after I left. Some notes in regard to these are appended to the descriptions of the properties visited.

Dolly Varden Group. Eight claims—*Dolly Varden*, *Dolly Varden No. 1*, *Dolly Varden No. 2*, *Dolly Varden No. 3*, *Dolly Varden No. 5*, *Dolly Varden No. 6*, *Dolly Varden No. 7*, and *Jim Varden*. Owners, Dolly Varden Mines Company; R. B. McGinnis, manager. This company also owns the *Wolf* property, described later, and four claims at Alice Arm, on which the wharf and main offices are situated—namely, *Beach*, *Waterfront*, *Dougall*, and *Dougall Fr.* claims.

The mine camp and main workings, at 1,700 feet elevation, are situated on the west side of the Kitsault river, the surveyed distance from the wharf being close to nineteen miles. The river at this point is about 1,000 feet above sea, and the hillside rises steeply from the water, past the mine, to an elevation of 2,200 feet, then over the summit slopes more gently down to Evindsen creek, on the west.

Development-work to September 1st, 1916, consists of 1,200 feet of tunnels and raises, 5,500 feet of diamond-drilling, besides numerous open-cuts, large and small. Pending the completion of the trail, no machinery has been installed, except the small gasolene-operated diamond-drills. The camp has good solid cabins, assay office, etc.

The vein strikes approximately east and west, with a dip to the north of 45 degrees and upward. Mineralization seems to follow a definite line or fissure, but extensive replacement also appears to have taken place, and ore occurs in widths up to 50 feet or more. The mineralization consists of quartz, both white and bluish tinge, accompanied by much pyrite, and smaller amounts of galena, ruby-silver, native silver, argentite, zinc-blende, and rhodocrosite or rhodonite. In places barite occurs in considerable quantity, but does not seem to be associated with good ore to any extent.

The original discovery was made on a projecting outcrop some 40 feet wide. At first only trifling values were found, but on development very high values in silver shortly appeared. A tunnel driven on the vein at this point encountered a strong cross-fault at about 50 feet.

The continuation of the vein was later found to the north, showing a throw of about 75 feet. This second section behaves in something the same way and development has continued into a third section, still farther north. Judging by surface outcrops, this step-faulting is probably local. In general the ore presents great local variations in appearance and occurrence, and its structural features are not fully worked out yet. In the third section good ore occurs which is not much mineralized in appearance; in fact, looks like country-rock more than ore, and close sampling is necessary to follow it intelligently. Should such ore occur in an outcrop it might readily be overlooked, and prospectors should be careful not to pass up hungry-looking outcrops in this section without close examination.

The workings include a 50-foot adit-tunnel, with crosscuts penetrating the first ore section; a second longer tunnel, with crosscuts penetrating the second ore section, connected by a raise with a tunnel 30 feet lower, in which several hundred feet of work has been done in the second and third sections of ore. The ore occurs in bodies or shoots, and has been proved in quantity below the last-mentioned tunnel by a series of diamond-drill holes.

A couple of hundred feet lower down the hillside a working-tunnel is being driven, which was in 400 feet in July. At 100 feet in, ore was encountered on the south side and partly explored by a short drift. The main portion of the tunnel is driven in a straight line, and apparently in the hanging-wall largely, as shown by the dump, which is largely red andesite. A raise has been started to tap the ore shown in the diamond-drill holes above.

Between the working-tunnel and the upper workings the apex of the vein has been proved by a series of open-cuts, showing a width of about 8 or 10 feet, practically in a straight line, indicating a north dip of about 45 degrees.

Above the upper workings the apex has been followed by a few open-cuts, which show widths of 4 or 5 feet mostly, in the green andesite, which suggests that there might be more vein farther north along the contact with the red andesite. On the summit of the hill, 500 feet above the upper tunnels, a great outcrop of quartz forms a large hump, on the west side of which an open-cut has been faced up to a depth of 15 feet, showing a clear width of 50 feet, which is considerably mineralized. It shows red andesite on the hanging-wall and green andesite on the foot-wall. It is being explored by diamond-drill holes. According to later reports, similar conditions were encountered by the drill-holes to those on the surface. The assay results have not been made public.

One thousand feet or more to the west an open-cut shows a vein width of 80 feet, horizontally measured. This consists of bands of rock and quartz, with a rather flat dip. By appearance it might be on a vein to the south of the *Dolly Varden* main vein. It contains a good deal of barite and the greenish rock is pyritized, but on the whole mineralization is not strong.

In the Kitsault canyon, at the river-level, on the *Toric* claim, a vein containing several feet of heavy barite with small silver values occurs, with dip and strike such that it might be a continuation of the *Dolly Varden* vein.

In general it may be stated that many thousand tons of ore are proved in this property, of a relatively high grade in silver. Concentration tests on the ore from this property and from the *Wolf* property have given recoveries up to 92 per cent. by flotation methods, with a concentration ratio of about 4 into 1.

The question naturally arises, will the ore continue in depth? In answer, it may be said that it is actually proved for a depth of about 200 feet. Again, an examination of specimens shows a notable lack of the usual signs of secondary enrichment, such as primary sulphides coated with secondary sulphides. The minerals seem rather to have a more or less heterogenous arrangement, and sulphides occur right on the surface, where little oxidation is noticeable. In one place native silver occurred right in massive galena at the surface. Judging by hand specimens, the ore appears primary.

The ore-shoots occur in the intersection of the vein with a wide zone of strong north-and-south fissuring, which they seem likely to follow in depth. If one ore-shoot plays out, another one would probably be liable to come in at greater depth. The fissure-zone seems to be later than the vein which it cuts. The fact that ore-shoots occur in the fissure-zone, and that values tend to be higher near the fissures, might be accounted for by a second period of mineralization along the fissures, following the primary mineralization of the original vein. This might also account for the occurrence of silver values of good grade in ore which seems at first sight to be mostly fissured country-rock, such as occurs in the inner part of the upper workings. Future

development will prove the nature of the deposit more fully, but in the meantime there seems to be good reason for an optimistic attitude.

One intrusive dyke occurs in the workings, which is cut by the fissuring, and is therefore probably older. It does not seem to have any special connection with the mineralization, as far as can be seen at present. Another one occurs south of the outcrops. They run more or less parallel to the vein, and seem to be similar in character to the multitude of dykes characteristic of the whole Alice Arm district, though the presence of quartz phenocrysts may indicate a more acid character than usual in many of the dykes in the argillite area.

Wolf Group. Four claims—*Wolf*, *Wolf No. 2*, *Wolf No. 3*, and *Wolverine*. Owner, Don Cameron. Under option to the Dolly Varden Mines Company. Situated on the east side of the main Kitsault river, near Trout creek, and about twenty-one miles from Alice Arm. Development-work consists of 80 feet of tunnel, a number of open-cuts, and 3,200 feet of diamond-drilling. Owing to the nature of the work the character of the deposit is not shown up as clearly as in the case of the *Dolly Varden*, but in general seems to be simpler and apparently free from complications. There are three veins, with a general easterly course and nearly vertical dip, so that the apex in each case runs up the steep, west-sloping hillside. This will make future development by drift-tunnels an easy matter, with little or no dead-work.

The discovery on No. 1 vein shows a precipitous bluff of quartz, rising nearly vertically for some 75 feet, with a width of 60 to 80 feet. This whole face seems to be quartz and projects prominently above the general surface. It is mostly inaccessible, but at one point I obtained a fine specimen of ruby-silver from the face of the bluff by picking through the somewhat rusty surface. A tunnel 80 feet long runs into the vein from the base of the bluff, in quartz all the way. This exposure seems to be exceptional and wider than the average, but the vein has been traced up the hillside for 500 feet by open-cuts, which show its continuity, but not always its full width for this distance, measured vertically.

Nos. 2 and 3 veins have been shown up by open-cuts, in one case 300 feet below the tunnel-level, near the base of the slope of the hill. Thus mineralization is proved to extend to a vertical height of 800 feet, with the upper end not yet reached. The indicated width of veins Nos. 2 and 3 is from 10 to 20 feet, but little work has yet been done on No. 3.

Diamond-drilling has been done on No. 1 and No. 2 veins, with satisfactory results. While these are not made public, it is known that good ore has been crosscut in a number of holes of good width and at a considerable distance from the surface. In general, as compared with the *Dolly Varden*, the *Wolf* is relatively considerably larger in tonnage and lower in value, but of profitable milling grade. The ore is of the same type as the *Dolly Varden*, and the company proposes to extend transportation to this point and here install a mill for both properties, using water and power from Trout creek, which has a fall of 500 feet in a comparatively short distance near the *Wolf*, with storage-lakes at its headwaters. Within a year or two the company will probably be producing a very considerable tonnage of pyritic silver-bearing concentrates.

The formation is andesite, but as the surface is much covered with surface wash and timber, no attempt was made to trace out the formation, or work out the reasons for the occurrence of good ore at this point. In a brief examination no special features were noticed with certainty, such as dykes or contacts, and the deposits appear to be just plain veins, apparently straight and strong, with no reasons for suspecting any marked changes in depth. Signs of strong fissuring were not noted, and the size may be due in part to replacement of the rock by mineralized quartz, though there is undoubtedly some fissuring as shown by smooth walls, etc., in places.

Kitsaul Group. Six claims—*Kitsaul No. 1*, *Kitsaul No. 2*, *Maud McPhee*, *Sportsman*, *Sunset No. 1*, and *Sunset No. 2*. Owners A. D. McPhee, of Seattle, *et al.* The claims are situated on the west side of the Kitsault river, at the upper end of the Big canyon, covering the ground between the *Red Point* property and the river. The vein runs along the edge of the canyon-wall, which is here some 75 feet high and precipitous. The most northerly working is an open-cut in the face of a steep bluff, dropping straight down to the river, and accessible from one end only. Most of the vein has apparently been eroded away at this point, and the open-cut is blasted into the face of the bluff, following the strike of the vein for some 50 feet, and probably largely in foot-wall material. It looks rather barren, but is slightly mineralized with quartz, pyrite, and galena. The vein was originally at least 10 feet wide here. A red-stained outcrop shows across the river-canyon a few hundred feet to

the north, difficult of access, which may represent the continuation of the vein, which should cross the river here owing to a curve in the canyon.

Two hundred feet south of the above an open-cut has been blasted in solid vein-matter, across the strike to the edge of the canyon, so that the full width may not be exposed. The cut is 25 feet long. This is rather strongly mineralized, though it includes some unmineralized rock. The mineralization consists of bluish and white quartz, with much pyrite, some rhodonite, or perhaps jaspery quartz, and a little chalcopyrite, galena, and blende. The bluish quartz seems to represent replacement of rock and is cut by small veins of white quartz. No definite walls were shown.

Two small cuts 100 feet farther south are in country-rock, with very slight mineralization, and may be on the vein. If not, it is rather a puzzle to say where the vein has disappeared.

Assays from this property are reported as high as 40 oz. in silver, but good samples seem to show average values of from 8 to 18 oz. in silver. The only showing of any consequence is the 25-foot open-cut described, the significance of which is difficult to puzzle out at present, the inaccessibility of the river-canyon making it impossible to follow along the vein. Formation andesite.

Ouray. Two claims—*Ouray* and *Victoria*. Owners B. J. Carpenter and Egan. Situated on the west side of the Kitsault river, adjoining the west side of the *Wolf* property, about one mile north of Evindsen creek. The work has been done at an elevation of about 1,500 feet above sea and 400 to 500 feet above the river. The surface is largely covered with wash and timber, leaving few natural exposures of rock visible.

On the crest of a small rise in the general slope of the hill four or five small open-cuts have been made. These show an unusual amount of oxidation, resulting in a kind of soft iron-capping. The capping is of irregular depth, showing more or less fissured greenish rock underneath. The width is 15 feet in one place, but it is not yet shown up enough to tell much about it.

There seems to be little quartz, but considerable spar, barite, or calcite shows, with some pyrite and a little chalcopyrite. Some of the capping is black in places, but mostly red and mixed with surface material. A few reddish spots were observed which resembled cobalt bloom, which suggests that arsenical iron may have been present. The whole occurrence is obscure, but on the whole appears to belong to the andesite type and should be worth opening up enough to determine its real character at least.

NOTE.—Both sides of the Kitsault river through the andesite area have been pretty well blanketed lately with claims, many of which have as yet nothing much to show visitors. It is to be hoped that they will be prospected more closely in the near future, in which case there is a good chance of opening up other good showings.

Silver Tip. Two claims—*Silver Tip No. 1* and *Silver Tip No. 2*. Owner, Chas. Swanson. Lies west of the *Dolly Varden* property and adjoining. It appears to have the extension of the *Dolly Varden* vein. A short distance from the *Dolly Varden* claim lines to the west two open-cuts on a small ridge show green andesite with several stringers of quartz, with a little barite and specks of galena and zinc-blende. An average assay gives 1 or 2 oz. in silver, but is said to get better when shot into. The west side of the little ridge shows smooth north-and-south polishing, which might be glacial. It looks hard and unpromising. Some pyrite also occurs.

A short distance west an outcrop of red rock occurs, which looks like red shale, but might possibly be schistose red andesite. It cuts squarely across the direction of the vein, and appears to cut off the mineralization. To the west of this, in Evindsen creek, red-stained schistose rocks occur, which resemble the copper-belt rocks rather than the andesites.

Toric Group. Three claims—*Toric*, *Anglo*, and *Moose*. Owners, John and Gus Strohnbeck. Situated in the Big canyon of the Kitsault, mostly on the east side, and east of the *Dolly Varden* property. At the river-level a tunnel has been driven in the steep side of the canyon, on the east side, for a distance of 15 feet on a ledge or vein of nearly solid barite. The strike is nearly east and west (mag.) and the dip is 45 degrees to the north. The vein is 9 feet wide at the surface. It is mineralized with pyrite in little bands parallel to the walls, and in bunches, rather heavily on the north side. Galena also occurs in specks. Four samples, taken at intervals as the tunnel was driven, gave 14 oz., 8 oz.,

12 oz., and 11 oz. in silver respectively. The barite is white, except a band of 2 feet on the south vein wall, which is dark and resembles rock at first sight, suggesting replacement action. The vein outcrops on the west side of the canyon and proves that the canyon is not the locus of any faulting. Here a tunnel has been driven for 8 feet, but is in the hanging-wall of the vein.

Considering its situation and dip, this vein might be the *Dolly Varden* vein, as no other outcrop of any vein is visible in the canyon-walls for some distance north and south. The formation is andesite of the green variety. The claims cover promising ground.

North Star. Owner, Gus Pearson. Situated below the *Dolly Varden* and above the *Toric*. From an open-cut showing the vein three assays of 2 oz., 4 oz., and 1 oz. have been obtained.

David Copperfield. Owner, Wm. McLean. Situated in the big Kitsault canyon, one mile or more south of the *Dolly Varden*. A 7-foot tunnel 25 feet above the river shows a vein 5 feet wide filled with barite and quartz. Strike east and west (mag.), dip 50 degrees north. Slightly mineralized with pyrite, galena, and blende in small specks. Four assays are reported as follows: 0.2, 0.2, 7.8, and 0.5 oz. in silver. It resembles the *Toric* in situation and appearance to a considerable extent, and might be worth further prospecting up the hill to the west. It is on the west side of the canyon, the No. 2 post being near the tunnel, at 930 feet elevation. Surface strippings north-west from tunnel show slight mineralization.

Surprise. Owner, Angus McLeod. Situated across the river from the *David Copperfield*, and reached by means of a foot-log felled across the river. It shows a continuation of the *David Copperfield* vein, but the vein here seems to be split up into stringers to a considerable extent. No important mineralization was noted and little work seems to have so far been accomplished.

Musketeer Group. Three claims—*Musketeer No. 1*, *Musketeer No. 2*, and *Musketeer No. 3*. Owners, Al. Miner and Miles Donald. Situated on the east side of the Kitsault river, a short distance above the bridge at the head of the Big canyon, and south of the Dolly Varden Mines Company's *Wolf* property. About 100 feet above the river, at 1,300 feet elevation, two open-cuts have been made in the side of a small creek gully. These do not show a well-defined vein, but considerable mineralization was seen in connection with fissuring. Its general direction and size could not be made out from the work done. Specimens show a variety of minerals, including silicified rock and quartz, with barite, rhodocrosite or rhodonite, pyrite, galena, chalcopyrite, and blende, the whole occurring irregularly, chiefly in the lower cut.

One hundred feet above the cuts and farther south a 14-foot tunnel has been driven on two or three little fissures, which are somewhat mineralized near the surface. The face seems barren. About 500 or 600 feet higher than the tunnel the owner states that there is a mineralized width of 14 feet, of which 7 feet assayed: Gold, 0.02 oz.; silver, 1 oz. The other 7 feet assayed: Gold, 0.05 oz.; silver, 4 oz. The property is situated in the andesite and appears to be in a good location, promising well for further prospecting, which will, however, involve much work, as the surface is heavily timber covered.

NOTE.—The mineral called rhodocrosite in this report, and locally known as such, seems to be somewhat doubtful. Some of it at least is not a carbonate, but appears rather to be a red-stained quartz resembling jasper.

Silver Horde. Owners, Al. Miner and A. Davidson. Situated on the east side of the Kitsault river, south of Trout creek, adjoining the *Wolf* property, which lies south. At the time of inspection work had not progressed very far. Two open-cuts about 400 feet above the river had been made, shooting through brown surface capping and exposing silicified vein-matter underneath. Some mineralization is present and native silver is reported to have been seen. It is said to be a continuation of the *Wolf* No. 3 vein, which is possible. The width of the vein was not exposed, but is evidently considerable. Later reports state that the property has been bonded, and developments may prove interesting, as it is in an excellent location in the andesite formation.

Moose. Owner, Don Cameron, discoverer of the *Wolf*. Situated north of Trout creek. *This was discovered after I left, and was therefore not seen. It is* reported to have a quartz-outcrop some 150 feet in width, which would make it the largest known of its type. It probably occurs in the andesite. It is said to be similar to the *Wolf* outcrop. Its situation is approximately noted on the map.

Tiger Group. Two claims—*Tiger* and *Lion*. Owner, Ed. Pickett. This discovery was also made after I left the section. The owner states that he has found a vein, which he has traced for 350 feet, in four faulted sections. Gouge shows on foot and hanging walls. There is also some surface oxidation. It is mineralized with galena, quartz, etc. Solid galena sample assayed 86.6 oz. silver, and a sample of black quartz with slight galena assayed 107.8 oz. silver.

It is situated on the east side of Kitsault Big canyon, some distance above the *Dolly Varden* bridge, at a considerable elevation. It is probably in the andesite, and might be an important discovery.

NOTE.—From *Dolly Varden* to *Tiger*, inclusive, the descriptions cover the properties in the andesite area. From *Red Point* to *Homeguard* the claims described belong to the Copper-belt of the upper Kitsault river. In a previous report of the Minister of Mines, for 1913, D. G. Forbes describes many of the copper-belt showings, since which time no striking changes have been made in most of them. The andesite silver deposits, however, are almost entirely new since that time.

Red Point. Three claims—*Red Point*, *Red Point Extension*, and *Black Bear*. Owners, Chas. Swanson, Ole Evindsen, Ole Pearson, Gus Carlson, and K. L. Eik. Situated on the north side of Evindsen Creek, about a mile west of the Kitsault river and some twenty miles from Alice Arm. The work done consists of 15 feet of tunnel, 500 or 600 feet of diamond-drilling, and a number of open-cuts.

The hillside rises steeply to the north from the sharp canyon of Evindsen creek, in a more or less irregular step-like fashion; thus a number of knob-like protuberances occur, the south or south-easterly faces of which break off in steep rock-faced bluffs. Along a general north-westerly line a number of these bluffs are heavily red and yellow stained, forming a mineralized zone, in which the workings occur, in many cases showing up very good ore.

To the south-east the zone should cut across Evindsen creek, but appears to cut off or fault to the west, as across Evindsen creek the andesites come in. To the north-west it appears to continue up the mountain through the *Combination* and *Racehorse* groups, where it seems rather to die out. It may be called the Red Point zone.

Above the *Red Point* to the west, in Black Bear creek, is a wide band of red bluffs which resembles strongly similar bluffs which show on the *Combination* and *Copper Cliff* groups to the north. This may be called the *Copper Cliff* zone. This also runs in a general north-westerly direction, but more northerly than the *Red Point* zone, the latter seeming to cut across it at an acute angle.

The *Red Point* formation appears to be intrusive diorite as determined in thin section on the *Red Point*, chloritic in places, and the mineralization, chiefly pyrite and chalcopyrite, seems to have been accompanied by a great deal of silicification, sometimes showing solid bodies of hard quartz of considerable size.

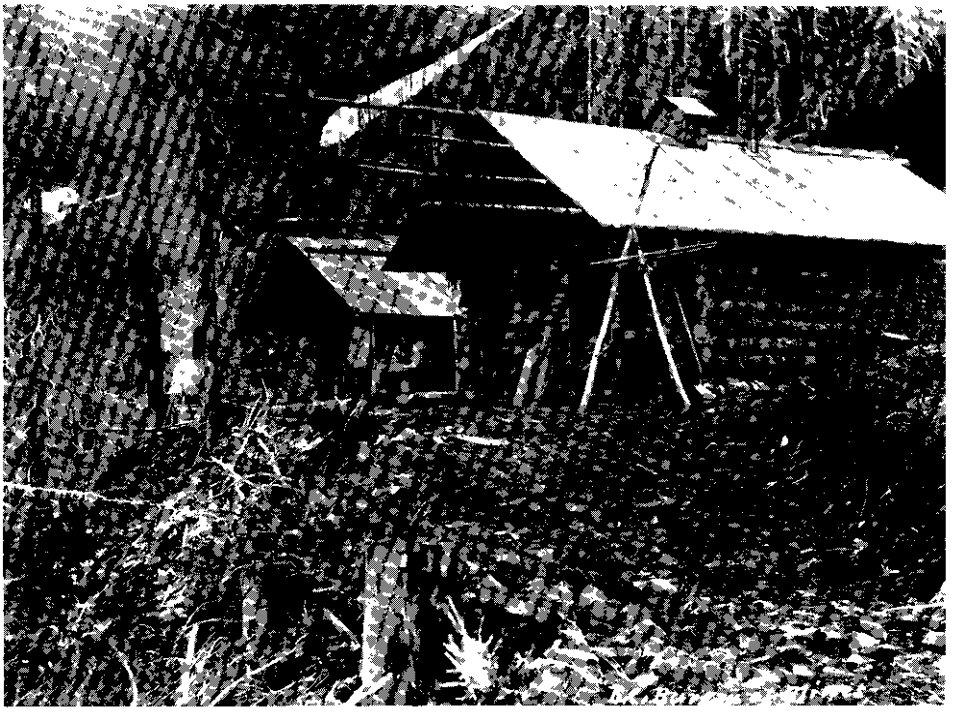
The *Copper Cliff* zone, though somewhat similar in appearance and mineralization, seems to be much less silicified, non-chloritic, and resembles the *Red Bluff* deposit near Alice arm, which is in tufaceous sandstone. The *Copper Cliff* zone is also paralleled on the east side by a band of argillite, which is confirmatory.

The whole is much covered by surface material, and the explanation given is far from proved, though there is certainly a difference between the two zones.

The bluff lowest down on the *Red Point* has a height of about 125 feet, the face sloping some 65 degrees. On top it runs back fairly flat for 100 feet or so. In the base near the west side three flat diamond-drill holes have been run, N. 35° W., N., and N. 20° E. These are approximately 200 feet long, and spreading out fan-shape have crosscut the zone to the extent of over 150 feet. The cores show disseminated mineralization, more or less all through, mostly pyrite with a little chalcopyrite, both in small quantities. The copper percentage is evidently very small, but gold values were found in all samples, probably averaging about 0.03 oz. a ton. Nothing was found equivalent to the good showings exposed on the surface on top of the bluff, nor did any of the cores show anything that looked like pay-ore. The chalcopyrite does not, however, disappear in depth.

Seventy-five feet above the drill-holes the red-stained rock is exposed for a width of 50 feet. Here a tunnel has been driven in 15 feet, showing bunches of ore. A dump of sorted ore,

Looking up Skeena River from Hazelton View Group.



Hazelton Gold-Cobalt Company's Camp.

about 8 or 10 tons, shows heavy mineralization, pyrite and chalcopyrite, and would probably run over 5 per cent. in copper by appearance.

On the crest of the bluff an open-cut 15 feet long shows bunches of heavy sulphides and some copper-stain. It might average 1 to 2 per cent. copper. Fifty feet back from the crest an open-cut shows a width of 18 feet of good-looking ore, consisting of quartz and sulphides, more or less banded with dark-green chloritic rock containing quartz stringers. The full width may not be shown. Several other open-cuts and red bluffs occur along the line of the zone.

The following samples, from a reliable source, cover a length of 400 feet: Width, 5 feet: Gold, 0.04 oz.; silver, 3.56 oz.; copper, 7.54 per cent. Width, 5 feet: Gold, 0.08 oz.; silver, 0.70 oz.; copper, 3.51 per cent. Width, 8.9 feet: Gold, 0.28 oz.; silver, 0.50 oz.; copper, 3.28 per cent. Width, 8 feet: Gold, 0.12 oz.; silver, 0.70 oz.; copper, 2.30 per cent. Width, 5 feet: Gold, 0.34 oz.; silver, 0.90 oz.; copper, 2.92 per cent.

These samples show the character of the best surface ore. There are a number of other cuts which, in general, ran lower in value.

One hundred feet easterly from the top of the tunnel bluff an open-cut shows a 4-foot fissure-zone with considerable pyrite and chalcopyrite. It seems to cross the general trend. On the line of this fissure, and 300 or 400 feet farther east, a red- and yellow-stained bluff is exposed, which is mostly inaccessible, but in one place it has been shot into, exposing a bunch of ore 4 or 5 feet wide, which would run probably considerably over 5 per cent. copper, and is reported to have assayed $20 in gold. The yellow-stained surface seems to be a better indication than the red-stained portions, and more likely to show ore when shot into.

On the *Red Point Extension* claim a bluff exposes a width of 100 feet of red stain, of which 50 feet has been open-cut. It is much silicified and contains a good deal of pyrite in places. At one point dark-green rock with east-and-west fissuring shows good ore. A reliable assay is reported as follows: Width, 3 feet: Gold, 0.44 oz.; silver, 0.8 oz.; copper, 2.48 per cent.

In general the sulphides occur right on the surface, being only covered with red oxidation to a depth of a fraction of an inch, and no reason was apparent why the values should not continue with depth. While the diamond-drill holes are undoubtedly disappointing, the possibilities do not seem to be exhausted, and some further work would appear to be warranted. The elevation of the diamond-drill holes is about 1,600 feet.

Combination. Owners, Chas. Swanson, J. B. Brown, and W. M. Martin. Adjoins the north side of the *Red Point* group, and is similar in general character, except that the main showings do not occur in red bluffs owing to difference in topography. At 2,150 feet elevation some 125 feet of tunnelling has been done, starting on the Kitsault River slope and running about south (mag.).

At 18 feet in, ore is encountered, which continues to the 36-foot point, where it is cut off by a dyke. This dyke is grey, fine-grained, and barren. It forms the sides of the tunnel for 32 feet, when mineralization again appears, consisting of silicification with a little sulphide, for a distance of 6 feet to the face. A drift on the north side of the dyke is 31 feet long, in ore, and a north crosscut shows the width to be about 15 feet at least. On the dump there is over 10 tons of ore which would probably run over 2 per cent. in copper. Four samples from the tunnel are reported to run from 0.52 to 1.84 per cent. copper, 0.01 to 0.02 oz. gold, and 0.58 to 2.60 oz. silver.

One hundred feet south-east from the tunnel, on the south side of the dyke, an open-cut shows a width of 6 to 8 feet of good-looking ore, which should assay 3 per cent. copper or more. The whole cut is reported to run: Gold, 0.03 oz.; silver, 0.78 oz.; copper, 1.71 per cent.

The ore is highly siliceous, the mineralization consisting of quartz, with rather dark pyrite and chalcopyrite. It should concentrate readily, but the concentrate might be rather low grade on account of the amount of pyrite present. The showings appear to warrant further development, though they appear rather bunchy.

A few hundred feet distant, on the break-off of the hill, an immense red-stained exposure can be seen, though not from the tunnel.

Racehorse Group. Sometimes called the *Dan Patch*. Five claims—*Dan Patch*, *Nancy Hanks*, *Lou Dillon*, *Maud S*, and *Pony*. Owners, Chas. Swanson and Al. Miner. At 2,775 feet elevation a considerable bluff occurs, in which a tunnel has been driven for 5 feet. Mineralization is generally slight. Reliable assays show from 0.01 to 0.03 oz.

gold, 0.2 to 1 oz. silver, and 0.03 to 0.18 per cent. copper. The bluffs above are red-stained. One hundred feet lower a crosscut has been driven some 40 feet in loose material, but seems to be approaching the solid.

At 2,975 feet elevation an open-cut shows hard patchy quartz, with small quantities or bunches of fairly clean chalcopyrite. Other cuts show similar conditions continuing to the north-west, where they seem to die out. The total quantity of copper is small.

At 3,000 feet elevation, for instance, a bluff shows 20 feet high and 50 feet long, in greenstone, with quartz veinlets, some pyrite and small bits of chalcopyrite associated with the quartz.

Copper Cliff. Four claims—*Copper Cliff No. 1, Copper Cliff No. 2, Copper Cliff No. 3,* and *Copper Cliff No. 4.* Situated on the north-east slope of Combination mountain, south of the West fork of the Kitsault river. The claims are arranged in a line along the hillside, and cross two small creeks tributary to the Kitsault river, in each of which the canyons show a large width of red-stained bluffs. The owners are A. Davidson and Jos. Wells. Elevation of open-cuts about 3,100 feet.

On Gash creek the red bluffs extend for several hundred feet on both sides of the creek, and are inaccessible in many places. Small cuts have been blasted in the sides, which show the red stain to be superficial. Underneath silicified rock is exposed, with a little pyrite and trifling amounts of chalcopyrite. Some rich float has been found down the creek, but no ore in-place.

On Copper creek the red-stained zone is at least 400 feet wide, and may extend farther up the creek. It is underlaid by a band of sedimentary argillites, considerably folded, with a general dip of 45 degrees or more into the mountain under the stained zone.

At 2,700 feet elevation an open-cut 26 feet long has been made in rock on the east side of the creek and 50 feet above it. This shows 6 feet width, considerably splotched with bunches of fine-looking chalcopyrite. The balance is mineralized, but not heavily. The chalcopyrite occurs along joints at their intersections, and to a small extent disseminated. A parallel cut 20 feet lower, shows similar conditions, but much less copper, and the rock is darker. The formation is light-coloured and is considerably altered apparently. It appears to be silicified, but under the knife is surprisingly soft, though somewhat gritty. It resembles the tufaceous sandstone of the *Red Bluff* property probably more than the *Red Point* diorite. Its appearance suggests limestone, but it is not calcareous.

A tunnel has been run, since my visit, from a point near the argillite contact to get under the open-cuts, which one of the owners informed me showed disseminated mineralization as far as driven, which he expected to average somewhere near 1 per cent. copper.

The immensity of the surface showings, and the fact that good ore is shown on Copper creek and good float on Gash creek, some 3,000 feet distant, are points in favour of the property.

Starlight. Two claims—*Starlight* and *Twilight.* Owners, Jas. Peardon *et al.* Situated on the upper east slope of Combination mountain at an elevation of 3,500 feet, above the *Racehorse* group. It was mostly snow-covered. One open-cut, partly visible, showed quartz stringers and brecciated black slaty rock, with bunches of pyrite and some red oxidized material.

Some distance to the east an exposure of grey coarse breccia was seen from a short distance. It looked like a surface patch, and was different from any other rock seen in the district.

Homestake Group. Three claims—*Homestake, Homestake No. 1,* and *Homestake No. 2.* Owners, A. Davidson and Gus Pearson. Situated on the south-west side of the main Kitsault river, opposite the lower end of the Kitsault glacier, some twenty-five miles from Alice Arm. The cross-gullies were snow-filled, which made examination somewhat incomplete. In general there seems to be a zone or zones with more or less mineralization parallel to the river, with bunches of good ore in places, and a good deal of reddish surface stain in others, but nothing very definite as yet exposed for any distance.

At 3,250 feet elevation a cavity shows drusy quartz, with carbonates and some galena. Two assays from here gave 42.2 and 38.8 oz. silver. The amount of lead is small. One belt showed wide bands or ledges of quartz and spar, possibly barite in part. Four assays from this showed under 5 oz. in silver.

At 3,400 feet elevation on the north-west end, just above a branch glacier, an open-cut shows 3 to 4 feet of good chalcopyrite ore in bunches, and red stain for 15 to 20 feet in width, on a strong north-west fissure. Forty feet below a 6-foot tunnel on this fissure shows 1 foot of soft

rusty material. Bunches of galena occurred near the mouth. An assay from the cut is reported to show $19 gold, and from 3 to 6 per cent. copper has been obtained. A rather definite little shoot of copper ore seems to be indicated here. The showings as a whole are very indefinite and obscure. Nothing of any great value seems to be indicated, and the transportation difficulties are serious.

Across the branch glacier to the north-west red-stained bluffs occur, which seem to indicate the extension of the mineralization in this direction.

The high round ridge parallel to the river above these claims has several properties staked on it. These are indicated on the map by the names of the owners, Smith, Flint, and Mann (not Manners as shown). The showings on these were snow-covered, but the ridge in general shows much red coloration. The *Monarch* claim on this ridge is owned by M. P. Olsen, who brought into Vancouver a specimen of limestone from his claim, also a light black substance from a 4-foot vein which burnt on heating, leaving a white ash, but also gave reactions indicating manganese. The vein may be a bed of limestone, as indicated by the specimen, and in general the formation seems most likely to be sedimentary. Red and green diabase or andesite occurs in the river-floor under the glacier, but the formation on the intermediate *Homestake* is mostly a fine grey rock, not determined. Dykes seem to be few or absent.

Vanguard Group. Four claims—*Vanguard*, *Nimrod*, *Mother Lode*, and *Nero*. Owners, John and Gus Strohnbeck and Morris Petersen, the last named having a half-interest. Situated on the west side of the upper Kitsault river, above the West fork, about twenty-four miles from Alice Arm. Much intelligent work has been done on this group, with good results.

At about 3,000 feet elevation an open-cut shows a width of 12 feet, carrying 12 to 15 per cent. pyrite, with some nice chalcopyrite in bunches. The rock seems to be a very dark, rather coarse greenstone, more or less altered, possibly a dyke. Fifty feet lower down the steep hillside a tunnel is just into the solid, and shows considerable pyrite. Some silicification is noticeable. Fifty feet lower again two open-cuts 12 feet apart show bunches of fine chalcopyrite. The more easterly one is much fissured and oxidized, and has 4 or 5 tons of ore on the dump that should run 10 to 15 per cent. copper, and is reported to run $9 in gold. A reliable sample across 4 feet gave on assay: Gold, 0.48 oz.; silver, 6 oz.; and copper, 8.2 per cent. Another gave: Gold, 0.22 oz.; silver, 5.3 oz.; copper, 4.1 per cent. across 8 feet, both from a surface stripping some 70 feet below the two open-cuts. This stripping exposes the ore for a length of about 30 feet, the width varying from 4 to 8 feet. The chalcopyrite in the stripping occurs in massive form, and can be hand-sorted to a very high grade. This is about the best-looking single copper-exposure in the district. It appears to cut off on a flat slip at the wide end. A tunnel has been started 40 feet lower to get under this showing.

Some 300 feet or more along the hill, in a southerly direction, a tunnel is in 15 feet. Just above it is a fine showing of chalcopyrite ore, nearly solid, 2 to 4 feet wide, which cuts off on a flat slip about the level of the back of the tunnel, which is therefore mostly in barren rock, which is fine-grained, greenish, and altered-looking, with a little pyritization in the face.

South of the tunnel a short distance, about on the line of the flat slip, chips of solid chalcopyrite were knocked off the surface, which may indicate the direction of throw, but were not opened out enough to determine the size.

These good shoots seem to angle across the general direction of what may be a wide mineralized zone, of which little is yet known. The property is capable at present of producing a small tonnage of high-grade sorted copper ore. A tramway 2,000 to 3,000 feet long would connect with the Kitsault valley at a point some two miles north of the *Wolf*, the terminus of the proposed railway, on an easy water-grade.

Wild Cat. Owner, A. Davidson. Situated on the south-west slope of Homestead creek, about seventeen miles from Alice Arm. A second claim, the *Slocan*, lying lower and adjoining to the east, is part of the property. At 1,400 feet elevation a dyke is exposed, running about north (mag.). On the west side of this a stripping 18 feet long and 15 feet high has been made. This shows an irregular lenticular body of copper ore, mostly pyrite and chalcopyrite and altered rock. This is about 2 feet wide in the widest part. A sample of this 2 feet gave 8.1 per cent. copper. It runs at an angle towards the dyke, against which it pinches. Below the lens is some scattered mineralization; above it is mostly altered rock, though the whole is more or less pyritized. The dyke is probably 30 feet wide, the

east side not being clearly exposed. On the east side, about 30 feet from the dyke, and 25 feet lower than the stripping, an open-cut 15 feet long and 12 feet high has been blasted in the face of a small bluff, in the upper part of which a small lens of ore is exposed, a few inches thick, which is more or less parallel to the lens in the stripping. The occurrences are small, but suggest that further prospecting along the dyke might give better results.

Medallion. Owner, Ed. Pickett. Adjoins the *Wild Cat* on the east, above the *Slocan* claim. A few shots have been put in on brownish surface patches, showing a little pyritization and slight chalcopyrite and galena. A sample of the latter is reported to have run 6 oz. in silver. No vein was definitely shown.

Homeguard Group. Five claims—*Homeguard*, *Traveller*, *Central*, *Canyon Boy*, and *Canyon Boy No. 2*. Situated on the east side of the Kitsault river, just below the Big canyon, and reached by cable-ferry across the river at Miner creek. On the *Canyon Boy* a 15-foot tunnel at 850 feet elevation shows a strong flat-dipping fissure, and follows it along a narrow vein of quartz. Mineralization is here very slight, including slight galena and chalcopyrite.

The main workings are on the *Homeguard* and *Traveller*. At 980 feet elevation an open-cut is faced up along the hillside for a length of 25 feet or more. This shows the rock strongly cross-seamed with thick stringers of calcite, giving the face a coarse brecciated appearance. It is rather strongly mineralized with pyrite and some chalcopyrite, and would hardly average over 2 per cent. copper. On the south side of this a tunnel has been run in about 50 feet, following a heavy fault, so that it is timbered and shows ore on the west side. It was caved near the face, but shows ore where observation was possible on the west side.

One hundred and twenty-five feet higher in elevation is a very similar combination of open-cut and tunnel, the upper tunnel also being in caving fault ground in the face. It shows ore on the west side for 25 feet. The ore is exposed for 25 feet in width in the upper open-cut, but seems to be less mineralized and lower grade. One hundred feet higher up the hill, along the same direction, are three black-stained bluffs.

Galena occurs in small quantity north of the lower cut. Late reports state that this property has been bonded and that diamond-drilling is in progress on it. It seems low grade, but is exceptional in regard to its large proportion of calcite.

In conclusion, acknowledgment is due to R. B. McGinnis, manager of the Dolly Varden Mines Company, for assays, information, hospitality, and courtesies too numerous to mention; to Professor E. T. Hodge, of the University of British Columbia, for valuable assistance in interpreting rocks and minerals; and to the many prospectors and inhabitants of Alice Arm for information and for hospitality; and finally for the time so freely given in guiding me to the many properties visited, without which the work could not have been accomplished.

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, 1916.

During 1916 very little prospecting was done in the hills, and there has therefore been a considerable decrease in the number of locations recorded. The annual assessment-work has been well kept up and compares favourably with 1915. During the latter part of the summer several properties were examined and reported on by engineers representing Canadian and American interests. Four of these properties have been bonded, and the owners expect that work will be commenced on them early in 1917.

The following reports on the year's operations at the properties of the Granby Consolidated Mining, Smelting, and Power Company, Limited, at Swamp point and Maple bay, were furnished by C. E. Rhodes, secretary to mine superintendent:—

SWAMP POINT.

"The limestone-quarry on the beach at Swamp point has been operated continuously during the year, an average of about 4,000 tons of rock being produced monthly. A new quarry is being opened up about half a mile from the beach. This necessitates a new railway and wharf, construction-work on which is almost completed. The railway will be operated by a 3½-ton gasolene locomotive with 4-ton ore-cars. About twenty men are employed at this point.

MAPLE BAY.

"At Maple bay in June last we started development-work on the *Star* claim by means of a 6- x 7-foot tunnel, which has been up to now driven some 350 feet. From the tunnel a 2-foot gauge railway has been constructed 4,000 feet to the beach, which will deliver ore from the mine-bunkers to a new wharf 700 feet long, which has also been built since June. In October we started development-work on the *Thistle* claim, a 6- x 7-foot tunnel being started here. A power plant has been installed at the beach, consisting of two 60-horse-power locomotive type boilers equipped for oil-burning. This furnishes power for a compressor of 750 cubic feet capacity. A 5-inch pipe-line extends from this plant to the mine. A 7-ton gasolene locomotive with 4-ton cars will handle ore from the bunkers to the wharf. A bunk-house and mess-house providing accommodation for sixty men has been built, together with three cottages, a general store and office, warehouse, blacksmith's shop, etc. Development-work has been carried on steadily at the *Star* claim, and the property is now almost ready to start shipping. The ore produced in these properties is quartz, with copper values. We have about 100 men working on the properties at this point."

GEORGIA RIVER.

Operations were resumed on the Georgia River group by the Georgia River Mining Company, Limited, in the month of May. A crew of from six to eight men was employed during the season. Development-work was somewhat handicapped, due to the lateness of the spring. The work this year was chiefly directed to advancing the tunnel on the *Bullion* vein; this tunnel is 362 feet in length, of which 117 feet was driven this year. On October 1st a contract was let to sink a winze on the first ore-shoot exposed in the tunnel, to a depth of 40 feet. The point where the winze starts is approximately 120 feet from the portal and about 40 feet vertical to the surface from the tunnel-level. Here the ore, which carries good gold values, was 10 inches in width. When the winze reached a depth of 22 feet the ore had widened out to 2 feet 6 inches, and in much of it considerable gold was visible. At the depth mentioned (22 feet) the ore, which inclined from the wall, went out into the other side of the winze. The winze was continued along the wall, which stands practically perpendicular, but at a depth of 35 feet so much water was encountered that it could not be handled with the means at hand; consequently, work was discontinued for the time being. At the bottom of the winze another seam of ore a few inches wide, inclining similarly to the ore occurrence above, was disclosed. Very little work was performed on the Main vein. An open-cut made on the Main vein near the top of the mountain, 2,000 feet or more from the intersection of the *Bullion* vein, exposed some very rich gold-quartz ore. The lateness of the season prevented any extensive development at this point. Another showing of the same kind of ore was uncovered at a point approximately 1,000 feet below the intersection. Owing to the promising results attendant on this work carried out, extensive development of both veins is now being projected.

MARMOT RIVER.

In the month of September the *Riverside* group, consisting of four claims—the *Riverside*, *Golden Star*, *Silver Dollar*, and *Wicktoria*—was purchased by Robert W. Martin. A crew of six men worked on this property from September to the end of October, when work was discontinued. Considerable exploration-work was done on the property and 20 feet of 5- x 7-foot tunnel has been recorded.

The *North Fork Basin* group, owned by Wood, Magee, and Fraser, consists of eight claims—the *North Fork Basin*, *Iron Mask*, *Crawford*, *Baldie*, *Prince*, *Copper*, *Mount Marmot*, and *Lucky Boy*—situated five miles from the mouth of the Marmot river, at an elevation of about 4,000 feet. Two hundred feet of tunnel was driven on this property during the past season. Work was

considerably hampered owing to the lateness of the spring, and it was not until well on in the season that the tunnel was completed, and as it was found necessary to do considerable timbering before commencing work on an upraise 58 feet to the bottom of the shaft, underground work was discontinued for the year. On the surface the vein was stripped for a distance of 80 feet, the vein averaging 12 inches in width. A trial shipment of this ore was made to the Trail smelter, from which the following returns were received: Silver, 142.7 oz. a ton; zinc, 20.6 per cent.; lead, 13.3 per cent. Arrangements have been made to continue work as soon as weather permits in the coming spring.

SALMON RIVER.

On the *Bush* property, work which had been carried on for a period of fifteen months, was discontinued towards the end of February. Later in the year P. Daly, under lease, mined about 10 tons of ore, but no shipment was made.

The *Big Missouri* group, consisting of fifteen full claims and five fractions, fourteen of which were Crown-granted during the past year, has been bonded to H. W. Witt, Goldfields, Nevada.

G. Mahood, owner of the *Lesley* and *Lesley M.* claims, mined 10 tons of ore carrying gold and high silver values. Assays made on this ore gave returns of close on $150 a ton. Owing to inability to make arrangements for transportation to tide-water no shipment was made.

On the other properties in this section there is only the annual assessment to report.

BEAR RIVER.

The owners of the *Prince John* group, Nesbitt & Archie, report that negotiations for the bonding of the property have been practically concluded, and they expect development-work will be commenced early in the coming spring.

On the *George* copper-mines only the necessary assessment-work was done.

On the *Red Top* group, owned by McNeill & Conners, considerable open-cut work has been reported and very encouraging results obtained. The owners intend commencing work on 200 feet of tunnel as early in the year as weather conditions permit.

The *Rufus* group, comprising four claims—*Rufus*, *Rufus No. 1*, *Rufus No. 2*, and *Rufus No. 3*—owned by B. O. Erickson and associates, has been bonded to Harry Welch, who has made arrangements with a view to starting development-work early in the year.

GLACIER CREEK.

The owners, McKay & Bibeau, of the *Lake View* group, report 100 feet of crosscut tunnel on the *Lake View No. 2* claim.

OFFICE STATISTICS—PORTLAND CANAL MINING DIVISION.

Free miners' certificates (individual)	77
Free miners' certificates (special)	1
Free miners' certificates (company)	1
Mineral claims recorded	81
Certificates of work issued	212
Bills of sale, etc., recorded	73
Filings	17
Certificates of improvements recorded	40

Revenue.

Free miners' certificates	$ 427 50
Mining receipts, general	1,293 95
Total	$1,721 45

QUEEN CHARLOTTE MINING DIVISION.

REPORT OF E. M. SANDILANDS, GOLD COMMISSIONER.

I have the honour to submit the annual report on mining operations in the Queen Charlotte Mining Division for the year 1916.

Owing to my leaving the Islands my report will be rather short, as some of the data I would have liked to embody in it is not as yet to hand.

JEDWAY AND VICINITY.

Ikeda Mines, Ltd.

The *Lily* mineral claim, owned by Ikeda Mines, Limited, employed between thirty and forty men during the year. A shaft was sunk in No. 3 tunnel 110 feet deep on the vein, from which a crosscut of 105 feet was made to a small vein. Stoping was also done in No. 3 tunnel 100 feet long and 75 feet wide. From these workings there was shipped to the Granby Smelter at Anyox 1,060 tons of ore; 1,600 tons of lower-grade ore was also taken out, which is being held for concentrating. A concentrator-mill is to be built during the year 1917.

Smelter returns from January 1st to December, 1916, and assay values are as follows:—

Net Weight.	Gold.	Silver.	Copper.
Lb.	Oz.	Oz.	Per Cent.
552,680	0.12	1.8	7.70
45,790	0.34	3.8	17.48
222,630	0.16	2.1	8.23
247,612	0.12	1.6	7.08
195,104	0.11	1.1	5.60
219,218	0.10	1.0	4.80
251,688	0.14	2.3	8.17
225,290	0.13	2.9	7.54
160,420	0.13	2.1	7.61

Lucky Seven.

This mine, situated near Jedway, is owned by H. E. Bodine. Development-work commenced on this property in May, 1916, about ten men being employed. A shaft 60 feet deep was sunk on the vein, on an incline of 35 degrees; a drift was made from the foot of shaft 50 feet in length, also on the vein. Ore was continuous for this length. Small shipments were made from this mine during the year; the values went from 9 to 11 per cent. copper, with 12 oz. silver. Development-work is being continued. This property promises to be a good shipper in a short time.

On all other properties in this vicinity the assessments only were done.

LOCKEPORT.

During the year the *Last Chance* group and *Swede* group have been under bond to the Granby Consolidated Mining & Smelting Company, and considerable diamond-drilling has been done on both groups. In all, some 2,000 feet of drilling was done, and I think with fairly good results. What the cores went I am not in a position to state. At the time the drilling has been suspended.

TASU.

During the year considerable work was done on the Elliott & Corlett properties (*Warwick* group) and some tons of ore was shipped. Most of the work was done by Young Bros. under contract. A crosscut tunnel was also run for about 150 feet. The returns for the ore shipped are not yet to hand.

CUMSHEWA AND LOUISE ISLAND.

Considerable assessment-work has been done on the iron claims on Louise island owned by Owens, Rogers, and Bensen. During the year several parties have visited the properties and examined them, and it is rumoured a deal is on foot.

SKIDEGATE.

The *South Easter*, adjoining the Indian reserve and owned by Gordon & McLellan, is looking very well. It was under lease until last May to Hickey & Leighton, who shipped several tons of very high-grade ore. At the present time the owners have it back and are working it themselves. It is rumoured that a sale may be made at any time now.

COAL AND OIL.

There has been no drilling for either coal or oil on the island the past year. It is reported that a railway is likely to be built up the Honna for logging purposes, and this should help out the coal section and possibly start something in that line again.

OFFICE STATISTICS—QUEEN CHARLOTTE MINING DIVISION.

Free miners' certificates issued	80
Claims recorded (quartz)	58
Certificates of work	79
Certificates of improvements	13
Bills of sale, etc., recorded	19

Revenue.

Free miners' certificates	$ 320 25
Mining receipts	490 10
Traders' licences	210 00
Gun licences	70 00
Liquor licences	250 00
Marriage licences	20 00
Police Court fines	116 50
Total	$1,476 85

PEACE RIVER MINING DIVISION.

REPORT BY F. W. BEATTON, MINING RECORDER. (OFFICE AT FORT ST. JOHN.)

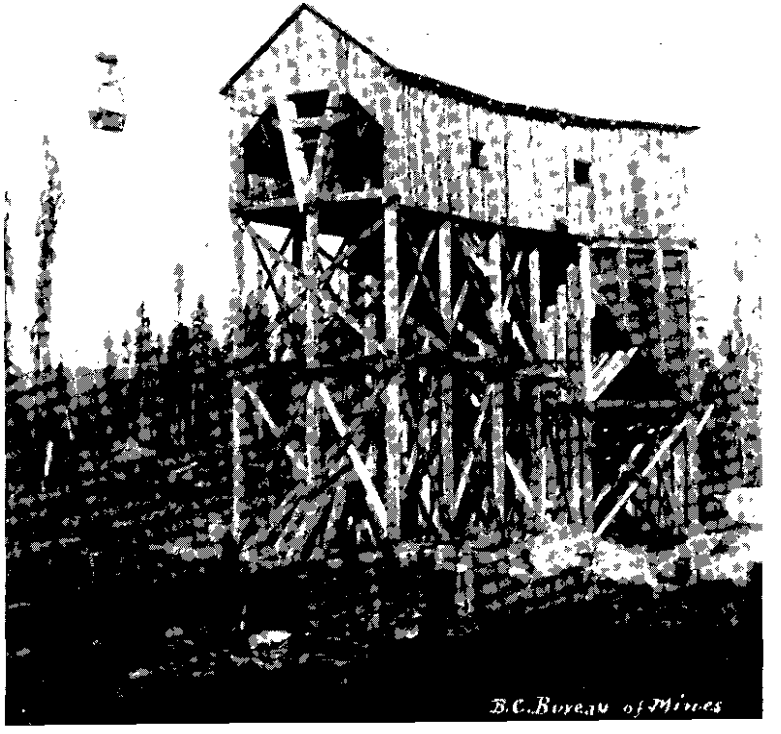
I have the honour, as Mining Recorder, to submit the annual report for the Peace River Mining Division for the year ending December 31st, 1916.

The mining situation remains practically unchanged since reporting last year, with the exception that a number of placer claims have been taken up on the upper Peace river, about fourteen miles above the Hudson Hope portage.

There were also a few placer claims recorded on the upper Peace river, but very little work has as yet been done on these claims.

A few prospectors were working on the river-bars during the past summer, but with very poor success.

Rocher Deboule Mine Camp.



Rocher Deboule Mine, Lower Terminal Tram.

OMINECA MINING DIVISION.*

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

I have the honour, as Gold Commissioner, to submit the annual report for the Omineca Mining Division for the year ending December 31st, 1916.

As forecasted in the report for the year 1915, the low-water mark as to mining revenue was reached in that year. The revenue for the year just passed exceeded that of the preceding year by nearly $2,000, although very many of the old-time prospectors and miners are still absent from the district, serving the Empire in various capacities.

During the past summer many parts of this Division were visited by mining experts, representing different interests, which in many cases has led to properties changing hands and the commencement of systematic development-work.

This being practically a new country, the problem of the means of transportation from the mining properties to the line of railway is not at all times an easy one, and both trails and roads, often many miles long, have been constructed, in some cases entirely by the mining interests, and in other instances with the assistance of the Government. This being one of the rich Mining Divisions in the Province, and at the same time one of the most difficult to work in owing to the nature of the country and absence of the means of transportation, those roads which are already in existence have been constructed with a view, mainly, of opening up the valleys and thereby making the agricultural lands more accessible. Comparatively little like assistance has to date been given to help in bringing the mineral wealth within reasonable shipping distance of the Grand Trunk Pacific Railway. During the coming season it is therefore to be hoped that ways and means may be found of rendering further assistance to those who are prepared to open up some of the rich mineral resources of our country.

GLEN MOUNTAIN.

Development-work on the *Silver Standard* group has been systematically carried on throughout the year with promising results, and several car-loads of ore have been shipped from this property. New machinery has been procured and placed in position.

The annual assessment-work was performed on the *Surprise* group and eleven new locations were recorded in this vicinity.

NINE-MILE MOUNTAIN.

The various properties in this vicinity have been practically dormant during the last season, but the annual assessments were recorded on all the older properties. A shaft some 70 feet deep, in conjunction with the former workings, was sunk on the *American Boy*. Ten new locations were recorded in this locality.

ROCHER DÉBOULÉ MOUNTAIN.

This vicinity has been a hive of industry, the largest shipments from this Mining Division having been made from what is known as the *Rocher Déboulé* mine. Work on this property has been continuous throughout the year and 17,000 tons of ore has been shipped to the smelter. About eight months ago a tunnel was started on this property. It was purposed to drive this tunnel over 3,500 feet to cut one of the veins which showed at the surface about 1,100 feet above. If this work proves successful it is anticipated that the tunnel will be continued through to the north side of the mountain, which may eventually be the means of greatly decreasing the cost of shipping ore from this property, and at the same time solve the transportation difficulties of other properties.

The *Red Rose* group has been continuously developed throughout the season, but work was closed down in the early fall.

The *Daly West* group has been systematically worked and machinery is now being installed upon the property.

* *See also* Report by Assistant Mineralogist, page 92.

The *Comeau* group has received attention with most encouraging results. It is anticipated development-work will be continued upon this property throughout the winter.

The *Indian* group, now owned by the New Hazelton Gold Cobalt Mines, Limited (Non-Personal Liability), has been developed throughout the season with encouraging results. Work on this property will be carried on throughout the winter.

It would appear that the *Highland Boy* group, which has been lying dormant during the past three years, is again coming into prominence. This has the appearance of being a remarkably rich property, upon which development-work has recently been resumed.

There are many other properties in this vicinity upon which more than actual assessment-work has been performed, among which may be mentioned the *Delta*, *Dyke*, *Chicago*, and *Armagosa* groups. One hundred and sixty-four new locations in this vicinity were recorded.

SKEENA MOUNTAIN.

In this vicinity the annual assessment-work was performed on existing mineral claims and eleven new locations were recorded.

The *Helen* group still continues to attract the attention of mining men, but to date no further work beyond the annual assessments has been performed.

FOUR-MILE MOUNTAIN.

Annual assessments have been recorded on existing claims and nine new locations have been recorded.

LEGATE CREEK.

In this vicinity the *Silver Way* group was bonded to local and Seattle interests. A sleigh-road has been constructed from the mine to the Grand Trunk Pacific Railway station, and it is expected that about 300 tons of ore will be shipped from this property during the winter, which is expected to average $200 a ton.

From the *Frisco* group 10½ tons of ore has been shipped to the Anyox smelter, the return for which averaged over $190 a ton.

Many other groups of claims have had more than the annual assessments performed on them during the past season, with encouraging results.

A mineral cabinet has been placed on the platform of the station of the Grand Trunk Pacific Railway at Pacific, where samples of ore emanating from Legate creek and other points in the vicinity of Pacific may be viewed by the travelling public.

A ferry across the Skeena was provided at Pacific by the Government during the past year, which has already been of great benefit to miners and prospectors holding mining properties in this section.

Sixty-six new locations in this vicinity were recorded.

KITSALAS.

Twenty-six new locations were made and the usual annual assessments were recorded on claims in this vicinity.

On the *Brantford* group the annual assessment-work only was performed.

A wagon-road was constructed from the railway at Dorreen Siding, on the Grand Trunk Pacific Railway, to the *Fiddler* group, a distance of about four miles, costing somewhere in the neighbourhood of $18,000; this work, it is understood, was undertaken by private enterprise.

It is also understood that on this property, consisting of three claims, a good permanent camp has been established and that active mining development has been started, which it is anticipated will lead to shipping ore in the very near future.

Twenty-one new locations were recorded from this vicinity.

ZYMOETZ (COPPER) RIVER.

The usual annual assessments and fourteen new locations have been recorded from this vicinity.

HUDSON BAY MOUNTAIN.

There are many properties in this vicinity well worthy of attention, but during the past year they do not appear to have attracted capital in the same way that properties in other portions of the district have.

Fifty-three annual assessments and twenty-one new locations have been recorded.

TELKWA.

Early last spring a group of four mineral claims, now known as the *Santa Maria* group, was staked by some Indians, who within a very short time agreed to sell their interests. This has led to the construction of a sleigh-road from Telkwa to the mining property, by private enterprise, at a cost of some $15,000. Active mining operations have been almost continuous on the properties since early summer, and the management anticipates that about 1,000 tons of ore will be shipped to the smelter before the coming of spring of 1917. This property is also locally known as the Jefferson-Dockrill group.

The *Hunter* group, in Hunter basin, has been bonded to outside interests and active mining is now in operation. Before shipments can be made from this property on any extensive scale it will be necessary for a sleigh or wagon road to be constructed from the property to connect with other road systems in the vicinity. It is understood that a road of about four miles in length will connect this property with the Jefferson-Dockrill road, and thus with the railway at Telkwa.

Thirty-eight new locations and twenty-four annual assessments have been recorded from this section.

BABINE RANGE.

On Dome mountain there has been considerable activity, this section having attracted the attention of outside mining men. During the past summer a trail was built for a distance of nine miles into this section, but further transportation facilities, in the way of roads, are urgently required.

The Babine Bonanza Mining and Milling Company has been steadily developing its properties under the management of James Cronin. A sleigh-road has been built with Government assistance a distance of sixteen miles during the past summer, giving this property access to the railway at Telkwa. Machinery has been shipped into this property, which will undoubtedly be listed among the shipping mines of the district within a measurable space of time.

The *Debenture* group has been actively developed throughout the season. Although closed down for the winter months, a more aggressive policy of development is to be instituted during the coming spring. Had it not been for the lack of roads, mining machinery would have been procured and taken into this property during the winter.

It is learned that a road into the *Debenture* could be economically constructed so as to join the Cronin road, and thus give this property connection with the railway at Telkwa. There is, however, an alternative route which would connect the mine with the railway near Moricetown. This would mean the construction of a road for over thirty miles and the building of a wagon-bridge over the Bulkley river.

Twenty-eight annual assessments and seventy-two new locations were recorded from this vicinity.

BABINE LAKE.

Eleven assessments and ten new locations were recorded.

BLUE GROUSE MOUNTAIN.

Active development-work has been continued throughout the year on the *Copper Crown* group. A road with Government assistance has been built during the past season connecting this property with the railway and a quantity of mining machinery has been installed on the workings.

Twenty-one new locations were recorded from this vicinity.

SIBOLA CREEK.

Annual assessments and sixty-three new locations were recorded from this vicinity.

OWEN LAKE.

Annual assessments and ten new locations were recorded from this vicinity. One property in this locality was bonded for $30,000.

PLACER-MINING.

On Lost creek, a tributary of the Omineca river, the property owned by William B. Steele and John A. Mullen has turned out better than anticipated. It is reported that after the owners struck the pay-streak they cleared over $50 a day apiece, but owing to the unfortunate illness of one of the partners the property had to be shut down.

On McConnell creek, a tributary of the Ingenika river, Peder Jensen, with a crew of four men, working all the season, cleared more than expenses, and he appears perfectly satisfied with his summer's work.

No other properties were working during the past season in the Omineca placer-gold field.

Although the Dry Hill Mining Company was working its property on Lorne creek for the entire season, no report of the season's work has come to hand.

It will be noted among the office statistics at the end of this report that eleven placer-mining leases have been applied for in this division during the last year.

OFFICE STATISTICS—OMINECA MINING DIVISION.

Free miners' certificates (ordinary)	713
Free miners' certificates (company)	5
Free Miners' Certificates (special)	1
Mineral claims recorded	722
Certificates of work issued	797
Certificates of improvements issued and recovered	17
Bills of sale and other documents of title	238
Powers of attorney	33
Mining documents filed	86
Placer claims recorded and rerecorded	6
Applications for placer-mining lease received	11
Placer-mining leases granted	12
Crown grants of mineral claims issued	17

Revenue.

Free miners' certificates	$ 3,967 00
Mining receipts	8,360 65
Total	$12,327 65

OMINECA MINING DIVISION.

HAZELTON-TELKWA DISTRICT.

REPORT BY JOHN D. GALLOWAY, ASSISTANT MINERALOGIST.

INTRODUCTORY.

During the summer of 1914 the writer spent two months and a half in the Hazelton-Telkwa region of the Omineca Mining Division, examining a number of the more important mineral properties and noting the general geological and physical features. The report on this was issued as Bulletin No. 4, 1915, and was also printed in the Annual Report of the Minister of Mines for the year 1914. The writer's main work during the summer of 1916 was to make a reconnaissance of the country south of the Grand Trunk Pacific Railway, and following, to some extent, the eastern contact of the Coast range south to Bella Coola. While this was the route laid out, it was impossible to adhere to it strictly owing to lack of trails.

Before commencing on this reconnaissance trip one month was spent in the Hazelton-Telkwa region, noting new developments and examining some new camps. A number of the properties

examined in 1914 were revisited and several new ones were examined. While the previous report on the Omineca Division was incomplete in many respects, it is, nevertheless, not felt that it is necessary to here recapitulate the introductory, historical, and general descriptive matter given at the commencement of that report, and to it the reader is referred for such information. This report will also avoid, unless where absolutely necessary, any description of work done prior to 1914, which is given in the 1914 report.

The main idea of this present report is to present as simply and clearly as possible a description of mining operations in this region during the past two years, together with, wherever possible, opinions in regard to the origin of the ore-bodies and information about the general geological features. It should be remembered, however, that, in examining about thirty properties in one month scattered over a distance of 150 miles, but little time is allowed for detail examination, and that the statements in regard to the geological features fall strictly into the category of "notes."

A word may be said in regard to assays. It is, of course, impossible that a Government engineer can take as many samples from a property as would a private engineer examining an individual property for purchase or sale. The writer has many times been told that one or two *samples taken from a property are misleading and that it is better that none should be taken.* To this view he cannot agree, as even one sample, if intelligently taken, will indicate the nature of the ore; at the same time the writer thinks that in all cases it should be made very plain just what the sample represents.

It is a pleasure for the writer to express his appreciation of the kindness and courtesy shown to him by the residents of the district. The ready assistance given to him by the prospectors and mining men greatly facilitated the work of examination.

SUMMARY AND CONCLUSIONS.

The territory embraced in this report may be best described as the Hazelton-Telkwa section of the Omineca Mining Division.

Some confusion exists in regard to the name "Omineca" which it seems best to clear up. The Omineca Mining Division is an arbitrary division made some years ago, as were other mining divisions, in order to divide the Province up into districts for administrative purposes. It so happens that this Omineca Division, which contains some 58,000 square miles, includes the Hazelton-Telkwa region, and also a placer-mining region distant some 100 miles from Hazelton which is generally known as "The Omineca." Popular custom in the Hazelton-Telkwa section limits the name Omineca Mining Division to the placer country only, but it should be remembered that it takes in, as outlined above, a much larger district, including the active lode-mining camps along the Skeena and Bulkley rivers.

Lode-mining in the Hazelton-Telkwa region may be said to have had its commencement *about 1902, but little headway was made until 1913.*

The following table of mineral output shows how mining has grown in the last few years:—

Metalliferous Output of the Omineca Mining Division for the Years 1913 to 1916.

	1913.		1914.		1915.		1916.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold, placer	300 oz.	$ 6,000	300 oz.	$ 6,000	600 oz.	$ 12,000	850 oz.	$ 17,000
Gold, lode	62 "	1,281	203 "	4,196	1,524 "	31,501	1,303 "	26,933
Silver	46,298 "	26,297	135,265 "	70,473	79,155 "	37,361	112,635 "	70,262
Lead	156,862 lb.	6,165	323,482 lb.	11,322	249,279 lb.	10,395	224,451 lb.	13,853
Copper	1,838 "	281	6,000 "	816	2,831,279 "	489,245	1,646,072 "	447,764
Zinc	....	....	....	....	....	....	168,616 "	18,345
Total values	....	40,024	....	$92,807	....	$580,502	....	$594,157

During the summer of 1915 the Canadian Geological Survey carried out further work in the vicinity of Telkwa river. This work was done by J. D. MacKenzie, and a short preliminary account of his observations is given in the Summary Report of the Geological Survey for the year 1915. His final report has not appeared yet.

The 1914 report of the writer contained a bibliography of the reports on the district up to that time. This list is reproduced here, together with the additions since that time:—

Name of Author.	Publication.	Year.	Page.
Dr. Geo. Dawson	Geological Survey of Canada	1888	73R
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

Mining in this district now seems to be in a healthy condition and promises well for the future. It is true that as yet there are only two important shippers—the *Rocher Déboulé* and the *Silver Standard*—but the encouraging thing is that development-work is being carried out in many places, and the writer has no hesitation in expressing his conviction that many of these properties now being developed will eventually become productive mines. As such properties are described farther on in the body of the report there is no need to enumerate them here.

As a rule, the ore-bodies in this district may be considered as small bodies of medium to high-grade ore as distinguished from the large low-grade ore-bodies found in other parts of the Province. For this reason this section should prove attractive to small mining syndicates and individual operators, as such large amounts of capital are not required as in developing and equipping large low-grade mines. At the same time, it may be pointed out that any form of mining is an expensive business, and that even a small mine requires quite an initial outlay. A prospect which gives promise of developing into a small high-grade mine can usually be tested out with a small expenditure, and in such a case, if successful, returns on the investment come quickly.

The writer would like to reiterate and to emphasize that this district contains a vast area which is as yet virtually unprospected, and which can be classed as a distinctly promising field for exploration. The whole Babine range, which has not been much prospected as yet, would seem to be a likely section in which to find minerals in paying quantities. A large tract of country which should be a likely field for prospecting lies in the "big loop" of the Grand Trunk Pacific Railway from Copper City to Telkwa. This territory is drained by the Zymoetz, Kitsequekla, and Telkwa rivers and many smaller streams; the country adjacent to these rivers has been run over, but much still remains back from the main streams which has scarcely been looked at.

In the mountains on both sides of the Skeena river below Pacific Station the rocks of the Kitsalas series are of frequent occurrence. In this formation many showings of copper ore have been discovered, but as a rule they are irregular and not continuous. It is possible, though, that some of these may later be shown to have enough copper minerals disseminated through a large area of rock-matter to constitute large low-grade ore-bodies.

GENERAL GEOLOGY.

The writer is unable to add anything of material importance to the geology as outlined in his 1914 report, which statement then was largely a compilation from the published works of the Geological Survey on the district. A complete geological study and geologic and topographic map of the Rocher Déboulé mountains would be of very considerable value in assisting mining in the district. The main formations of the district have previously been outlined and no change in the former description of them is to be made.

In the Hazelton-Telkwa region the important rocks are the great series of pyroclastic, effusive, and sedimentary rocks called the Hazelton formation, the intrusive granitoid rocks known as the Bulkley eruptives, and the sedimentary, coal-bearing Skeena formation.

The first two are important as being the home of the metalliferous minerals and the Skeena formation for its coal-seams. It would be well for prospectors to make themselves familiar with these rocks in order to prospect more intelligently.

The rocks of the Hazelton formation consist of quartzites, argillites, and schists, as well as partly altered volcanics which were originally andesites, rhyolites, diabases, basalts, porphyrites, breccias, and a third class of ash rocks and tufaceous sedimentaries. Where these rocks have been sheared, sheeted, fissured, or crushed, mineral deposits have in some cases been formed. This shearing, etc., and subsequent mineralization have apparently been caused by the intrusion of the granitoid rocks known as the Bulkley eruptives. Mineralization has generally, but not always, taken place in the Hazelton formation rocks at points not far distant from the granitoid rocks. Mineralization in the granitoid rocks is also of frequent occurrence, generally in fairly definite veins. The close relationship between ore-bodies in the Hazelton formation rocks and the granitoid rocks and in contacts between these formations is the main reason for supposing that the intrusion of the granitoid rocks was the main cause of the mineralization throughout the district. It is evident, though, from the occurrence of ore-bodies wholly within the granitoid rocks, that mineralization—that is, the circulation of mineralizing solutions—was the last phase of the granitoid intrusions. Very probably the intrusion of these rocks set up stresses and strains in the older rocks, causing shearing and fracturing, thus providing suitable places for the deposition of minerals when the last or mineralizing phase of the intrusion took place. Probably also the ore-bodies, now found in the granitoid rocks, are filling fractures and sheared zones formed in those rocks by the partial cooling of the magma which took place before the mineralizing phase commenced. In some cases apophysal dykes thrown off from the main batholiths of granitic rock are apparently responsible for the introduction of mineral to the older rocks, and in several instances these dykes are mineralized. Dykes such as these represent the culminating phase of the intrusion, and are probably either contemporaneous or but slightly antecedent to the mineralizing phase.

The Bulkley eruptives are granitoid rocks, the most common variety being granodiorite, but true diorite and quartz diorite are often seen. Wide variations in composition and texture are found in different places, but at all times the rocks are easily identified. In dyke form acid phases are common, such as felsite and granite porphyrys. The texture is as a rule granular, but porphyritic facies are common.

For the prospector the important thing to remember is that the most likely place to find ore-bodies is near the contacts of the two rocks and also within the granitoid rocks. The two series of rocks are well shown on Rocher Déboulé mountain; the core of the mountain is granodiorite, and this rock is exposed on the surface in many places, having been exposed by the erosion of the overlying quartzites

The Hazelton formation, consisting here mainly of quartzites, is represented by patches, some of great size, which are the remnants of the rocks intruded by the granodiorite and which at one time completely surrounded the granodiorite core.

Throughout the district many different types of ore-bodies are found. Under the heading of the *Rocher Déboulé* mine will be found a discussion of the ore-bodies on that property. They are listed as replacement veins in sheared fissure-zones and are of special importance as being typical of a number of such deposits in the district.

The ore-bodies found on Glen and Nine-mile mountain belong to the true fissure vein type, and the tendency often noted in other districts of a number of parallel quartz veins is well exemplified at the *Silver Standard* mine.

In the western part of the Division remnants of the Kitsalas formation are found. These rocks are older than the Hazelton formation and consist of a highly altered complex of volcanic, intrusive, and some sedimentary rocks. The formation is intruded, and over large areas obliterated, by granitic dykes and stocks of granitic rock belonging to the Coast Range batholithic rocks.

The deposits in the rocks of the Kitsalas formation on St. Croix, Legate, and other creeks are of an irregular nature and correspond more closely to mineralizations in sheeted zones and along dykes than to anything else. In one way they may be listed as replacement deposits,

as the mineral was formed by the metasomatic replacement of the country-rock. In the Babine range the prevailing ore-bodies are of the vein type, but some contact replacement deposits also occur. The Dome Mountain properties have well-defined quartz-filled fissure-veins.

The Hudson Bay mountain, Hunter basin, Howson basin, and other deposits are replacements in altered rocks of the Hazelton formation and intrusive dykes, and are directly connected with not far-distant intrusions of granitoid rocks.

MINERALOGY.

Throughout the Hazelton-Telkwa region the mineralization may be broadly divided into two groups which, however, grade into one another. One may be called the copper-gold group and the other the silver-lead-zinc group. The predominating minerals in the first group are chalcopyrite, pyrite, arsenopyrite, pyrrhotite, and bornite; the last mineral in most cases probably being of secondary origin. In this group the predominating value is, of course, copper, but where arsenopyrite is plentiful and chalcopyrite of lesser importance, then the gold values become of greatest importance. It is evident from many samples taken by the writer during two seasons that arsenopyrite in this district almost invariably carries good gold values. This mineral should therefore have more particular attention paid to it by prospectors than it has in the past. Silver occurs with this group of minerals generally in association with low gold values in the chalcopyrite, but as a rule it is of very minor importance. In some instances high gold values (i.e., up to 6 oz. to the ton) are found in chalcopyrite, while some gold is often associated with the pyrite. Pyrrhotite as a rule is valueless, and although several specimens have been tested for nickel, no appreciable nickel percentages have been noted. In one or two instances cobalt bloom (erythrite) has been noted and cobalt percentages up to 3 per cent. have been found.

This cobalt would seem to occur in the arsenopyrite, probably isomorphously replacing some of the iron. It is not likely that this is a mineral distinct from arsenopyrite, but when cobalt occurs in quantities from 4 to 10 per cent. in arsenopyrite, then the distinguishing name of danaite is sometimes applied to it.

The secondary minerals belonging to this first group are bornite, chalcocite, native copper, and native silver. A little specular-iron ore (hæmatite) is also sometimes noted.

The minerals found in the second group are galena, sphalerite (zinc-blende), tetrahedrite (grey-copper), stibnite, and very subordinate amounts of chalcopyrite, pyrite, arsenopyrite, and native silver. Of these the first two are the most important. The galena, of course, carries the greater proportion of the silver values found in the ores of the district, but the ratio of silver to lead in this galena varies within wide limits. As a rule, the silver will run at least 1 oz. to the unit of lead, but higher and lower ratios than this are common. Sphalerite occurs nearly everywhere in association with the galena, but it is as yet of minor importance. This mineral is plentiful in the *Silver Standard* mine, the silver-lead shipments from that property running from 15 to 20 per cent. zinc. In shipping this ore to a lead-smelter zinc is a decided detriment, as any zinc above 8 per cent. is penalized at 50 cents a unit. This year, however, a start has been made in sorting out the zinc ore so as to make a product running 40 to 45 per cent. zinc and also carrying 40 to 60 oz. of silver to the ton; about 200 tons of this class of ore was shipped to United States zinc-smelters.

As a rule, the zinc-blende does not carry much silver, and in many instances the silver values are negligible.

Tetrahedrite occurs in sparing quantities in many places associated with galena and sphalerite. It nearly always carries high silver values, and is therefore of considerable economic importance. A little of it scattered through the galena often causes higher silver assays to be obtained than the average run of the galena will give.

Stibnite is found principally in the claims of Nine-mile mountain, in association with galena and subsidiary amounts of sphalerite. It has not yet been found in large enough quantities to make it valuable for its antimony contents, but it, as a rule, carries about as high silver values as the galena does, and is therefore shipped with the lead ore.

Chalcopyrite, pyrite, and arsenopyrite and oxidation products therefrom are sometimes found in very small quantities with the silver-lead-zinc ores, but are of no economic importance. Native silver is occasionally found in the upper portions of the ore-bodies, having been formed in a secondary manner.

SKETCH MAP

OF PORTIONS OF

OMINECA, BELLA COOLA AND NANAIMO

MINING DIVISIONS

ACCOMPANYING REPORT OF J. D. GALLOWAY ON AREA, LYING BETWEEN THE G. T. P. RAILWAY AND THE CHILCOTEN DISTRICT.

B.C. BUREAU OF MINES. 1916.

Scale, 20 miles to 1 inch

20 10 0 20 40

This broad classification into two kinds of mineralization must be accepted as only general, as, for instance, at the *Fiddler* property the ore is a complex mixture of chalcopyrite, pyrite, galena, and some zinc-blende, thus showing a joining together of the two types. Here the principal value is in gold, but silver, lead, and copper values are also quite noticeable.

Sufficient information has not yet been obtained to be able to say whether the two different types of mineralization represent two different epochs of mineralization, but the writer is of the opinion that the two were not separated by any great time period.

Some molybdenite and tungsten have been reported from claims on Mud creek, Rocher Déboulé mountain, but sufficient development has not been yet done to prove whether or not they occur in commercial quantities.

Gold is found in quartz veins in the Dome Mountain camp, probably occurring partly in the quartz and partly in association with pyrite in the quartz.

Oxidation of the surface outcroppings of veins and ore-bodies is of common occurrence throughout the district. Some of the veins are very thoroughly leached out on the surface. This oxidation, however, rarely extends downward more than 10 to 30 feet, and often only a foot or two.

The *Santa Maria* property, in Howson basin, has a vein in which the valuable mineral is mainly chalcocite, but in addition there is some bornite and smaller amounts of chalcopyrite. It is quite probable that here the higher sulphides of copper are of secondary origin, having been formed from primary chalcopyrite.

DESCRIPTIONS OF MINERAL PROPERTIES.

In describing the various claims visited, they are given in geographical order from west to east, going easterly along the Grand Trunk Pacific Railway. First of all, several properties west of Hazelton were examined, starting with the *Autumn* group at Amsbury, then the *Diamond* group at Pitman, properties on Legate creek, the *Fiddler* group on Fiddler creek, and claims on Skeena mountain.

In the vicinity of Hazelton all the properties which were being worked were examined, besides some other claims. Next came the coal property at Seton, some twenty miles beyond Hazelton.

From Telkwa a number of camps lying at some distance back from the railway-line were examined; these included Howson basin, Cronin's camp, and Dome mountain.

Autumn Group. This group is situated five miles west of Amsbury Station and about half a mile north of the railway-track. It is owned by Edward Chesley, Philip Chesley, Geo. W. Kerr, Samuel Alger, and Harry McMann, and consists of the *Autumn No. 1*, *Autumn No. 2*, *Happy*, *Wellington*, and *Lottie M.* claims. Amsbury Station, a flag-station on the Grand Trunk Pacific Railway, is eighty-five miles east of Prince Rupert. The property has a good cabin on it and the workings are only a few hundred feet away.

The rocks exposed on these claims are volcanics and sediments, all considerably metamorphosed, and belonging to the Kitsalas formation. Granitic dykes of a later age cut these rocks, but are not numerous. The volcanic rocks are generally light-coloured and consist of porphyrites, and volcanic tuffs and breccias. These rocks are, in places, so highly altered as to make it quite impossible in the field to determine just what they are. They are characterized by an abundant development of epidote and chlorite. While as a rule these altered volcanics are of an acid type, some of them are dark-coloured and basic in composition.

The sedimentary part of the Kitsalas formation is here represented by a band of crystalline limestone—practically marble—which has quite a distribution, and by a light-coloured rock which may be a tufaceous quartzite, but is possibly a true volcanic ash bedded under water. This limestone-deposit was taken up by the Western Canada Portland Cement Company a few years ago with the intention of developing a Portland-cement industry at this point. A synopsis of the report of W. E. Lossee to the holding company is given in the Annual Report of this Department for the year 1914, page 152. This report shows the limestone-band to have a width of 400 feet and a length of four miles. An analysis of it shows that it is highly suitable for cement purposes. Abundance of shale and clay is also available on the property, which is held by a number of leases, all of which have been surveyed.

This band of limestone is apparently overlain by the volcanic rocks, although the crumpling and folding to which the region has been subjected has, in places, transposed the regular order.

It seems rather peculiar that this body of limestone has not been mineralized to some extent by the mineralizing action which has taken place in the volcanics. Limestone is a particularly easily soluble rock, and as a rule lends itself more readily to metasomatic and replacing processes than igneous rock. However, as far as is at present known, this limestone does not carry any metalliferous minerals, but further prospecting of the contacts might discover some.

The showings of ore on this group are confined to a greenish-coloured, highly altered volcanic rock. It is impossible to say definitely what it originally was, but it was evidently of medium acidity, possibly a porphyritic andesite. It now consists of epidote, chlorite, and silica.

The rocks here show considerable fracturing, there being many lines of schistosity developed. Mineralization has taken place along these lines of shearing, and also particles of mineral are disseminated through the unsheared rock. This mineralization is, however, slight, and only in a few places is there much of the rock sufficiently mineralized to constitute pay-ore. Pyrite and chalcopyrite are the principal minerals, with some thin films of bornite developed by oxidation of the chalcopyrite.

Description of Workings.—A tunnel 80 feet long, a surface cut with a shaft from it 10 feet deep, and a smaller open-cut constitute the principal workings on the property. The large cut shows a little mineralization, and in the shaft there is at the bottom a band of rock 2½ feet wide which is fairly well mineralized. The best ore taken out from this open-cut and shaft has been roughly sorted out and piled into a dump which contains about 10 tons. An average sample of this was taken which returned the following assay: Gold, trace; silver, trace; copper, 1.5 per cent.

The small open-cut contains the best showing of ore on the property. In this working there is a width of 10 feet which shows mineralization; a sample cut across the full width assayed: Gold, trace; silver, 0.4 oz.; copper, 1.9 per cent.

The tunnel was driven from a point 40 feet below the large open-cut in a direction N. 63° W. (mag.). At a point about 60 feet in it is underneath this cut and has been continued 20 feet farther. At a point 66 feet in the tunnel a crosscut has been driven to the right for 15 feet, which brings the face approximately under the small open-cut in which the 10-foot width of ore is exposed. The tunnel development has proven disappointing, as practically no mineralized rock was encountered in driving it.

Development-work with one or two men was carried on during the summer and fall, and a letter from one of the owners says that this work disclosed more ore, and that it had been satisfactory.

Diamond Group.

This group, owned by Stanley Ross & Sons, and consisting of the *Ruby*, *Diamond*, *Earle*, and *Rainbow* claims, is situated on Hardscrabble creek a short distance above the Grand Trunk Pacific Railway. The trail to the property, which leaves the railway about half a mile from Pitman Station, is about one-third of a mile long.

The property was staked two or three years ago; since then some development-work has been carried out and a 10-ton shipment of ore was made to the Anyox smelter during the summer of 1916. A comfortable cabin has been built on one of the claims; this is at an elevation of 560 feet, while the workings are 100 to 200 feet higher. The elevation of Pitman Station is 337 feet and it is situated 114 miles east of Prince Rupert.

The outcrops of ore and workings are situated on the east bank of Hardscrabble creek at a point where the creek flows through a rocky canyon with sides nearly 200 feet high. The main showings are on the edge of, and down the side of, this rocky wall, and the remainder are back a short distance where the land surface is comparatively flat. The property is nicely situated for economical working, as it could be developed for a time by tunnel-working, and also is practically on the railway-line.

This property is situated in a district where the predominating formation is that known as the Kitsalas formation, a highly altered complex of intrusive, pyroclastic, and volcanic rocks. Locally the rocks showing are diorite, felsite, and some highly altered volcanic rocks. This diorite and felsite probably belong to the intrusive stocks of granitic rocks, which are contemporaneous with the Coast Range batholithic rocks, and have a widespread distribution in the western part of the Omineca Mining Division.

The volcanic rock is mainly diabase, which, however, has been profoundly altered to chlorite, epidote, and talcose material. There are lines of shearing which run through all the rocks and which have produced a schistose structure along certain zones; slickensiding seen here denotes some movement along these lines of shearing. The felsite has apparently been intruded as a large irregular dyke and carries in it inclusions of the diorite and also of the Kitsalas formation. This felsite is probably a later intrusive dyke which has smashed across the older rocks and incorporated fragments of them which the molten magma was unable to assimilate before cooling. These fragments have therefore preserved their identity, but have at the same time been considerably altered in chemical composition. This felsitic rock is important economically, inasmuch as the showings of ore on the property are confined to it. The local name for this felsite is "pink quartz."

The ore-bodies which have been formed in this felsite are somewhat irregular and the writer was unable to determine just how they occurred. The ore is developed along cracks and seams in the felsite, but no definite system of shearing or fissuring could be determined. The widest of these mineralized seams is about 1 foot wide, and in this there is a considerable percentage of chalcopyrite and a little bornite. These seams are not continuous for more than a few feet and most of them are irregular and disjointed. The felsitic rock is jointed along a direction N. 65° W. (mag.) and also in a direction approximately north and south (mag.). The general strike or direction of the felsite is also N. 65° W. (mag.).

The origin of the ore would seem to have been by means of a replacing action from mineralized solutions flowing along cracks in the felsitic rock. Chalcopyrite is the main mineral present, but some bornite has been developed by secondary action from oxidation of the chalcopyrite. Gold and silver values are practically negligible.

The main working on the property is a large irregular-shaped cut which is roughly 20 x 20 x 20 feet. In this cut felsite rock and porphyritic diorite are very much mixed up and a certain amount of mineralization can be seen. Specks of chalcopyrite are scattered indiscriminately through the diorite and felsite, but not in sufficient quantity to constitute commercial ore. In addition, there are a few seams which contain a larger percentage of chalcopyrite. None of these seams or veins are of sufficient size or regularity to admit of profitable mining by themselves, and so the only thing to consider is whether or not any zone of the felsitic rock is sufficiently mineralized to be profitably mined.

Fifty feet below this cut and on the side of the bluff a tunnel has been commenced which is in about 8 feet. This working does not show very much workable ore, and again what there is is confined to small irregular seams. The ore extracted from these two workings was carefully hand-sorted so as to make up a 10½-ton shipment which was shipped to the Anyox smelter. This gave returns of 65 cents in gold and silver to the ton and 5.2 per cent. copper. The rejected material from this hand-sorting has been piled in two dumps, one about 20 tons and the other about 10 tons. These were carefully sampled and returned the following assays:—

Description.	Gold.	Silver.	Copper.
20-ton dump, average	Trace	Trace	1.9
10-ton dump, average	Trace	Trace	1.3

A selected sample of the richest ore on the property assayed: Gold, trace; silver, 0.4 oz.; copper, 15 per cent.

To get to the tunnel a steeply sloping ladder has been built down the side of the bluff. Below the tunnel there is nearly a straight drop to the creek of 135 feet. Ore taken out of the tunnel was hauled up to the bench above on skids. From the ore-sorting shed the ore was lowered on skids for 100 feet down the sloping side-hill, and from this point it was hauled to the railway on a go-devil.

The *Diamond* property has a certain amount of copper ore disseminated through a fissured zone in a felsitic rock. The ore in places is found in narrow irregular cracks, the widest noted being 1 foot wide, but none of these seams are big enough to be individually mined at a profit. The specks of chalcopyrite which are scattered through the felsite, together with a little malachite and azurite (oxidation products), are not in sufficient quantity to make the whole rock-mass into low-grade ore.

The low-grade ore now lying in the two dumps, together with the 10 tons shipped, totals about 40 tons, which has an average assay of 2.5 per cent.; to get this ore something like 500 tons of rock had to be handled.

The possibility for the future of the property is that the whole felsite dyke may carry sufficient copper to make a large low-grade ore-body, but the present development has not yet shown this to be the case. Where there is evidence of mineralization on an extended scale, such as is shown here, it is always worth thorough investigation to see whether or not a large low-grade ore-body may be developed. The present showings are not promising, but somewhere else in the felsitic rock a more highly mineralized zone might be found.

LEGATE CREEK.

Legate creek is a rapid mountain stream which enters the Skeena on the eastern side opposite the town of Pacific, a divisional point on the Grand Trunk Pacific. It rises in a spur of the Coast range and is fourteen miles long. The mountains at the head of the creek are very rugged with sharp, jagged, and abrupt peaks and often have small glaciers on the higher levels. The vegetation is very dense, and while the trees are not particularly large they are quite numerous. The influence of the Coast rains and moisture is plainly shown, particularly in the shrubs and small trees. This heavy growth of small trees and brushes, together with the rough, rugged topography of the country, makes it extremely difficult country to get around in; prospecting there is most arduous, and the wonder is that any men can be found to tackle it. That this locality has been thought promising for prospecting is evident from the fact that during this season about twenty prospectors have been searching the mountains surrounding the headwaters of the creek. In addition to this, one group was bonded by J. J. Price and a force of twelve men put to work. The writer made a trip up the creek to see this latter property, and one other was also examined. At that time the trail up the creek was only a trail in name, as it was not even properly cut out and often followed the bed of the creek. A road-gang, however, was at work and had by then built four miles of a first-class trail good enough for a sleigh-road. It is believed this trail was finished as far as the forks of the creek, roughly twelve miles. From this trail prospectors can easily make branch trails to their own claims. A ferry was also to be built across the Skeena at Pacific, which would be of great assistance to anybody operating up Legate creek.

The rocks in this district belong to two formations—viz., the Kitsalas series and Coast Range granitic rocks. The Kitsalas series consists of the usual type of highly altered volcanic rocks, a basaltic rock being of most frequent occurrence. The granitic rocks are intrusive into the older volcanics in the form of dykes and bosses.

Price Group.

The group of claims bonded by J. J. Price and Aitken consists of the *M. and K.*, *O. and W.*, and some other claims, which were staked by Whitmore & Orr. They are situated at the head of a small creek coming into Legate creek near its head and distant about three miles from the forks. From the creek-level Mr. Price has built a switchback trail up the mountain-side to the claims. A temporary tent camp was put up while this trail wes being built, but later it was intended to put in a permanent camp close to the showings of ore.

The main showing of this property—the *M. and K.* group—is a rather peculiar one, as the vein has not as yet been definitely found in place. In a small flat gulch a large quantity of float-ore has been found for a distance of 150 feet up and down the hill. Some surface cuts have been put in and large pieces of the ore dug out, but while the vein or ore-body from which the ore comes has not been definitely found, it is possible that by further prospecting it will be found. Mr. Price estimates he has 150 to 200 tons of this float-ore; this seems excessive, but at least there are several car-loads "in sight." The ore itself is peculiar; consisting of a fine-grained mixture of galena and bornite and carrying, it is claimed, good values in silver. Nearly all the float-ore is practically solid sulphide, and some of the pieces are of a size such as to suggest that the vein from which they come is from 2 to 3 feet wide. It may be difficult to market the ore so as to get paid for both copper and lead, but with the copper and silver values alone the ore is good grade ore.

A typical analysis of the solid ore is: Gold, trace; silver, 22.5 oz.; copper, 25.5 per cent.; lead, 32.7 per cent.

Besides this main showing, there are several sheared zones in the altered volcanic rock which show some mineralization with chalcopyrite and iron sulphides. In one of these there is about 2 feet of ore at one place; a sample taken across this assayed: Gold, trace; silver, 6.3 oz.; copper, 9.5 per cent.

None of these showings have had any appreciable work done on them.

The second group bonded by Price & Aitken is the Halliday property. This is said to have a large vein carrying silver-lead minerals and is considered very promising by Mr. Price. This property was not examined as the showings were covered with snow.

Whitmore & Orr have a group of claims near the head of Legate creek and on the eastern side. The only work done is an open-cut on the *Frisco* claim, which shows a mineralized zone in altered basaltic rock. This vein lies almost flat and is from 1 to 2 feet wide. It is mineralized with bornite, chalcopyrite, and copper carbonates. In places the width of clean bornite is from 6 inches to 1 foot. A sample which represents hand-sorted ore, of which there is about 10 tons on the dump, assayed: Gold, trace; silver, 33.5 oz.; copper, 42.2 per cent.

Fiddler Group.

This group consisted originally of three claims owned by Louis Knauss, but now there are eight claims in the group, all held by annual assessment-work. The three original claims—the *Boulder*, *Indicator*, and *Intrusive*—are staked on Knauss creek, about two miles above the junction of that stream with Fiddler creek. Knauss creek is a small, short, glacial stream rising in Knauss basin, and the claims are only a short distance below this basin. The vein was discovered on the *Boulder* claim and has been exposed for a considerable distance on this claim, and the next one, the *Indicator*. The property is distant about four miles from Dorreen, a station on the Grand Trunk Pacific Railway, 125 miles east of Prince Rupert. A trail from the station was formerly the means of access to the property, but recently a wagon-road has been constructed.

After preliminary development by the owner the property was bonded by Martin Welsh in July, 1914. Mr. Welsh carried out further development, but relinquished his bond about the end of 1914, the property reverting to the original owner. Some further work was then done by the owner, which effectually showed why a tunnel run by Mr. Welsh failed to continue on the ore, the principal cause for the bond being allowed to lapse.

In July, 1916, the property was acquired under option by the Fiddler Creek Gold Mining Company, an Edmonton concern, which carried out further work during the latter months of that year. The head office of this company is at Edmonton. Mr. Knauss was in active charge of the work done by this company, the work being continued until the heavy winter weather set in. At the time of writing this (March, 1917) work has not been recommenced, but it is confidently expected that larger scale development will be carried out this summer.

Geological Description.—The predominating rock in this vicinity is a thick-bedded argillaceous limestone of a bluish-black colour. Occasional fossils occur in this limestone, apparently being some species of ammonite. This rock apparently does not belong to any horizon of the Hazelton formation and may therefore be tentatively referred to the Kitsalas formation, in which some bands of limestone do occur. This limestone contains a considerable percentage of argillaceous material, or clay. The beds are fairly regular and have a general strike of S. 60° E. and dip at 30 to 45° to the north-east.

Cutting the limestone roughly at right angles to the bedding-planes are several granitic dykes which apparently are connected with an intrusion of granitic rocks which can be seen some distance away at the head of the basin. These dyke rocks as a rule are well described as granite porphyrys, but some of them are quartz porphyry.

The vein is a typical example of a bedded fissure-vein, and although it pinches and swells and is somewhat faulted, it is nevertheless very regular, persistent, and well defined. The strike and dip conform with the bedding-planes of the enclosing country-rock, but the exposure of the vein is peculiar, in that it is exposed along, or rather down, the dip instead of along the strike, as is usual. This is owing to the topography of the country and the fact that Knauss cuts down into the country across the measures, so as to expose on its sides the dip of the limestone-measures. The strike of the vein is practically at right angles to Knauss creek, while the dip is in the direction in which the creek flows, and, as the creek has cut out a V-shaped channel, it exposes on the north-west side the vein along its dip.

The vein varies between extremes of 6 inches to 4 feet, but the general size is from 2 to 3 feet; it is safe to say it will average at least 2 feet throughout. It has been exposed by

development for at least 800 feet along the dip, not, of course, continuously, but in a sufficient number of places to make the continuity practically certain.

The gangue-filling of the vein is quartz, together with chalcopyrite, zinc-blende, pyrite, and galena. The sulphides constitute a considerable percentage of the total vein-matter, possibly from 5 to 10 per cent. The values are chiefly in gold, but the silver, copper, lead, and zinc contents are quite sufficient to warrant consideration as to how to save them. It has not been ascertained which of the sulphides it is that contains the gold, but it seems fairly certain that most of it is contained in the sulphides and that but little is free in the quartz. From many assays taken by the owners and others it seems probable that the gold is not confined to one sulphide, but occurs, at least occasionally, in all of them. It will probably be found, however, that the gold is mainly contained in the chalcopyrite and pyrite; the silver is probably carried in the galena.

It seems likely that the vein has been formed from mineralizing agencies set up by the granitic dykes. About 15 feet north of the main tunnel one dyke 75 to 100 feet wide cuts the vein, but this does not necessarily prove that the dyke was later than the vein. The intrusion of the dyke may have fissured the sedimentary rock on either side, but with the fissure not necessarily extending across the dyke. Another dyke can be seen in the tunnel close to the vein, but may be a part of the one seen on the surface. One hundred and fifty feet south-west from the tunnel, up the creek, there is a well-defined fault-plane which displaces the vein about 30 feet in a vertical direction.

As a rule, where the vein is seen outcropping, it consists of quartz with very little sulphides, but in practically every case a little development has shown a well-mineralized vein.

Description of Workings.—The development-work on the property consists of a number of open-cuts exposing the vein for a distance of some 800 feet, and an adit-tunnel 140 feet in length. The tunnel was driven by Martin Welsh when he had the property under option. This tunnel was started as a crosscut a short distance under the vein, it being thought that the vein was broken over at the surface, and was exposed on the strike and not on the dip, as is now proved. It was therefore expected that the vein would soon straighten up, but the vein refused to fit in with this theory, and the tunnel therefore had to be heightened sufficiently to break into the ore in the roof. The vein was followed in this way running on the strike for over 100 feet. At this point the vein would seem to have split, and one stringer a few inches wide was followed going into the foot-wall for 40 feet. It was thought at the time that this was the main vein, and as the stringer was small and carried only slight values, Mr. Welsh threw up his bond on the property.

The owner of the property then proceeded to prove that beyond the 100-foot point the tunnel, by turning to the left, had left the main vein in the roof or hanging-wall. This he did by starting at the point and breaking into the roof and exposing 2½ feet of good ore. At other places a few feet farther in the tunnel it has been demonstrated by shooting into the roof that the vein continues. The principal trouble with the old tunnel-work was that, by starting it too low down and thereby only having a fringe of the vein in the roof, it was not possible to get a proper idea of which way the vein pitched. By crosscutting into the hanging-wall from the face of the tunnel the main vein could have been picked up.

Lower down the hill there is a large open-cut and tunnel 21 feet long which shows the vein to be well defined and nicely mineralized. Here also the vein has been partially left on the roof, due to the persistent belief that it should straighten up when driven into. In nearly all of the open-cuts on the vein good ore is found.

The present company holding the property commenced operations in the fall of 1916 by building a wagon-road from Dorreen Station into the property, a distance of four to four and one-half miles. It was decided to attack the vein by a tunnel some distance farther down Knauss creek. The portal of this working is about 500 feet in elevation and 975 feet along the dip of the vein, below the main prospect-tunnel. It was started in the alluvial wash on the side of the creek and was driven through 183 feet of gravel before striking bed-rock; shortly after work was stopped for the winter. This tunnel was laid out so as to strike slightly below the expected continuation downwards of the vein. After getting well into the solid rock a short raise is expected to strike the vein. If the ore is struck here it will give a distance of 1,500 feet of "backs" on the dip of the vein.

Values.—The values are somewhat irregularly distributed through the vein, but it is claimed by the owners that the whole vein will run from $15 to $30 in total values. In 1914 the property was examined and reported on by W. M. Brewer, his report being given in the Annual Report of the Minister of Mines for that year. The following table shows a list of assays taken from his report:—

Location Sampled.	Assay Values.		
	Gold.	Silver.	Copper.
	Oz.	Oz.	Per Cent.
Taken across 12 inches at a point 200 feet from discovery post on Boulder claim	0.4	2.3	Trace
Taken across 3 feet at a point about 70 feet from same discovery post	0.25	1.4	Trace
Taken across 1 foot 10 inches wide at a point 62 feet from same discovery post	2.46	7.6	3.4
Taken across 2 feet wide at a point 49 feet from same discovery post	1.96	8.9	0.8
Taken across 1 foot 10 inches wide at a point 9 feet from discovery post	1.43	5.2	0.6

The writer took several assays during his examination, which are listed below. These samples are not to be considered as representing averages for the whole ore-body, but are taken as average samples across the vein, where the vein was most highly mineralized.

Description of Sample.	Gold.	Silver.	Copper.	Lead.
	Oz.	Oz.	Per Cent.	Per Cent.
No. 29. Across 2 feet in surface stripping above tunnel	6.54	5.1	1.5	3.5
No. 30. Taken across 25 inches at point 100 feet in the main tunnel	1.52	5.2	3.5	8.8
No. 31. Across 2 feet 4 inches in open-cut above tunnel	5.78	5.0	1.2	12.5
No. 32. Across 3 feet in open-cut below tunnel	0.80	2.0	*Nil.*	4.5

None of these assays show the percentage of zinc, but the zinc content is quite appreciable and is probably, on the average, as great as that of the lead.

It can be readily seen that this ore is a complex one, and that to obtain all the values (i.e., a reasonable percentage of them) a concentration and a separation of the different minerals is necessary. For instance, in shipping the ore to a copper-smelter, only the gold, silver, and copper would be paid for; in shipping to a lead-smelter the copper and zinc would not be paid for; and, as for the zinc, it would only be marketable if almost completely separated from the other sulphides. In order, therefore, to handle the ore to best advantage a most modern concentrating-mill would be required. It cannot be said that sufficient ore has yet been proven to warrant the erection of a mill, but, in the event of development proving a considerable tonnage of ore, as is reasonably expected, then a mill would be necessary.

The management of the company has realized this and has already commenced getting tests made on the ore in order to find out what design of mill will make the best recoveries of the different metals. Through the courtesy of the manager the writer has been shown the results of the tests so far made.

This preliminary test was made on a small lot of the ore at the Arthur plant of the Utah Copper Company. The analysis of the ore tested was as follows: Gold, 4.06 oz.; silver, 12.8 oz.; lead, 18.8 per cent.; zinc, 14.65 per cent.; copper, 0.752 per cent.; iron, 5.7 per cent.; insoluble, 44.5 per cent.

The ore was first treated in a Janney flotation machine, and four tests were made under varying conditions, only one of which was satisfactory, but this one showed a good extraction of all but the gold values.

The following is quoted directly from the report on the tests and indicates the results obtained:—

"*Test No. 3835.—Oils and Reagents used.*—First period: G-154 and D-98 oils. Sulphuric acid. Second period: 1,100-G-141 oil. Sodium sulphide.

	% Wgt.	Av. oz.	Ag. oz.	Pb. oz.	Zn. %.	Cu. %.	Fe. %.	Insol. %.
Heading	100.00	4.06	12.80	18.80	14.65	0.752	5.7	44.50
Tailing	38.13	1.92	2.30	2.00	1.30	....	2.8	....
Concentrate, 1st period	32.82	2.50	20.15	29.00	27.60	....	7.2	3.60
" 2nd period	29.05	10.04	18.75	19.05	17.70	....	7.9	....
" combined	61.87	6.04	19.49	24.33	22.95	....	7.5	....

	Per Cent.
Per cent. indicated extension, combined concentrates, gold	77.27
" " " silver	93.01
" " " lead	97.37
" " " zinc	96.59
Lb. oil per ton	2.27
Lb. sulphuric acid per ton	7.38
Lb. sodium sulphide per ton	2.00
Ratio of concentration, by weight, combined concentrates	*1.62

"*Remarks.*—This test was divided into two rougher periods of five minutes each. The first period was conducted in an acid water with 1.41 lb. oil to obtain a high-grade zinc product and a low-grade lead. The second period was conducted, plus sodium sulphide, with the object of securing a lead concentrate rich in silver and gold. In the first period there was created a good volume of dark-coloured froth floating a good amount of slime concentrate. In the second period good frothing conditions were created, showing strong preferential action. Each product was assayed separately.

"As shown by the separate assays, it would be impossible to float this ore upon differential principles. While some selective action shows along these lines with the zinc, the lead also follows this product.

"With the exception of the gold, the extractions are good, and probably all could be obtained by the treatment practised in the second period."

It is anticipated that by an amalgamation or cyanidation treatment of the tailings from the flotation process the greater part of the gold left in the tailings could be recovered. The silver, lead, zinc, and copper recovered by this flotation would be in the form of a fine concentrate. It is then expected that by treatment on slime-tables the different sulphides could be separated and so made marketable. This test is, of course, only a preliminary one and will have to be followed by others on a larger scale, but it indicates that the ore can probably be treated.

General Remarks.—This property is nicely situated for economical working, being within easy reach of the railway-line. Dorreen Station is at an elevation of 404 feet, while the prospect-tunnel on the property is at 2,225 feet elevation, or a rise of 1,821 feet in four and one-half miles of wagon-road, or approximately an 8-per-cent. grade. The property is, of course, well below timber-line and an ample supply of suitable timber for mining purposes is available on the ground.

During part of the year Knauss creek is a fair-sized stream with a rapid drop, but for four to five months it falls very low. It could not therefore supply sufficient power to run the mine and a small mill. Fiddler creek, however, is a large stream with a considerable flow of water throughout the year. It does not have any direct falls, but has in places a steep grade, so that by putting in a pipe-line for a mile or more, 200 or 300 horse-power could probably be developed in a hydro-electric plant. This power would be distant some two or three miles from the mine.

It is said to be the intention of the company to put in a small plant on Fiddler creek this year which will supply power for drills in the mine, and at the same time provision would be made for sufficient power to run a small mill.

The present showings of ore on the property are very encouraging; the vein is small but very clean cut and well defined, and the values are decidedly good. If with further development

* Probably means ratio of concentration is 100 lb., reduces to 62 lb., or about 5 to 3.

the vein holds up to present indications, then there is no reason why the property should not pay nicely.

SKEENA MOUNTAIN.

Skeena mountain is an isolated mountain mass lying ten miles to the south of Skeena Crossing and on the south side of the Kitsequekla river. It is reached by a trail which is hardly good enough to take pack-horses over. A number of claims have been staked there by B. R. Jones, J. K. Jameson, and J. S. Bagg, but very little development-work has been done.

The long deep canyon which is occupied by the Kitsequekla river divides the Rocher Déboulé Mountain range from another group of mountains to which no particular name has yet been applied. This group of mountains includes the rugged and picturesque group of high peaks known as the Seven Sisters, which lie to the south-east of Miniskinisht, an Indian village on the Grand Trunk Pacific Railway. Skeena mountain is also part of this large group and lies behind the Seven Sisters. These mountains are placed by McConnell as "in the Interior region, although they are not separated from the Coast Range mountains by any marked depression." They merge indefinitely into the long spur of the Coast range which lies to the east of the Kitsumgallum valley, and hence form a connecting phase of mountain-building action between the Coast range and the Interior mountains.

No exact definition of the term "Interior mountains" can be given as yet, as the physiography of this section of British Columbia has never been worked out in any detail. A very considerable amount of work has been done by different officers of the Geological Survey in the territory from Prince Rupert and Telkwa, but this work has not yet been gathered together, correlated, and linked up.

Pole Pick Group.

This group consists of the *Pole Pick*, *Extension*, *Valley View*, *Friendship*, and *Outlet* claims, and is owned by Jones, Jameson, and Jardine. The showings are at an elevation of 5,200 to 5,400 feet, well above timber-line. The main showing is a small vein of arsenical iron from 2 inches to 1 foot wide, exposed in a small open-cut. This vein has an east-and-west strike and dips to the south at 40 degrees. Where seen the vein is in granodiorite rock, but a contact between the granodiorite and quartzites is close by. The contact is irregular and bunches of granodiorite are exposed breaking through the quartzites in many places. The vein may not continue to lie in granodiorite throughout its whole length, but may pass into quartzite or lie in the contact between the two rocks.

The main sulphide mineral present is arsenopyrite, but a little pyrite and chalcopyrite were also seen. A sample across 10 inches was taken at the best-looking place in the vein and assayed, with the following results: Gold, 0.2 oz.; silver, 9 oz.; copper, 4.4 per cent. Another selected sample of nearly solid arsenopyrite returned: Gold, 0.78 oz.; silver, 0.6 oz.; copper, *nil*. This latter assay is interesting in that it shows that the arsenical iron carries very fair gold values. It is, of course, evident that such a small vein with comparatively low values is not of much importance other than as an indicator. The vein is as yet undeveloped, but somewhere it might contain an ore-shoot of commercial value, or it can be taken as an indication that this locality has been to some extent mineralized, and other more promising veins may be found. The writer would advise the owners to systematically prospect the surface of their claims rather than to undertake any development of this small vein.

On the *Extension* claim there is a large "blow-out" of quartz which does not appear to be in the form of a vein. It may not be true quartz, although it appears to be so; the exact nature of its occurrence was not determined by the writer. It shows some very small streaks of arsenical iron and in places a little flourite. It is probable that this occurrence is in the nature of an extremely acid dyke connected with the intrusions of granitoid rock. Samples taken and assayed show that this "quartz" carries no appreciable percentages of the precious metals.

Helen Group.

This group, consisting of the *Helen*, *North Star No. 1*, and *North Star No. 2* claims, lies a mile or more to the north-west of the other claims. The showing is on the *North Star No. 1* claim and at an elevation of 5,550 feet; Jones & Jameson are again the owners.

There are two nearly parallel veins striking east and west (mag.) and dipping at 60 to 75 degrees to the south (out of the hill), on which but little work has been done. Apparently

these veins also occur in granodiorite rock and are only a short distance apart. They both represent fissured zones in the granodiorite rock in which the crushed rock has been in part replaced by minerals. Both veins are considerably leached out and oxidized on the surface; the outcrops consist of soft gangue rock and limonite and small amounts of pyrite and chalcopyrite. The upper vein has a width of 3 to 4 feet and the lower one about 2 feet, but neither are exposed for any great distance.

A sample of sulphide mineral, which had to be carefully selected as there is very little of it, assayed: Gold, trace; silver, 15.6 oz.; copper, 14.5 per cent. The showings warrant a little further exploration to determine the size and character of these veins.

Prospecting in this vicinity was being carried out by J. S. Bagg, but at the time of visiting the camp in July he had made no important discoveries.

HAZELTON.

The town of Hazelton and its younger sister, New Hazelton, are in about the same condition as they were in 1914. During the summer of 1916 a mild form of a mining boom was in evidence, but it was of a healthy kind and not the "wild-cat" type.

Several mining camps are tributary to either or both of these towns. Those camps are Rocher Déboulé, Glen, Nine-mile, and Four-mile mountains. As yet, however, none of these camps has reached a sufficiently productive stage, which would entail the employment of large numbers of men, to provide support for a good-sized town. With the growth of mining in the district, however, and the increase in agricultural production which will gradually take place, both towns expect to prosper and hope to gradually increase in size.

The greatest activity in the district was on Rocher Déboulé mountain, where a number of properties were acquired under options during the year, and on several of these work was commenced.

ROCHER DÉBOULÉ CAMP.

The name "Rocher Déboulé camp" may be restricted to mean that piece of country surrounding the head of Juniper creek and its small tributary, Balsam creek. It includes the *Rocher Déboulé* mine, *Great Ohio*, *Highland Boy*, *Delta*, and *Red Rose* group, besides many less-well-known claims. The *Hazelton View* group and other claims controlled by the New Hazelton Gold-Cobalt Company are situated a short distance over the ridge of Rocher Déboulé mountain from the mine of the same name, but they are reached by means of a trail starting at Carnaby, on the Skeena River side of the mountain.

Rocher Deboule.

This mine still continues to hold its place as the most important mine in the Omineca Mining Division. It was worked steadily during 1916, and while a considerable tonnage of ore was shipped, at the same time development-work was pushed ahead. The lease under which the Montana Continental Development Company commenced to work the mine in August, 1913, ran out in February, 1916, and since that time the operation has been in the hands of the original company—the Rocher Déboulé Mining Company. During the tenure of its lease the Montana Company developed the mine from a prospect; equipped it with a hydro-electric plant, compressor, surface and aerial tramways, and much incidental machinery, ore-bins, buildings, etc.; and shipped ore to the value of about $700,000.

When the location of the property is considered, its high elevation (4,000 to 6,000 feet) with workings above timber-line, the long severe winter weather to be contended with, and the usual difficulties of opening up a mine in a new camp and a new country, this record, attained in thirty months, stands as a testimonial to the ability, energy, hard work, and initiative of the manager, D. J. Williams.

The change of control from the leasing company back to the owning company is more apparent than real, as the leasing company was largely made up of the majority stockholders of the owning company. No change in management was made, and the only change in policy is that more attention is now being paid to development.

As might be expected, the leasing company, after developing to a certain point, then turned to ore-extraction almost exclusively. The result was that at the end of the lease the mine was practically exhausted from the 300-foot level to the surface, and extensive development was the first requirement for the mine.

In his 1914 report on the Omineca Mining Division the writer described the *Rocher Déboulé* mine in some detail, so that no repetition of the early development will be given here.* At that time the 300-foot crosscut tunnel was being driven and was in 300 feet. This crosscut struck the vein at a point 670 feet from the portal, and an additional 70 feet was driven on into the hanging-wall in order to make sure that the main vein had been encountered.

The vein was not mineralized to any extent where it was first struck, but drifting to the east on the vein soon revealed a good pay-shoot of ore. This drift was run for some distance to the east and four distinct ore-shoots were found, the first being 80 feet long and the second 160 feet; the lengths of the other two were not noted, but they were in the neighbourhood of 100 feet. These first two shoots were stoped out right to the surface and the others nearly to the surface. The average width of ore is not known to the writer, but it fluctuated from 1 to 8 feet. The sulphide minerals in these pay-shoots are chalcopyrite and pyrite, and very occasionally a little tetrahedrite (grey-copper). Along the hanging-wall of the vein there is, as a rule, from a few inches to 1 foot of crushed broken granite which in mining cannot be kept from falling into the ore, and therefore lowers the grade of the ore. This, of course, only occurs where the pay-shoot is developed, against the hanging-wall. The pay-shoot may be found on either wall, and sometimes it splits into a shoot on each wall, separated by a band of waste rock of varying width. The ore-shoots, as a rule, cut off abruptly and low-grade ore carrying disseminated chalcopyrite is not of frequent occurrence. The values are mainly in copper, together with small gold and silver values. The production for 1915 was 17,000 tons, averaging about $1.65 in gold and silver to the ton and 8 per cent. copper. When it is considered that, mining in this way and shipping without hand-sorting, a large amount of waste-rock necessarily is included in the ore, it is evident that the clean shoots of ore carry a high pecentage of chalcopyrite. The production for 1916 was 16,800 tons, containing 1,200 oz. gold, 16,700 oz. silver, and 1,619,145 lb. copper (recovered copper).

When the Montana Company's lease expired in February the mine was in this condition, and a comprehensive plan of development was immediately commenced by Manager Williams. In order to keep up ore production underhand stoping was continued from the 300-foot level downwards, this work being confined to the most easterly ore-shoot. In order to develop the ore-shoots to a greater depth a winze was sunk from the 300-foot level. This was sunk at a point 500 feet from the crosscut tunnel and between the second and third ore-shoots; in this way the winze was about in the centre of the known ore areas. A crosscut from the drift was first driven into the foot-wall for a distance of 75 feet; a station was then cut out for hoist, ore-bins, etc., and the winze proper is 35 feet from the main drift. It is 200 feet deep on a 60-degree pitch. From the bottom of the winze a crosscut 62 feet in length was driven to intersect the vein. Drifting was commenced on the vein in both directions, and on July 10th (time of visiting the property) the east drift was in 234 feet and the west drift 254 feet. The shaft (winze) is fitted up in good shape with a compressed-air hoist, automatic skip, made at the mine, ore-bins, etc., and is capable of handling a large tonnage of ore and waste.

The drifting on the 500-foot level from the bottom of the winze had failed to reveal any large ore-shoots up to the time of examining the property, but later information is that good ore has been found on this level. There is little doubt but that the shoots of ore found on the 300-foot level will have a downward continuation somewhere; by this it is meant that, though these shoots may end abruptly, other shoots will be found not far distant.

The ore when taken out is hoisted up the winze and run out the 300-foot crosscut tunnel and dumped into ore-bins. From these bins it is taken in a surface tramway about 3,000 feet to ore-bins situated at the top of the mountain and facing the Carnaby side. From here an aerial tramway in two independently operated sections takes the ore down to ore-bins at Tramville, the company's station on the Grand Trunk Pacific Railway. Tramville is one mile and an eighth from Carnaby, the official Grand Trunk Pacific station. As there is nothing at Carnaby, the Rocher Déboulé Company has made many efforts to get the railway company to recognize Tramville as a station, but without avail. The case has been before the Railway Commission once or twice, and this Board has ordered the railway company to make some concessions to the Rocher Déboulé Company. There is no doubt in the mind of any impartial observer that the station should be where the business is—viz., at Tramville—and not at Carnaby.

* Annual Report of the Minister of Mines, 1914, page 185.

The 300-foot level tunnel from which the main vein is worked is situated about 900 feet above Juniper creek. The compressor, camp buildings, etc., are all situated down in the Juniper Creek valley (gulch). The mine is therefore worked from the Juniper Creek side of the mountain, but owing to the configuration of Rocher Déboulé mountain it was found possible to run the ore around to a low part of the summit of the mountain and down by tramway to the railway on the Skeena River side of Rocher Déboulé mountain. This topographic feature of the mountain was a fortunate thing which was fully taken advantage of, as it would have been a good deal more difficult to have taken the ore down to the railway via Juniper creek.

Between Juniper creek and the main vein there are two other veins roughly parallel to the upper one. The work done on them was described in the 1914 report, and since then no further development has been done. In order to prospect all three veins at depth a crosscut tunnel has been started at a point a short distance above the compressor. It is about 800 feet below the 300-foot level tunnel and will have to be driven half a mile or more to intersect the upper vein. The lowest vein on the hill should be encountered in a distance of 1,100 to 1,200 feet. From the surface showings and small amount of work done on the two lower veins it seems reasonable to suppose that development may reveal some good ore-shoots. Eventually, if all three veins develop as expected, some sort of concentration scheme will have to be devised. This is particularly true for the two lower veins, as the surface indications are that if ore-shoots are found in them they will consist in part at least of disseminated ore which would require concentration before shipping.

A short description of the probable origin of the ore-bodies was given in the 1914 report, and the writer sees no reason to change the general statement then made, but a more full account can now be given. As there are so many veins in the Rocher Déboulé mountains that are similar to the *Rocher Déboulé* mine veins, a thorough study of the latter would no doubt be of considerable economic value to the district. The writer regrets that he was unable to spend more than one day on the property during last season, but as much as possible was ascertained in that time.

In going in the 300-foot crosscut tunnel, which is 700 feet long, a good section of the granodiorite formation, in which the veins occur, can be seen. In places the rock is very acid, consisting almost entirely of quartz and feldspar, with little or no hornblende present; another phase consists of zones or bands of dark material which is nearly altogether hornblende. These extreme phases pass gradually and sometimes sharply into normal granodiorite and rock which is normal diorite or quartz diorite. The basic and acidic zones do not represent true intrusive dykes, although in places they look very much like this, but were probably formed by the segregation of bands of mineral during the cooling stages of the granodiorite magma.

The main vein has been said to be a replacement ore-body formed in a hornblendic dyke; but the writer considers that the postulated "hornblendic dyke" is one of the segregation bands of hornblende and not a true dyke. The vein follows this hornblendic band fairly closely, but in some parts it is in normal granodiorite.

It would appear as if the fractured zone, produced by differential shearing, in which the ore has been formed had to some extent followed a hornblendic band, or, in other words, this basic zone of rock formed a line of weakness, so that when differential stresses were set up in the granodiorite, fracturing and shearing took place in this zone. This fractured zone roughly follows the hornblendic rock, but not entirely. There would appear to have been two main fractures varying from 1 to 12 feet apart, with a fractured zone between which varies from gouge-matter to normal granodiorite.

The fractures, seams, and possibly open fissures in this sheared zone allowed the circulation of mineral-laden solutions which formed the ore-body. The actions which took place were a partial replacement of the rock-matter of the sheared zone by mineral sulphide and an alteration of the mineralogical composition of the rock-matter—a metasomatic process. In places there may have been definite open fissures which were filled with sulphides and quartz which had precipitated and crystalled out from the mineral-bearing solutions. As has been before noted, the ore occurs in very definite ore-shoots, and it may be that these shoots were formed in places where the rock was very thoroughly fractured and brecciated, or possibly these ore-shoots were formed in zones where there were many small open fissures which allowed a thorough circulation of the ore-bearing solutions. When the ore-shoots cut-off, as they do often very abruptly, the vein consists for the most part of nearly normal granodiorite with

seams on either wall, with but slight evidence of fracturing in the vein-matter. All stages between normal granodiorite, partially altered and mineralized granitic rock to solid bands of chalcopyrite lying between the main walls of the vein, can be seen in different parts of the mine.

The hanging-wall is nearly always well defined with a considerable development of kaolinized gouge-matter and crushed granodiorite against the wall, but the foot-wall is often very indefinite. Ore-shoots more often follow the hanging-wall than the foot, but in places there is a shoot on both walls separated by a few feet of barren, partially silicified and altered granodiorite.

The vein is not quite a simple vein—that is, a definite fracture-zone confined between two walls of varying width—but in places it splits up or sends off subsidiary branching fractures distinct from the main fracture which continues. Apparently the hanging-wall represents the direction of the main fracturing force, but the foot-wall, while approximately parallel to the hanging-wall, is less definite, and in places consists of several fractures in different directions.

Highland Boy Group.

This group was described by the writer in his 1914 report.* That report, although brief, covers the main facts, and but little further need be said here. In addition to the veins described in the earlier report, there is another one outcropping on the *Iowa* side of the mountain, which may prove to be a continuation of one of the others. It has not been developed to any extent. Between 1914 and July, 1916, practically no development-work had been done on the property.

A Spokane syndicate secured an option on the group about the end of 1914, but did not commence work immediately. Later a dispute arose as to the terms of the agreement and the case was taken to the Courts. Finally, the property reverted to the original owners, and in the fall of 1916 was acquired under option by the Delta Copper Company; a report on the operations of this company follows.

Delta Copper Co.

The Delta Copper Company, an Edmonton syndicate under the general supervision of Harrison Clement, last year secured control of the *Delta* and *Chicago* groups and some other claims on Rocher Déboulé mountain. Later an option on the *Highland Boy* group was obtained and work was actively carried on during the winter of 1916-17. Some of the claims adjoin the *Rocher Déboulé* mine, and the property is reached by an extension of the wagon-road from Skeena Crossing to that mine.

Through the courtesy of Mr. Clement, the writer has been favoured with a copy of a report on the holdings of the company by W. G. Norrie, M.E., with permission to use it for publication. The following quotations from Mr. Norrie's report give considerable information about the property. In addition to these excerpts, the report outlines the possibilities for transporting the ore, and points out how the *Rocher Déboulé* tramway could be utilized for taking the ore to the railway, provided arrangements were effected with that company. Other sections of the report deal with the question of power, detail descriptions of the workings, working costs, etc.

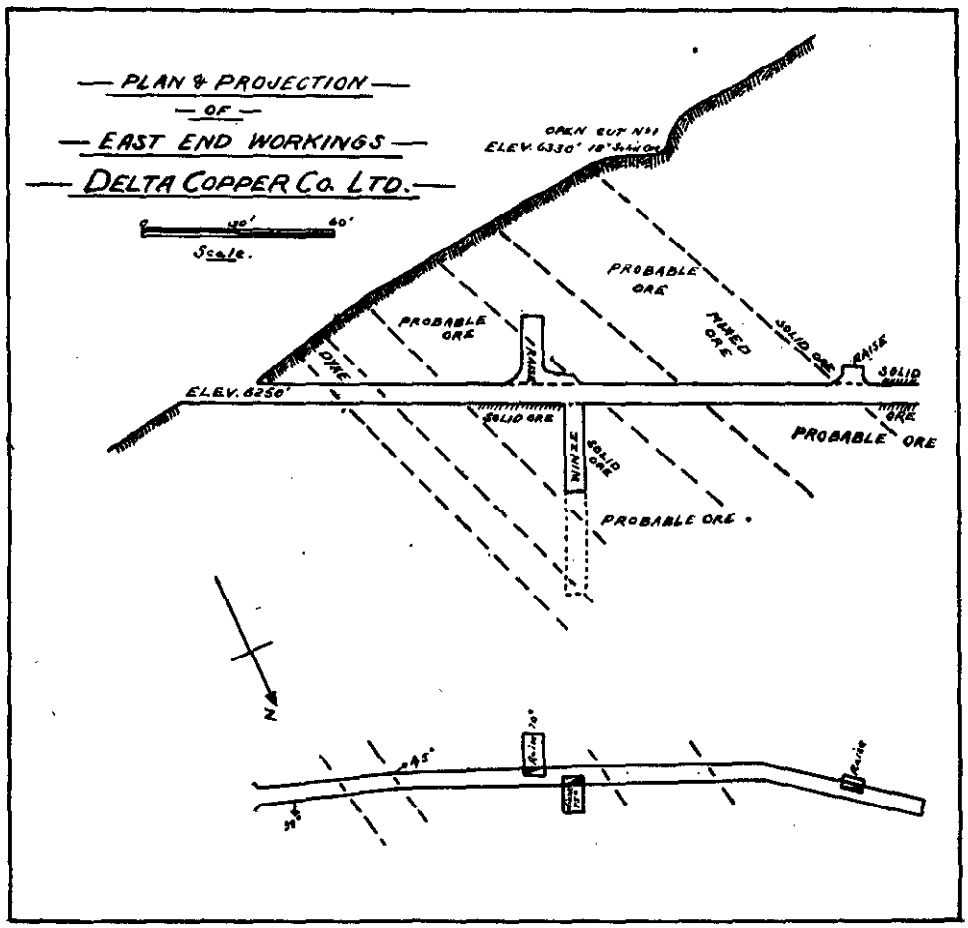
"*Holdings.*—A total of twenty-five claims and five fractional claims are comprised in the property, the status of ownership being that sixteen are held under clear title, with five ready to Crown-grant; six under long-term option, with two ready to Crown-grant; and eight—namely, the *Highland Boy* group—under option to control, all of these latter claims being ready for Crown-granting.

"*Transportation and Equipment.*—During the earlier stages of the development of the property all ores extracted will most probably be hauled down by road to Skeena Crossing. It will therefore be necessary to sack the ore. To get the ore down from the east side workings a 2-bucket tram is now being installed which will deliver the ore from the tunnel to the point of hauling, a distance of about 2,000 feet; from that point to the end of the wagon-road there is a distance of three-quarters of a mile over which there is a good snow-road at present.

"On the west or *Delta* side of the property there is in the course of construction an inclined surface tram from the *Delta* tunnel to the camp. This will be about 2,000 feet long and the difference in elevation between the terminals will be about 1,000 feet. It is proposed to use a 15-horse-power gasolene-hoist, located at the foot of the incline, for power purposes for this tram. This tramway will be used for the hoisting of men and supplies to the tunnel, and for letting ore down whenever it is encountered in the course of the development-work. The lower terminal of the tram is on the Skeena wagon-road and is within 800 feet of the portal of the lowest tunnel on the *Rocher Déboulé* mine, so that a connection can very easily be made with the latter at

* Annual Report of the Minister of Mines, 1914, page 189.

any time. It should also be mentioned that the *Delta* tunnel is about 3,500 feet distant from the upper workings of the adjoining property, and approximately the same distance, though at a higher elevation, than the lowest tunnel, so that a 2-bucket tramway could very easily be put in to connect either of the points mentioned.



"Present equipment consists of a combined power-house, hoist-room, and blacksmith-shop, two bunk-houses and boarding-house sufficient for the accommodation of fifty men, office, warehouse, and stable for eight horses.

"Machinery being installed will include a 65-horse-power distillate engine, a 12- x 12-inch air-compressor, large enough to run four or five drills, mechanical steel-sharpener, machine-drills, etc. The cost of all this equipment, together with its erection, and the cost of trails, etc., and all work of a preliminary nature, will not exceed $20,000.

"With this plant installed you will be able to do all the development-work necessary for the thorough exploitation of the veins on the *Highland Boy* and *Delta* groups; in addition, should you discover ore in the course of this development-work, you will have no difficulty in handling a sufficiently large tonnage to enable the property to become self-supporting.

"For future operations on a large scale it will be necessary to extend your plant gradually as the circumstances dictate, so that a discussion of this matter now is somewhat premature; however, it may be of service to very briefly outline a few of the alternative plans which have been suggested.

"First, in reference to power, Harrison Clement, your manager, states that he has secured for you the rights of 10 cubic feet per second at a head of 650 feet on Mission creek, which is

on the north side of the mountain; with this head and quantity available, it will be possible to develop 750 horse-power, which will probably be ample for all your requirements the year round. . . .

"*Geology.*—The country-rock in the section of claims examined is a granodiorite, and, generally speaking, has a massive and crystalline structure. Several dykes of a basic character were observed on the eastern workings, and also in the workings of the adjoining property. These dykes are apparently of earlier origin than the veins, as the latter cut through them, and, as the ore so far encountered on the east tunnel has been found adjacent to and following these dykes, there is every possibility that they have had considerable influence in the formation of the ore-bodies. It would therefore appear to be of interest and importance for you to study the nature and occurrence of these dykes, as they may supply valuable information for the location of valuable ore-shoots.

"It was not possible for the writer to go over all the claims on the property on account of the covering of snow, but during an examination of the *Highland Boy* group made in the fall of 1915 it was possible to examine the two veins outcropping on this property very thoroughly, and, as the principal development of the property generally is likely to be confined to these two veins for some time to come, it is only necessary to consider them for the present. Nevertheless, Mr. Clement states that he has been over six other veins on the outlying groups, and while none of them have had much work performed on them, in several instances he has obtained some very promising assays, so that these veins, while they have no immediate importance, must be reckoned as possible assets for the future.

"These two veins on the *Highland Boy* group are very strong and well defined, and give every promise of continuity; their outcrops can be traced quite continuously from the eastern to the western boundaries of the property. They are known respectively as the upper and lower veins. Most of the work so far performed has been confined to the upper vein (which has also been referred to as the *Highland Boy* vein), which has been opened up by means of a tunnel and open-cuts for a distance along the strike of approximately 3,500 feet. This vein outcrops on the *Delta Fraction* claim, and is prominently exposed in a depression between two peaks at an elevation of 6,300 feet. From this point westerly for a distance of about 1,000 feet it is covered with slide-rock, but again outcrops towards the west on the *Rocher Déboulé* ground. The outcrop referred to shows a vein about 5 feet wide, carrying magnetite and chalcopyrite, with considerable decomposition and displacement of the rocks, due to weathering action; for this reason it was impossible to obtain a sample or to gauge the extent of the ore. A tunnel has been started on this ground at an elevation of 5,900 feet, and after it intersects the vein, at a distance of 125 feet from the portal, about 450 feet of drifting will bring it under the showing of ore referred to. This tunnel has been referred to in this report as the *Delta* tunnel, or west working. From this point towards the east boundary of the *Highland Boy* group the open-cuts on the vein, which are very nearly on the same elevation, show a strong fissure with prominent foot and hanging walls, and widths varying from 3 feet up to 15 feet. The vein-filling, generally speaking, as exposed in these cuts, is principally decomposed, strongly oxidized material, showing some magnetite and copper and iron sulphides; in no case were the cuts at a sufficient depth to get below the zone of oxidation, which on account of the exposed nature of the hillside and the elevation may be of some depth.

"These cuts show such strongly mineralized material that undoubtedly some ore will be found below them, though it is impossible to state the probable grade of this ore from surface indications only.

"About midway between cut No. 3 and the portal of the tunnel on the east end, at an elevation of 6,450 feet, an open-cut, known as the Munroe cut, exposes the vein over a width of 5 feet 6 inches, of which 18 inches in the centre of the vein is solid chalcopyrite, or nearly so, as decomposition here was also quite pronounced, and it was difficult to judge exactly as to the ore occurrence; it is quite probable that there is actually more ore than that stated. In cut No. 2, about 150 feet west of the tunnel portal, the elevation has decreased sufficiently to expose the more solid material, and in this case I found the vein to be 4 feet wide, with 18 inches of high-grade ore on the hanging-wall, the balance, on the foot-wall side, being lower-grade ore. It may be mentioned here that the tunnel has now been extended beyond this cut, and is at present following on ore of the same width and character as that shown on the surface.

"The lower or *Rocher Déboulé* vein has not been as extensively prospected as the upper vein, but like the latter has been very clearly defined by nature on the surface, and the writer has traced it almost continuously across the *Rocher Déboulé* and *Highland Boy* ground until it becomes buried in slide-rock below a tunnel on the *Waterfall* claim, a distance of over a mile. The tunnel on this vein, on the *Waterfall* claim, follows the vein for a distance of 40 feet, and shows it to vary in width from 18 inches up to 3 feet in that distance. A sample taken over a width of 20 inches by J. D. Galloway, Assistant Provincial Mineralogist, during his official examination in 1914, is stated in the bulletin of that year to have the following assay: Gold, trace; silver, 0.5 oz. per ton; copper, 1.5 per cent. Following this vein in a westerly direction, a short tunnel has been driven at an elevation of 6,050 feet, which has penetrated beyond the oxidized material for a distance of 12 feet, and has exposed the vein over a width of 4 feet, with 2 feet of low-grade ore, which looks rather promising for the formation of a higher-grade ore-shoot. From this point towards the west no further work has been done on the vein, except at one place where the vein crosses the *Zigzag Fraction* and the *Highland Boy* claim; here open-cutting and stripping has exposed the vein on both sides of a draw for a length of 100 feet and a width of 8 feet. Of this width, 2 feet 7 inches on the hanging-wall side is magnetite impregnated with chalcopyrite, assaying (sample B): Gold, 0.01; silver, trace; copper, 1.10 per cent. The remaining 5 feet 5 inches of vein consists of decomposed material very similar to that observed along the upper vein; this assays (sample A): Gold, 0.01; silver, 0.40; copper, 0.14 per cent. The copper and gold and silver values here are certainly significant, and there is certainly every prospect of obtaining ore below this showing. This vein is known as the upper vein on the *Rocher Déboulé* mine, and it has been the principal producer of ore on that territory. It has a strike of N. 80° W. and a dip of about 70 degrees towards the north, though this is very variable over the extent of the vein. The section of this vein crossing the *Iowa* and *Coral Queen* claims is dipping into your *Delta Fraction*, *Balmoral Frac.*, and the *Lucky Jack* claim, and the claims north of these, and it will undoubtedly be encountered in depth on these claims.

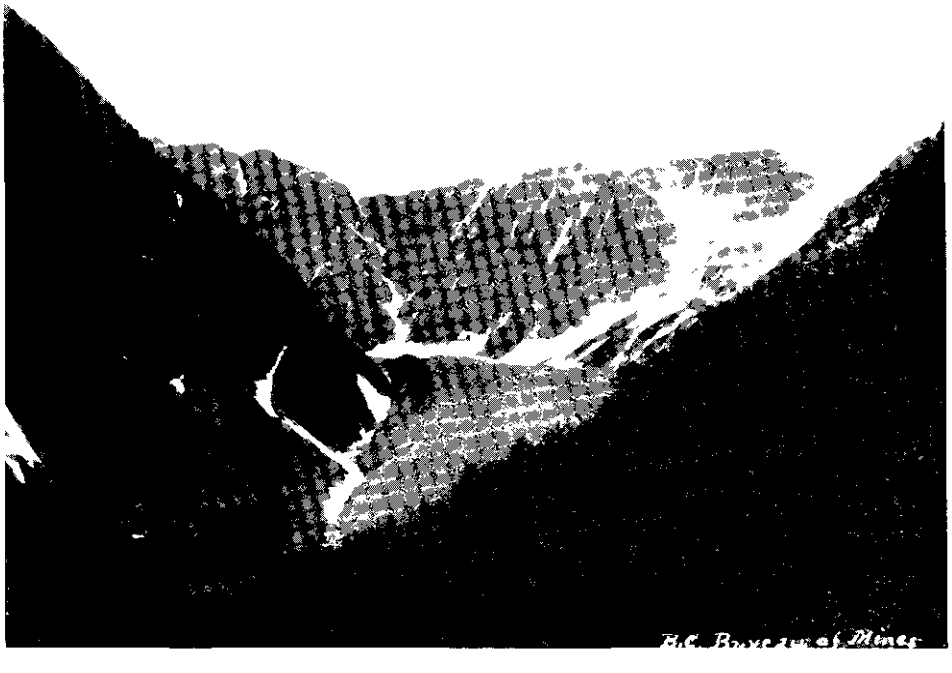
"The two veins above referred to are certainly very well defined on the surface, and there should be no question of their occurrence at depth. The gangue, as evidenced by the east tunnel work and that on the *Rocher Déboulé*, is composed principally of hornblende, iron pyrite, and quartz. The veins have evidently been formed by ascending solutions carrying metallic sulphides and siliceous material, which have in part replaced the original rock included between the two main fractures now constituting the foot and hanging walls; the veins may therefore be referred to as of the replacement-fissure type, though the presence of magnetite in several places indicates that there has been some metamorphic action as well.

"A favourable characteristic noted in connection with these veins, principally on the adjoining property and on your east workings, is that as a rule the ore is confined to solid high-grade shoots along one of the walls, generally the hanging, and that when these end there is not much dissemination along the length of the vein. Of course, there is a certain amount of lower-grade material accompanying the higher grade, generally on the foot-wall side, and this material will be a valuable asset to you in the future for milling purposes.

"*Conclusion.*—You have for the present decided to concentrate all your energies towards the development of the *Highland Boy* group of claims on the property and the *Delta* group. In my opinion this is certainly the best policy to pursue, for the reason that, while the veins are very strong and well defined, and likely to continue to great depths, their situation has resulted in such a considerable amount of oxidization along the surface outcrops that it is impossible to estimate their economic importance from these alone, and recourse must necessarily be had to underground development at a moderate depth below the surface.

"Under the circumstances in which you are placed in regard to the situation of your holdings, the upper vein was the only one conveniently accessible to attack, without the necessity of considerable dead-work in the way of crosscut tunnelling. But, apart from this consideration, the upper vein is the best to develop first in any case, as you have actually opened up two workable bodies of ore on the east workings, and the results of your exploration in depth have so far indicated a considerable improvement in the ore-body. It is entirely reasonable to assume that you will discover other bodies of commercial ore during the course of your drifting from the west end towards the east, but, even if you should not, the work will probably be justified in any case if it only is successful in opening up the eastern ore-bodies in depth.

Looking down to Skeena River from Red Rose Basin.



Basin at Head of Knauss Creek.

"The plant you are now installing will be of sufficient size to develop the property to the producing stage, or until shipments have reached the point where all future extensions and plant can be paid for out of ore receipts. When that happens, it will then be possible for you to turn your attention towards the development of some of the other veins on the property. Particularly, I would call your attention to the lower vein, which has as good a chance of producing ore on your property as it has done on the *Rocher Déboulé* mine.

"The plan of your manager, Harrison Clement, to endeavour to make the receipts from shipments from the east end workings pay for the development from the west end is commendable, and in my opinion there should be no difficulty in doing this. I have shown that you have approximately 1,500 tons of high-grade ore, which, while not technically 'in sight,' is nevertheless reasonably assured, and the surface indications on the east end indicate that this is only a small proportion of the ore you will ultimately develop. But the 1,500 tons you have will net you, at present prices of copper, about $38,250, and with this amount of money you can certainly explore a large section of ground from the west end. I would, however, strongly recommend you, in spite of what possible ore receipts may net you, to provide a sufficiently large reserve fund to ensure continuous operation, so that the plan of development now under way may be carried through to a successful conclusion. For this purpose you should have at least $50,000, which amount may not necessarily be used, but it should be available at all times for your management.

"Finally, I may state that, while this property has passed only slightly beyond the prospect stage, it possesses considerable possibilities, and as such I regard it as a very attractive speculation."

Great Ohio.

This property, owned by Jennings, Trimble, *et al.*, was described in the 1914 report by the writer and was not visited in 1916. The main working two years ago was a drift-tunnel about 350 feet long which followed a small stringer. The work during the last two years has been to explore, by means of a crosscut from this drift, the main vein which outcrops on the surface and which is roughly parallel in strike with the stringer in the drift-tunnel.

The crosscut from the end of the drift-tunnel was run 189 feet, where a small vein was encountered, and this was drifted on for 127 feet. As it was evident that this small vein was not the main vein outcropping on the surface, the crosscut was continued for some distance until the main vein was finally struck. The vein was then drifted on in an easterly direction (into the mountain) for a distance of 260 feet, and drifting is being continued. As yet no commercial-sized ore-shoot has been found, but small lenses and bunches of good ore have been run into from time to time, sufficient to encourage the owners to keep on. From the surface showings it would seem probable that somewhere in the vein commercial ore-shoots might be found.

Red Rose Group.

This group of claims was also examined and reported on by the writer in the 1914 report, where details of the first work done are given. In the fall of 1914 the *Red Rose* group was acquired under option by a development syndicate, which commenced operations at once with T. J. Vaughan-Rhys in charge. Since that time changes have occurred in ownership, but the exact details are not known to the writer. The property is now under the control of the Skeena Development Company, but it is understood that it is still only held by option or lease and bond, subject to further money payments to Peterson & Elk, the original owners who staked the claims.

The prospect-tunnel described in the previous report as being 30 feet long has been extended to a length of 125 feet. Nearly 500 feet below this and at some distance to the south a crosscut tunnel was started to tap the vein. This was driven 450 feet without striking anything; it is entirely in quartzite.

At the time of visiting the property in 1916 (July 11th) John McIsaac was in charge, and was at work himself together with one man. A larger force was expected to be employed in a short time.

The formation at this point consists of quartzites and argillites of the Hazelton formation, which are intruded by small bosses and dykes of diorite and granodiorite belonging to the granitic batholithic rocks known as the Bulkley eruptives.

The main showing on the property is a vein which occurs in places in the contact between the sediments and the granodiorite, and in other places is entirely within one or other of the rocks. In the 1914 report it was stated that the vein as disclosed in the prospect-tunnel lay

in granodiorite, but it is now apparent that the tunnel swings away from the granitic rocks and is entirely in quartzite. The whole rock of the tunnel is much decomposed and is soft, friable, and of a reddish colour from the presence throughout of iron oxide. This material carries some gold values, but is evidently too much leached out to contain much copper mineral. Near the mouth of the tunnel and on the surface there is a good development of copper minerals on the granodiorite foot-wall, but the tunnel by swinging away from the foot-wall affords no information about this ore. A crosscut from the face of the tunnel back to the foot-wall might be useful development-work.

The vein was then ground-sluiced and exposed down the hill for 200 feet. Here it shows as a band of iron oxide, 2 feet wide, and in contact with diorite rock. Fifty feet below and nearly on the line of continuation of the vein a tunnel was started and was in 20 feet in slide-rock. This was expected to strike the vein in a short distance and then would be continued as a drift-tunnel. The crosscut tunnel, which was driven 450 feet, is 250 feet below this present working and would strike the vein 150 feet farther to the east. Also if the vein was vertical, or nearly so, the crosscut would have to be 200 or 300 feet longer to strike the vein. It will be seen, then, that this crosscut was a "long shot," and hence cannot be considered as being very definite work in proving or disproving the property.

Another tunnel, known as the intermediate and 40 feet long, lies just to the north of the present tunnel now being driven. It shows a contact between quartzite and granodiorite and slight mineralization. The extreme irregularity of the different contacts between the quartzite and granodiorite make it difficult to follow them on the surface, but there seems little doubt that mineralization is most pronounced near these contacts. The word "vein" perhaps inadequately describes the ore-body on this property, as it is possibly not a true vein, but is more of the nature of a contact ore-body.

It must be admitted that the actual amount of ore disclosed by the money spent in development is disappointing, but it is also certain that the property is not yet thoroughly tested.

New Hazelton Gold-Cobalt Mines, Ltd.

The claims owned by this company comprise the *Hazelton View* group and the *Victoria* group (eight claims in all), situated on the west side of Rocher Déboulé mountain, and at an elevation of from 4,000 to 6,300 feet. The property is reached by means of the old *Rocher Déboulé* mine trail from Carnaby, on the Grand Trunk Pacific Railway. This trail is followed for some distance up the mountain to an elevation of 4,000 feet, where a branch trail half a mile long is taken to the camp of the Gold-Cobalt Company, this being at an elevation of 4,150 feet. At the time the property was examined—July 13th—the company had not commenced development-work on the property, but during the last month had built three good cabins, and was just finishing a trail up the mountain-side to a point on the vein where it was intended that the driving of a drift-tunnel would be immediately commenced. Eight men were employed under the superintendence of Duke Harris.

There are two veins on the property, but only one is sufficiently developed to be considered at the present time. The formation of the mountain in this section is mainly granodiorite, but some areas of the Hazelton quartzite also occur, generally some distance below the top of the ridge. The vein which is to be worked lies entirely within the granodiorite. Attempts have been made by means of surface cuts, which, however, are not conclusive, to trace this vein down the hill towards the camp and into a quartzite area, but these have not been successful. The vein is a well-defined fissure, varying from 1 to 3 feet wide, and striking N. 50° E., with a north-westerly dip of 60 degrees. The lowest point at which the vein is exposed is in an 18-foot tunnel at an elevation of 5,400 feet; from this working the vein can be traced at intervals to the top of the ridge at an elevation of 6,300 feet (this ridge is a long north-westerly spur running out from the main Rocher Déboulé Mountain mass). Beyond the top of the ridge—i.e., down the other side—the vein has been traced for a short distance. The mountain-side up which the vein is exposed has a slope of approximately 45 degrees, and therefore a drift-tunnel would gain a foot in depth for each foot driven. It was proposed to drive ahead on the present prospect-tunnel; it would therefore require a 900-foot tunnel to get under the top of the ridge and would give nearly a corresponding depth.

The vein-filling consists of altered granite, hornblende, chloritic material, and some quartz, and the ore-minerals are arsenical iron and pyrrhotite and occasional flakes of molybdenite. Cobalt bloom is of frequent occurrence in the oxidized portions of the vein-filling, and it is

evident from the assays which are tabulated below that cobalt is contained, in percentages up to 3.4 per cent., in the sulphides. This cobalt occurring in the sulphide cannot be distinguished by the eye, but it seems probable that it occurs in the arsenopyrite, isomorphously replacing some of the iron. Such a combination of arsenical iron carrying cobalt in appreciable percentages—from 4 to 10 per cent.—has sometimes had the distinguishing name of danaite applied to it. As is customary 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.

In the tunnel the vein is about 18 inches wide and shows on the hanging-wall 4 to 6 inches of sulphide mineral, while the balance is mainly hornblende. Sample No. 17 was taken across 8 inches of the most mineralized portion of the vein in this working.

From this tunnel going on up the hill the vein is for the most part covered with slide-rock and snow to an elevation of 6,250 feet, but Mr. Harris says that he has uncovered the vein at intervals along this distance. Sufficient evidence in the shape of iron oxide and float could be seen to make it certain that the vein is continuous up the mountain-side. At elevation 6,250 feet a prospect-cut has been made which shows about 2 feet of oxidized vein-matter which is said to carry good gold values. Sample No. 16 was taken across 20 inches at this point.

Fifty feet vertically above and right on the top of the ridge a small cut shows the vein to be dipping at an angle of 45 degrees and having a width of 20 to 24 inches; here the vein is well mineralized with arsenical iron and is said to assay well in gold and cobalt. Cobalt bloom occurs here plentifully along the seams of the rotten rock-matter, but not on the sulphide minerals. Sample No. 15 was taken in this cut across 2 feet.

Sample No. 13 is high-grade selected ore from the vein at the top of the ridge. Sample No. 14 is rock-matter showing cobalt bloom which will show whether any gold occurs in this material or only with the sulphides.

On the other side of the ridge the vein is exposed in an open-cut 6 feet deep. The bottom of this cut had water in it, but a sample (No. 12) was taken across 2 feet 6 inches (the full width of the vein) on the side of the cut. Six inches of the vein at this point shows sulphides; the balance is decomposed and leached vein-matter.

The development-work described above was all that had been done on the property at the time of examination, so that it was then an undeveloped prospect. There is very little doubt but that the vein will be found to continue at depth and to maintain an average size of at least 2 feet.

The following list gives the assays of samples taken on the property; the sample numbers correspond to numbers previously mentioned in the text:—

Description of Sample.	Gold.	Silver.	Cobalt.
	Oz.	Oz.	Per Cent.
No. 12. Across 2 feet 6 inches in cut over the ridge, 6 inches sulphides and 2 feet rock-matter with some limonite	0.65	0.2	1.0
No. 13. Selected high-grade arsenical iron, top of ridge	3.6	0.4	3.4
No. 14. Selected material showing cobalt bloom, mostly decomposed hornblendic material	0.44	0.1	0.9
No. 15. Across 2 feet of good ore, full width of vein, top of ridge	4.0	0.2	3.0
No. 16. Across 20 inches decomposed rock-matter in cut at elevation 6,250 feet	0.32	Trace	0.7
No. 17. Across 8 inches of pay-streak in tunnel, should be good ore	0.82	0.3	1.4

These assays show that the vein carries gold values everywhere it was sampled. It is evident that most of the gold is carried in the arsenical iron and but little in the gangue-filling of the vein. Where the vein-filling carries considerable limonite, resulting from the oxidation of iron sulphide, values are better than in the straight gangue rock.

The assay results show that this prospect has some ore carrying good gold values, and the only question to be solved is the amount of ore—i.e., whether or not there are commercial-sized ore-shoots. With judicious management this property may develop into a productive mine.

Cap Group. This group was described by the writer in his 1914 report.* The property is now owned by Denis Comeau, Magnus Johnson, and Gus Norberg, and consists of the *Cap*, *Belton*, *Beatty*, and *Hermes* claims, none of which is Crown-granted. The workings consist of surface cuts, a 20-foot shaft, and a tunnel. Of these,

* Annual Report of the Minister of Mines, 1914, page 200.

only the tunnel is new work in the last two years; the other workings were described in the previously mentioned report, to which the reader is referred.

The tunnel was commenced at a point 40 feet below the collar of the shaft, and is a crosscut for 81 feet, at which point the vein was struck. A drift was then run 20 feet to the north-east, where a flat fault cuts off the vein. By drifting up the hill the continuation of the vein would probably be found. A drift was then run to the south-west for 27 feet, which brings it under the 20-foot shaft. At the time of visiting the property (July 7th) a raise was being put up from this drift to connect with the bottom of the shaft.

Throughout this working the vein consists for the most part of gangue-matter with but little ore in it, except where the south-west drift approaches, and is under the shaft. This part of the tunnel is in a small shoot of ore which is also shown at the surface and in the shaft. In the raise this shoot of ore has a width of 30 inches, and an average sample across this width assayed: Gold, trace; silver, 3.2 oz.; copper, 3.7 per cent. About 20 tons of the best ore taken out in drifting on this ore-shoot has been saved and piled on the dump. An average sample of this assayed: Gold, 0.03 oz.; silver, 10 oz.; copper, 8 per cent. A piece of solid arsenical iron was assayed to see if it carried higher values in gold than the other sulphides; this returned: Gold, 0.14 oz.; silver, 10.5 oz.

The contour of the ground is such that if the drift to the south-west were continued on the vein it would soon come out at the surface. It is evident, therefore, that this shoot of ore has not any great size above the present working-tunnel. It is, of course, quite possible that this shoot of ore extends down, and if so could be reached by a lower tunnel.

From the experience in a similar kind of vein on the *Rocher Déboulé* mine it is evident that the ore is confined to well-defined ore-shoots, and that the intervening spaces on the vein are practically barren vein-filling. Reasoning from this experience, it is likely that, while the north-east drift on the *Cap* property is in a barren zone of the vein, a further continuation of drifting might bring the drift into another ore-shoot. The fault at the end of the drift should present no serious obstacle, as it is very likely that by following the fault-plane up the hill a short distance the vein would be found again.

Daley West Group.

This group is situated two miles and a half from New Hazelton, on the northern slope of Rocher Déboulé mountain. At a point half a mile from New Hazelton a wagon-road to the property leaves the main road and extends to the camp and compressor-site. From the compressor-site a trail leads up a rock-slide to the workings some 300 feet above.

The Spokane Rocher Déboulé Mining and Copper Company secured this group a year ago and commenced development-work this summer (1916). Work was continued for a short time, but stopped in August, and it is not believed anything has since been done. The writer examined the property on July 6th, at which time a tunnel was being driven and the compressor being installed.

The compressor is a 3-drill machine and was to be driven by a 25-horse-power engine, using distillate as fuel; the machinery had been hauled in and concrete beds were being put down on which to place the engine and compressor. A frame building was being erected over the compressor-site. The blacksmith-shop is situated at the mouth of the tunnel. No camp buildings had been erected, the men at work walking to the mine from New Hazelton. Wm. Brady was in charge of the work.

Rocher Déboulé mountain consists of a core of granodiorite, intrusive into the older rocks of the Hazelton formation. On the northern side this granodiorite is the most frequent rock seen, and on the *Daley West* group it is the only rock exposed. Cutting this granodiorite in a direction N. 12° W. (mag.) is a fairly well-defined vein. It is from 1 to 4 feet wide, with an average of about 3 feet, and strikes up and down the hill, thus making it possible to develop by means of drift-tunnels.

This vein is of the replacement sheared-zone fissure type and has for the most part a filling of altered granodiorite. The vein represents a fissured zone in the granodiorite along and up which flowed alkaline solutions carrying silica and some metallic sulphides; by metasomatic processes the original granodiorite of the fissured zones was in places removed and replaced by silica and metallic sulphides, while the whole vein-filling was considerably silicified. Occasionally places in the vein show true quartz with some metallic minerals.

The principal metallic mineral found in the vein is arsenopyrite, which has a more silvery colour than usual. Other minerals found are pyrite, pyrrhotite, and a little chalcopyrite.

Description of Workings.—The workings consist of a few surface cuts and a tunnel which at the time of examination was 65 feet long. The tunnel is the lowest working down the hill. A shallow cut 150 feet above the tunnel shows the vein to carry at this point 1 foot of nearly solid arsenical iron. Two more cuts about 75 feet above the tunnel show the vein to carry some pyrite and a little chalcopyrite. The surface outcroppings of the vein are as a rule decomposed and rusty-coloured from the action of surface waters causing oxidation of the iron sulphides present.

The tunnel goes in as a half-crosscut for 20 feet to where the vein was encountered; from this point the tunnel is a drift on the vein. Throughout this working the vein is slightly impregnated with sulphides, the best place being where the vein was first struck, where there is a width of 1 foot of nearly solid arsenopyrite. At the face the vein was nearly the width of the tunnel and consists of a band of quartz with a little mineral on the hanging-wall, next a thin talcose seam, then a band of nearly unaltered granodiorite in the centre, and a band of slightly mineralized and silicified granitic rock on the foot-wall.

About a ton of ore has been saved from the material extracted in driving this tunnel; this ore is mainly arsenical iron. An average sample of it was taken and assayed, with the following results: Gold, 0.1 oz.; silver, 1.5 oz.; copper, 0.9 per cent.

A sample of solid arsenical iron was also taken and tested for nickel and cobalt, with the following results: Gold, 0.1 oz.; silver, 1.7 oz.; cobalt, *nil;* nickel, *nil.*

These results are disappointing, as it was confidently expected that the arsenical iron would carry good gold values. With a well-defined vein such as this is and showing some evidences of mineralization, it is, however, quite possible that at some places a good ore-shoot might be found. Most of the veins on Rocher Déboulé mountain show good copper ore in places, and it is possible that this vein if further developed would also do so.

Since this was written it has been learned that there is a prospect-tunnel on the vein higher up the mountain which was not seen at the time of examination. In this tunnel there is said to be a shoot of chalcopyrite showing in the vein.

MUD CREEK.

Mud creek rises in the Rocher Déboulé mountains, in the group of high peaks around the head of Juniper creek, and flowing almost easterly, or in a direction nearly opposite to that of Juniper creek, joins the Bulkley river about eight miles above New Hazelton. A number of claims have been staked at the head of this creek and the surrounding territory. The more important of these claims were examined by the writer's assistant, D. A. MacKinnon, and the following notes are based on his observations.

The claims are reached by a wagon-road for a part of the distance and then a trail, a total distance of about twelve miles. On the *Black Prince* group there is a cabin camp at an elevation of 4,050 feet, while all the showings are at higher elevations. The cabin is approximately at timber-line and the showings all above.

The main formation exposed is the typical granodiorite of the Rocher Déboulé mountains, and cutting this are a number of veins which are probably of the sheared-zone type, but which in places are apparently true fissure-filled veins.

Black Prince Group.

This group, consisting of the *Black Prince, Black Diamond, Lake View, Annex, Trumwater, Chickamon,* and *Kelting* claims, and owned by Barney Halloran, R. Hadden, and William Thompson, is situated in the Mud Creek basin. On the *Black Prince* claim, at an elevation of 4,200 feet, a tunnel 125 feet long has been driven on a vein varying from 3 to 10 inches in width; this vein strikes S. 58° E. and dips at 50 degrees to the south-west. A sample taken from the high-grade dump at this tunnel assayed: Gold, 0.04 oz.; silver, 0.9 oz.; copper, 6.4 per cent.

At an elevation of 4,300 feet an open-cut has been made on a vein which strikes S. 73° E. and dips 60 degrees to the south-west. This cut is about 30 feet to the west of the vein on which the tunnel has been driven. The vein here is about 4 feet wide, slightly mineralized throughout, and with a 10-inch pay-streak on the foot-wall. A sample taken across this 10-inch pay-streak assayed: Gold, 0.14 oz.; silver, 2 oz.; copper, 11.2 per cent.

Stripping the vein on the surface should show whether the tunnel and open-cut are on separate veins or on the same vein, faulted. The tunnel is driven along a mineralized stringer for about 90 feet, and, from here on, the vein is practically barren. At this point, 90 feet from the portal, a well-mineralized stringer 4 to 6 inches wide joins the vein on the hanging-wall. This may be a cross-stringer between the two veins or it may be an indication that the faulting of the vein takes place here. The tunnel would have to be driven about 50 feet farther and then crosscut to the west about 30 feet to get under the open-cut.

The veins are in granite and have a quartz gangue where well mineralized; but poorly mineralized portions of the vein have a slightly decomposed granite-filling.

Black Diamond.

The workings on this claim are about 1,500 feet south-westerly from the tunnel on the *Black Prince* claim, and are at elevations of from 4,600 to 4,700 feet. The vein is traced about 600 feet by means of open-cuts and stripping, and has a strike of S. 65° E. and dips to the south-west at 65 degrees.

At an elevation of 4,600 feet an open-cut shows the vein to be about 8 feet wide, but mineralized only in stringers; four stringers are from 3 to 11 inches wide. The filling of these stringers is badly decomposed and leached out, probably originally of granitic character; a sample of this vein-filling was analysed for tungsten, with the following results: Gold, trace; silver, 0.6 oz.; tungstic oxide, 4 per cent. Some wolframite is found in these stringers in small lumps scattered throughout the vein-matter.

At an elevation of 4,650 feet the stringers come together to form one vein about 2½ feet wide. An open-cut shows the vein here also to be highly decomposed and leached out. A sample taken across 2½ feet in this open-cut assayed: Gold, trace; silver, 0.6 oz.; tungstic oxide, 1.1 per cent.

At an elevation of 4,670 feet a small open-cut shows 2½ feet of badly leached-out vein-matter. A sample of this assayed: Gold, trace; silver, 6.4 oz.; tungstic oxide, trace.

The vein is in granite, having a quartz gangue where mineralized, and is quite strong whenever exposed, and scattered lumps of wolframite are found in the open-cuts that have been made.

The percentages of tungstic oxide as shown by two of these assays are encouraging, and further prospecting of the showings should be carried out. The samples were taken of decomposed granitic vein-filling, in which no tungsten-bearing mineral was apparent to the eye. It has been determined, though, that the tungsten mineral is wolframite occurring in minute particles in the gangue rock. Occasional pieces of wolframite are found in places in the vein, weighing up to an ounce or two.

The mineral wolframite is a tungstate of iron and manganese, with the formula $(Fe, Mn)WO_4$, in which the iron is generally present in greater quantity than the manganese. Wolframite is a dark brownish-black to reddish-black mineral, with a resinous to sub-metallic lustre, and a hardness of 5 to 5.5 (scratchable with a knife), while the specific gravity is from 7.2 to 7.5 (about three times as heavy as quartz, which is 2.65). The streak is usually black to dark reddish-brown, but sometimes lighter to a greenish-grey. The mineral is usually opaque, but sometimes translucent, and is sometimes weakly magnetic. The fracture is uneven, but generally there is one good cleavage and the mineral is brittle. The mineral contains from 75 to 76 per cent. tungstic oxide—WO_3. It is easily fusible before the blow-pipe and becomes magnetic on fusing.

The market requirements are such that a tungsten ore to be saleable must contain about 60 per cent. tungstic oxide (WO_3). This means that the ore must contain at least 80 per cent. wolframite, so that but little gangue rock is allowed.

It follows, therefore, that nearly all tungsten-bearing ore must be concentrated to get rid of the gangue before it is marketable. The price paid for tungsten ore, of a grade of 60 per cent. WO_3 and upwards, is about $15 to $20 a unit of WO_3. A ton of ore containing 60 per cent. WO_3 would therefore be worth from $900 to $1,200. The price has risen considerably in the last two years owing to the great demand for tungsten in the manufacture of special steels for war purposes. The price has fluctuated considerably during the last year and is still subject to sudden changes.

It is evident from the price paid for tungsten-bearing ore that material carrying even 1 per cent. tungstic oxide, if found in sufficient quantity, constitutes good ore, but, of course, would require concentration before being saleable.

The decomposed granitic vein-filling carrying wolframite at Mud creek would be easy to concentrate, but it is quite probable that where the vein is not oxidized it will be found to contain some sulphides, and the concentration to save the wolframite would then be more difficult.

A few other claims near the head of Porphyry creek were looked at, but they are as yet unimportant prospects.

FOUR-MILE MOUNTAIN.

Some claims on Four-mile mountain were also examined by D. A. MacKinnon, and from his observations the following notes are written:—

Centre Star. The principal group is the *Centre Star*, owned by J. S. Martin and partners. Several veins are exposed on the hill varying in width from 6 inches to 4 feet; they are filled up with a quartz gangue, carrying a little galena and zinc-blende and in places a little molybdenite. Values are principally in silver. The formation consists of sedimentary beds of the Hazelton formation intruded by acidic granitic dykes.

The upper vein, which strikes N. 70° W. and dips at 35 degrees to the north, is traced on the surface for 140 feet by means of open-cuts. This vein is about 3 feet wide, but only carries some small stringers of ore; it is at an elevation of 1,300 feet. The lower vein strikes N. 30° W. and dips to the north-east at 60 degrees; it is at an elevation of 1,200 feet.

The No. 3 vein as shown in an open-cut is 12 inches wide, while 30 feet west of this tunnel 60 feet long has been driven on the vein, which varies in width from 2½ feet to 1 foot at the face. The vein is sparingly mineralized, principally with zinc-blende. A sample from the tunnel dump assayed: Gold, trace, silver, 2.8 oz.; copper, *nil;* zinc, 3.8 per cent.

At an elevation of 1,240 feet an open-cut has been made on the No. 3 vein, and from this a 15-foot tunnel put in. A picked sample from the ore-dump assayed: Gold, 0.02 oz.; silver, 47.2 oz.; copper, trace; zinc, 6.1 per cent.

Work was being carried on in July, 1916, on another vein at an elevation of 1,600 feet. A shaft, which was then down about 20 feet, was being sunk on the intersection of a 4-foot vein with a 12-inch cross-vein. A sample across 4 feet of vein-matter in the shaft assayed: Gold, trace; silver, 1.2 oz.; copper, trace. A selected sample from the ore-dump returned: Gold, 0.02 oz.; silver, 17.2 oz.; copper, trace.

Silver Standard. This mine is situated on Glen mountain, about four miles from Hazelton, connection with which is secured by means of a good wagon-road. The mine was operated nearly continuously from 1910 to August, 1914, when, owing to war conditions, it was closed down indefinitely. The 1914 report of the writer contains an account of the mine, its development and production up to that time.

In the summer of 1915 the mine was reopened under the management of W. G. Norrie and substantial progress has since been made. The same syndicate, consisting of Stewart, McHugh, McLeod, and others, still owns the mine, and the general manager is D. McLeod, with office and headquarters in Vancouver. Development of the mine has been steadily carried out by Mr. Norrie, and at the same time continuous ore shipments have been made; during the past year (1916) the first shipments of zinc ore from the mine were made, and this also is the first zinc ore to be shipped from the Omineca Division.

When work was recommenced at the mine one of the first things started was a systematic resorting of the second-class ore previously sorted out from the shipping-ore. From these old dumps a considerable tonnage of shipping-ore has been obtained, a large part of the zinc shipments being obtained in this way. Mining and ore-extraction were also recommenced in the shaft, and a crosscut tunnel was driven which will be described later.

The production for the year 1916 was about 651 tons of silver-lead ore shipped to the Trail smelter, containing 126 oz. gold, 74,593 oz. silver, and 162,051 lb. lead; and 209 tons of zinc-silver ore shipped to the United States, containing 168,616 lb. zinc and 12,647 oz. silver. The total production of the mine to date is given in the following table:—

Year.	Tons.	Gold.	Silver.	Lead.	Zinc.
	Oz.	Oz.	Oz.	lb.	lb.
1913	282	59	38,839	134,953	....
1914	736	200	121,944	282,033	....
1915	154	41	26,699	54,877	....
1916	860	126	87,240	162,051	168,616
Totals	2,032	426	274,722	633,914	168,616

In all, there are about nine veins on the hill which have approximately, but not entirely, parallel strikes.

This series of veins is best described as consisting of a number of true-fissure veins which are filled with a white quartz gangue carrying galena, zinc-blende, and subsidiary amounts of tetrahedrite, pyrite, arsenopyrite, and chalcopyrite. It has been noted in many parts of the world that where one quartz-filled fissure vein is found, there is quite often a series of roughly parallel veins which are quite close together; the veins on the *Silver Standard* form a typical example of this parallelism. It is hardly to be expected, and, indeed, rarely happens, that all the veins of such a series can be profitably worked, but where one is economically valuable, some of the others in the series generally repay exploitation. In the case of the *Silver Standard* most of the work has been devoted to one vein, but at least three others have yielded high-grade ore which has been shipped to the smelter.

The main vein has been described as "a compound vein, with quartz veins developed on either wall, and with bunches and stringers of quartz lying irregularly between." From work done during the past year it is now evident that these two quartz veins, respectively called the foot-wall and hanging-wall veins, are not quite parallel, but that they intersect at a point to the south-west of the shaft. At the shaft these veins are about 40 feet apart. The area between was evidently fractured in a subsidiary manner by the forces which made the main veins; irregular seams and fissures were made, which in many instances are roughly parallel to one of the main veins, but in other cases are striking in various directions, and in these some good but small, shoots of ore have been discovered.

The silver-lead ore shipped to the smelter carries from 17 to 20 per cent. zinc, and a penalty of 50 cents a unit is charged for all zinc in excess of 8 per cent. This charge, together with smelting cost, wagon-haulage, and railway and boat transportation from Hazelton to Trail, brings the total costs of smelting and transportation up to somewhere about $30 a ton. When the cost of mining is added it is evident that nothing but closely sorted ore can be shipped at a profit. There is, however, a lot of ore which carries values from $15 to $20 a ton in which the mineral is so disseminated in the rock that it cannot be hand-sorted. For this ore mechanical concentration would be needed.

The shaft-workings on the main vein total in all about 3,500 feet, and it is estimated by the management that there has been disclosed by this work some 5,000 to 6,000 tons of ore of a milling grade. It is hoped, therefore, that with further work on some of the other veins a sufficient tonnage may soon be demonstrated to warrant the erection of a small concentrator.

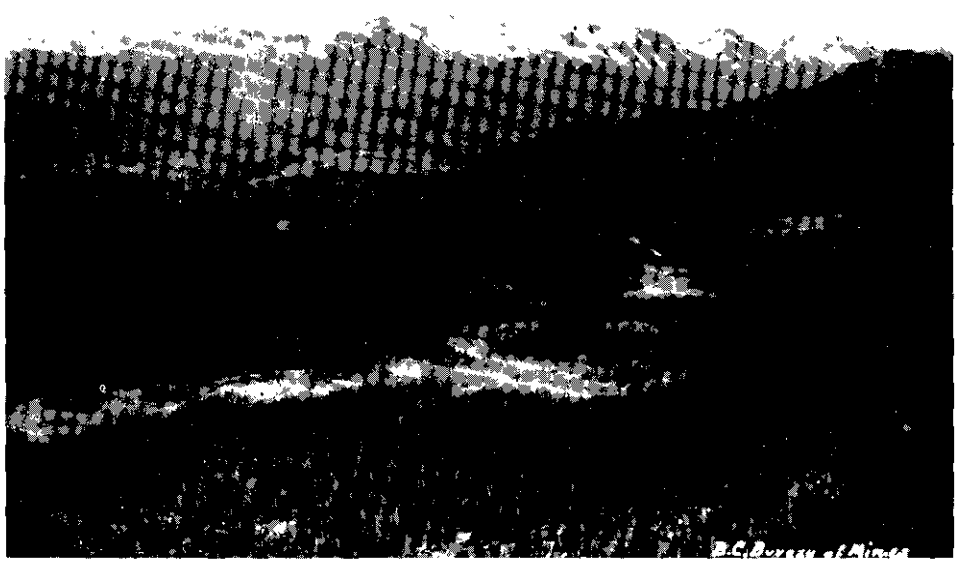
As the ore contains galena, sphalerite, grey-copper, pyrite, and arsenopyrite, it will probably prove a difficult ore to treat so as to make a high extraction of the values. The ore is, however, high-grade, so there would not be a necessity for making a very clean separation of the quartz gangue, and hence a rough concentration which would remove a considerable proportion of the gangue would suffice to make a concentrate that would easily stand shipping costs.

The ore is not unlike that of the Silverton Mines Company's property, where, after many experiments and disappointments in milling the ore, very fair success has been obtained by the use of an oil-flotation process. At this mill by a judicious combination of tables and oil-flotation a good separation of the zinc from the lead has been attained.

The crosscut tunnel was started at an elevation of 1,581 feet and strikes the main vein at the 250-foot shaft level. In all, five veins have been crosscut, and the main vein is expected to be cut at a distance of about 850 feet. Some of these veins show good ore on the surface, and while but little or no work has been done on them from the crosscut level, it is understood that some of them look promising. These veins, with development, may be expected to show ore of a milling grade. They vary in width from a few inches up to a maximum of about 6 feet; from 1 to 3 feet is the usual width.

The main vein has been developed by a shaft which follows down on the foot-wall vein; in consequence it is not regular in dip and is more of a prospecting-shaft than a working-shaft, and a further disadvantage in using it as a working-shaft is that it is only equipped with a small hoist operating a bucket. Between the 250-foot level and the surface there is a considerable tonnage of ore which could probably be handled at a profit if mined cheaply. For this reason, as well as to prospect the other veins, the crosscut tunnel was driven, which taps the main vein at the 250-foot level at a point south-west of the shaft. To have driven a tunnel which would have tapped the bottom of the shaft or still lower would have meant a considerably longer cross-

Comb Creek, Siboln Mountain.



View from Siboln Mountain.

cut, which at the time was not considered advisable by the management. In addition to the work of driving this tunnel and sorting over the old dumps, throughout the year work has been steadily prosecuted from the shaft. A good deal of work was done in the lowest or 400-foot level of the shaft-workings in following up and extracting streaks of high-grade ore. Other levels of the shaft-workings were also worked, and in all several car-loads of high-grade ore were taken out and shipped.

Wright Coal Co.

The property of the Wright Coal Company, consisting of about twelve claims, is situated near the station of Seaton, on the Grand Trunk Pacific Railway, and about twenty-two miles from Hazelton. Coal-bearing beds of the Skeena series are here found in a rather shallow but fairly regular basin, with a total length of about four miles and a half and a maximum width of about one mile and a half. The property was formerly owned by the Seaton Coal Company, and before that it is believed the name was the Grand Trunk British Columbia Coal Company, Limited.

Coal was discovered here many years ago, the seams being exposed along the banks of the Bulkley river. In all, ten or eleven small seams have been found, occurring in about 500 feet of sandstones and shales. These seams range in thickness from 1 to 3½ feet and are lying quite regularly and with little or no distortion. The average strike is N. 66° to 70° W. (mag.), with a northerly dip of about 30 degrees.

On the main seam a tunnel has been driven from the bank of the river for 230 feet, and at a point 120 feet from the portal a slope is down 30 feet, which had water in it at the time of examination. In the slope this seam has 2½ feet of coal on the roof, then a layer of bone 8 to 10 inches thick, and then 1 foot of coal on the floor. A sample across the 2½ feet of coal on the roof gave the following analysis: Moisture, 1.2 per cent.; V.C.M., 17.2 per cent.; F.C., 34.9 per cent.; ash, 46.7 per cent.

At other places this seam shows more bone or shale, as the following section at the face of the tunnel shows:—

	Inches.
Coal	9
Shale	5
Coal	8
Shale	2
Coal	5
Shale with a little coal mixed in it	18
Total	47

A sample was taken cutting across the three bands of clean coal and excluding the shale-bands and the bottom 18 inches, and the analysis of this is as follows: Moisture, 0.9 per cent.; V.C.M., 18.7 per cent.; F.C., 45.6 per cent.; ash, 34.8 per cent.

During last summer the company made preparations to sink a slope on this seam and prospect it thoroughly. The slope breaks through from the surface into the tunnel at a point 100 feet from the tunnel-mouth. A donkey-engine has been installed on the bench above the workings and only a few hundred yards distant from Seaton Station. This will hoist the waste material up the slope to the surface and take the coal on a tramway up the side-hill to the bench, 500 feet in distance and 170 feet higher elevation. At the time of visiting the property (July 12th) the donkey-engine was set up, the tramway being put in, and connection broken through from the surface to the tunnel, but work had not been started in sinking the slope below the tunnel-level. Nothing has since been heard as to how the work progressed.

Short prospect-tunnels have been run on two or three other seams, but it was not anticipated that any further work would be done on them in the immediate future. One of these tunnels is 87 feet long and shows a seam about 3 feet wide. A sample taken across 2 feet 10 inches at the face gave the following analysis: Moisture, 0.9 per cent.; V.C.M., 18.2 per cent.; F.C., 43.9 per cent.; ash, 37 per cent.

The analyses of the samples taken show an unduly high percentage of ash, and unless portions of the seams can be found which have a much lower ash content the value of this coalfield is problematical. Coal with such high ash is not of much commercial value, and at least it would have to be cleaned by washing before marketing. It will be also noted that the seams are barely above the economic limit in width.

The following table of analyses of samples, taken by W. W. Leach, of the Canadian Geological Survey,* also shows a high ash content for these seams:—

Sample.	Moisture.	Vol. Comb. Matter.	Fixed Carbon.	Ash.
No. 1. 15-inch seam	1.02	25.70	52.96	20.32
No. 2. 18-inch seam	1.39	25.56	50.06	22.99
No. 3. 20-inch seam	1.12	33.70	51.72	23.46
No. 4. 38-inch seam	2.15	22.03	43.66	32.16
No. 5. 20-inch seam	1.36	25.18	55.41	18.05

TELKWA.

The town of Telkwa is situated on the Grand Trunk Pacific Railway at the confluence of the Bulkley and Telkwa rivers. This town has apparently improved a little in the last two years, and the railway-freight business from this point is gradually increasing. The adjoining town of Aldermere, situated on a bench half a mile behind Telkwa, has been entirely abandoned, everybody moving down to Telkwa. This has assisted by centralizing all the business in Telkwa. There are now three general stores there, which keep a very complete stock of goods and apparently do a good business; in addition, there are some smaller stores.

Telkwa is surrounded by some very fair agricultural country, and the production is increasing and will continue to still further increase. An annual fall fair is held at which the farmers can show a large variety of agricultural produce.

There are no mining camps close to Telkwa, but at the same time the town is an outfitting-point for prospectors and several camps, at which work has been carried on intermittently during the last few years, purchase their supplies from the Telkwa merchants.

The town is compact, and now that Aldermere is defunct there is no near-by rival to prevent the centralization of the trade in one place. Hubert, four miles away—a railway town—is about in the same condition as Aldermere.

The railway divisional town of Smithers is apparently a larger place than Telkwa, but the business done is about the same in amount. There is room for both these places to grow and prosper, and a healthy co-operation should take the place of rivalry.

The Grand Trunk Pacific Railway has not yet gone ahead with the plans for building a big station, yards, etc., at Smithers, but it will come in time. The mining camps on Hudson Bay mountain are tributary to Smithers, and possibly also some of those in the Babine range. The ranches all along the Bulkley valley are gradually increasing their production and making more business for the towns, but this growth is slow.

HUDSON BAY MOUNTAIN.

Several properties on both sides of Hudson Bay mountain were described by the writer in his 1914 report. None of these was revisited during the summer of 1916, but some other claims were examined and the following descriptions of them written.

The claims examined are located on the north-eastern slope of Hudson Bay mountain, and most of them are as yet undeveloped prospects. The first property visited was that of Jennings Bros., situated near Lake Kathlyn, and the others were the Schufer and Martin claims near the top of the mountain.

Lone Star Group. A group of six claims situated one mile and a half from Lake Kathlyn in a south-westerly direction, and owned by Jennings Bros., is known as the *Lone Star* group. Lake Kathlyn is a small but beautiful lake on the line of the Grand Trunk Pacific Railway about three miles north-west of Smithers, a railway divisional point. It is said to have been the intention of the Grand Trunk Pacific officials to make this into a tourist resort, but as yet nothing has been done and the place is only a flag-station. Nevertheless, the place is very popular with the Smithers people, who go there for summer camping, picnic parties, etc.; it is a particularly pretty place and the lake provides bathing, boating, and fishing.

* Summary Report of Geological Survey Branch, 1910, page 100.

The old name for the lake was Chicken's lake, but as a preliminary to advertising the place as a "scenic resort" the Grand Trunk Pacific publicity agent succeeded in inducing the Geographic Board to substitute the more artistic name of Lake Kathlyn; this latter is now therefore the official name for the lake and the station. It is therefore to be hoped that in the future the "fair Kathlyn" will not be dubbed a "Chicken."

Jennings Bros. own a considerable piece of land around Lake Kathlyn and run, in a small way, a stopping-place for visitors. They have quite an extensive garden in which they grow a large variety of market produce. Amongst various other lines of work the Jennings have taken up a group of claims and carried out considerable development-work. These claims are situated one mile and a half from their house on Lake Kathlyn in a direction right up Hudson Bay mountain, and are on a small creeklet known as Jennings creek. The workings are at an elevation of 2,575 feet, and the claims are in the same locality as the Empire group, described by the writer in his 1914 report.

The formation consists of andesitic tuffs, breccias, and highly altered sedimentaries; in many places the rocks are decomposed, crumbly, and badly weathered. Some lines of shearing and sheeted zones can be seen, but at no place is there any great width of crushed rock. The most predominant strike noticed was N. 50° W. (mag.), with a south-westerly dip of 60 degrees. Slight mineralization has taken place along cracks and narrow shears, but no continuous streak of ore of appreciable width has yet been found. It was hoped by the Jennings Bros. that there was sufficient mineral disseminated all through the rock-matter to make a large low-grade body of ore, but, while this is a possibility, it cannot be said that such is yet proven.

Three tunnels have been driven in, two on the north side of the creek and one on the south, which prospect likely-looking mineral-bearing zones. The tunnel on the south side is 100 feet long, with a 22-foot crosscut from the end. This working shows a little mineral in seams an inch or two wide. The upper tunnel on the north side is 70 feet long and the other one is 150 feet long. The solid galena that is found occasionally in the small seams carries nearly an ounce of silver to the unit of lead. A little zinc-blende is sometimes also found.

Schufer Property.

This group of claims, owned by Peter Schufer, is situated on the north-western slope of Hudson Bay mountain, about nine miles by pack-trail from Lake Kathlyn. This property was bonded a few years ago to the Hudson Bay Mining Company, the first work being done under the superintendence of Colonel Steele, and some further work later on by Mr. Bromly. Owing to the refusal of the owner to extend the time of and lower the price of the bond, Mr. Bromly gave up the company's option on the property two years ago. Since that time very little work has been done.

The main showing is a body of zinc-pyrrhotite ore occurring in a vein or mineralized zone in a formation consisting of altered volcanic rock. This ore-body is exposed by two open-cuts 50 feet apart and an 18-foot shaft (full of water). The width is from 15 to 20 feet and the length exposed about 100 feet. Further work may show that this ore-body has a greater length than 100 feet. The vein, which shows as a rusty iron-capping, has been traced down the gulch from the main showing, and at an elevation 100 feet below the collar of the shaft a tunnel was driven in 135 feet by Mr. Bromly. This tunnel apparently is driven on the vein, but it shows no appreciable amount of sulphides, the rock from the tunnel being silicified country-rock. This tunnel is 80 feet short of being under the main showing, and it was to drive this additional 80 feet that Bromly desired an extension of the company's option on the property.

The zinc-pyrrhotite ore in the main showing will assay from 10 to 15 per cent. zinc, and it is not believed that it carries high values in either gold or silver. Sample No. 44 is an average across 14 feet of the main showing, and this assayed: Gold, 0.14 oz.; silver, 1.5 oz.; lead, *nil;* zinc, 16 per cent. An average sample of the whole dump from the open-cut and shaft returned: Gold, 0.02 oz.; silver, 1.4 oz.; lead, *nil;* zinc, 13 per cent. These two samples give a fair idea of the grade of ore in the main showing.

There is another vein on the property which is developed by open-cuts and an 80-foot tunnel. This tunnel shows no ore and this vein cannot be considered to be of as much value as the other one.

A crosscut tunnel at a point a long way below the main showing was driven in 400 feet by Colonel Steele. This is waste work and is of no value in proving any of the ore-showings on the property.

The ore now exposed on the property is low-grade zinc ore and cannot be marketed in its present condition. It would have to be concentrated and such concentration may prove to be difficult. As yet there is not sufficient ore proved up to warrant the erection of a concentrator.

The property requires further development, and this development can be carried out quite well by hand-work. As no machinery is required, the present mode of transportation by pack-trail is quite sufficient to allow development of the property for some time to come.

White Heather Group. This group of four claims is owned by Frank Martin and is situated above the Schufer property at an elevation of 6,900 feet. The formation consists of a peculiar reddish-coloured volcanic breccia, in some places porphyritic, and the ore is found in small irregular fissures which are often faulted considerably in small step-like faults.

The main showing is a vein which varies in width from a mere seam up to nearly a foot, which has been developed by open-cut stripping and one shallow shaft or prospect-pit. The valuable minerals found are bornite and grey-copper and occasionally some native silver. This vein is cut into slabs of about 10 feet in length by fault-planes, and it is very evident that the ore is better near where a fault-plane intersects the vein. Mineralization also occurs in places along the fault-planes. It would seem as if the ore now found was of a secondary nature, formed after the faulting had taken place, but this is by no means certain.

Where the vein is well mineralized it is as a rule quite small, so that the total amount of ore is not great. A few tons of ore were shipped at different times in the past from this property, and during the summer of 1916 Mr. Martin had taken out a few more tons which he expected to pack out in the fall. The ore is, of course, closely hand-sorted before shipping, and this sorted ore contains a high percentage of copper and often high values in silver. A representative sample of this shipping ore taken by the writer assayed: Gold, 0.45 *oz.*; silver, 120.1 oz.; copper, 47.8 per cent.

Two hundred feet east of the main showing there is another vein striking N. 20° E. which is from a few inches up to 2 feet in width. The vein-filling is mainly gangue-matter somewhat decomposed and carrying a little chalcopyrite and a lot of limonite, and somewhat stained with malachite and azurite. A sample across 2 feet of this vein gave the following assay: Gold, trace; silver, 1 *oz.*; copper, 4 per cent.

Bonanza. This claim is located farther over the ridge from the *White Heather* group and on another slope of the mountain. There is on this claim a small vein very similar to that on the *White Heather*, except that the bornite does not carry as high silver values. The only development is some open-cuts and stripping up and down the gulch in which the vein is exposed.

HUNTER BASIN.

As far as could be learned, there had been very little new work done on the claims in Hunter and Hankin basins since they were examined and reported on by the writer in 1914, and therefore they were not revisited during 1916. Later in the year it was heard that the *Hunter* group, or holdings of Wm. Hunter, were bonded to a company which immediately commenced work on them. The report of J. D. MacKenzie, previously mentioned, contains a good description of the more important showings in Hunter basin.

HOWSON BASIN.

Howson basin is situated at the head of Howson creek, a tributary coming in from the west to the South fork of the Telkwa river. It is distant about twenty-eight miles from Telkwa, and is reached by a trail following up the main Telkwa river and then the South fork of the river to its headwaters.

Mineral claims were staked in this district many years ago, and also coal-showings were partially prospected, but the district was quiet for a long time. A report on the district was made by W. W. Leach in 1906, published in the Summary Report of the Geological Survey for that year. From this report the following quotation is taken:—

"Another and larger area of intrusive rocks occurs near the head of Scallon creek, an important tributary to the South fork of the Telkwa from the west, extending across the divide to the headwaters of the Morice and main branch of the Telkwa. This rock has sent out

numerous dykes in all directions into the surrounding volcanics, and has also caught up and included in it many patches of the latter. Near the contact of these two formations and along the dykes from the former, a large number of mineral locations have been made, including the *Duchess*, the *Anna-Eva*, and the *Evening* groups on Howson creek, the Starr group on Starr creek, and numerous other claims."

The camp was examined by W. Fleet Robinson in 1911 and a report on it can be found in the Annual Report of that year. The writer was unable to find time to personally visit Howson basin, but his assistant, D. A. MacKinnon, spent two days there, and from his notes the following report has been prepared. The principal operator is F. M. Dockrill, together with associates, and it is understood that he will haul out this winter on a sleigh-road some 300 to 400 tons of high-grade copper ore.

Briefly, the geology of the district is that the rocks of the Hazelton formation, here consisting largely of volcanic and tufaceous rocks, have been intruded by dykes of a granitic rock which come from stocks of granodiorite belonging to the Bulkley eruptives. Mineralization has followed these dykes, sometimes in the older rocks near the dykes, but more often along the walls and through the body of the dykes. Some of the ore-bodies are of the replacement type and are characterized by a development of epidote and calcite. The gangue consists largely of the decomposed and highly altered wall-rocks, together with small quartz stringers. Chalcocite, bornite, and chalcopyrite are the important ore-minerals, and in addition pyrite and hæmatite are found. Copper is the principal valuable metal present, the values in precious metals being quite low.

Santa Maria Group.

The *Santa Maria*, *Kathrina*, *Telkwa*, and *Howson* claims constitute the *Santa Maria* group, which is under bond to Jefferson & Dockrill. The property has a fairly well-defined vein averaging about 4 feet in width, and striking N. 30° W. and dipping at 70 degrees to the west, which cuts through a volcanic rock formation. Open-cuts expose the vein at intervals for a distance of about 250 feet. At an elevation of 4,330 feet a shaft has been sunk on the vein, which, at the time of visiting the property, was down 38 feet. Work was being continued in sinking this shaft.

The hanging-wall of the vein is definite, but the foot-wall is irregular and discontinuous. The vein as exposed in the shaft seems to be made up of a number of parallel stringers, which are all, in places, well mineralized; but the pay-streaks in each stringer are discontinuous and break off abruptly. Chalcocite is the most important mineral found, but other sulphides of copper and iron also occur.

A sample across 4½ feet of the vein taken at a point 35 feet down the shaft assayed: Gold, trace; silver, 7.5 oz.; copper, 12.2 per cent. From the material taken from the shaft about 50 tons of good ore had been hand-sorted and piled on the dump; a grab sample of this dump was taken which assayed: Gold, trace; silver, 13.2 oz.; copper, 21.7 per cent.

Work was continued steadily on this property all fall, and it is believed several hundred tons of high-grade copper will have been shipped during the winter months. A rough sleigh-road has been constructed, and over this the ore will be hauled to Telkwa and then shipped. Since the above was written it has been learned that during the winter of 1916-17 247 tons of ore was shipped to the Anyox smelter, averaging about 18 per cent. copper, and 11 oz. in silver to the ton.

Duchess Group.

This group was one of the first locations in Howson basin and was held by the Telkwa Mines Company; it is now under bond to Jefferson & Dockrill. The ore-bodies are found in dykes which cut through volcanic rocks of an andesitic character. Mineralization with copper and iron sulphides has taken place along the walls of the dykes, and in places throughout the dykes. These ore-bodies are admittedly low-grade—i.e., from 1 to 5 per cent. copper—but may be shown to be quite extensive. Further development is being proceeded with in order to determine the amount of ore existing.

The present development consists of two tunnels, one of which is 400 feet long, and some surface cuts. Considerable mineralization is evident in the long tunnel for 90 feet, but no sampling was done. It is claimed that considerable ore in this working averages 4 per cent. copper, and that some streaks carry 11 per cent. copper. The claims are at an elevation of 4,700 to 5,000 feet. The hill is much shattered by the intrusive dykes, and therefore should be a likely locality in which to find large ore-bodies. These dykes are called "green dykes," the name describing their prevailing colour. From an examination of a hand specimen they are

fine-grained and only slightly porphyritic; they now contain a good deal of epidote and some chlorite, and probably originally had about the composition of a diorite. The rock through which they intrude has a general reddish colour, is in places porphyritic, sometimes brecciated, and occasionally amygdaloidal.

Cassiar Crown Copper Co.

About two years ago the Cassiar Crown Copper Company secured a lease and bond on the claims on Grouse mountain, which are owned by Samuel Bush, Louis Schorn, and other partners. These claims were described by the writer two years ago under the name Bush group.* At that time they had only been staked a few months, and shortly after the writer examined them they were bonded by Trimble & Anderson, who formed the above-named company.

In 1915 J. D. MacKenzie, of the Geological Survey, examined this property in some detail. His report on it is in the 1915 Summary Report of the Geological Survey and includes a contoured geological map of the claims. His report is so complete that little further need be said. It may be pointed out that his accompanying map has, probably through a printer's error, a wrong scale on it. The scale as given is 5 miles to the inch, but it is evident that the actual scale of the map is about 5 inches to the mile.

The concluding sentence of his report says: "This deposit, so far as it has been prospected, is of a promising appearance, and is also favourably located with regard to transportation, as it lies on the very edge of the Bulkley valley, with the railway across the river only four miles and a half distant in an air-line."

The first work done by the Cassiar Crown Copper Company was to sink a shaft at a point where there was a good showing of ore. This shaft is 56 feet deep and had water in it when the writer examined the property in July, 1916. This working shows several streaks of good ore, but in general the whole rock taken from the shaft is mineralized. To judge by the eye, the rock taken out, which now forms the dump, would assay from 3 to 4 per cent. copper. A rough grab sample of the whole dump was taken which, however, will only give a very rough approximation at an average sample; this assayed: Gold, trace; silver, 2.6 oz.; copper, 2.5 per cent.

The company apparently considered that the indications of ore as shown by this prospect-shaft were sufficiently encouraging to warrant a more extensive development plan. A small gasolene-driven compressor was installed and work commenced on a crosscut tunnel, which is 300 feet lower than the collar of the shaft and is distant 500 feet in a horizontal direction. This tunnel may possibly strike stringers of ore before getting vertically underneath the shaft. The face of the tunnel at the time of examination was in about 100 feet and was in a hard, dense, flint-like rock, which is a highly silicified volcanic tuff or tufaceous quartzite.

The following is an excerpt from Mr. MacKenzie's report: "The metallic minerals, which are chalcopyrite and zinc-blende, are localized in a sheeted zone, which is in general parallel to the strike of the sediments and nearly vertical. The joints (sheets) of the zone show little or no slickensiding and are spaced from a fraction of an inch to several inches apart. The ore-minerals are found in narrow fissure-veins, representing filling of the openings in the sheeted zone, and also as irregular replacement veins and masses throughout the zone. There is a little quartz gangue associated with the sulphides. Well-defined walls were not observed for the deposit as a whole, though they are present locally. This ore-bearing, sheeted zone has been broken by post-mineral faults, usually of only a few feet displacement and nearly vertical. Those observed are roughly parallel to the strike of the dykes and the direction of the schistosity in the sediments. Proceeding east along the zone, it can be seen to be offset to the north along the faults, and from the areal distribution of the ore-minerals it is thought that the western portion of the zone may be affected by faults of greater displacement than those observed elsewhere.

"With respect to the tenor of the ore but little definite information is available, as no systematic exploration nor assaying has been done. The following descriptions of some of the prospect openings will serve to give an idea of the character of the more highly mineralized portions of the deposit:—

"At the initial post of the *Copper Crown* claim a sheeted zone 12 feet wide is made of closely spaced joints from ½ to 4 inches apart, most of which can be traced on the surface for 10 feet,

* Annual Report of the Minister of Mines, 1914, page 227.

and in some cases two or three times that far. Chalcopyrite occurs in the fissures in this zone, forming lenticular and irregular veinlets of the solid mineral, the largest seen being 3 inches thick by 16 inches long. A shoot in the zone, 3 feet thick and 10 feet long, contained about 20 per cent. chalcopyrite, and other less-rich shoots also occurred. Twenty-two feet east of the place just described a 2-foot pit shows a shoot 4 feet thick, visible for 10 feet, which contains about 25 per cent. chalcopyrite, and a 10-inch vein in the middle of the shoot, exposed for 5 feet, is nearly pure chalcopyrite. At a distance of 190 feet from the initial post mentioned the continuation of the same zone is 35 feet wide, prospected by a shaft on the south side of the zone and a trench on the north side. The shaft is 5 x 6 x 8 feet deep, and exposes a 5-foot shoot that may run 20 per cent. chalcopyrite. The rest of the 35 feet is lower-grade ore, except for one or two small shoots up to 18 inches thick. Eastward from here for a distance of about 100 feet are many short veinlets of chalcopyrite from ½ to 4 inches thick.

"At the east end of Coppermine lake, on the *Eureka* claim, a shaft 6 x 5 x 8 feet deep and some trenching expose a 10-foot mineralized zone in greenish tuffs, which is probably the continuation of the one just described. The zone strikes N. 80° E. and dips about 75 degrees north. Following is a section of the zone, from the hanging-wall to the foot-wall:—

"Chalcopyrite, pyrite, and quartz ..... 6 inches.
Rock, slightly and irregularly mineralized ..... 6 inches.
Ore-shoot, about 25 per cent. chalcopyrite ..... 2 feet.
Rock, slightly and irregularly mineralized ..... 2 feet.
Ore-shoot, about 25 per cent. chalcopyrite ..... 5 feet."

BOB CREEK.

Buck river flows into the Bulkley river at Houston, a station on the Grand Trunk Pacific Railway thirty-one miles east of Telkwa. Ten miles up the Buck river from Houston a small tributary comes in which is called Bob creek. About half a mile from where it joins Buck river, Bob creek flows through a narrow canyon which has been cut down by the creek. At different times some placer-mining has been done on this creek, mostly near the foot of the canyon; some of this work was done in recent years and some of it may date back to forty years ago. Various stories are heard as to the results of this work, but it is fairly certain that some placer gold has been taken out of the creek. The origin of this gold is supposed to be in a belt of volcanic rocks some 1,500 to 2,500 feet in width which are cut across by the creek where it flows in the canyon. Evidence of this is said to be shown by the fact that no placer gold is found in the creek-gravels farther up the stream above these rocks.

This belt of rocks is known locally as a "porphyry dyke," and claims have been staked covering the locality of outcrops and some prospecting has been done. The rocks appear to be true volcanic rocks consisting for the most part of volcanic breccias and andesite. They have a general north-west strike, but strikes and dips of joints and fracture-planes can be seen going in all directions. No distinct flow-structure can be seen nor can lines of separation of different lava rocks be easily seen. As a rule, the rocks where shown on the sides of the canyon are soft and crumbly and contain a considerable percentage of iron oxide or limonite, which has probably resulted from the oxidation of original iron sulphide. There seems to be no question that certain zones or streaks in these rocks carry some gold values, but the writer was quite unable in the short examination he made to determine just how these ore-bearing zones originated. These rocks from their lithological appearance may belong to a horizon of the Hazelton formation, which is almost entirely made up of volcanic rocks, but they may be of much later age—possibly Tertiary. If, however, they belong to the Hazelton formation, then, in common with these rocks as occurring in other localities, they could have been subjected to fracturing and mineralizing agencies.

No definite veins, sheared zones, nor sheeted zones can be seen, and what mineralization there is is quite scattered, irregular, and also very slight. Metallic sulphides are very scarce, but from the presence of considerable secondary iron oxide, it is evident that iron sulphide was present at one time. Minute amounts of zinc-blende have been found in concentrates from panning samples from certain zones of the rock. The only work which has been done is a number of prospect holes and cuts from which many samples have been taken.

As yet, however, no systematic sampling to find out the average grade of the whole body of volcanic rock ("dyke") has been done which is considered conclusive. It would not seem

as if there was any small area or zone which carries sufficient gold values to make small-scale mining possible at a profit. The only possibility is that the whole "dyke" is sufficiently mineralized to make a large low-grade ore-body. While this possibility is problematical, further testing is required.

BABINE RANGE.

The Bulkley river rises in Bulkley lake and flows nearly north-west to the Skeena river at Hazelton. It marks a divisional line between the Rocher Déboulé and Hudson Bay mountains and the Babine range, which latter extends from the Suskwa river (a tributary of the Bulkley coming in ten miles above Hazelton) to Telkwa, from whence these mountains gradually fade away. This range reaches elevations of 6,000 to 8,000 feet in the neighbourhood of the Suskwa river, and then gradually decreases in height towards Moricetown, where it consists mainly of ridges covered with scrub timber. Continuing south-easterly, it again rises to high peaks in the vicinity of Driftwood, Deep, and Canyon creeks. Immediately to the east of the Babine range is Babine lake, which parallels the range for a distance of 105 miles.

Mineral discoveries have been made in many places in the Babine range, but the difficulty in arranging for suitable transportation has retarded development. Cronin's mine was re-examined during the year; the *Debenture* group, active development of which was started in July, was visited and also the gold-quartz camp at Dome mountain. These will now be described.

Babine-Bonanza Mining and Milling Co.

The property owned by the Babine-Bonanza Mining and Milling Company is popularly known as "Cronin's mine," the reason being that James Cronin is heavily interested in the company and is also manager of the mine. This property was described in detail by the writer in his 1914 report. Since that time further development-work has been carried out by Mr. Cronin, and shipments of ore would probably be now commenced if suitable transportation arrangements were provided.

No further work has been done in the shafts described in the former report, but the tunnel (No. A tunnel) which was in 33 feet in 1914 has had a good deal more work done on it. This tunnel went in for a short distance in slide-rock and then for 25 feet crosscut obliquely a body of good ore. The tunnel was then continued for 173 feet and at that point struck the No. 2 shaft vein. Where encountered this vein was small, but drifting on it was being commenced when the writer was on the ground.

The large ore-body cut near the mouth of this tunnel appeared so promising that the management decided to run a crosscut from the lower main tunnel (No. 1) to prospect the ore-body at greater depth. The lower main tunnel is situated 100 feet below the No. A tunnel, is in some 400 feet, and was driven several years ago as a drift prospecting the first vein found on the property. Accordingly a crosscut was run from it to a point underneath the large ore-body, but while no appreciable ore was found, this work is not conclusive proof that there is no downward continuation of the ore-body in No. A tunnel. More work is now being done on and near the surface to find out the exact strike and dip of this ore-body, so that it will be possible to calculate more exactly where the ore should be on the main tunnel level. In furtherance of this idea a prospecting-tunnel was being driven at a point 60 feet from tunnel A and at an elevation 30 feet lower. This tunnel was only in a short distance, but showed ore in the face of a good milling grade. This tunnel is apparently running on the strike of the ore-body in tunnel A, and it was the intention before long to crosscut so as to determine the width, character of wall-rock, dip, etc.

The ore-body exposed in tunnel A and the prospect-tunnel below has evidently been formed in the contact between an igneous rock, which on the contact is a rhyolite, but is generally a granite porphyry, and a black schistose rock of argillitic composition.

This same contact deposit is exposed at various places on the surface. It occurs on the sloping side of the hill, and it would appear as if in most places the schistose rock had been eroded off and left the ore exposed lying on top of the siliceous rock. The contour of the hill thus conforms roughly to the dip of the ore-body and of the contact.

From these showings of ore a considerable tonnage of galena could be hand-sorted and shipped if suitable transportation were available, but eventually with further development, if sufficient tonnage is demonstrated, a concentrating-mill would be the best way of handling this ore.

Pack-train on Siboja Mountain.

Benson's Camp, Sweeney Mountain.

A vein on the eastern side of the hill which has been developed by a shallow shaft and tunnel has some nice-looking ore exposed in it. Work is being done on this vein also and it seems to promise well for the future.

Still another vein is exposed on the eastern side of the hill roughly parallel to the one just described, but nearer to the main workings. Practically no work has been done on it, principally because Mr. Cronin has been too busy elsewhere. It is, however, a promising-looking vein about 4 feet wide and carrying in places bands of galena up to 2 feet in width. The galena here is said to assay 3 or 4 oz. of silver to the unit of lead.

Mr. Cronin is thoroughly familiar with the country and has spent considerable time in cruising out various routes for a wagon-road from the mine to some point on the Grand Trunk Pacific Railway. The great difficulty to be overcome is that, as the property is on the Babine Lake slope, there is, therefore, on most routes an adverse grade against the ore in taking it over the divide of the Babine range to the railroad in the Bulkley valley. The route of the present trail up Driftwood creek and over the divide was obviously impossible, and the route of the old trail from Moricetown also proved to be inadvisable. For a time the possibility of taking the ore down to Babine lake, thence to the head of the lake and out on a wagon-road to Burns Lake on the railway, was considered, but this also was finally considered impracticable.

The route now decided upon by Mr. Cronin is from the mine down Cronin creek for about five miles in a south-easterly direction (towards Babine lake), then swinging southerly and westerly and coming 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 July, 1916, Mr. Jens, a Public Works engineer, surveyed out this route and reported it feasible, and that at no place would there be an adverse grade against the ore being hauled out. This road will also open up about ten miles of agricultural country east of Telkwa, in which there are now some settlers, and also will assist further prospecting in the Babine range.

It is understood that Mr. Cronin during the fall of 1916 had this road slashed out and partially completed so as to serve as a sleigh-road in winter. The writer's information at the time of writing this (in December) is that the road lacks three or four miles of being completed as a snow-road, and therefore it is not anticipated that any ore will be hauled out in the winter of 1916-17.

There are several good veins and showings of ore on the property, and there is no doubt that, with a wagon-road, the property should be able to ship hand-sorted ore steadily. Eventually, however, the bulk of the ore will have to be concentrated before shipment.

In the Preliminary Report on this district, issued as Bulletin No. 2, 1917, the character of the igneous rock which is in contact with the schistose rock on this property had not been definitely ascertained. The rock in question had been called a granite porphyry by W. W. Leach, of the Geological Survey, and in 1914 was so called by the writer following Mr. Leach's classification. On examining the property in 1916 it was found that this classification was questioned, as some phases of the rock resembled closely in outward appearance a quartzite. Several specimens were taken by the writer, and on examining these it is certain that the rock is of igneous origin and hence not a quartzite. One specimen taken from near the contact was submitted to Professor E. T. Hodge, of the British Columbia University, who kindly offered to make an examination of it. The following is his report on the rock:—

"*Petrographic Description.*

"*Hand Specimen Description.*—General appearance: A fine-grained, pale, bluish grey, subvitreous, fresh rock, which shows tiny 0.5 mm. grains of quartz, black crystals of hornblende, and rarely a little book of biotite, and many large (1-2 mm.) lath-shaped, vitreous, non-striated feldspars.

"*Microscopic Study for Classification.*—Texture: Felsitic. Size of grains: All less than 2 mm. = felsite. Original structure: Massive. Secondary structure: Massive.

"*Mineralogy.*—Primary essential minerals: Orthoclase, 15 per cent.; oligoclase, 3 per cent.; hornblende, 7 per cent.; quartz, 5 per cent.; biotite, 4 per cent. Primary accessory minerals: Apatite, 1 per cent.; magnetite, 5 per cent. Secondary alteration products: Kaolin, 55 per cent.; chlorite, 5 per cent.

"*Special Features.*—Orthoclase: Fresh, 1.5-2 mm. fine Carlsbad twinning, and contains many inclusions or chadocrysts of apatite, a few brown flakes of biotite, and even a few shreds

of hornblende. Oligoclase: A few prismatic crystals. Quartz: Subhedral, embayed grains with many inclusions of apatite and glass (?). Biotite: Euhedral, deep brown, pleochroic flakes. Hornblende: Very prismatic, subhedral, poorly terminated, dark green, and altered. Magnetite: Numerous grains in two generations (0.4 mm. and 0.1 mm.); the larger are euhedral.

"*Origin of the Rock.*—Igneous.

"*Classification.*—Rhyolite.

"*Discussion.*—The fine grain, the pale colour, and the subvitreous lustre due to orthoclases and the quartzes might lead one to think this rock to be a quartzite. Careful examination of the rock in hand specimen shows it to be igneous. It would be impossible to classify it definitely as a rhyolite or andesite in hand specimen, but in thin section the minerals and structures are so well defined that there can be no doubt as to it being a rhyolite. The rock is exceptionally fresh. The structure indicates that in the field it occurs as a thin dyke, sill, or flow, or the outer portion of thicker dykes, sills, or flows. In whatever series of rocks that it occurs, it belongs to the younger group."

It will be noted from this description, which it may be said is an unusually good one, that the rock is a rhyolite. This particular specimen was taken just beside the contact with the schistose rock, and hence was in a position where it cooled very quickly from the molten condition. Hence no large crystals could be formed in it, and the rock-structure is such that it is classified as a rhyolite. In the mass of this igneous rock the texture becomes coarser with small phenocrysts of the different minerals, and the rock is better described as a granite porphyry. It may be well to point out that the only difference between rhyolite and granite porphyry is in structure, and the mineralogical composition is, or can be, identical. The final conclusion is that the general name of granite porphyry applied to this igneous intrusion, which is either a large dyke or stock, by W. W. Leach is correct.

Debenture Group.

This group of five claims is owned by Henry Bretzins and partner and is under bond to Thos. Rea and associates. It is organized as a stock company, with head office in Victoria, under the name of the Debenture Mining Company. The property is situated in the Babine range, on the Babine Lake slope, ten miles north-west of Cronin's property, and is at present reached by a twenty-eight-mile pack-trail from Moricetown.

The property is a prospect with very little development-work done, but has a most promising surface showing. It has a large vein showing up to 10 feet of milling-ore, and in some places shoots of solid galena from 2 to 5 feet in width. The ore is galena carrying about an ounce of silver to the unit of lead and is very similar to Cronin's ore, with the exception that there is no zinc-blende present.

The main showings are in a bluff where it is impossible to do any systematic work, so Mr. Rea is now driving a crosscut tunnel which will be from 200 to 400 feet in length before striking the vein; it was in July in 60 feet. A camp with two good log buildings has been built and nine men are at work.

DOME MOUNTAIN CAMP.

At Dome mountain, in the Babine range, a number of claims have been staked on showings of quartz veins carrying gold. It was considered advisable from what had been heard as to the camp to make an examination of it, but the writer was unable to find time to personally visit the camp; he therefore sent his assistant, D. A. MacKinnon, who examined the more important showings. The following report on the camp is therefore based on notes written by Mr. MacKinnon. From his description and the assays obtained on samples taken by him it is evident that the camp is a promising one and should attract the attention of mining men.

Dome mountain, an isolated lone hill, deriving its name from its similarity in shape to an engine-dome, is situated about twenty miles easterly from Telkwa and forms a part of the Babine range. It rises to an elevation of about 5,300 feet, with timber-line at about 4,700 feet. At the present time a roundabout route is used to get to the camp, consisting of fourteen miles of wagon-road and thirteen miles of trail. By building about thirteen miles of new trail or road from the north end of Round lake to the camp a practically direct route of about twenty miles, from Telkwa to Dome mountain, could be obtained.

Geological Features.—From an examination of a number of rock samples collected by Mr. MacKinnon it would seem as if the main formation on Dome mountain was a series of considerably altered and metamorphosed sedimentary rocks. Many of the samples are almost

impossible to identify accurately from a hand sample, and a microscopic examination of thin sections of the rocks would be required to obtain an absolute identification. Most of the rocks have some lime in them, and one of them, taken from the *Bullion* group, is a straight limestone, although somewhat impure. The rocks have in places a partial schistose structure, and some of this schist would appear to have been originally of volcanic origin. It is probable that the rocks were originally a sedimentary series in which some volcanic flows had been intercalated and interbedded, and that now metamorphism has considerably altered them from their original character. The set of samples does not include any which appear to be plutonic rocks.

The formation on Dome mountain does not seem to bear much resemblance lithologically to the Hazelton formation, and it is possibly an older formation. The presence of interbedded limestone would suggest that these rocks may be correlated with the Kitsalas series, but more information must be obtained before anything definite could be said.

The showings of ore are found in well-defined quartz-filled fissures, a number of which give evidence of being of a permanent nature. The veins vary in size from about 6 inches to 6 feet, and practically always contain a true quartz-filling. The metallic minerals which are found in the quartz are pyrite, arsenopyrite, a little chalcopyrite, and occasionally a little galena. The main values are in gold, but in some instances the silver content becomes appreciable, and assays showing copper up to 2 per cent. have been obtained. The camp must, however, be considered as a gold camp, as the other values are very subordinate to the gold.

No tests have been made yet to find out whether the gold is carried in the pyrite or other sulphides or is free in the quartz. It is probable, though, that some gold is free, but that a large percentage of it will be found to be contained in the pyrite. Silver values might be expected to run up where there is some galena present.

The mixture of sulphides present will make the ore a little difficult to mill or concentrate, but no very great trouble should be experienced.

Bullion Group. This group, consisting of the *Bullion*, *Shamrock*, *Maple Leaf*, and *Pansy* claims, is situated on the easterly slope of Dome mountain; it is owned by J. Bourgone, T. J. Thorpe, J. Probendite, and G. Hazelton. The main showing is a well-defined quartz vein from 3 to 5 feet wide occurring in a band of altered sedimentary rock which might be classed as an argillaceous limestone. The strike of the vein is N. 35° E. and it stands approximately vertically. It is apparent that there are, besides the main vein, small subordinate stringers of quartz through the rock which are in places mineralized to some extent; these are, however, of lesser importance than the main vein.

By means of two short tunnels and an open-cut the vein has been exposed along a length of 100 feet. In the open-cut, which is the farthest opening to the north-east, the vein is 33 inches wide, and the following is the result of the assay of a sample cut across the full width: Gold, 0.48 oz.; silver, 2 oz.; copper, trace; lead, *nil*.

About 50 feet south-west of this open-cut a tunnel 30 feet long has been driven which cuts across the vein near the portal, and then goes on into the country-rock to where the argillaceous limestone is in contact with a more siliceous bed. The width of quartz showing in this working is 5½ feet, a sample across which returned on assay: Gold, 0.10 oz.; silver, 1 oz.; copper, trace.

About 45 feet farther to the south-west from this tunnel another tunnel has been started, which is in 12 feet. Here the vein shows in the upper part of the face; it is slightly bent over and is considerably leached out and oxidized, the lowest part showing more quartz than at the top. A sample across 30 inches of the leached matter assayed: Gold, 0.76 oz.; silver, 4.6 oz.; copper, trace.

Homestead Group. This group is also situated on the eastern slope of the mountain, and consists of the *Lucky Boy*, *Homestead*, *Gold Standard*, and *Snowflake* claims, the owners being T. J. Thorpe, J. Bourgone, J. Probendite, and G. Hazelton.

The lowest showing on this group is on the *Lucky Boy* claim, at an elevation of 4,400 feet. Three open-cuts trace the vein for about 120 feet, showing a strong, well-mineralized quartz vein 4½ feet wide, which strikes N. 45° E. and dips to the south-east. The surface appears to be lying somewhat flatter than the real pitch of the vein. A sample taken across 18 inches of the vein on the foot-wall side returned the following values: Gold, 0.60 oz.; silver, 3.6 oz.; copper, 1.9 per cent.

At an elevation of 4,580 feet on the *Snowflake* claim a 15-foot open-cut shows a 24-inch quartz vein cutting through a schistose formation; this vein strikes N. 35° W. and dips to the

east. The vein is badly leached out on the surface and is not shown except in this cut. A sample taken here across 24 inches assayed: Gold, 2.7 oz.; silver, 19.7 oz.; copper, 0.8 per cent.

About 100 feet north-west of this open-cut a tunnel has been started to crosscut this vein. It is in about 20 feet and has still 20 feet to go to reach the vein.

Pioneer Group. This group is also situated on the east slope of the mountain, and consists of the following claims: *Mohawk*, *Silver Fox*, *Lone Star*, *Black Hat*, and *Silver Tip*, owned by T. J. Thorpe, J. Bourgone, J. Probendite, and G. Hazelton. At an elevation of 4,750 feet an open-cut on the *Mohawk* claim shows several quartz stringers through the main schistose rock, with a strike N. 70° W. These stringers vary from 3 to 8 inches and some are well mineralized. A sample taken here across a 6-inch quartz stringer assayed: Gold, 0.46 oz.; silver, 3.3 oz.; copper, trace. Another from an 8-inch stringer returned: Gold, 0.36 oz.; silver, 25.4 oz.; copper, trace.

From this open-cut, following along the line of strike N. 70° W., the vein has been open-cut again about 800 feet to the west, but no intermediate cuts have been made. This is at an elevation of 4,780 feet, about 100 feet above timber-line, but owing to the thick covering of earth over the hillside the vein cannot be seen except at open-cuts. This work is on the ground of the *Silver Fox* claim.

The vein here shows 20 inches quartz, with 24 inches of vein-matter mixed with rock on the foot-wall. The vein has the appearance of being slid over on the surface and has a dip of 45 degrees to the north. A sample taken across this 20 inches of quartz gave the following results: Gold, 0.56 oz.; silver, 15 oz.; copper, 1.2 per cent.

This is the middle vein on the hillside, a vein being found about 200 feet below, that is to the north-east, and another one about 400 feet higher up the hill. The veins are practically parallel and all are vertical. They are all very similar in character and mineralization.

At an elevation of 4,810 feet an open-cut on the upper vein shows 18 inches of vein-matter. This vein is opened by cuts in several places; a sample taken across 18 inches of the vein at the farthest north open-cut on the *Pioneer* group gave the following values: Gold, 0.36 oz.; silver, 1.6 oz.; copper, trace. The lower vein is also exposed in a cut on the Pioneer group, showing it to be the same character of vein as the other two.

La Petite Fraction. This claim, owned by T. J. Thorpe, lies immediately to the north-west of the *Pioneer* group. A vein, apparently the upper vein of the *Pioneer* group, as it is on the same strike, is open-cut on this property at an elevation of 4,720 feet. About 60 feet west of this open-cut another vein is exposed, which is an offshoot of the main vein. It has a strike due west and is lying flatter on the surface than the other vein. A sample across 16 inches in the open-cut on this vein assayed: Gold, 6.56 oz.; silver, 10.2 oz.; copper, 2 per cent.

It is noteworthy that this sample contained a much higher percentage of sulphides than the others from the camp. This may account for the high gold values and would tend to show that the gold occurs in some of the sulphides.

What appears to be the lower vein of the *Pioneer* group is also found on this property. An open-cut and two 10-foot shafts show a 14-inch vein, considerably leached out and decomposed. This vein also stands vertical and has the general strike of N. 70° W. A sample taken from the most southerly shaft across 14 inches of this leached vein-matter returned the following results: Gold, 1.26 oz.; silver, 4.4 oz.; copper, trace.

North Star Group. Adjoining the *La Petite Fraction* on the north-west is a group of claims consisting of the *Blue Grouse*, *North Star*, *Gold Seal*, and *Gold King* claims, and owned by T. Hyslop, B. Robinson, Ira McLean, and J. McKendrick. Three main veins cross these claims roughly parallel and with the same general strike—N. 70° W.—and about the same distance apart as the *Pioneer* group veins. They are considered to be extensions of the *Pioneer* veins, and probably are.

On the lower vein several open-cuts have been made which show a well-defined vein from 12 to 18 inches wide. A sample taken across 16 inches returned on assay: Gold, 0.58 oz.; silver, 2.2 oz.; copper, trace.

On the central vein considerable work has been done, consisting of several large open-cuts and two shafts about 20 feet deep. This vein is from 2 to 4 feet wide and somewhat oxidized on the surface. In a cut at an elevation of 4,500 feet the vein is 4 feet wide, of which 2 feet is

mineralized; a sample taken across this mineralized portion assayed: Gold, 0.74 oz.; silver, 1.8 oz.; copper, trace.

At an elevation of 4,600 feet an open-cut shows a strong well-mineralized vein. A sample across 12 inches at this place returned the following results: Gold, 3.34 oz.; silver, 6.4 oz.; copper, 0.4 per cent.

The upper vein has not as much work done on it as the other two veins. It is very similar to the upper vein as found on the *La Petite Fraction*, in that it is about the same size and it is split, the offshoot going off to the west, at practically the same strike and dip. At elevation 4,550 feet a 10-foot shaft is sunk on the vein. A sample taken across 18 inches of the vein gave the following results: Gold 0.18 oz.; silver, 1.2 oz.; copper, 0.3 per cent.

Gold Crown. This claim, owned by E. Hoops, is situated on the eastern side of the mountain and lying to the south-east of the *Pioneer* group. There are three veins showing on this claim, only two of which were sampled. At an elevation of 4,805 feet an open-cut shows a vein 2 feet wide, apparently on the same strike as the upper vein of the *Pioneer* group, and having, where exposed, a strike of N. 70° W. A sample taken across the full width of vein in this cut returned on assay: Gold, trace; silver, 0.8 oz.; copper, trace.

About 300 feet to the north-east of this open-cut a vein is uncovered at an elevation of 4,790 feet; this vein is close to where the extension of the centre vein of the *Pioneer* group should be, and where shown has a strike of S. 80° W. and stands vertical. A sample taken across 26 inches of the vein here assayed: Gold, 0.56 oz.; silver, 1.5 oz.; copper, 0.5 per cent.

It is very probable that the three veins of the *Pioneer* group are the veins of the *Gold Crown*, *La Petite*, and *North Star* groups, as the veins are in the proper place and have the same appearance and characteristics as well; this would show them to be very strong, persistent veins.

For convenience the following tabulated list of the assays of samples taken from the claims is inserted:—

Name of Claim.	Description of Sample.	Gold.	Silver.	Copper.
		Oz.	Oz.	Per Cent.
Bullion group	Across 33 inches	0.48	2.0	Trace.
"	" 30 "	0.76	4.6	"
Lucky Boy	" 18 "	0.60	3.6	1.9
Snowflake	" 24 "	2.70	19.7	0.8
Mohawk	" 6 "	0.46	3.3	Trace.
"	From 8-inch vein	0.36	25.4	"
Silver Fox	Across 20 inches	0.56	15.0	1.2
Pioneer	" 18 "	0.36	1.6	Trace.
La Petite	" 16 "	6.56	10.2	2.0
" (lower vein)	" 14 "	1.26	4.4	Trace.
North Star	" 16 "	0.58	2 2	"
Gold Seal	" 24 "	0.74	1.8	"
"	" 12 "	3.34	6.4	0.4
North Star group (upper vein)	" 18 "	0.18	1.2	0.3
Gold Crown	" 24 "	Trace.	0.8	Trace.
"	" 26 "	0.56	1.5	0.5

The general average of these samples is good, and while too much reliance should not be placed on them, they at least show that there is some gold-bearing quartz in the camp of a commercial grade. Gold ores are, as a rule, very pockety, and many samples must be taken before an approximation of average values can be obtained.

BULKLEY VALLEY TO CHILCOTIN DISTRICT.

A RECONNAISSANCE OF A PORTION OF THE EASTERN CONTACT OF THE COAST RANGE.

REPORT BY JOHN D. GALLOWAY, ASSISTANT MINERALOGIST.

INTRODUCTORY.

The main work laid out for the writer for the field season of 1916 was to make a rough reconnaissance of a portion of the eastern contact-zone of the Coast range lying to the south of the Grand Trunk Pacific Railway. The carrying-out of this work was done by means of a long pack trip from Houston, on the Grand Trunk Pacific Railway, to Alexis Creek, in the Chilcotin country.

Before commencing on the long southern trip the month of July was spent examining mines and prospects in the Hazelton-Telkwa district, and a start on the main trip was not made until the beginning of August. This was about a month later than desirable, and as a consequence it was necessary to hurry everywhere, and observations were largely confined to what could be obtained in steady travelling on the pack-trail. At a few places, however, where mineral locations had been made, stops were made long enough to obtain detail information; all the rest of the time steady travel was kept up.

Another object of the trip was to secure information in regard to reported occurrences of hæmatite on the Klinaklini river and Tatlayoko lake. As these showings were at the southern end of the trip, it was necessary to travel fast in order to reach them before they were covered with snow in the late fall.

The route followed on this trip enabled the writer to get information in a general way about a larger district than that actually covered along the trail. The area described in this report is therefore a portion of that section of country lying between north latitudes 51° and 54° 30′ and 124° 30′ and 128° west longitude. It must, of course, be remembered that in discussing this large area of country it is only in certain places that details are known, but that these places are considered typical of much larger tracts.

The report is divided up into headings as follows:—

1. Introductory.
   - Object of Trip.
   - Party, Equipment, etc.
   - Bibliography.
2. Summary and Conclusions.
3. General Physical Features.
4. General Geology.
   - Regional.
   - Detail.
5. Economic Geology.
6. General Remarks on Agriculture, Timber, etc.

An Appendix is added which is practically a diary of the daily travel, with notes as to camps, etc., as it may be of some assistance to others travelling the trails followed by this party. It is often difficult to get advance information about trails and routes which are not often used, and it is hoped that this Appendix will in part supply such information, giving directions as to good camps, horse-feed, mileage, elevations, etc.

OBJECT OF THE TRIP.

Between the Grand Trunk Pacific Railway and the Lillooet district there is a strip of virtually unprospected and almost unexplored country in which mineralization and economically valuable ore-bodies may be expected to exist. It has been pointed out many times in the Annual Reports of this Department that wherever the contacts of the Coast Range batholithic rocks with the older measures have been carefully prospected, widespread mineralization has been found to have taken place. This is well shown by the number of productive mines and camps which are situated on these contact-zones.

We know that this Coast range—which is 1,000 miles long, stretching from the International Boundary-line through British Columbia and into Alaska—has commercially valuable ore-bodies in many places along both its eastern and western contacts, and, according to the more modern theories of the origin of ore-deposits, such contact-zones should be favourable places in which to find mineralization.

In speaking of the eastern contact-zone of the Coast range it must be remembered that such a contact is generally a zone many miles wide, constituting an area which is transitional from the solid granitic rocks of the heart of the range to the older rocks flanking the range. In a general way a section through at right angles to the axis of the range would show on the west, in the heart of the range, granitic rocks; thence coming east an area in which there were a few inclusions of the older rocks suspended in the granitic rocks; gradually the proportion of granitic rocks fades away until the section would show the older rocks almost unbroken, except for a few dykes interjected from the Coast Range batholithic rocks. It should be remembered, too, that, on its eastern side, the Coast range has thrown out many subsidiary ranges which increase the width of the range and increase the area of intrusive contact relations with the older rocks.

It is apparent, therefore, that the eastern contact-zone of the Coast range is an area often many miles wide and paralleling the range along its axis.

The *Britannia* mine, on Howe sound, is an especially good example of a very large low-grade copper-bearing ore-body occurring in the western contact of the Coast range. Here a large inclusion of the older rocks through which the batholith was intruded has been caught up in the Coast Range granitic rocks, turned into schist, and mineralized.

The mining camps situated on this eastern contact which show the continuity of the mineralization over considerable distances are in Alaska, near Stewart, Alice arm, and Anyox, Hazelton, and away south in Lillooet.

It was therefore considered that a rough reconnaissance of the strip lying south of the Grand Trunk Pacific and stretching to the Lillooet district might afford some indication as to likely areas in which to prospect. It soon became apparent in the field that, owing to lack of trails, it would be impossible to follow this contact-zone very closely. The best that could be accomplished was to examine the area in a few different places and come southerly on the trails that could be followed. A few places on the contact-zone where claims have been staked were known of and these were all examined.

On the northern end of the journey the Coast Range eastern contact was fairly well touched on in the examinations of the Owen Lake and Sibola sections; and farther south in the country at the head of Whitesail and Eutsuk lakes and the Tahtsa river. Farther south in following the Bella Coola trail from Ootsa lake the Coast range was left some distance to the west, but on entering the Bella Coola valley the Coast range was partially crossed. Reports of mineral locations in this latter district were heard, but, as it was then so late in the season, no time was available for any examination.

Another object of the trip was to obtain information about the iron-showings on the Klinaklini river and other mineral-showings around Tatlayoko lake. This completed the field season, and here again the contact area of the Coast range was entered and general information obtained.

Although the examination of this contact area was disconnected and rough, it is believed that the information obtained has been considerable, and that it may assist in the future in directing prospecting of the region in an intelligent way.

PARTY, EQUIPMENT, ETC.

In addition to the writer, the party consisted of D. A. MacKinnon, field assistant; Barney Mulvany, packer; and the position of cook—not an unimportant personage in such an expedition—filled for a time by J. R. Galloway, and later from Ootsa Lake to the finish by James Morgan. All performed their duties in a satisfactory manner. Ten horses were bought, six of which were used as pack-horses and the other four as saddle-horses.

The horses were assembled at Houston by Mulvany by August 4th, and the other members of the party arrived there by train from Telkwa on the same day. Part of the supply of stores for the first stage of the journey—from Houston to Ootsa Lake—was purchased at Telkwa and shipped to Houston by rail; the balance was secured at Houston. August 5th was spent in arranging packs, adjusting pack-saddles, and fixing up the numberless little things which have

to be done in getting ready an outfit for a long trip. The actual start was made on August 6th, and all went well the first day out—a good omen which speaks well for the packer, as with horses which have not been packed for a year, many things may happen the first day.

It turned out later that a very good set of horses had been obtained, as but little trouble was experienced with them all season. None of them developed sore backs during the trip, which also is a tribute to the packer, and with few exceptions no time was lost in looking for "lost horses," the common bugbear of a pack trip, which, in addition to causing loss of time, is very trying on the temper of the party.

From Houston the first stage of the journey was to Ootsá Lake, which included the examination of claims at Owen lake, Sibola mountain, and Sweeney mountain. Ootsa Lake was reached on August 31st, and two weeks were then spent in examining the shores of Ootsa, Whitesail, and Eutsuk lakes by boat. Meantime the packer had secured additional supplies from stores on Francois lake. Here J. R. Galloway left the party and his place was taken by James Morgan, the pioner rancher of the Ootsa Lake district. On September 17th, the start for Bella Coola was made, which was reached via the mountain trail on September 30th. After reprovisioning, the party went up the Bella Coola valley and out to Alexis Creek, including on the way an examination of iron-showings on the Klinaklini river and Tatlayoko lake, mineral claims at the southern end of Tatlayoko lake, and some other mineral discoveries.

Alexis Creek was reached on November 7th, and here the party disbanded. The horses were sold to Mulvany and Morgan, who took them back to the northern country via the Blackwater-Fort Fraser wagon-road route, and the writer and his assistant returned to the Coast by auto to Ashcroft and the Canadian Pacific Railway to Vancouver.

BIBLIOGRAPHY.

A large part of the region described in this report has never been previously reported on from a geologic view-point. In 1875 and 1876 Dr. George Dawson examined a portion of this country following preliminary surveys which were then being run for the Canadian Pacific Railway. In the first year his reconnaissance-work covered from Soda Creek via the Chilcotin country and the Blackwater river to Fort George. In 1876 the area between the Fraser river and the Coast range and lying south of Francois lake and north of Bella Coola was partially examined. In most of his work Dawson's examinations were of country somewhat to the east of the route of the writer, although the Bella Coola-Ootsa Lake trail was traversed and also the region around Tatlayoko lake.

In 1910 Wm. Fleet Robertson, Provincial Mineralogist, made a trip from Alexis Creek to Tatlayoko lake, his report appearing in the Annual Report of the Minister of Mines for 1910.

In 1912, Bateman, of the Geological Survey, examined an area surrounding Chilko and Whitewater lakes, but this lies to the south of the ending point of the writer's trip. His report, however, enables the geological formations around Tatlayoko lake to be correlated with those of Chilko lake.

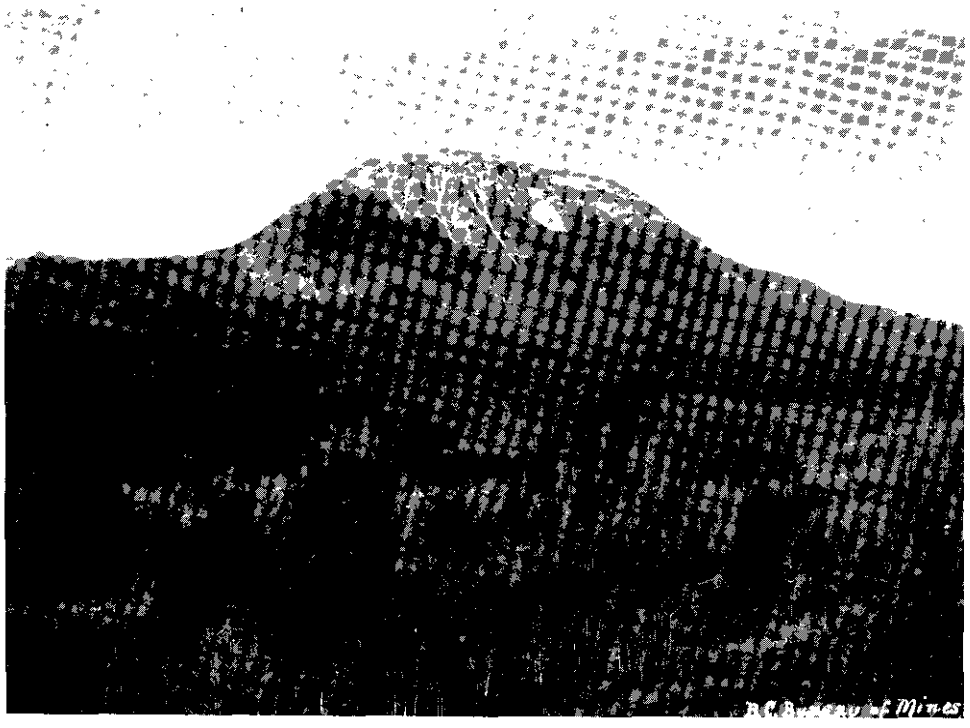
The geological investigations which have been carried on in the Hazelton-Telkwa district afforded a key to the study of the formations in the northern portion of the area examined by the writer.

So far as is known, no other reports on this area have been published, with the exception, possibly, of some literature on the land areas of the Francois-Ootsa district.

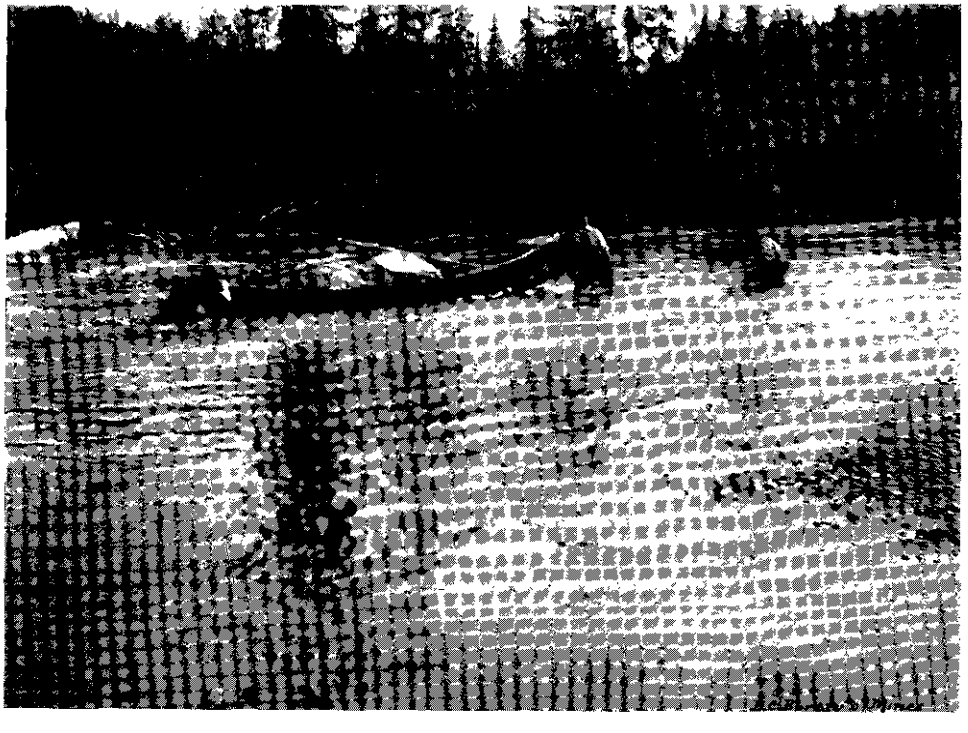
SUMMARY AND CONCLUSIONS.

In a general way a large portion of the territory embraced in this report is considered to be possible mineral-bearing country, and many localities may be classed as being probable areas of mineralization. In some places locations have already been made, but as yet practically no development has been done.

In the area south-west of Houston, including Owen lake, and the Sibola district, there is evidence of widespread mineralization, and at least one section—viz., Sweeney mountain—is decidedly promising. Farther south there is a large area around Tahtsa, Whitesail, and Eutsuk lakes, including those portions of the Coast range known as the Tahtsa and Whitesail mountains, which, from a geological view-point, should be likely country for prospecting. The country south of this along the contact-zone was not examined, the route followed being somewhat to the east along the Bella Coola trail from Ootsa Lake. In this area actually travelled no evidence



Nadina Mountain, Omineca Mining Division.



Whitesail River Rapids, Omineca Mining Division.

was seen of mineralization, and the country is not considered by the writer to be a promising area for prospecting. To the west of the route of the trail, however, conditions may be more favourable. The contact-zone where crossed by the Bella Coola valley is largely capped with the recent Tertiary volcanics, and no signs of mineralization were noted. In many places erosion has laid bare the granitic rocks of the Coast range, and on this granitic surface the Tertiary lavas have been extruded. Reports of mineral discoveries in the rugged parts of the range on the headwaters of the Bella Coola river were heard, but time was not available for examination. Many localities along this portion of the contact may not be capped by the recent volcanics, and there again mineralized areas may be found.

Southerly from the Bella Coola valley on the headwaters of the Klinaklini, Homathko, and Tatlayoko rivers further evidence of mineralization in the contact-zone is apparent; here some claims have been staked and slightly developed. Although the present discoveries are as yet only of slight importance, it must be remembered that the area is virtually unprospected, with the exception of the few locations made near the main streams. With further prospecting more promising showings may be discovered.

Farther south around Chilko lake large deposits of low-grade copper minerals are reported, but this district was not visited.

To sum up: this area lying along the eastern side of the Coast range between the Grand Trunk Pacific Railway and the Lillooet district is a large virgin field for prospecting, in which it may be reasonably expected that many valuable ore-bodies will yet be found. At the present time the district is somewhat inaccessible, but with the gradual extension of trails and roads it is expected that certain sections will become productive.

Speaking generally, the area under consideration will have to be opened from the east, as the Coast range interposes an almost impassable barrier to the Coast. There are, of course, some passes through the range, but as a rule these are not such as to lend themselves to favourable transportation routes.

Part of the country travelled through during the season has a future in stock-raising and mixed farming. The area lying between the Grand Trunk Pacific Railway and Ootsa lake and extending to the Owen Lake district contains a great deal of country suitable for stock-raising. The altitude and summer frosts may prevent any very extensive farming, but potatoes and oats can in most years be grown without difficulty. Wild grasses grow luxuriantly, and there is at present unlimited summer range for cattle. Stock-raising has been started, but not as yet on a very extensive scale, but each year will see a larger production.

The country lying between Ootsa lake and the northern end of the Chilcotin country (traversed by the Ootsa Lake-Bella Coola trail) does not appear to be of any particular value for anything. It is covered mainly with a sandy, gravelly soil, on which nothing grows but a thick growth of small jack-pine. Here and there, there are meadows in which beaver-grass grows plentifully, and occasionally a little pine-grass is seen amongst the pine-trees, but as a rule the country is barren. Towards the Chilcotin district the meadows become very numerous, and the character of the country gradually changes until the bunch-grass hills of the Chilcotin are entered. Here stock-raising has been carried on for years.

Practically no sawmill timber of large size was seen during the season, except in the Bella Coola valley, where there is an exceptionally good stand of Douglas fir and pulp timber. There may be a few other places in the area under consideration where there is some good timber, but they cannot be very extensive. Timber for mining operations and local use is, of course, plentiful nearly everywhere.

The country is reputed to be a good game country, but no big game at all was seen on the trip. The lakes and rivers are well stocked with trout of all sizes up to those in Francois lake, which are said to weigh 30 lb. A point worthy of mention is that no salmon ever get into the great lake system surrounding Ootsa, Francois, and other lakes, which is drained by the Nechako river. The reason is that the fish cannot get past the falls on the Nechako river. If a fish-ladder was installed at this point these numerous lakes would provide an ideal spawning-ground for salmon, and would thereby increase the run of salmon in the Fraser river.

This is a good fur-producing country; fox are quite common and fox-farming has been started around Ootsa lake in a small way. Marten, fisher, beaver, and lynx are plentiful. The coyotes are too numerous for the good of the country, but considerable revenue is obtained by the settlers from the bounty and selling the hides.

In the detailed description of the itinerary which is appended to this report will be found information regarding existing trails in this district. As certain sections develop some aid from the Government in trail and road building will be undoubtedly required. The trail running from the Sibola district, and known as the Bonthrone trail, should be repaired and fixed in good shape in order to assist prospectors in getting into this district. This could be done for a small expenditure. At some future date transportation for a part of this district, by using the lakes and rivers for boat travel, may be arranged but it is too soon yet to consider this.

Another future possibility is that a branch line may be run south from the main line of the Grand Trunk Pacific Railway to tap the Francois-Ootsa country, but this will not materialize for some time yet.

GENERAL PHYSICAL FEATURES.

The area covered in this report embraces three distinct physiographic provinces, which, however, grade into one another. In the long trip which was taken the route lay in a general way between the eastern border of the Coast range and the Interior plateau of British Columbia. As has been before outlined, the primary object of the trip was to obtain information about a portion of this eastern contact of the Coast range. But owing to the necessity of following existing trails it was only possible in some places to be on this contact-zone.

The three physical types in the area under consideration are: First, on the west, the Coast Range area; second, an area ten to twenty miles wide in which the topography represents a transition-zone from the Coast range to the Interior plateau; and, third, the Interior Plateau area on the east. The Coast Range area is characterized by rugged mountains deeply carved with canyons and gorges occupied by torrential streams. Secondly, there is a strip of country ten to twenty miles wide and trending in the general direction of the Coast range which forms a gradual transition to the plateau country to the east. Thirdly, to the east lies that country which is the northerly continuation of the Interior plateau, which, however, at least in the more northerly portion, has features distinguishing it from typical Interior Plateau country.

COAST RANGE.

The Coast range is one of the most important physiographic units of the North American Cordillera. It stretches practically from the International Boundary-line to Alaska, a distance of 1,000 miles, and the range proper has a width of from forty to eighty miles. In many parts this range has been closely examined by different geologists; in the northern part of the Province it has been studied by McConnell and Cairnes; In Alaska by officers of the United States Geological Survey; and at its southern termination by Daly, Drysdale, Camsell, and other geologists of the Canadian Geological Survey. The eastern side of the Coast range near its southern extremity was thoroughly studied by Bancroft* and also by Le Roy.

Physiographically, the Coast range is terminated to the south by the Fraser river, which separates it from the Cascade range, which extends south through the State of Washington. In some reports the continuity of crest-line of these two ranges has caused them to be regarded as one range, to which the name "Cascade" is applied. But popular usage, and also now the official ruling of the Geographic Board of Canada fixing the name "Coast range," has recognized that the master-trench occupied by the Fraser river is the dividing line between the Coast and Cascade ranges. Nevertheless, we still find our own Provincial departments constantly referring to the "Cascades" and "Cascade range" of British Columbia when in reality the Coast range is referred to.

A lengthy discussion of the nomenclature of the mountains of British Columbia at the International Boundary-line is given in a very comprehensive memoir by R. A. Daly. This work, which is entitled "North American Cordillera, Forty-ninth Parallel," is issued by the Canadian Geological Survey. Dr. Daly was attached as Canadian geologist to the International Boundary Commission and spent on the work the field seasons of 1901 to 1906, inclusive. His report, issued in two volumes and well illustrated, and with accompanying maps in a third volume, is perhaps the most important piece of geological and physiographic work done in British Columbia. The numerous and varied names applied to the different mountains in British Columbia and the looseness with which different names were used in designating the

* Geology of the Coast and Islands, Geological Survey of Canada.

same mountain systems, ranges, and units soon became apparent to Dr. Daly, with the result that Chapter III. of the report is devoted to a consideration of the various names used at different times. To quote his own words: "A chapter on the nomenclature of the Cordilleran ranges at the International Boundary illustrates the need of a systematic attack on the difficult problem of names." Thanks to Dr. Daly, the problem has been greatly simplified, as after thorough consideration he has adopted those names which seemed best, and in each case has defined what territory is embraced by the name, and it seems likely that his names will soon be universally adopted, as they certainly should be.

The term "Coast range" must be understood to mean much more than a single defined range unit, as it really embraces a system of mountains. It is true there is a more or less well-defined Coast range extending from the International Boundary to Alaska, a distance of 1,000 miles, and varying in width from forty to eighty miles. But in addition there are, especially on the eastern side, numerous secondary ranges radiating out from the main Coast range which in themselves form important mountains.

The Coast range has a width where crossed by the Skeena river, according to McConnell, of fifty-eight miles. This, however, refers to the Coast range proper, but in this latitude there are a number of granitic ranges which must be considered as belonging to the same epoch of mountain-building, and which are also physiographically connected with the Coast range. To quote McConnell in this connection: "The eastern boundary of the Coast range is not always easy to define, as it often merges insensibly into the high plateaux and mountains of the interior. . . . East of the Kitsumgallum valley a second wide range of high, nameless mountains, mostly built of schist and granite, is crossed. These connect to the south with the Coast range and may be considered a spur from it." Farther to the east and the south-east are the Rocher Déboulé mountains and the lofty Hudson Bay group of mountains, both of which are to some extent connected with the Coast range, as they are formed of granitic cores. The connection between these ranges physiographically with the Coast range is better seen by considering them at some distance south of the Skeena river. The headwaters of the Morice and Telkwa rivers are in the outlying eastern fringes of the Coast range, and by following due north on these "Telkwa" mountains the mass of mountains lying in the "big loop" formed by the Skeena and Bulkley rivers is reached. The main Coast range, however, by trending to the west is found along the Skeena river to lie roughly between Copper City and Prince Rupert. Similarly, in many other parts of the Coast range the secondary spur ranges running off from it increase the real width of the range very materially.

The Bulkley river forms a well-marked trench or dividing line separating these outlying mountains of the Coast range from the Babine range to the east.

The eastern portion of the Coast range considered in this report lies between north latitudes 51° and 54° 30'. Of course, in this large section actual examination was confined to a few places, and even there only the outer fringe of the range was touched. But in a general way throughout the whole trip the Coast range was practically always in sight and its general characteristics and features could be noted. The range here, as elsewhere, is characterized by its ruggedness and extreme compactness. Compared with other mountain ranges, the elevations are not high, ranging as they do from 7,000 to 10,000 feet. But these mountains lose nothing in grandeur, scenery, and alpine features by having a comparatively low average altitude. There is throughout the main range a general accordance of summit-levels which, especially at a distance, is about the first feature to attract the eye. This same feature is pronounced throughout the range and has led many observers to postulate the theory that the range represents an uplifted Tertiary peneplane, which has been partially dissected in late Pliocene and early Pleistocene times. But other geologists consider that no peneplanation took place in British Columbia in the Tertiary, and that the present topographic surface is due to continued erosion since the Laramie revolution, when the mountains were largely built.

The Coast range in this area is characterized by the same rugged topography which is common throughout the range. The average elevation of the higher portions is from 7,000 to 9,000 feet above sea-level, and the relief between the valley-bottoms and the mountain peaks is from 4,000 to 5,000 feet. Timber-line is at about 4,500 feet in the northern portion, gradually increasing to 5,500 feet coming south.

Deep U-shaped valleys cutting the range either in a north-and-south direction or an east-and-west direction are conspicuous features of the topography. In the northern portions a number

of east-and-west valleys heading in the heart of the range are occupied by Loring, McAulay, Tathsa, Whitesail, and Eutsuk lakes. In the southern portion Tatlayoko, Chilko, and Whitewater lakes occupy north-and-south valleys which are on the outer eastern edge of the range. The Klinaklini and Homathko rivers cut the range transversely by valleys which have a general southerly direction.

The individual peaks of the range are steep and rugged and many of them rise abruptly from the surrounding country in precipitous walls. Some of the higher peaks are sharp and jagged, apparently being above the limit of glaciation. Generally, however, the range shows the effects of profound glaciation, which has smoothed down the rough edges and left smooth massive bluffs and surfaces which are most impressive in aspect. Snow and ice fields are general at the higher elevations and small glaciers extending down to lower levels are numerous. Deposits of moranial material strew the valleys, all of which show the modifying effects of the flow of ice in the Glacial period. The small tributary creeks entering the main valleys often occupy hanging valleys.

The mountains of the Coast range are formed mainly of granitic rocks, together with inclusions, patches, and remnants of older sediments and volcanics; these older rocks are well developed on both flanks of the range, and there in places the granite rocks become of secondary importance. Speaking generally, the rocks forming the range are hard and very resistant to erosion agencies, the result being that the mountains are as a rule of massive appearance. Glaciation has, however, cut deep trenches, gorges, and cirques in these mountains and has in places chiselled out most beautiful forms of rock-sculpture. The summits are generally dome-like in appearance, but sharp needle-shaped peaks are not entirely absent.

INTERMEDIATE PHYSIOGRAPHIC AREA.

The transition area which lies between the Coast range and the Interior Plateau country is a strip of country of variable width running down the eastern flank of the Coast range. The Sibola-Tahtsa River country may be considered typical of it. Here the plateau surface is broken by spurs of mountains radiating out from the Coast range.

This area is characterized by mountain masses generally less rugged than the main Coast range and interspersed with areas of plateau land. The relief is considerable and the mountains are broken and irregular. Flat areas covered with meadows, small lakes, and streams are of frequent occurrence.

From Houston south to Eutsuk lake this transitional topographic type is well developed, but farther south this type fades out as the Coast range rises abruptly from the Interior plateau with no transitional area. The development of it in the northern portion is due to the number of subsidiary mountains or foot-hills radiating out from the main Coast range. The main axis of the Coast range trends in a north-west direction, while as a rule the secondary ranges project from the main range in a northerly direction. Some, however, strike easterly or north-easterly.

INTERIOR PLATEAU SECTION.

The commencement of the writer's trip was made at Houston, where the Bulkley river is but a small stream and only a short distance from its head in Bulkley lake. This lake represents the height of land in this portion of the Province, as east of this point water flows into the Nechako-Fraser River system. The large lake area, to be described later, lying south of the railway-line all drains to the east, eventually going into the Fraser river.

The route of travel by the writer from Houston was in a general direction west of south to the Sibola country. By coming southerly and westerly, and as the general trend of the Coast range is west of north and south of east, the outer edge of the range was soon entered.

From Houston to Owen lake and beyond that to the Sibola section is a rolling country which, however, is more mountainous than typical Interior Plateau country. This section, which is typical of a large part of the northern interior of the Province, differs considerably in its topography from the Interior plateau of the south. In the south the Interior plateau is an uplifted peneplane into which deep river-valleys have been carved, giving the appearance when in the valleys of a mountainous country, but from the ridges, of a flat plane country. In the north the relief between the river-valleys and lakes and the surrounding country is not great. There has not been any great uplift of the country since peneplanation, and, in fact, it may be

doubted if there has been any. Further, peneplanation has not proceeded to the degree which it attained in the Interior plateau. The resulting topography is an area in which the general level of the waterways is but little below that of the average level of the surrounding country. But another feature is the number of hills, which in places attain sufficient elevation to be called mountains, which are more numerous than in the southern part of the Interior plateau. In the northern section the most prominent and outstanding of these single mountains is Nadina, which is rendered the more noticeable because of its being an isolated dome in no way connected with other ridges or hills.

The topographic features of this section give it the appearance of an upland plateau which has been maturely eroded and is now in the period of old age. The ridges, hills, and mountains which are still prominent above the general level are probably formed of rocks which offered considerable resistance to erosion, but in some cases may be due to local upwarpings.

Further to the south along the Bella Coola trail the country is flat and typically plateau-like in appearance. Here the plateau extends westward to the base of the Coast range, which rises abruptly from it. The plateau area is broken to the east by the Ilgachuz, Tsitsutl, and Itcha mountains. These lie to the east of the writer's route, but were easily visible. They are described by Dawson as being remnants of volcanic mountains. Another prominent mountain which is visible for long distances is Anahim butte, about 6,000 feet in elevation, which lies fifteen miles south of Altgatcho. This also is an old volcano, and here the Indians used to secure obsidian for making hatchets, knives, etc., before the advent of the white man brought steel implements to them. This mountain was seen distinctly from Mount Morgan, on Eutsuk lake, a distance of about 80 miles. The summer trail to Bella Coola passes to the west of this mountain and the winter trail to the east of it.

On leaving the Bella Coola valley and following the telegraph trail to Klinaklini, the Interior Plateau country is reached by gradually climbing up the Bella Coola valley, and more quickly as the trail follows up the Atnarko and the Hotnarko rivers. The transition from Coast range to Interior plateau here is abrupt. The plateau has a general elevation of 3,000 to 3,500 feet, and here again the rivers are not cut deeply into the surface.

Farther on in the northern end of the Chilcotin district the country is all of the Interior Plateau type, but nowhere are the rivers incised deeply into the country. Going southerly, however, they gradually cut down, or, to put it in another way, the plateau has been elevated.

In this northern Interior plateau the relief is varied. The average level of the plateau is hardly above that of the waterways, and therefore there is an almost absolute lack of relief; but the number of hills and mountains occurring at frequent intervals introduce considerable relief at many places. The large number of lakes and small ponds and sluggish streams show plainly the flat nature of the country.

DRAINAGE.

The main drainage of the country under consideration is easterly to the Fraser river. Starting at the northern portion, the Bulkley and Morice rivers, which latter flows into the Bulkley river, drain the eastern side of the Telkwa and other mountains which lie to the east of the Coast range, eventually flowing into the Skeena river, which empties into the sea at Port Essington. The Skeena cuts right through the Coast range and carries a considerable volume of water obtained in its drainage-basin east of the main watershed of the Coast range. Farther south there is the large lake area including in it Tahtsa, Eutsuk, Whitesail, Tetachuck, Ootsa, and Fraincois lakes, all of which drain into the Nechako river, and finally into the Fraser.

The rivers in this area are not as a rule large, and usually flow but a short distance from one lake to another. The Tahtsa river, rising in the lake of the same name, flows for thirty miles, coming into the western end of Ootsa lake. The Nadina river gathers waters from many small lakes in the Sibola section and flows easterly to Francois lake.

The accumulated waters in Ootsa lake flow out by the Ootsa river, which flows five miles to Intahtah lake, then from that lake by a short river into Natalkuz lake. Cheslaslie lake, into which drain the waters from the mountains, lying between Eutsuk and Ootsa lakes' (called on some maps the Quanchus range), gives rise to the small, sluggish, but deep Cheslaslie river, which flows into Enchu lake. The accumulated waters in the Eutsuk-Tetachuck system flow out by the Tetachuck river, a swift and fairly large stream, which, going about ten miles, also

enters Enchu lake. This lake practically forms an arm of Natalkuz lake, joining it by a stream a mile or two in length. Natalkuz lake is the starting-point of the Nechako river, which flows easterly and northerly, gathering waters from many other smaller lakes, and joins the Fraser at Fort George. Intahtah, Natalkuz, and Enchu lakes are all small and form collecting-reservoirs for the waters which feed the Nechako.

Francois lake, with its accompanying chain of smaller lakes, empties by the Stellako river into Fraser lake, which in turn discharges by the Nautley river, only a few miles in length, into the Nechako near Fort Fraser. South of this, on the Bella Coola trail, there are very few rivers, but the country is dotted with small lakes and creeks, all of which drain gradually easterly to the Fraser system.

The western drainage of the Coast range south of the Skeena river is by a number of short streams which, as a rule, have a steep gradient, flowing in canyons and with numerous falls and rapids. The more important of these are: The Ecstall river, coming out at Port Essington; the Kitimat, flowing into Kitimat arm; the Kildala, flowing into Kildala arm; the Kemano and Kitlobe rivers, flowing into Gardner canal; and the Kimsquit, flowing into Dean channel.

The first river south of the Skeena to carry waters from the eastern side of the Coast range, right through the range to the Pacific, is the Salmon or Dean river, which flows into Dean channel. This is crossed on the Bella Coola trail ten miles south of Algatcho. The Bella Coola river is the next deep valley which cross-sections the Coast range, but only a very small amount of water from the eastern side of the range is collected by this river, by means of some small tributaries.

Farther south the Klinaklini river, draining into Knight inlet, cuts right through the range, but again the drainage-basin on the eastern side of the range is quite small.

The country south of the lake area which drains into the Nechako river and east of the Coast range is partly drained by the Nazko-Blackwater system, the waters from which join the Fraser via the Blackwater river. Still farther south, Tatla, Tatlayoko, Chilko, and Whitewater and many smaller lakes drain by means of the Chilko, Chilanko, and smaller streams into the Chilcotin river, which joins the Fraser below the 150-Mile House.

It can thus be seen that the main drainage east of the country from the watershed of the Coast range is easterly into the Fraser river.

In the description in the Appendix of the lake trip taken by the writer it will be seen that a long circuit of country can be covered by going around Ootsa, Whitesail, Eutsuk, and Tetachuck lakes. Francois is also about seventy miles long. The number of large lakes and navigable streams joining the lakes in this country will undoubtedly prove of considerable value in the future in opening up the country and providing transportation.

The Tahtsa river, which drains Tahtsa lake, could be made navigable for river-boats at small expense. The Whitesail river, which joins the Tahtsa river, could also be made navigable during at least a part of the year. This river drains Whitesail lake, and a portage of only one mile separates this lake from the large body of water known as Eutsuk lake. The Tahtsa river flows into Ootsa lake, which is nearly fifty miles long by three or four wide. From the end of this lake the Ootsa river flows out, going a short distance into Intahtah lake. From here the Nechako river commences, which is formed by the confluence of the waters from Ootsa, Eutsuk, and other smaller lakes. This Nechako river is therefore, at its commencement, a large stream, and it is believed it is easily navigable for fair-sized boats right to Fort Fraser, on the Grand Trunk Pacific Railway. The distance by this water route from Fort Fraser to the head of Tahtsa lake is at least 200 miles, and from it there is the tributary route up to the head of Whitesail lake of forty miles more. Then connecting with Whitesail lake by a short portage is a stretch of sixty miles of water in Eutsuk lake. It must be remembered that this system of waterways is at present only navigable for canoes and rowboats, but throughout this chain of rivers and lakes there are no falls and only a few slight rapids, so that, if the need arises in the future for adequate water transportation, it is believed that such could be provided at a comparatively small expense. The principal work in making this system of waterways navigable would be in removing log-jams in the rivers and in places straightening out and confining the streams to one deep channel.

The lake to which the name Whitesail is applied is marked on most of the maps as "Tahtsa." These maps, however, are wrong, as Tahtsa lake lies at the head of the Tahtsa river, but the maps call Tahtsa lake "Emerald" lake, which is also wrong. It seems best to preserve the names Whitesail and Tahtsa, as they are well known and used locally, applying them respectively to "Tahtsa" and "Emerald" lakes as marked on the maps. This has been done in this report and on the accompanying map. The lake expansion on Whitesail river is marked on the maps as Long lake and also as Sinclair lake. The latter name seems preferable, as "Long" lakes are frequent all over the country, and so "Sinclair" is used. Again, in the Nechako pre-emption sheet Ootsa river is marked "Nechako" river, which is clearly wrong, and the Tetachuck river is marked "Eutsuk" river, which is also an error. All these corrections have been made on the map.

The stream flowing out of Tatlayoko lake forms the East branch of the Homathko river, and as such it is named on the existing maps. It is suggested, however, that a better and more distinctive name is that of "Tatlayoko river," and this name has been adopted in this report.

The name "Klinaklini" applied to the river and the telegraph-office and settlement around One Eye lake is spelt in a variety of ways. The telegraph-office is officially known as "Kleena Kleene," and other spellings are numerous. On looking into the matter it is found that the spelling "Klinaklini" has been used for a long time on the lower part of the river, and it seems best to adhere to this throughout; accordingly this has been done in this report.

GENERAL GEOLOGY.

REGIONAL.

In a general way the geology of the section of country covered in this report is comparatively simple, however complex it may prove to be in detail. To some extent the key to the whole geological problem is provided in the work already done at the northern and southern ends of the section, which have been worked out in at least a partial manner. As in nearly every other portion of British Columbia, pioneer work was done in this region by that tireless worker and accurate geological observer, Dr. Geo. M. Dawson, consisting of a rapid reconnaissance of a portion of the territory under consideration.

In 1875 and 1876 Dawson examined a considerable part of the middle interior of British Columbia, following to some extent the preliminary surveys which were then being run to find a route for the Canadian Pacific Railway. In the first year his route was from Soda Creek, on the Fraser, up through the Chilcotin country, thence via the Nazko and Blackwater rivers, and finally to Fort George and Quesnel. In 1876 the area examined is described by himself as: "Attention was devoted to the area between the Fraser river and the Coast range to the east and west, the Bella Coola valley and Francois lake to the north and south. In this country various lines were in course of examination as possible railway routes, and it also formed a natural extension of that in which the reconnaissance-work of the summer of 1875 was carried on."

Since that time, so far as is known, practically all of the country included in this report has never been examined or reported on by any geologist. It is therefore a large area of country on which the last word was written some forty years ago.

In 1910 the claims at the southern end of Tatlayoko lake were examined and reported on by W. Fleet Robertson, Provincial Mineralogist.

A short distance south of where the writer left off his field-work—viz., at Tatlayoko and Tatla lakes—lies Chilko lake. Starting from Bridge river and travelling to Chilko lake, a reconnaissance examination of this section was made by A. M. Bateman in 1913. From his description the country surrounding Chilko lake is very similar geologically with the Tatlayoko Lake section. His report on this work can be found in the Summary Report of the Geological Survey for 1913. Bateman's report links up and correlates the geological formations with those farther south, and the writer hopes to show how the rock formations from Hazelton south can be correlated with those that have already been studied.

In the region examined, which is covered by this report, there are four divisions of formations which are tentatively advanced as covering the greater part of the rocks exposed. These are set out in the following table:—

Quaternary	Superficial deposits	Sand, gravel, clay, glacial, and stream deposits.
Tertiary	Volcanic rocks	Principally olivine basalt, but including diabase, rhyolites, and porphyrites.
Jurassic to Post-Lower Cretaceous	Coast Range batholithic rocks..	Granite, granodiorite, diorite, and porphyritic rocks.
Lower Cretaceous..	Hazelton formation and formations lithologically similar, divisible in places into an upper and lower series	Sedimentary, volcanic and tufaceous rocks. In part metamorphosed rocks. Sometimes volcanics and sediments separate and sometimes interbedded and intercalated.

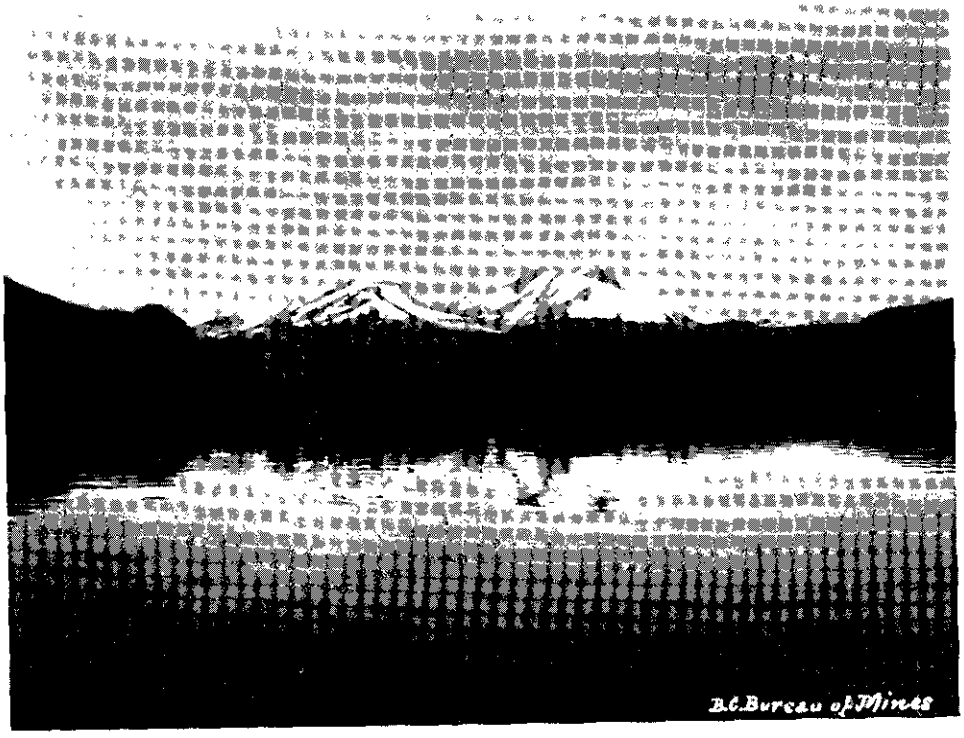
The above table is, of course, very tentative and provisional and only gives a general indication of what the chief rock formations are. With more detailed work other formations will probably be found, and the formations already identified will probably be subdivided into many divisions. Rocks belonging to the Cache Creek group of Carboniferous age might be expected to be found somewhere in the area, but none were recognized.

At many places along the route travelled rock samples were collected. It was hoped that it would be possible to examine at least some of these in thin section with the microscope, but time has not been available. It is felt also that such examination of these rocks, while it would doubtless be of interest, is not at the present time necessary. The rocks can in most cases be determined at least partially from examination of the hand sample, and the writer has had no difficulty in placing them in whatever series they belonged. It may be said that the classification of rocks over a wide area and the placing of them in different time series without thin section examination can have no scientific value, but it must be remembered that this report makes no pretensions of being other than a very rough reconnaissance. Other errors of observation will be infinitely greater than errors in determination of rocks from hand samples.

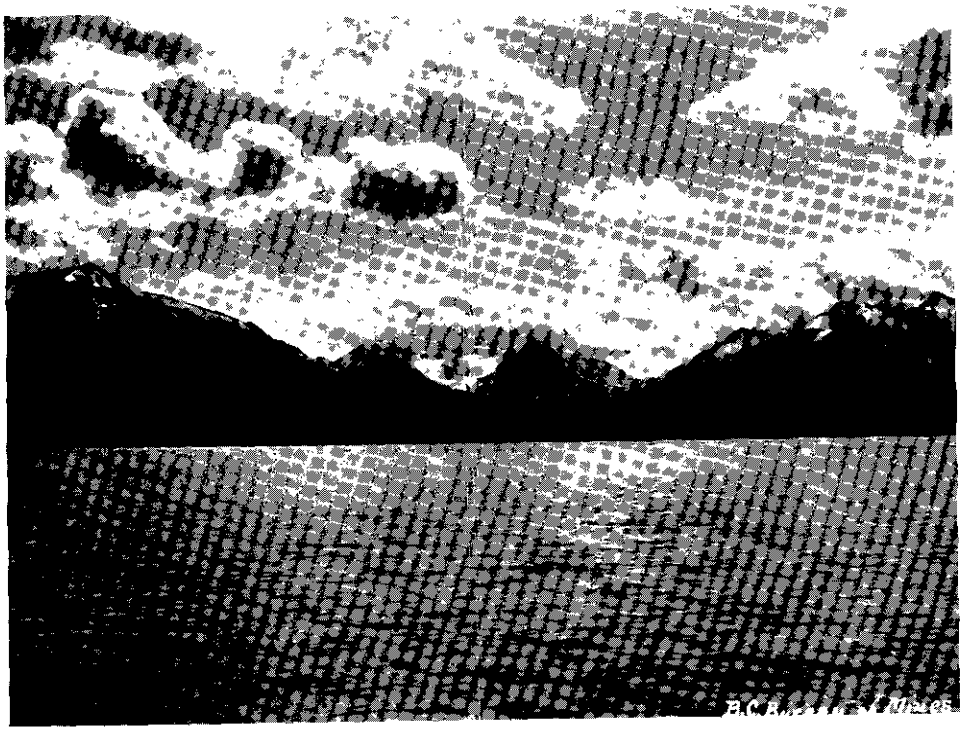
Following is a list of the more important rock samples collected on the trip, with their classification. The descriptions have been condensed as much as possible, and in many instances more information was learned from the hand examination than is apparent from the descriptions given.

From Houston to Sweeney Mountain.

No.	Place.	Name.	Remarks.
1	Diamond Belle, south-west of main showing, Owen lake	Feldspathic quartzite..	Consists mainly of silica and appears to be a quartzite, but has a very little feldspar in it. Dark-grey colour.
2	Vein-filling, Diamond Belle....	....	Largely siderite with some quartz.
3	Diamond Belle, main country-rock	Altered granite	Rock of granitic appearance, but badly weathered with kaolinized feldspar. Plenty of pyrite in it. This specimen was taken near the vein and has been pyritized and otherwise altered by the vein formation.
4	Sunnyside claim, ore occurs in this formation	Granitic rock	Dyke rock; contains some calcite.
5	Sunnyside claim	Gabbro	Consists nearly altogether of very black basic feldspar, possibly labradorite, with some augite.
6	Sunnyside claim	Gabbro porphyrite ...	Basic feldspar in good-sized phenocrysts, with fine-grained ground-mass.
7	Sunnyside, vein-filling	Altered granitic rock..	Mostly feldspar kaolinized, some quartz, and a very little chlorite.
8	Chisholm property, vein-filling..	....	Soft; consists of a little quartz and a lot of kaolinized feldspar with some pyrite.
9	Top of Nadina mountain, forming core of the mountain	Granite	Holocrystalline, but fine-grained biotite granite.



Western End of Whitesail Lake, Omineca Mining Division.



Eutsuk Lake.

From Houston to Sweeney Mountain—Concluded.

No.	Place.	Name.	Remarks.
10	South-eastern slope, Nadina mountain	Argillaceous rock	Homogeneous grey rock, sedimentary in origin.
11	Four miles south of Alexander's (Indian reservation)	Porphyry	Large phenocrysts of feldspar; very little mica. Some pyrite in the rock.
12	Near Poplar lake	....	Much-weathered rock, but is apparently of igneous origin. Contains feldspar (kaolinized) and a little quartz and abundant iron oxide.
13	Between Poplar and Crescent lakes	Diorite (?)	Feldspathic rock of dioritic affinities.
14	Half-way between Poplar and Crescent lakes	Fragmental rock	Partly fragmental volcanic material with siliceous matrix and quartzite fragments.
15	Near Crescent lake	Argillite	Abundant pyrite throughout.
16	Sibola mountain	Quartz diorite (?) ...	Contains quartz, feldspar, and hornblende; has greenish colour.
17	Sibola mountain	Andesite porphyrite ..	Numerous small even-sized phenocrysts of feldspar and slightly reddish-coloured ground-mass.
18	Sibola mountain	....	Basic volcanic rock, altered. Brecciated and plenty of iron oxide in it.
19	Sibola mountain	Andesite porphyrite ..	Partly altered rock; contains peculiar spherical and oval rings of kaolinized feldspar, sometimes concentrically banded. Plenty of hornblende and rock has reddish cast.
20	Sibola mountain	Granodiorite	Semi-porphyritic structure.
21	Sibola mountain	Argillaceous quartzite	Grey-black rock and quite hard with some small inclusions of pure silica.
22	Sibola mountain	Volcanic breccia (?)..	Consists of fragments of felsite and hornblende with a siliceous groundmass. Rock is greenish-coloured from secondary chlorite.
23	Jolimont, wall-rock	Altered diabase	Contains a good deal of chlorite and is brecciated in places.
24	Bellecini property, Sibola mountain	Diabase	Somewhat altered; pyroxene partially changed to chlorite.
25	Bellecini property, Sibola mountain	Quartz porphyry	Typical specimen.
26	Bed of White river	Granite	Contains biotite as dark mineral; some feldspar looks like plagioclase, so rock may be granodiorite. Fresh-looking rock; contains a little pyrite.
27	Hanging-wall, Emerald vein, Sweeney mountain	....	Granular rock consisting mainly of kaolinized feldspar and silica. From its structure it looks to be of sedimentary origin.
28	Dominion group, Sweeney mountain, wall-rock of copper vein	Felsite (?)	Mainly feldspar and may be dyke rock.
29	Sunset claim, Sweeney mountain	Altered limestone	This rock still contains a lot of lime, but also has a lot of quartz, hornblende, and chlorite in it. The specimen was taken near where a dioritic dyke cuts through and a considerable growth of secondary minerals has taken place in the limestone.
30	Sunset claim, Sweeney mountain	Diorite porphyrite ...	Dyke rock; contains even-sized phenocrysts of feldspar and basic groundmass.
31	Sunset dyke, paralleling vein..	Diorite	Quite basic and contains pyroxene, so approaches gabbro.

Bonthrone Trail.

No.	Place.	Name.	Remarks.
1	Five miles from Lake Lyster (easterly)	Diorite (?)	Consists of feldspar and chlorite.
2	Near White river, one mile from Sibola Crossing	Sediment (?)	Some lime, but is mostly silica; contains some small black specks that look like hornblende. May be altered ash rock.
3	Near summit of trail	Diorite porphyrite ...	Some specimens much weathered.
4	Three miles west of west end of Ootsa lake on north side	Syenite porphyry	Dyke rock with ground-mass of white orthoclase feldspar and small crystals of hornblende altered to chlorite.
5	Same locality	....	Light-coloured acid rock, probably of igneous origin.
6	Same locality	Diabase	Coarse-grained; contains amygdules of quartz.
7	Same locality	....	Apparently an igneous rock consisting almost entirely of feldspar.
8	Opposite west end of Ootsa lake	Granite porphyry	Contains phenocrysts of quartz and feldspar and lesser amount mica; also some pyrite partially oxidized to limonite. Almost a pegmatite.
9	Five miles east of west end of Ootsa lake, north side	Andesite	Fine-grained; mainly feldspar and a little hornblende, but has a very little quartz. Some iron oxide present.
10	Same locality	Andesite porphyrite..	Much-weathered rock. Feldspar partially kaolinized. Abundant iron oxide present.

Ootsa, Whitesail, and Eutsuk Lakes.

1	Two miles west of Bennett's...	Vesicular volcanic rock	Very much weathered and oxidized. Stained red with iron oxide.
2	Same locality	Diabase	Fine-grained with occasional amygdules.
3	Six miles west of Bennett's...	Rhyolite	Very fine-grained white rock.
4	Five miles west of Harrison's, south side of lake	Quartz porphyry	Typical specimen. Quartz phenocrysts with pinkish felsitic ground-mass.
5	Seven miles west of Harrison's, south side of lake	....	Rock consists mainly of silica, is very hard, and is stained red in places. May be quartzite.
6	South side Long lake, three miles from east end	Andesite (?)	Light-coloured acid rock with greenish cast, apparently of igneous origin.
7	South side of Whitesail river, one mile and a half above commencement of rapids	Granite porphyry	Feldspar considerably kaolinized.
8	Shore of Whitesail lake, near eastern end	Granite porphyry	Feldspar entirely kaolinized and whole rock altered very much. Originally very acid rock.
9	Shore of Whitesail lake (farther along)	....	Fine-grained, soft gray rock containing some lime. May be of volcanic origin.
10	Shore of Whitesail lake, northern side, ten miles from east end	Diorite	Fine-grained, sometimes porphyritic.
11	Beach Whitesail lake, near Harrison's cabin	Impure dolomitic limestone	Homogeneous, semi-crystalline, yellow-white rock.
12	Cariboo group, Whitesail lake..	Greenstone	Fine-grained green rock. Probably altered andesite.
13	Cariboo group, half-way in crosscut	Andesite (?)	Fine-grained red-stained rock. May be small dyke in contact with argillite.
14	Cariboo group, face of drift...	Calcareous argillite ..	Black argillaceous rock carrying a lot of calcium carbonate, but not as calcite.

Ootsa, Whitesail, and Eutsuk Lakes—Concluded.

No.	Place.	Name.	Remarks.
15	Whitesail lake, three miles above Cariboo group	Diorite (?)	Greenish-coloured rock, apparently largely fine-grained feldspar with possibly a little silica. Contains small crystals of dark mineral, probably hornblende, partly chloritized.
16	South end of bay in "Hole in the Wall," Whitesail lake	Diabase	Fairly coarse-grained and even in texture and very fresh and unaltered.
17	Bay in "Hole in the Wall," Whitesail lake	Calcareous argillite ..	This rock has veinlets of calcite in it and in places is fresh and unaltered.
18	Whitesail lake, south side, five miles above Cariboo group	....	Much-altered rock; contains quartz, feldspar, chlorite, and plenty of calcite. Appears to be igneous in origin.
19	Head of Whitesail lake, near southern edge	Diabase	Somewhat coarse-grained and granular.
20	Head of Whitesail lake	Granite	Contains quartz, biotite, and pink and white orthoclase. Medium-grained and fresh-looking. Amount of quartz is less than a normal granite.
21	Dyke rock from Mount Morgan	Porphyry	Mainly feldspar with very little quartz. Porphyritic structure not well marked. Plenty of iron oxide through it and feldspar partly kaolinized.
22	Mount Morgan	Syenite	Fine-grained; mainly feldspar and a few very small crystals of mica.
23	Mount Morgan	Diorite	Slightly porphyritic with phenocrysts of feldspar. Some grains of pyrite present.
24	Mount Morgan	Diorite	Fine-grained but holocrystalline and very little dark mineral present.
25	Mount Morgan	Gabbro	Porphyritic structure. Feldspar appears to be labradorite.
26	Mount Morgan	Gabbro	Porphyritic structure. Some chlorite present, but has fresh appearance.
27	Four miles east of Iron point, Eutsuk lake	Diorite (?)	Basic rock apparently of igneous origin; contains feldspar and hornblende and plenty of calcite.
28	Two miles from head of Eutsuk lake	Diorite (?)	Semi-porphyritic structure and much altered. Contains feldspar (partly kaolinized), a little silica, chlorite, and some calcite (secondary).
29	Two miles from head of Eutsuk lake	Argillaceous limestone	Black and contains pyrite crystals.
30	South-west end of Little Bear island	Andesitic breccia	Red-coloured with inclusions of greenstone.
31	Iron point	Slate	Black and somewhat calcareous. In contact with diorite.
32	Iron point	Diorite	Fine-grained. Contains a good deal of pyrite.
33	Two miles from head of Eutsuk lake	Andesite porphyrite ..	Greenish-coloured. Contains phenocrysts of feldspar much kaolinized.
34	Head of Eutsuk lake	Granodiorite	Contains both hornblende and mica.
35	From falls on river near head of Eutsuk lake	Granite	Light-coloured acid granite with very little dark mineral present. Contains pink orthoclase.
36	Head of Eutsuk lake	Syenite	Dyke cutting granodiorite. Fine-grained.

Taken between Ootsa Lake and Bella Coola Valley.

1	Bella Coola trail, three miles east of Ootsa Lake Post-office	Diorite	Fine-grained and altered. Dark mineral is partly leached out, leaving small pits through the rock. A little mica in the rock.

Taken between Ootsa Lake and Bella Coola Valley—Continued.

No.	Place.	Name.	Remarks.
2	Bella Coola trail, eight miles west of Ootsa Crossing	Basalt	Very fine-grained, fresh, hard, and basic.
3	Cheslaslie valley, west end	Andesite porphyrite..	Slightly reddish-coloured rock. Small phenocrysts of plagioclase and fine ground-mass.
4	Tetachuck falls	Granite	Medium-grained acid rock containing a little muscovite and biotite mica. In places quite porphyritic with quartz phenocrysts and fine ground-mass.
5	Tetachuck falls	Diorite	Typical specimen.
6	Tetachuck falls	Diorite	Peculiar rock, apparently a diorite. Weathers out to honeycombed mass.
7	Between Tetachuck and Cold camp	Granite	Hornblende granite; pinkish colour, fresh appearance.
8	Between Tetachuck and Cold camp	Granite porphyry	Mainly quartz and orthoclase phenocrysts without ground-mass.
9	Between Tetachuck and Cold camp	....	Consisting of silica and feldspar and very fine-grained. May be dyke rock.
10	Between Tetachuck and Cold camp	Olivine basalt	Typical specimen. Weathers to a soft grey-black colour on surface.
11	Between Cold camp and Majuba Hill	Diabase	Rock has fresh appearance.
12	Four miles north of Majuba Hill camp	Quartz porphyry	Very typical fresh-looking quartz porphyry. Has small rounded quartz phenocrysts in a faintly pinkish ground-mass consisting mainly of orthoclase feldspar.
13	One mile south of Majuba Hill camp	Quartzite (?)	This is a very peculiar rock consisting of practically straight silica. It is banded in alternate bands coloured white, red, and yellow; some of these are only ⅛ inch wide, but vary up to 1 inch in width. In places the rock is considerably folded and contorted. It does not look like a true quartzite, but may be.
14	Three miles south of Majuba Hill camp	Olivine diabase	Olivine occurs in small crystals. Rock is fresh in appearance.
15	Six miles from Algatcho	Granite	Typical specimen of hornblende granite of pinkish colour.
16	Seven miles from Algatcho ...	Diabase	Typical specimen.
17	Four miles south of Salmon river	Porphyrite diabase ...	Fine-grained porphyritic rock of dioritic affinities.
18	Eight miles south of Salmon river	Agglomerate or breccia	Rock consists of light-coloured ground-mass, mainly silica, and small dark angular fragments which appear to be diabase.
19	Seven miles north of Takia Lake camp	Diorite	Holocrystalline, but fine-grained hornblende is partially altered to chlorite and many grains of hæmatite through the rock.
20	Four miles north of Takia Lake camp	Argillite (?)	Appears to be a clay rock of some kind highly altered.
21	One mile north of Takia Lake camp	Argillite (?)	Dark rock with very slight bedded structure. Clay-formed rock.
22	South end of Takia lake	Granite	Good specimen of fairly coarse-grained granite. Contains biotite and hornblende. One phase shows preponderance of basic feldspar, but most of it is pinkish-coloured from pink orthoclase.
23	Three miles south of Takia lake	Porphyritic rock	Volcanic rock of medium acidity and much weathered at surface.
24	Fourteen miles from Takia lake	Granite	Coarse-grained, holocrystalline, normal hornblende granite. Typical Coast Range granite.

Taken between Ootsa Lake and Bella Coola Valley—Concluded.

No.	Place.	Name.	Remarks.
25	Twenty-two miles from Takia lake	Rhyolite	Typical specimen showing flow-structure and vesicles.
26	Same locality	Olivine diabase	Typical specimen, fresh, and showing flow-structure and some amgydules.
27	Between Marvin's and Kivet's..	Granodiorite	Typical Coast Range hornblende granodiorite.
28	Two miles above Marvin's ranch	Gneiss	This rock is a granite showing a typical gnessic structure with the hornblende drawn out in narrow lines. These give the rock a banded appearance with bands ¼ to ⅛ inch wide.
29	Bella Coola trail just beyond the "Precipice"	Olivine basalt	Numerous small amgydules in this rock filled with glassy, yellowish mineral.
30	Near Anahim lake	Diabase	Fine-grained fresh-looking rock.

Hazelton Formation.

The rocks in this area which are included under this heading have a widespread occurrence. They are found all along the eastern flank of the Coast range, being in places almost entirely obliterated by intrusions of granitoid rocks, and in other places being well developed.

The Hazelton formation in the vicinity of Hazelton consists of a great mass of pyroclastic and effusive volcanic rocks, with which are associated some thin beds of sedimentary measures. This formation was originally called the "Porphyrite group" by Dr. Dawson where it was examined by him in the Francois Lake district and on the Skeena river. This name was later abandoned as being misleading, as in many places the rocks of this formation are not porphyritic, and the name Hazelton formation applied by W. W. Leach.

The volcanic rocks in this series as developed near Hazelton consist chiefly of andesites, massive, and with characteristic green and red colours. Volcanic breccias and tufaceous rocks are of common occurrence. Some more basic lavas as diabase, basalt, and augite porphyrite also occur. The sedimentary beds consist of sandstones, shales, and conglomerates. The sediments are often considerably metamorphosed into quartzites, argillites, and schistose rocks. A tufaceous quartzite is a common member of the series.

In the northern part of the area under consideration these rocks consist of one distinct series of rocks, as is the case in the Hazelton district. Farther south the rocks gradually change into two distinct divisions of the series, which, however, are conformable with one another and are therefore considered as making up the main formation. The division into two series is well shown at Tatlayoko lake, where the upper series, consisting chiefly of sedimentary measures, rests apparently conformably on porphyritic volcanic rocks which have a very considerable thickness. Farther south on Chilko lake these rocks have been described by Bateman as consisting of two series, and from his description they are identical with the development around Tatlayoko lake.

The only fossils found anywhere on the trip were at Tatlayoko lake and one on the shore of Eutsuk lake. At the former place, on the east side of the lake, there is a bed of quartzite which carries a number of well-preserved fossils. These were first noted and examined by Dr. Dawson in 1876, and from his examination the age of the measures was placed as Lower Cretaceous. Fossils found by Bateman place the upper or sedimentary portion of the series found at Chilko lake in the Lower Cretaceous. Bateman suggests that these rocks be correlated with the Queen Charlotte formation as found in the vicinity of Lillooet. On the other hand, Drysdale suggests that this Queen Charlotte formation (Lillooet) should be correlated with the Skeena formation, which would therefore correlate the Chilko Lake upper series with the Skeena formation. From Bateman's description of the Chilko Lake rocks, which he does not name but assigns to the Lower Cretaceous, it is evident that they should be correlated with the Tatlayoko Lake rocks, and the writer considers that they should all be classed as portions of the Hazelton formation. The Skeena series in the Hazelton district lies on top of the Hazelton

formation, but is as a rule conformable with it, and fossils collected by Leach showed it also to be of Lower Cretaceous age. Correlation of these rocks, therefore, with the Hazelton and Skeena formations depends to some extent on lithological similarity, as the fossil evidence is so far not conclusive. It seems probable that the Hazelton and Skeena formations represent a time period starting in Jurassic and continuing on into Lower Cretaceous. At first the rocks were almost entirely volcanic, but soon periods of sedimentation occurred alternating with volcanic activity. Proceeding on into the Lower Cretaceous age, volcanic action gradually died away and sedimentation became dominant, and at the top is the Skeena formation, consisting entirely of sedimentary measures. The rocks, therefore, in this area which are listed as belonging to the Hazelton formation may in places contain sedimentary measures which should be correlated with the Skeena formation. Regarding these two series, Leach says: "The Skeena formation is apparently conformable with the Hazelton formation, and the line between them must be rather arbitrarily drawn, the coarse conglomerate already mentioned being regarded as the base of the Skeena formation."

After returning from the field the writer was given some fossils collected by James Corkle from a place lying to the south of Sweeney mountain and a few miles down the Tahtsa river from Tahtsa lake. Mr. Corkle says that at that place there is a development of sandstones and shale which, from his description, would seem to be similar to the Skeena series. The fossils belong to the genus *Aucella*, which are diagnostic of the Lower Cretaceous age.

Two fossils were given to the writer by Sam Colwell, of Klinaklini, which he secured on a branch of the Klinaklini river. These fossils are similar species to those occurring in the Tatlayoko Lake horizon, and apparently would confirm the classification of rocks in this region as being of the same age. Lithologically the rocks in the Klinaklini River section are typical Hazelton formation rocks.

The cast of an *ammonite* about 10 inches in diameter was seen in argillite on the shore of Eutsuk lake. In attempting to break it out it was shattered. Other fossils may be found in this locality, but time was not available for an extended search.

In the Hazelton district the Bulkley eruptives, which undoubtedly are connected with the Coast Range batholithic rocks, are intrusive into both the Hazelton and Skeena formations. In the Sibola district rocks of the Hazelton formation are intruded by granitic dykes and small batholiths from the Coast Range granitic bodies. Around the head of Eutsuk and Whitesail lakes the main batholithic granitoid rocks of the Coast range are exposed, and there again the Hazelton formation rocks are intruded and largely obliterated by the granitoid rocks. Farther south on the Bella Coola trail porphyritic volcanics of the Hazelton formation (Dawson's Porphyrite group) are intruded by small bodies of granite, and again around Tatlayoko lake the Hazelton formation is evidently older than the intrusive Coast Range granitic rocks. Similarly, Bateman shows that the Chilko Lake series (correlated with the Hazelton and Skeena formations) are intruded by the Coast Range batholithic rocks.

From this it is apparent that the eastern flank of the Coast range is made up of batholithic rocks which are younger than the Hazelton and Skeena formations, and therefore the rocks of this portion of the range are Post-Lower Cretaceous in age. The age of the Coast Range granitic rocks has generally been placed as late Jurassic to Lower Cretaceous. It is evident that the Coast range is made up of many different batholithic intrusions which were successively intruded during a long period. It would seem, however, that the eastern side of the range was the last portion to be intruded.

The volcanic rocks of the Hazelton formation consist largely of andesitic lavas and some diabase flows, volcanic breccias, and some tufaceous rocks. The andesites are often porphyritic and are usually of purple, grey, or green colours. They are compact and in places considerably altered, with the development of secondary minerals. They consist of plagioclase and hornblende or augite in small crystals occurring in a fine-grained ground-mass. The breccias are as a rule purple-coloured and the fragments are generally andesite occurring in a grey or purple ground-mass which is volcanic ash.

The sedimentary rocks of this formation, which in places are interbedded with the volcanics and in other places form a distinct upper series, are mainly argillites and sandstones which can generally be called quartzites. Beds of conglomerate, shale, and limestone—sometimes dolomitic—also occur, but are much less abundant. Feldspathic sandstones or quartzites are of frequent occurrence and many of the sediments contain tufaceous material. The argillites often contain considerable percentages of lime.

Where this formation is divisible into two series, the lower one consists almost exclusively of volcanic material and the upper one of sedimentary rocks. The lower series is generally rudely stratified and much of it is pyroclastic.

The whole series has been considerably folded and in places crumpled. The strata as a rule dip at high angles, and the strike is in general parallel to the main trend of the Coast range or west of north.

The series has passed through considerable regional metamorphism, due to the intrusion of the Coast Range batholithic rocks and the subsequent uplift of the range. Near the contact with the granitoid rocks the Hazelton formation rocks are often highly metamorphosed and altered. Such zones are economically important, as in them mineralization has often taken place.

Coast Range Batholithic Rocks.

The western border of this area is flanked by the Coast range, in which the predominating rocks are enormous intrusions of granitoid batholiths, together with dyke phases of these plutonics. The area covered in actual examination was in part along the outer fringe of the main batholithic rocks, and in the southern part a good section of the main range was visible when travelling in the Bella Coola valley. This is a tranverse valley cutting obliquely across the heart of the range. Where the summer trail from Ootsa Lake comes into the valley a depth of 4,000 feet is cut down into the granitoid rocks.

The intrusive rocks of this series may be divided into the deep-seated or plutonic rocks which have been injected or worked their way up through the stratified rocks as immense batholiths and the hypabyssal forms which, as dykes and stocks, are generally slightly younger than the main batholiths. These latter rocks traverse both the plutonic rocks and the older volcanics and sediments, and often radiate out long distances from the parent plutonic masses. In places they take various forms and may stretch out as sheets and sills in the stratified rocks.

The common type of the plutonic rock is a grey holocrystalline granodiorite, but many other phases occur, including granites, diorites, quartz diorites, and gabbros. The normal rock is holocrystalline and fairly coarse-grained, in which the predominating minerals are quartz, orthoclase, and plagioclase feldspar, and hornblende and biotite. The more acid varieties contain more biotite than hornblende. The feldspars are as a rule white, but pink shades, giving a pinkish cast to the whole rock, are more common in the masses outlying at some distance from the main range. Porphyritic facies are of frequent occurrence, usually as granite porphyrys and more rarely quartz porphyrys. The only place where a gneissic structure was seen was in the Bella Coola valley a short distance beyond Marvin's ranch.

Dyke rocks are of frequent occurrence, most of them apparently being connected with the main plutonic masses, but probably forming the culminating phase of igneous activity. They are generally of an acid type, although basic dykes are seen. Some basic dykes cutting the Hazelton volcanic formation may bear a genetic relationship to the extrusive rocks of that series. Felsites, aplites, and diorite dykes are most common, but pegmatites and lamprophyres were also noted.

Tertiary Volcanic Rocks.

Volcanic rocks of Tertiary age have a widespread occurrence along the eastern border of the district under consideration. The Interior Plateau region of British Columbia is in many places covered with Tertiary lava-flows and associated rocks which lie either conformably on Tertiary sediments or unconformably on Mesozoic or Palæozoic rocks. These rocks have been described in many places, notably by Dawson in the Kamloops area. They are as a rule easily recognizable, although where they are in contact with the porphyritic rocks of the Mesozoic they are sometimes not so easily identified. The first place in this area where these rocks were identified was along the northern shore of Ootsa lake near the eastern end. The rocks a short distance west of Ootsa lake were classed as Tertiary rocks on Dawson's geological map of 1876. This section was not examined by Dawson, but the classification was made from the examination of a set of rock specimens collected by Mr. Cambie, of the Canadian Pacific Railway survey.

The localities where these rocks were noted in this area are as follows: Along the northern shore of Ootsa lake. At frequent intervals along the Bella Coola trail as far as the Dean river, and again beyond to a point overlooking the Bella Coola valley. On the Telegraph trail from

Bella Coola to Alexis Creek these rocks commence a short distance beyond the "Precipice." From there on they are of frequent occurrence and cover the greater part of the northern Chilcotin country.

The commonest type is a black basalt generally vesicular or amygdaloidal. Greenish-black diabase, olivine basalt and diabase, augite andesites, green, grey, and purple andesites are also members of this series, and more occasionally trachyte and rhyolite flows are seen. Tufaceous rocks are nearly absent.

These rocks are as a rule lying nearly horizontally, and wherever they have dips these are due to slight local deflections. They rest unconformably on the older formations, generally on the Hazelton series, but on the Bella Coola trail these rocks can be seen resting on the eroded granite of the Coast range. The basalts usually show a columnar jointing. Many of the porphyritic facies are difficult to distinguish in hand specimens from the older porphyrites of Lower Cretaceous age.

These rocks stated to be of Tertiary age are correlated with the Tertiary volcanic rocks of the Interior plateau because of their lithological similarity.

Superficial Deposits.

Superficial deposits are found all over this area, flooring the valleys with gravel, sand, and clay. When travelling over that portion of the western edge of the Interior plateau in the vicinity of Ootsa lake and the Bella Coola trail, superficial deposits cover a large part of the country and often very few exposures of the solid rocks occur. Glacial morainal deposits are of frequent occurrence, and along the Bella Coola trail eskar-like deposits are seen.

In the mountainous area adjoining the main Coast range, and in the range itself, superficial deposits do not blanket the surface as they do farther to the east, but vast accumulations of glacial drift are seen in many places. In the mountains morainal deposits are common. Working-over of these deposits by stream-action is seen in many places, and roughly stratified stream gravels can be seen in some places.

DETAIL.

A description of the rock formations found along the different portions of the route followed is next given.

Houston-Owen Lake Area.

In this area rocks of the Hazelton formation predominate, and they are cut by later granitic and dioritic rocks. The Hazelton formation here consists largely of volcanic rocks of a prevailing acid type, such as andesites, volcanic breccias, and ash rocks; some basalts occur. Quartzite, often feldspathic, and argillites are seen interbedded with volcanic rocks.

In the neighbourhood of Owen lake the country-rock consists largely of plutonic and hypabyssal rocks as granite, gabbro, gabbro porphyrite, and diorite. The Hazelton formation has apparently been largely obliterated by these plutonic intrusions, but on the *Diamond Belle* claim a feldspathic quartzite can be seen.

Nadina mountain consists of argillaceous and volcanic rocks of the Hazelton formation, one steep face showing basaltic structure. The core of the mountain is apparently granite, as this rock is exposed at the top, cutting up through the other series; erosion has exposed the granite.

Owen Lake to Sweeney Mountain.

Hazelton formation rocks again predominate in this section. Along the trail between Owen lake and Sibola mountain are seen argillite, porphyritic basic volcanics, fragmental rocks, and andesite, and intrusive into these are diorites and quartz diorites. Sibola mountain consists of typical Hazelton formation rocks as diabase, andesite, breccias, and some sedimentary measures sufficiently metamorphosed to be called quartzite and argillite. Intrusive into these are granitic and quartz porphyry dykes, presumably of Coast Range age and affinities.

The rocks on Sweeney mountain are similar to Sibola mountain, but the intrusive plutonics of Coast Range age are present in much larger dykes and masses. White river, which occupies a deep canyon between the two mountains, has by erosion exposed the top of a granitic batholith which doubtless underlies both mountains, and has been the reservoir from which the dykes and sills in the upper parts have been fed. Among the sedimentary measures of Sweeney mountain is a band of limestone which, where seen near a dioritic dyke, is considerably altered with the

Eutsuk Lake, Omineca Mining Division.

Eutsuk Lake, Omineca Mining Division.

introduction of quartz, hornblende, and chlorite. This region represents a contact area of the Coast Range batholithic rocks with the older series, and has apparently been the scene of considerable mineralization.

Bonthrone Trail.

The lower horizon of the Hazelton formation rocks, consisting dominantly of volcanics, often porphyritic, is exposed along the Bonthrone trail. These rocks are very similar in appearance to the same formation first described by Dawson as the "Porphyrite group." Andesite, diabase, and some fragmental rocks were seen. Near White river an altered rock which looks like a quartzite was noted covering a considerable area; it contains some lime.

From White river to the summit of the trail only volcanic rocks were noted, all porphyritic and prevailingly basic in composition. At the west end of the lake andesite rocks are common, and the loose shingle on the beach is largely made up of this material.

On the trail five miles from the west end of Ootsa lake an exposure of granite porphyry was noted, but its relations with the volcanic rocks was not evident.

Ootsa, Whitesail, and Eutsuk Lakes.

The northern shore of Ootsa lake on the western end consists of volcanic rocks assigned to the Hazelton formation. Six miles west of Bennett's—which is the post-office for Ootsa Lake settlement—there is a wide belt of white rock which apparently crosses the lake and crops up in two islands off the shore. This rock strikes S. 50° E. and is standing nearly vertical. It is thin-bedded and is at least a mile in width. From examination of hand specimen it is listed as a rhyolite.

Two miles west of Bennett's there is an outcrop of vesicular vlocanic rock much oxidized and stained with iron oxide. This flow has a thickness of about 8 feet and is brecciated in places. Some of the vesicles are partially filled with agate. Above and below this flow is diabase. The whole is distinctly bedded with a north-and-south strike and a dip to the east at 30 degrees. On the south side of the lake near the western end there is a large outcrop of a very typical quartz porphyry which is probably an extrusive rock.

Along Tahtsa river, Sinclair lake (which is a narrow lake expansion of Whitesail river), and Whitesail river the rocks are similar, consisting of andesite, diabase, and ash rocks. One specimen was obtained much like jasper, which is presumably of sedimentary origin. Within a few miles of Whitesail lake and continuing on up the Whitesail river to the eastern end of the lake there are intermittent outcrops of granitic rock with a porphyritic structure. The rock is altered, the feldspar being largely kaolinized, but this may be mainly a surface phenomenon. This rock is intrusive and is evidently an outlier of some of the larger batholiths of the Coast range.

Ten miles from the eastern end of the lake on the northern side there is an outcrop of fine-grained diorite, in places porphyritic. Harrison's claims are on the south side of the lake fifteen miles from the eastern end, and here the formation consists of interbedded sediments and volcanics assigned to the Hazelton formation. The sediments consist of argillite and an impure dolomitic limestone. The greenstone seen on these claims is probably an altered andesite. Three miles above Harrison's cabin is an outcrop of diorite which is apparently intrusive into the older series.

Towards the head of Whitesail lake granitic and dioritic rocks are of frequent occurrence, and only remnants of the older series are left. At the head of the lake there is an exposure of granite which is fresh-looking and of a pinkish colour; it shows an intrusive contact into diabase.

The mountain lying between Whitesail and Eutsuk lakes, which has been called Mount Morgan, was climbed, and from this point a good view of the country was obtained. The mountain is made up largely of plutonic rocks of a basic tendency—gabbro, diorite, and syenite; basic porphyritic dykes are intrusive into the plutonic rocks; minette and quartz porphyry dykes were also noted.

Viewing the mountains of the Coast range at the head of these lakes from Mount Morgan, it can be seen that there is a considerable amount of stratified or partially stratified rocks in them. The higher portions often consist of these rocks, while below are massive homogeneous plutonic rocks. It is evident that the stratified rocks are remnants which were caught up and

suspended in the invading batholithic rocks. They lie at various strikes and dips. At one time, of course, the stratified rocks covered the whole area, but erosion has laid bare the granitoid rocks nearly everywhere. Glaciation has been intense on Mount Morgan and the glacial striæ are very fresh-looking; the general direction of these striæ is north-east and south-west. The east and west valleys of Eutsuk and Whitesail lakes would seem to have been formed, or at least enlarged, by the flow of ice moving easterly from the Coast range. The range at this point still contains innumerable mountain glaciers, and westerly from the head of Eutsuk lake vast fields of ice and snow can be seen. Hanging glaciers reach down within 500 feet of the water's edge near the head of the lake.

The whole scene is one of surpassing grandeur, no finer scenery existing anywhere in the Province. Viewed from Mount Morgan, the frowning battlements of the snow-capped Coast range loom up as if to bar the advance westwards, and most effectually do they bar the way to the prospector or trapper, excepting by a few favoured passes. On a clear, sunny, windless day, when the waters of Eutsuk lake are smooth and placid, the reflection of the peaks and glaciers is a beautiful sight not easily forgotten.

The rock formations exposed on Eutsuk lake from the centre to the eastern end are similar to those on Whitesail lake. Hazelton formation rocks consisting of argillaceous rocks and andesites and volcanic breccias are seen in many places, but the predominating rock is diorite, intrusive contacts of which with the Hazelton formation can frequently be seen.

On a point called Iron point, nearly opposite St. Thomas bay and on the northern shore of the lake, is one of these contacts between diorite and argillite. Slight mineralization with iron pyrite and a speck or two of chalcopyrite occurs here. Four or five miles easterly from Iron point another contact occurs. Here in the argillite was seen a well-preserved cast of an *ammonite* about 10 inches in diameter. In endeavouring to get it out the rock was shattered to pieces. Doubtless fossils could be secured in this locality, but time was not available for an extended search.

Bear island is a large island situated near the centre of the lake, but slightly towards the western end; one smaller island lies south of it, sometimes called Little Bear island. The rocks here are mainly volcanics, usually with a porphyritic structure, and apparently belong to the lower series of the Hazelton formation.

At the head of the lake granite and diorite form the base of the mountains rising abruptly from the water. In one place, the diorite is intrusive into the granite, and the general appearance of the mountains are granite at the bottom, diorite higher up, and Hazelton formation rocks still higher, up to the top. This, of course, is general, as in the case of Mount Morgan the plutonic rocks are exposed at an altitude of 6,200 feet. Some of the granite is apparently a true pinkish-coloured granite, but some outcrops consist of typical granodiorite. Variations in composition and texture are common.

Ootsa Lake to Bella Coola.

On leaving Ootsa Lake and following the trail along the northern shore of the lake, it is not long until rocks belonging to the Tertiary volcanic formation appear. These appear in patches overlying porphyritic rocks of the Hazelton formation. About five miles from Ootsa Lake a fresh-looking, fine-grained basalt was observed which lies flat and is undoubtedly referable to the Tertiary volcanics of the Interior plateau. This is seen at intervals, but is not, apparently, very continuous. Rock-exposures between Ootsa Lake and Tetachuck are not frequent along the trail, and no time was available for going off the trail.

At the west end of Chesiaslie valley an exposure of andesite porphyrite occurs which apparently is typical of Dawson's "Porphyrite group"—i.e., the Hazelton formation. At Tetachuck falls, which are only a mile above where the Bella Coola trail crosses the Tetachuck river, the rock is granite, with diorite dykes cutting it. A rock was observed there which is apparently of igneous origin and weathers out to a peculiar honeycombed mass. Granite and granite porphyrys outcrop between Tetachuck and Cold camp. Outcrops of basalt and diabase were also seen, but little could be learned as to the relations of the various rocks to one another from these isolated exposures. The country is mostly covered with glacial gravel and boulders, with a scattered growth of small jack-pine—a barren-looking country.

Between Cold camp and Majuba Hill camp an outcrop of fresh-looking diabase was seen at twelve miles from Cold camp. From Majuba hill to Algatcho the rocks are diabase, rhyolite,

and quartz porphyry, all fresh-looking volcanics evidently of the Tertiary formation. One mile south of Majuba Hill camp a peculiar banded rock was seen outcropping right on the trail. It is apparently all silica, very hard, and occurring in alternating bands coloured white, red, and yellow; these bands vary from ⅛ inch to 1 inch in width. In places the rock is considerably folded and twisted. It may be a quartzite or may be a siliceous deposit from hot springs.

Six miles beyond Algatcho a pinkish hornblende granite was observed, but it was not certain that this was in-place. For several miles south of the Dean (Salmon) river occasional outcrops of diabase were seen, some phases of which are quite porphyritic. Then an outcrop of diorite was seen, and near the northern end of Takia lake the rock is a volcanic breccia. The trail passes over a long rock-slide of this material. Farther on diabase comes in again.

At the southern end of Takia lake granite outcrops and continues intermittently along the trail for three miles. Then basalt and diabase apparently capping the granite come in. Four miles from Takia lake is a bedded rock which is a new, friable, and only partly consolidated sandstone which has been formed from the eroded material from a granite. This rock outcrops in a small creek and may represent a Tertiary sediment. Nine miles from Takia Lake camp, at a point where the trail runs along a little ridge just beyond an Indian camp, a contact between granite and basalt is exposed. It is evident that the basalt has flowed over the eroded surface of the granite. Later erosion has exposed the granite in places, with the basalt resting horizontally and unconformably on it.

From here on to the Bella Coola valley, some twenty or twenty-five miles, frequent exposures of Coast Range granite and diorite are seen, and in many places Tertiary volcanics can be seen capping the older granitoid rocks. The trail in one place (about twenty miles south of Takia lake) runs near a bluff which shows granite at the foot overlain by a flow of rhyolite 50 to 100 feet thick, and on top of this a basalt flow (or succession of flows) several hundred feet thick. In many places on the hills in the distance these same conditions can be seen.

On commencing the steep descent from an elevation of 4,500 feet down into the valley of the Bella Coola river, the rocks are the normal ones of the Coast range—viz., granite, diorite, and granodiorite, with accompanying dykes and showing wide variations in composition and texture. Some remnants of older rocks (probably Hazelton formation) occur in very small patches near the top of the mountains, but none of these were examined.

Bella Coola to Klinaklini.

The Bella Coola valley cuts rights through the heart of the Coast range. The mountains rise abruptly and steeply from the valley, and in places are so abrupt as to be unscalable. The valley is in reality a deep canyon made U-shaped by glaciation and has an average width of less than a mile. The soil in the valley is good, being made up of glacial mud brought down by the river and vegetable humus from the decay of the timber. It is covered with a heavy growth of trees—Douglas fir, spruce, and cottonwood. This timber makes clearing very expensive and slow, so that after twenty years no very large clearings have been made in the valley.

The mountains enclosing the valley are built of granitoid rocks, and as a rule contain very few inclusions of older stratified rocks. Viewing the mountains from the valley, it would seem as if near the tops there were some inclusions, but none of these were examined. Up the Whitewater and other tributaries of the Bella Coola river mineral discoveries have been reported occurring in contacts between granite with schistose and slaty rocks. The mountains enclosing the valley rise to 7,000 to 8,000 feet and possibly higher elevations; but in places, as where the Ootsa Lake trail comes into the valley, the height decreases to 4,000 to 5,000 feet.

The granitoid rocks exposed along the sides of the valley show no unusual features, but are typical of the normal Coast Range batholithic rocks. Two miles above Marvin's ranch, which is some fifty miles from Bella Coola, the granodiorite has a well-pronounced gneissic structure.

Nine miles beyond Marvin's there is a large inclusion of schistose rocks apparently entirely surrounded by granitoid rocks. For a distance of mile or more these schistose rocks occur in bunches surrounded by the granitic rocks. The schistose rocks are highly metamorphosed, and are stained with iron oxide. They would appear to have been originally volcanic rocks, and probably represent roof-pendants engulfed in the batholithic rocks. Some small quartz stringers

were seen in these rocks, but nothing that looked to be of any importance. Black lamprophyric dykes cut the granitic rock.

The granitoid rocks continue to the top of the "Precipice"—a steep rise in the trail fifteen miles beyond Marvin's. Beyond this the capping of Tertiary lava rocks—basalt and diabase—commences.

For some distance on past Anahim lake very few outcrops of rock occur on the trail, but float of basalt and diabase is of frequent occurrence. The trail following the telegraph-line runs south-south-east, paralleling the Coast range, and distant ten to fifteen miles from it. The country is an elevated plateau, but without any deep watercourses cut down in it. Glacial drift and soil covers the country, with few exposures of rock in-place. Large meadows which provide good grazing cover a considerable portion of this section.

From the crossing of the Dean river (which is here only a small creek), beyond Anahim lake, to Klinaklini no exposures of rock were seen which were known to be definitely in-place. Float basalt and some andesite were frequently observed.

Headwaters of the Klinaklini River.

From Klinaklini a trip was made twenty miles in a south-westerly direction to the Wallace iron-showings, situated at the head of the most westerly branch of the Klinaklini river and at the foot of Perkins peak. This mountain is one of the highest in the Coast range, reaching to an elevation of 9,500 feet. A detail description of the iron-showings will be found under the heading "Economic Geology."

Going westerly from Klinaklini, the Tertiary volcanic rocks are soon left behind and the formation becomes that of the eastern contact-zone of the Coast range. At the iron claims and on Perkins peak rocks of the Hazelton formation occur, into which are intrusive the Coast Range rocks consisting of granite, diorite, and granodiorite.

The older rocks, into which these plutonics are intrusive, are quartzites and argillites, together with interbedded volcanic flows consisting of andesite, basalt, diabase, and porphyritic rocks. These older rocks all show the effects of profound regional and dynamic metamorphism, which has probably been mainly caused by the thermal and dynamic action of the intrusive Coast Range batholithic rocks.

The older metamorphic rocks now occur as patches and large inclusions surrounded by the batholithic rocks, and are deeply cut by dykes which are apophysal phases of the plutonic magmas. The contact-zone is an irregular area which is variable in width and gradually changes, going easterly, to where the older rocks predominate, with only a few dykes of the younger plutonic rocks cutting them. Still farther east these older rocks are capped by volcanic flows of Tertiary age, which are mainly of a basaltic nature.

Klinaklini to Tatlayoko Lake.

Along the wagon-road from Klinaklini to Tatla lake rock-exposures are not frequently seen. Three miles from Tatla lake there is an exposure of gneiss which is seen here and there for a distance of two miles along the road. The gneissic structure is well defined and the general appearance of the rock would indicate a very old rock. This may belong to granitic rocks of an age older than the Coast Range rocks. In the vicinity of Tatlayoko lake the rocks of the Hazelton formation fall into two series, the lower of which consists of volcanic rocks and the upper one of sedimentary measures. These two series were recognized by Dawson in 1875, the lower series being called the "Porphyrite group" and the upper series as a representative of the "Jackass Mountain group." Although separating these rocks into two groups, Dawson points out that they are apparently conformable with one another. In regard to the age of the sedimentary series, Dawson says that fossils discovered in them have been determined as Lower Cretaceous in age, "of the horizon of the Shasta group of the California geologists."

Along the eastern shore of the lake the porphyritic volcanic rocks can be seen overlain conformably by the sedimentary measures which rise abruptly, forming a rampart-like wall 2,000 to 3,000 feet high and twelve miles in length. Above this the slope is gradual, forming a mountain with a large plateau top which is called Potato mountain, on account of the growth of wild potato-plants there. The sedimentary series consists of compact bluish-grey quartzites, or hard sandstones, and conglomerates of various textures, associated with blackish or dark-

coloured slaty and argillitic beds, which recur frequently at different horizons. Some beds have a considerable percentage of lime and can be classed as argillaceous limestones. Fossils occur in these beds. Fragments of fossiliferous quartzite are found along the shore and lower slopes of the hill, but the horizon from which these come is a quartzite band some 2,000 feet above the lake. Fossils also occur in some of the shaly beds. The general strike of the rocks is north and south, in the same direction as Tatlayoko Lake valley, and the dip is at a low angle easterly, or away from the lake. The fossils observed are mostly of the genus *Aucella*, but, as the age of the measures was definitely determined by Dawson, the fossils secured by the writer were not sent to a palæontologist for exact determination.

The rocks of the lower series underlying the sedimentary measures consist of purplish and greenish andesites, and many that can only be described as porphyrites and breccias. The rocks are as a rule bedded and in many places must have been partly stratified under water. They have suffered considerable metamorphism and secondary minerals are developed in many places.

Towards the base of these rocks diorite is intrusive into them. At the southern end of the lake, where the Morris claims are situated, the rock formation is the upper sedimentary portion of the Hazelton formation, consisting of argillites, quartzites, and conglomerates. Intrustive into this are dykes and stocks of granitic and dioritic rocks which are evidently of Coast Range age.

The larger masses of the plutonic rock are granitic, while the dioritic dykes are smaller and younger, cutting through the granite. As these sedimentary rocks are of Lower Cretaceous age, it follows that here the Coast Range granitoid rocks are Post-Lower Cretaceous. It is, however, possible that these granitic rocks, being at some distance from the main batholiths, represent the culminating phases of the intrusion, and are therefore slightly younger than the main range rocks.

Along the western shore of Tatlayoko lake the mountains rise abruptly from the water. The rocks are similar to the eastern shore, but the division of the Hazelton formation into an upper and lower series is not so plainly marked to the eye. Granitic and dioritic rocks form a larger part of these mountains than in those on the eastern side, and the older formation is more broken up.

The lower series of the Hazelton formation around Tatlayoko lake is older than the sedimentary series, but only slightly so. The whole formation probably represents a time period stretching from Upper Jurassic into Lower Cretaceous. Wherever fossils have been found in the sedimentary horizons of the Hazelton formation they have been determined as being of the Upper Jurassic to Lower Cretaceous in age.

Around Chilko lake Bateman describes a formation of Lower Cretaceous age which evidently corresponds with the Hazelton formation. This he divides into two series, the lower of which is predominantly volcanic material, while the upper is mainly sedimentary measures. The two series are conformable in their structural relations. Fossils found in the upper series were determined to be of Lower Cretaceous age and similar to those of the Shasta group of California.

Tatlayoko Lake to Alexis Creek.

Very little attention was paid to the geology of this section, as the field-work was finished at Tatlayoko lake, and the main effort was to get to Alexis Creek and disband in the shortest possible time. Also in travelling along the wagon-road rock-exposures are infrequent. In a general way, from Tatla lake to Alexis Creek the country is virtually covered with Tertiary lava rocks mainly of a basaltic nature. Close examination would probably reveal some of the older formations in places, but none were noted.

This portion of the Province is a good stock-raising country; bunch-grass grows in abundance all over the low rolling hills and thousands of head of cattle range on them.

ECONOMIC GEOLOGY.

The area under consideration in this report has not yet been prospected except in a very few places, nor has it even been entirely explored. In many places the geological conditions are such that the occurrence of ore-bodies might be expected. In a few sections where prospecting has been done locations have been made, but on most of these locations very little development-work has been done.

The determining factor and cause of mineralization in those ore-showings already located is the intrusion of the Coast Range granitoid rocks. From this it is inferred that large areas in

which these rocks are known to be intrusive into the older rocks should be promising places in which to prospect. It may be well to point out that simple contact between an eruptive rock and an older sedimentary or other formation does not necessarily always give rise to mineralization. Many such instances occur where not even pronounced metamorphism of the older rock is caused by the intrusion of the igneous rock. Accompanying such intrusions, however, as a rule, some faulting, fissuring, and crushing of the strata take place, and in these zones ore-bodies are formed by circulating mineral-laden solutions.

The older rocks into which the Coast Range granites are intrusive in this area are grouped under the heading "Hazelton formation," although it may be shown later that they are divisible into several formations. In a general way the showings already found occur in Hazelton formation rocks at or near the contacts with the granitic rocks, but instances are not lacking where mineralization has taken place entirely within the granitic rocks. (The term "granite" is here loosely used and includes all kinds of granitoid rocks belonging to the Coast Range batholithic formation.)

It would seem that the sedimentary measures of the Hazelton formation were more favourable places for the formation of ore-bodies than were the volcanic members of that formation. The Hazelton-Telkwa district forms a useful indicator for the area discussed in this report, as the geological conditions are similar. In that district the most important ore-bodies occur either in the granitic rocks or in the sedimentary measures of the Hazelton formation, and usually at no very great distances from the contacts of the two formations. Ore-bodies are found in the volcanic members of the Hazelton formation, but as yet they are of lesser importance, and as a rule are irregular and non-continuous.

In the area described in this report the most promising section seen is that of Sweeney mountain, where sedimentary measures, including limestone, of the Hazelton formation are intruded by granitic rocks. Similarly, on Whitesail lake, the Klinaklini river, and Tatlayoko lake, mineralization has taken place in sedimentary horizons of the Hazelton formation where intruded by the granitic rocks. At Owen lake the claims staked show mineralizing action in the granitic rocks, although here also sedimentary measures of the Hazelton formation are not far distant. Doubtless in this large area ore-bodies may be found occurring in the volcanic or lower series of the Hazelton formation, but none have been located as yet. The sedimentary series of the Hazelton formation has, however, a widespread distribution, and in many localities it is not possible to divide the formation into an upper and lower series, as the volcanic and sedimentary rocks and interbedded and intercalated. So prospecting may well be directed to any areas where the Hazelton formation is intruded by granitic rocks, but the prospector should remember that the sedimentary beds of this formation, as limestone, sandstone, quartzite, shale slate, and argillite, are apparently the most likely horizons in which mineralizations may occur.

The area of country surrounding the head of Tahtsa, Whitesail, and Eutsuk lakes, and including the Tahtsa and Whitesail mountains (really portions of the Coast range), is recommended as highly promising country in which to prospect. It is, of course, true that this area is now remote from transportation, but transportation can be provided if sufficient ore can be proven. The main waterway provided by the Tahtsa river and the big lakes could be made available for boat transportation at not a prohibitive expense. The first need for the country is a large influx of prospectors, and if valuable ore-bodies are found the disadvantages and obstacles will readily be overcome.

It is not possible to generalize as to types of ore-bodies in this area from the few scattered locations of mineral showings that have been made. In a general way copper, lead, and zinc minerals may be expected to predominate, but at Tatlayoko lake some claims staked there have quartz veins carrying irregular gold values.

The different types of mineralization are indicated in the following descriptions of the mineral locations that were examined (for a description of trails and routes into these claims *see* Appendix):—

OWEN LAKE DISTRICT.

A number of claims have been staked in the territory contiguous to Owen lake and a little development-work has been done on some of them. This section of country is flat and rolling, with an abundant growth of wild grass, consisting of peavine, rye-grass, and red-top. It is a fine

grazing country and should prove a good place for stock-raising. Rock-exposures are infrequent, and at first sight the wonder is that any mineral showings were found. On closer inspection, however, it is evident that the mantle of soil is thin and that there are many places where the rock formation is exposed.

The rocks seen here are for the most part basic igneous rocks ranging from gabbro to diorite. A porphyritic structure is most common; apparently many different dykes are intrusive into the main formation, but it is impossible to tell from the few exposures just what relations the one rock has to the other. Granitic dykes would seem to be intrusive into the more basic rocks, which make up the major portion of the country-rock. Remnants of sedimentary rocks belonging to the Hazelton formation are visible in places, but erosion has largely removed these and exposed the underlying, younger intrusive rocks.

The ore-bodies occur in more or less poorly defined veins; in some cases these veins are irregular zones of shearing or sheeted zones in which slight impregnations of mineral occur. Copper, lead, and zinc sulphides occur, together with iron sulphides, and in some showings the ore is quite complex. Gold and silver values are as a rule low.

Owen lake is distant by trail about twenty-six miles from Houston, but this distance could be shortened considerably by a more direct route.

Diamond Belle Group.

This group consists of the *Black Bear*, *Diamond Belle*, and *Burro* claims, and is owned by O. W. James, J. P. Cole, and Frank Brown. It is situated about a quarter of a mile from James camp and is about one mile distant from the shore of Owen lake on the east side; the elevation is 3,250 feet. The outcrop of the vein is on a flat grassy place just west of a small pond. The vein is from 3 to 4 feet wide, strikes about east and west, and stands about vertically. It is exposed at intervals for a length of 400 feet, the stripping actually exposing the vein for a total length of about half this distance. The country-rock in which the vein occurs is apparently a granite porphyry, somewhat decomposed.

The vein-filling is quartz, siderite, and altered wall-rock, while the metallic minerals present are galena, sphalerite, and pyrite. These latter minerals are disseminated through the gangue and form but a small part of the gangue. Appreciable-sized shoots of solid mineral apparently do not occur.

The development consists of stripping and cuts on the vein, but nowhere has a greater depth than 4 feet been obtained. A sample taken across 4 feet in the most easterly cut assayed: Gold, 0.04 oz.; silver, 1.6 oz.; lead, 7.2 per cent.; zinc, 37 per cent.

A sample of carefully selected solid ore assayed: Gold, 0.02 oz.; silver, 10.4 oz.; lead, 43.5 per cent.; zinc, 37 per cent. Another average sample across 3 feet taken at a point 50 feet west of the first sample assayed: Gold, 0.04 oz.; silver, 4.6 oz.; lead, 12.4 per cent.; zinc, 35.8 per cent. Both places where the vein was sampled contained a good deal more zinc-blende than the general run of the vein. The main values are in zinc, the other values being quite low. It is doubtful if zinc ore, even if in considerable quantities, can be considered as of value in such a place at the present time.

Chisholm Property.

A group of claims owned by Chisholm and partners is staked along the south end of Owen lake, extending for a distance of about a mile. The property was developed by two shallow shafts and two cars of ore shipped in 1915. The vein occurs in a porphyritic rock and is not very regular, but has a general strike of N. 65° W. and dips at 45 degrees to the north-east. The deepest shaft is probably 50 feet deep on a 45-degree slope, but, as it had water in it to within a few feet of the top, nothing could be learned as to conditions at the bottom. Most of the ore shipped came from this shaft, and it is believed a short drift and stope were made at the bottom of the shaft from which ore was extracted. This ore, which amounted to 38 tons, assayed about 6 oz. silver to the ton and about 31 per cent. lead. The ore therefore carried considerable galena, but was quite low in silver. This is rather strange on comparing it with an assay of an average sample taken by the writer of the dump containing the ore rejected from the hand-sorting of the shipped ore; this assay gave: Gold, 0.08 oz.; silver, 29.2 oz.; lead, 11.4 per cent.; zinc, 29.5 per cent. This ore was evidently rejected because of its high zinc content, but it would seem as if either zinc or pyrite rejected contained the most of the silver.

Two hundred feet east of this shaft there is another one about 12 feet deep, also containing water. The side of the shaft shows some mineralized rock in a 10-inch band on the foot-wall

and another on the hanging-wall, separated by a strip of waste. This ore had to be packed out twenty-eight miles to the railway at Houston and then shipped to the smelter. It is evident, therefore, that the charges for mining, transportation, and smelting would total so much that no profit could be made on this grade of ore. The ore-body on this property is not a true vein, but seems to consist of mineralization along seams and fractures. The width of the mineralized zone is perhaps 3 to 4 feet, but it may be greater.

Wrinch Property.

There are five claims in this group, which is owned by Dr. Wrinch and partners. The showings are situated along the sides of a small creek running into Owen lake, where this creek cuts down in a small but steep-sided canyon about half a mile up from the lake. The general rock formation is a porphyry of medium acidity and the mineralization occurs quite irregularly in fractures and seams, but not in definite veins.

Towards the upper end of the canyon, at an elevation of 3,000 feet, there are several open-cuts on the south side of the canyon, all of which show iron-cappings and some mineralization.

The strike of the seams in one of these cuts is N. 80° W., and at the face there is 4 feet of mixed sulphides and rock-matter. An average sample across this width assayed: Gold, 0.02 oz.; silver, 5.6 oz.; copper, *nil;* lead, 9 per cent.; zinc, 12.5 per cent.

Going up the canyon from an elevation of 2,800 feet, there are several cuts and short tunnels which show slight mineralization; one tunnel is 12 feet long and follows a poorly defined vein in porphyritic rock which at the face has the following section: Hanging-wall, 6-inch talc seam, 2 inches siderite, 1 foot mineralized rock, 3 feet waste rock, 2 feet mineralized rock, foot-wall. A sample was taken across the two bands of mineralized rock and the siderite, a total width of 3 feet 8 inches, which assayed: Gold, 0.02 oz.; silver, 8.8 oz.; copper, trace; lead, 1.3 per cent.; zinc, 3.8 per cent. The minerals noted were galena, zinc-blende, pyrite, siderite, and a few grains of chalcopyrite.

One hudred feet farther up the creek there is another tunnel 10 feet long, which shows from 3 to 5 feet of material carrying some siderite and zinc-blende. Other cuts show small amounts of zinc-blende, arsenopyrite, and a very little galena.

At an elevation of 2,975 feet, and just above a 20-foot fall in the creek, there is a mineralized zone crossing the creek with a strike of N. 55° W. and dipping slightly in a direction up the creek.

This zone is irregular, but is at least 20 feet wide and has sparingly disseminated through it chalcopyrite, pyrite, galena, and zinc-blende, with some oxidation products of these minerals on the surface. A few small cuts have been made on the zone, but sufficient development has not been done to determine the extent and width of the mineral-bearing zone and the amount of mineralization. From one cut a ton of the best-looking ore has been piled to one side. An average sample of this returned on assay: Gold, 0.06 oz.; silver, 17.8 oz.; copper, 13.2 per cent.; lead, 14 per cent.; zinc, 20.4 per cent. This shows a very complex ore and one that would be hard to treat. The evidences of mineralization in many places on this property make it possible that a good body of ore might be found somewhere. It is evident, though, that the average run of the ore would be low grade and complex, and so sufficient tonnages would have to be demonstrated by development to warrant the erection of a concentrator on the ground.

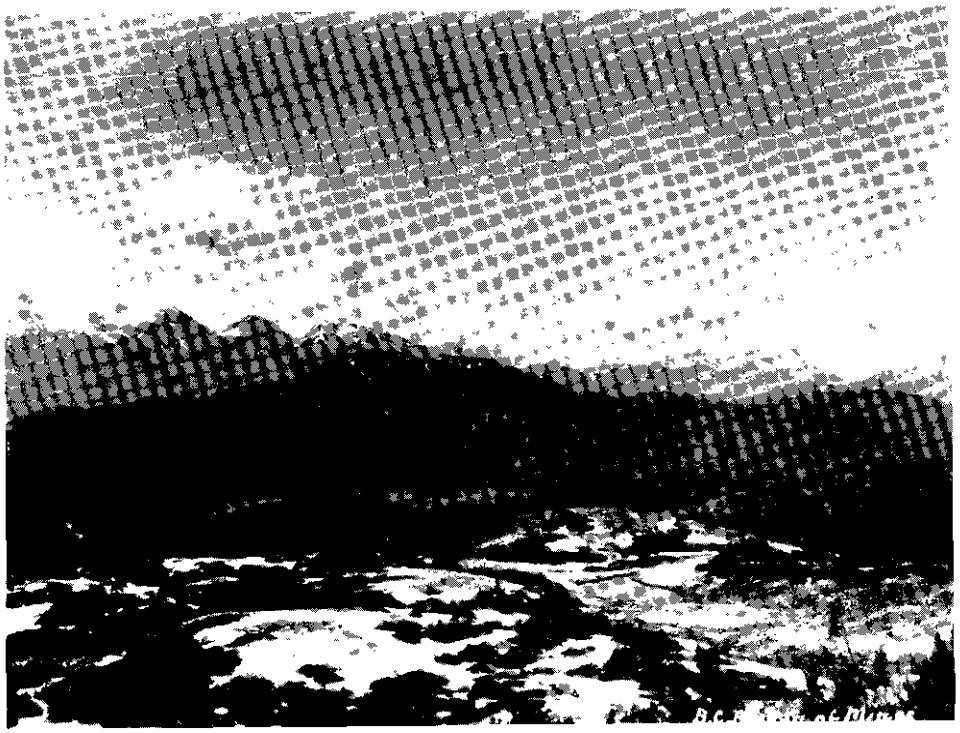
Sunnyside.

This claim joins the Wrinch property to the south and the *Tiptop* claim lies between it and the *Diamond Belle*. It is owned by George Fowler and O. W. James. An open-cut 50 feet long by 4 x 3 shows a dyke or vein of rock which is much oxidized. It looks like an acid dyke, but carries siderite which weathers to a black colour on the surface. Sulphide minerals are absent, excepting a few grains of pyrite. Below the oxidized surface or iron-capping more mineral might be found, but the surface shows nothing of value.

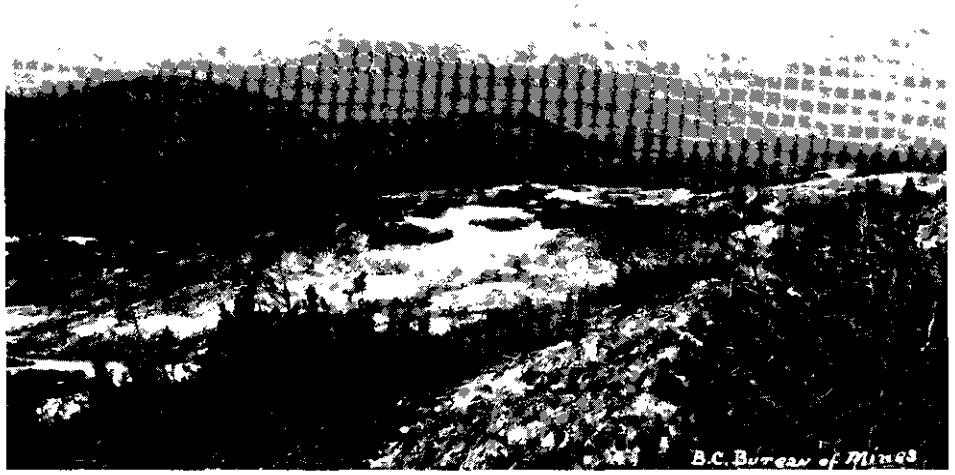
Dominion Group.

The *Dominion*, *Treadwell*, and *Lake Queen* constitute this group, which is owned by O. W. James, Andrew Martinson, F. L. Mosher, and Al. Harris. It was staked in 1916 and so it could hardly be expected that much development would have been done.

On the banks of a small creeklet lying 100 yards east of James camp slight mineralization consisting of zinc-blende, pyrite, and galena has been found in seams in a porphyritic rock. On the east side of the creek there is a cut 10 feet long with a 10-foot face and a smaller cut on the opposite side. The surface is leached out and contains a good deal of limonite from the



Coast Range from Sibola Mountain.



View from Sibola Mountain, looking West.

oxidation of original pyrite. The width of vein-matter is about 4 feet, and the strike is S. 70° E., standing vertical. A sample was taken across 2 feet at the most mineralized portion seen, which assayed: Gold, trace; silver, 1.9 oz.; lead, 3.8 per cent.; zinc, 8.5 per cent. The showings are only of value as an indication that more extensive ore-bodies might be found in the vicinity.

SIBOLA DISTRICT.

The section of country designated as the Sibola district is that surrounding Sibola and Sweeney mountains. These two mountains represent the tail end of a spur running out from the main Coast range in a south-easterly direction. Sibola mountain rises somewhat abruptly from the flat, rolling country characteristic of the Francois Lake district, and which also is a portion of the Interior plateau.

Sibola mountain was the scene of a small stampede in 1914, quite a number of men going in for the purpose of staking claims on small quartz veins which were supposed to be highly auriferous. The excitement was started by "Kid" Price, who first of all did some placer-mining on Sibola creek, a stream which drains one side of the mountain, and then following up the stream to its source discovered some small quartz veins, which he staked.

On his return to Houston he had a number of very rich gold-quartz specimens and the news soon spread that a bonanza camp had been found. In the next two years Price did a lot of work on different claims, but in 1916 he left the country and went to Arizona.

The writer examined the most important claims, and, while it is quite possible that some specimens showing free gold may have been found there, it is also quite apparent that the veins on the average carry but little gold, and also that they are so small that they would need to carry high values to enable them to be worked at a profit.

Sibola mountain is the end of a long spur, or secondary range of mountains, running out from the Coast range in a south-easterly direction. It is cut off from the Sweeney Mountain part of the same spur to the north by the deeply carved canyon occupied by White river. The mountain is drained on one side by Sibola creek, which swings around the foot of the mountain and joins White river. Comb creek cuts a deep gash across the face of the mountain and joins Sibola creek below. Drainage from the northern side is by small streams to lakes which eventually drain into the Nadina river.

Sibola mountain covers several square miles and a large area lies above timber-line, which is at about 5,000 feet elevation. Above this there is a rolling plateau ranging in height up to 6,000 feet, which is carpeted with a luxuriant growth of grass and wild flowers. Above this several pinnacles rise from 800 to 1,000 feet higher.

The rock formations exposed on the mountains consist of sedimentary measures and volcanic rocks, which are, however, interbedded and intercalated, and cut in places by granitic dykes. The sedimentary rocks consist of argillites and quartzites, and the volcanics are tuffs, breccias, andesite, basalt, and diabase. The whole series is practically identical with the Hazelton formation as exposed in the Hazelton-Telkwa district, and is tentatively correlated as being a part of the Hazelton formation.

Lone Star. This claim is situated on the eastern side of Sibola mountain just above and to the west of three small ponds. On the discovery post the name of the locator is Roy Stone. The elevation here is about 5,325 feet.

The vein is a small quartz-filled fissure, striking N. 65° W. (mag.) and dipping to the west at 65 degrees, occurring in diabase rock. As a rule the vein is split into two stringers, with 6 to 8 inches of quartz on the hanging-wall and from 1 to 3 inches of quartz on the foot-wall, separated by 6 to 15 inches of unaltered country-rock. The development-work consists of an open-cut on the vein 20 feet long by 4 x 3 feet deep. A sample across 8 inches of the hanging-wall streak on assay only returned traces. The quartz is stained with iron oxide and in places there is a considerable percentage of iron oxide, but very little unoxidized pyrite can be seen.

Gold Crown. This claim lies about a quarter of a mile to the south of Maxwell's cabin and has more work done on it than any claim in the district. The main work is a long cut on the vein which starts on the side-hill and goes along the vein for 50 feet, and is 20 feet deep at the face, and has a width of 10 feet. The country-rock is of sedimentary origin and is classed as an argillite or argillaceous quartzite. The vein is irregular and slightly broken up, but has a general strike of S. 80° E. to S. 60° E. (mag.) and dips to the south at 75 degrees. There are streaks of quartz from 4 to 8 inches wide on either

wall, often separated by a wide band of practically unaltered country-rock. The main streak of quartz is on the foot-wall, and at the top of the cut it is 10 inches wide, of rusty, honeycombed, and rose quartz. Going down, this band of quartz gets narrower and at the bottom has practically disappeared. Half-way down the cut there is an area of mixed quartz and wall-rock in which there is an intergrowth of long quartz crystals. The foot-wall streak at the bottom is about 3 inches wide. A sample was taken at the bottom of the cut across 2 stringers of quartz totalling 4 inches in width, which returned on assay: Gold, trace; silver, 0.4 oz.

An average sample of the ore-dump which contains the quartz taken out in the working only returned traces of gold and silver. Another sample across the hanging-wall streak of 10 inches at the surface also returned only traces of the precious metals.

In places through the quartz there are some small specks of a bluish-black mineral which is apparently molybdenite. This mineral was supposed to be a gold telluride, but this is not so. A picked sample of the quartz containing more than an average amount of this molybdenite was assayed, but only returned traces of gold and silver.

Bellecini Property. This property, owned by Bellecini, is situated half a mile south-east of Maxwell's cabin. One showing is at an elevation of 4,550 feet, and here an opening 6 x 4 x 3 feet shows a small quartz vein varying from 3 to 6 inches in width. An average sample taken across the vein assayed: Gold, 0.18 oz.; silver, 2.9 oz.

A little farther round the hill and at an elevation of 4,700 feet a shaft has been sunk 15 feet on a quartz vein, which may be a continuation of the former one. At this place there is a band of quartz 6 inches in width on the hanging-wall, and then for 6 feet in width there are a number of stringers from ½ inch to 1 inch interbanded with wider bands of country-rock. The rock taken out in sinking the shaft contains a considerable percentage of quartz, but an average sample of the dump on being assayed only returned traces. A selected sample of the quartz assayed: Gold, 0.2 oz.; silver, 0.5 oz.

Three hundred yards above Maxwell's cabin there is an open-cut 15 x 4 x 4 feet which shows a quartz vein about 2 feet wide. The quartz is rose-coloured and rusty and shows an occasional speck of pyrite. A sample cut across the full width only returned traces of the precious metals.

Golden Chest. This claim lies about one mile north-east of Maxwell's cabin, the main showing being exposed in a small creek. C. P. Price and partner are the owners. The vein has an average width of about 1 foot, but in places swells to 18 inches. It is well defined, has a strike of N. 60° W. (mag.), and stands vertically. The quartz is as a rule rusty and decomposed, but in places there are small masses of nearly solid pyrite.

On the north-western side of the creek a cut has been made, starting in just above the creek-level, which is 15 feet long on the vein and has a 12-foot face. A sample was cut across the vein at the face, where it is 13 inches wide, which assayed: Gold, 0.14 oz.; silver, 1.8 oz.; a selected piece of solid pyrite assayed 1.4 oz.; silver, 2.6 oz.

The vein is exposed crossing the creek and going up the other side.

Jolimont. This claim adjoins the *Golden Chest* and contains the same vein as that property. The owner is Alfred Maxwell. The country-rock in which this vein occurs is an altered volcanic, probably a diabase; it contains a good deal of chlorite and in places is brecciated.

The main working on this claim is a large cut 25 x 8 x 4 on the vein, and a crosscut into this cut 20 feet in length. The vein here varies from 4 to 8 inches in width, and has a filling of black and rusty-coloured quartz. A selected sample of the quartz taken from the dump assayed: Gold, 0.04 oz.; silver, 0.4 oz.

Comb Creek.

Comb creek cuts down transversely across Sibola mountain, rising in the highest part, and joins Sibola creek at the foot of the mountain. Several claims have been staked towards the upper end of this creek and in the deep gulch cut by the creek at an elevation of 4,800 feet, practically at timber-line, a comfortable cabin has been built by C. P. Price.

Orinoco. This claim is owned by Price and is situated about half a mile up Comb creek from his cabin, at an elevation of 4,950 feet. The formation here is of sedimentary origin, the rocks being distinctly bedded in a general south-

easterly direction of strike. These sedimentary rocks vary from an argillaceous quartzite to rocks carrying a considerable percentage of limestone. The rocks have a considerable amount of iron oxide in them, sufficiently so to give them a reddish appearance in many places. They are also in some places soft and crumbly.

The only working seen on the *Orinoco* claim is a tunnel 70 feet long, which is on the south-west side of and a short distance above Comb creek. It goes into the hill nearly at right angles to the creek and crossing the strike of the formation. It does not follow any vein or ore-body, but the whole rock contains a small percentage of fine grains of pyrite. The rock here is quite soft, and the whole dump, although only year or two old, looks like a pile of mud. No place in the tunnel showed anything that could be classed as ore, but some material from the face of the tunnel was tested and only returned traces of gold and silver. A few pieces, selected from the dump which contained a considerable amount of pyrite, were tested for gold, silver, and copper with negative results. It seems reasonable to suppose that somewhere, either at the mouth of the tunnel or above it, values were obtained to induce the owner to do this work. A close search was made above the tunnel for any indication of a mineralized band or zone, but nothing was found, except that everywhere there is a little pyrite and iron oxide in the rock.

Ethel D. Farther up Comb creek and at an elevation of 5,125 feet there is a claim staked by J. M. Jeannette. On the north-east side of the creek there is a small cut made in rusty, decomposed rock, but which is apparently just the ordinary sedimentary country-rock. A sample of this soft decomposed material was taken, but on assay it only returned traces of gold and silver.

West View. This claim is situated on the ridge lying between Comb creek and White river and is owned by M. E. E. Bellecini. The showing consists of a rather irregular vein about 4 feet wide, in which the filling is partly quartz and partly wall-rock. There is a considerable amount of zinc-blende in the vein-filling and a little pyrite and galena. The vein is exposed by a surface crosscut which is 20 feet long and has a face 10 feet high. This shows the vein to be quite freely mineralized with zinc-blende. A sample was cut across 4 feet of the vein where it appeared to be most highly mineralized, and this assayed: Gold, 0.34 oz.; silver, 3.8 oz.; copper, trace; lead, 2 per cent.; zinc, 46.5 per cent. Another sample of selected ore assayed: Gold, 0.64; silver, 5.7 oz.; copper, trace; lead, 3.3 per cent.; zinc, 48.6 per cent. No other work has been done on this claim so far as is known.

Sweeney Mountain.

Sweeney mountain lies north of Sibola mountain, White river forming the dividing line between them. The two mountains form the tail end of a spur running out from the Coast range, and are only separated and given different names by reason of White river having incised a deep gorge down into the mountain mass. White river is mainly fed from glaciers along the ridge of this spur of mountains and derives its name from the milky colour of the glacial water in it.

The rocks on Sweeney mountain are similar to those on Sibola mountain, consisting of sedimentaries and volcanics of various kinds, some of which are considerably altered. Dykes of granitic and dioritic rocks cutting these older rocks are of frequent occurrence, while these are not nearly so numerous on Sibola mountain.

In the bed of White river there is a considerable exposure of granite which is apparently a portion of a granite stock or batholith underlying Sweeney mountain and exposed by the erosion performed by the river. From this large body of plutonic rock the granitic dykes which have intruded the older rocks have been given off. These granitic rocks are probably contemporaneous with the Coast Range batholithic granites, while the sedimentaries and volcanics are considered to be representatives of the Hazelton formation. These granitic intrusions have, without doubt, been the cause of the mineralizing actions which have taken place on Sweeney mountain.

Sunset Group. This property, which is situated on the south side of Sweeney mountain, consists of the *Sunset* and *Sunset No. 1* claims, owned by N. P. Moran and John Goold. The claims have not been long staked, so but little development-work has been done, with the exception of some surface cuts.

The formation here consists of limestone, very considerably altered, into which dioritic dykes are intrusive. One dyke which is about 20 feet wide and is best described as a diorite porphyrite cuts up and down the hill in a N. 45° W. direction. Close to the wall of and within this dyke there is a small quartz vein a few inches wide carrying galena and pyrite. The vein has been traced down the hill by surface stripping, and at 100 feet lower elevation the dyke gets narrow and appears to die out, but the vein is continuous and has for its hanging-wall the altered limestone. The vein here consists of 4 inches of quartz with galena, pyrite, and zinc-blende, and 14 inches of crushed blackish gouge-matter. One hundred feet to the north-east another outcrop of dioritic rock can be seen which is not so porphyritic as the dyke. A selected sample of the ore assayed: Gold, 0.64 oz.; silver, 7.2 oz.; lead, 8.8 per cent.

A formation like this—viz., limestone cut by igneous dykes—is a favourable place in which a fair-sized ore-body might be expected to be found. Here there is a small vein which in itself is too small to be of value, but, as it is an evidence of mineralization, the locality is worthy of careful prospecting. The contacts of the dyke with the limestone should be carefully examined.

Emerald Group.

This group consists of the *Emerald Nos. 1 to 7* and is owned by W. J. Sweeney, O. J. Benson, and Frank Madigan. The rock formations exposed on this part of Sweeney mountain are quite varied and complex. There is apparently an older series of sedimentary and probably ash rocks into which granitic and dioritic dykes and small bosses have been intruded. The sedimentary measures include limestone, dolomitic limestone, and argillites, but owing to the igneous intrusions the rocks are considerably altered and it is not always easy to say just what they are.

The ore-body on the *Emerald* claim is a fairly well-defined vein occurring in a rock which consists of dolomite, silica, and possibly a little kaolinized feldspar—a rock, therefore, for which it would be hard to find a name. Pyrite and limonite can also be seen in this rock, which have probably been brought in by the mineralizing solutions forming the vein. The vein is distant from 50 to 100 feet from a granitic dyke, with which it is roughly parallel. The granitic dyke and other near-by intrusions played a prominent part in the mineralization which has taken place.

The vein is somewhere about 20 feet wide where exposed on the surface, but only carries metallic minerals across 8 to 10 feet on the foot-wall side. The other half (of the width) of the vein is an oxidized decomposed vein-filling largely made up of altered wall-rock. This surface condition of the values, being only on the foot-wall half of the vein, may, of course, not continue, and as the vein is definitely defined as having a width of 15 to 20 feet it is quite possible that with further development the whole width may be mineralized. The only important metallic mineral present is galena, but this forms a considerable percentage of the foot-wall half of the vein. Practically no zinc-blende was seen, although it may be expected that some will occur; pyrite is not found to any great extent, and a little chalcopyrite occurs in places. The gangue-filling of the vein is partly quartz and largely altered wall-rock. On the surface the vein is partially oxidized, with the usual iron oxide staining the rock a reddish colour. The vein is exposed up and down the hill for 400 feet, most of this exposure being natural, but some open-cutting and stripping has been done. The galena occurs as a rule in bands from a few inches up to a foot in width of nearly solid sulphide, but in places the galena is disseminated in small particles throughout the vein-filling. A sample was cut across a width of 9 feet of the vein where it is well exposed on the surface, and this assayed: Gold, 0.02 oz.; silver, 19.1 oz.; copper 0.7 per cent.; lead, 28 per cent. The place where sampled probably represented a rich place in the vein, but there is no doubt that a good deal of the vein is similar to this section sampled. At the same place a sample was taken across the hanging-wall side of the vein, across 6 feet, but this only returned traces. A few pieces of solid galena were selected, which returned on assay: Gold, trace; silver, 49.5; copper, 0.5 per cent.; lead, 83 per cent.

Stringers of solid galena traversing the country-rock parallel to the main vein can be seen at intervals across several hundred feet in a direction at right angles to the strike of the vein. These stringers are subsidiary fractures and can be seen on both sides of the granitic dyke mentioned before as paralleling the vein. The elevation of the showings on the *Emerald* claim is, roughly, 6,000 feet, well above timber-line, and the solid rock formation is well exposed practically everywhere at the surface. All over the side of the hill solid galena float can be picked up and stringers of galena are of frequent occurrence. A selected sample of one

of these about 1 foot wide from a cut considerably above the main vein assayed: Gold, trace; silver, 35 oz.; lead, 76 per cent.

The showings of silver-lead ore on this property are decidedly promising; in fact, the extent of the surface outcroppings and the favourable geological formation would make it seem quite possible that development may show the existence of a very large ore-body. It is evident, though, that the ore is comparatively low grade and would require concentration if any considerable tonnage was shown up. The property is at present remote from transportation, which makes a consideration of its present value different from what it would be were it located close to a railway. Hand-sorting would easily produce a considerable tonnage of solid galena which could be shipped were transportation near by, but this is impossible as things are now.

The possibilities for the property are that if it were taken over by a company with sufficient capital to develop it thoroughly, then a sufficient tonnage of ore might be proved to warrant the erection of a concentrating-mill and to provide some kind of transportation. In the opinion of the writer this property and the district generally is well worth such serious investigation on the part of some company or individual.

Grand View Group.

Six claims constitute this group, commencing with the *Grand View* and running up to *Grand View No. 6*. The owners are O. J. Benson, W. J. Sweeney, Geo. Fowler, and Frank Madigan. The best showing on this claim is said to be under a glacier and can only be seen at certain times. When this examination was made the showing was covered with ice, and hence could not be seen. There are several stringers of ore showing in the rock near the edge of the glacier, but they are irregular. One somewhat indistinct vein is showing, and a sample of this was taken across 5 feet, which, however, showed but little mineral. This sample assayed: Gold, trace; silver, 1 oz.; lead, 4 per cent.

Another vein can be seen which may join with the former ore, and in it the vein-filling is altered wall-rock, quartz siderite, pyrite, and a little galena. In fact, in many places there are evidences of mineralization, and while nothing of much importance has been found yet, further prospecting and development may disclose some good-sized ore-bodies.

Dominion Group.

This group is situated a short distance above Benson's camp, at an elevation of 5,470 feet, and on the southern slope of Sweeney mountain. It has an irregular vein from 1 to 2 feet wide occurring in an acid volcanic rock. The vein-filling is altered wall-rock and carries chalcopyrite, magnetite, pyrite, and hæmatite. In some places there is solid chalcopyrite up to a foot in width. Several small cuts constitute the development-work.

On this same group, but on the White River slope of the mountain, some prospecting has been done on a much-weathered acid dyke which is from 10 to 15 feet wide. On the surface this dyke is soft, crumbly, and stained a yellowish-red colour. A little pyrite can be seen in it. It was thought that it might carry gold, but an assay of a sample taken by the writer only showed traces of gold and silver.

WHITESAIL LAKE.

Cariboo Group.

This property, which consists of nine claims, is situated on the southern side of Whitesail lake, about fourteen miles from the eastern end. The owners are Michelson & Harrison, but for the last two years the property has been under option to a Prince Rupert syndicate, of which A. C. Garde is the engineer and manager. The workings on the property are right on the water's edge, and about a mile farther westerly along the shore a cabin camp has been erected. From the water's edge the rock formation rises abruptly in broken bluffs from 50 to 100 feet high. Farther back from the shore the slope becomes more gradual, although there is a steady ascent, and there the surface is covered with a considerable growth of small trees and brush.

Geologically, the formation consists of interbedded volcanic and sedimentary rocks similar lithologically to and correlated with the Hazelton formation. The volcanic rocks consist of diabase and a greenstone which is apparently a much-altered volcanic rock. The sediments consist of calcareous argillites and, along the beach near the cabin, impure dolomitic limestone. In the district diorite and granodiorite occur as intrusions into these older rocks, but so far as seen none of these plutonic rocks are exposed on the property.

The vein consists of a sheared zone from 10 to 15 feet wide, striking N. 25° W. and dipping at 60 to 75 degrees towards the east, which is slightly mineralized. The vein is really a partial replacement in this sheared zone in which the ordinary wall-rock forms the major portion of the gangue. A few irregular stringers of quartz and calcite occur in the gangue, which gangue is not materially changed from the wall-rock. The metallic minerals occurring are zinc-blende, pyrite, a little chalcopyrite, and occasionally a little galena.

Development has been by means of a tunnel which goes in for 50 feet in the foot-wall paralleling the vein. Then from the end of this approximately at right angles, a crosscut was run 100 feet.

About 8 feet from the commencement of this crosscut the vein was cut, and it is here roughly 15 feet wide, but is very slightly mineralized. The tunnel was continued on past the vein for 80 feet in the hanging-wall in order to crosscut other parallel sheared zones outcropping on the surface, but as far as it is driven no mineralized rock was found.

Considering the vein as a whole, it is evident that the average value would be almost negligible. The only thing, then, to consider is the amount of ore occurring in the stringers throughout the vein. The only stringer of any importance seen was one 14 inches wide. An average sample was cut across this which assayed: Gold, trace; silver, 1.2 oz.; zinc, 30.5 per cent. In driving the tunnel the best ore taken out has been saved and placed to one side. This amounts to about 1 ton. An average sample of this dump returned: Gold, trace; silver, 0.8 oz.; copper, 0.5 per cent.; zinc, 32 per cent.

These assays show that zinc is the only metal of possible importance in the ore, and the quantity of zinc-blende proved by the present development is not sufficient to be of any commercial importance, even should transportation be available. It is, of course, possible that in a large vein such as this, even though it is very irregular and sparsely mineralized where now exposed, further development might discover commercially valuable ore-shoots. Some further prospecting of the vein on the surface might be advisable, and such surface prospecting would be less expensive than continuing the present underground work.

Geologically, this section of country along and around the head of Whitesail lake is a promising place in which to prospect, and the slight mineralization in the *Cariboo* vein is evidence that the district has been the scene of mineralizing action. The intrusion of granitoid rocks into argillaceous and limestone measures provides a reasonable basis for supposing that valuable ore-bodies may have been formed in the district.

Some samples of galena and grey-copper were shown to the writer by Harrison, when at his ranch, which come from the district, but none of the showings have been staked. Without Mr. Harrison as guide, it was not possible to find these showings. These specimens looked promising and are further evidence of mineralization in the district.

A description of the route into this property and the district generally is given in the details of the itinerary of the whole trip.

WALLACE IRON SHOWINGS ON KLINAKLINI RIVER.

Introductory.

A deposit of hæmatite on a branch of the Klinaklini river, and therefore in the Nanaimo Mining Division, was staked a few years ago by Sam Colwell. Later his holdings were acquired by the Hæmatite Mining Company, the control of which is held by Peter Wallace and associates, of Vancouver. The property comprises thirteen claims, which are surveyed but not yet Crown-granted. Development-work has been carried on during each summer since the claims were staked; this work consists of open-cuts and a 600-foot tunnel. Mr. Morris, who is interested in the company, has been in charge of this work, subject to instructions from the Vancouver office.

Location.

The Klinaklini river rises in the eastern side of the Coast range and flowing easterly enters One Eye lake, and then flows out of this lake, going in a general south-westerly direction for sixty miles, cutting through the Coast range and emptying into Knight inlet. The iron claims owned by the Hæmatite Mining Company are situated on the headwaters of one branch of the river. They are situated at the head of Chromium creek and at the base of and on the west side of a prominent pyramid-shaped mountain named Perkins peak; this is one of the highest peaks

in this section of the Coast range, reaching to an elevation of 9,500 feet above sea-level. The claims are all well above timber-line and are so staked as to take in the rocky glacial cirque at the head of Chromium creek, and extending up the sloping side of Perkins peak.

The showings of iron ore are situated on the *Britton* and *Monarch* claims at the foot of the mountain, where the slope is not great. A short distance above the showings the mountain rises steeply and in places forms nearly perpendicular bluffs. The surface where the iron-outcrops were discovered is for the most part covered with talus material from the bluffs above. This talus consists of sharp jagged rocks of all sizes, the depth varying from 1 foot up to probably 20 feet.

Geology.

This district is situated in the zone of the eastern contact of the Coast range with the older sediments and volcanics. The Coast Range rocks here as usual consist mainly of granite, diorite, and granodiorite. The older rocks, into which these plutonics are intrusive, are quartzites and argillites, together with interbedded volcanic flows consisting of andesite, basalt, diabase, and porphyritic rocks. These older rocks all show the effects of profound regional and dynamic metamorphism, which has probably been mainly caused by the thermal and dynamic action of the intrusive Coast Range batholithic rocks.

The older metamorphic rocks now occur as patches and large inclusions surrounded by the batholithic rocks, and are deeply cut by dykes which are apophysal phases of the plutonic magmas. The contact-zone is an irregular area which is variable in width and gradually changes, going easterly, to where the older rocks predominate, with only a few dykes of the younger plutonic rocks cutting them. Still farther east these older rocks are capped by volcanic flows of Tertiary age, which are mainly of a basaltic nature.

This deposit of hæmatite is of contact-metamorphic origin. The ore is developed in an argillitic rock generally at points not far distant from where pegmatitic granitic dykes cut the argillites. As is usual in this character of an ore-body, the occurrences of ore are irregular, but further development may prove that the different outcrops are more continuous than they now appear to be. As the surface is covered with slide-rock, the iron ore is only exposed here and there in trenches and cuts. As far as can be seen, it would appear as if the argillite occurred as small lenses engulfed in a granitic magma and cut by dykes of granitic rock. Towards the end of the granitic intrusion iron-bearing solutions followed along the dykes and attacked and dissolved out the argillite, metasomatically replacing it with iron oxide. In places this iron oxide—hæmatite—is solid, and in others it fades gradually away to straight argillite. The hæmatite is of the hard variety, the colour being a very dark red to almost black.

The granitic dyke-rock is characterized by being very completely altered from its original condition; it now consists of kaolin, chlorite, with some quartz and mica crystals. The large amount of kaolin present, formed from alteration of original feldspar, makes the rock quite soft.

Description of the Workings.

The main showings of iron are situated on the *Britton* and *Monarch* claims. The surface work consists of eight open-cuts, with a depth of 4 or 5 feet and a length of from 10 to 50 feet. These openings are mainly in slide-rock, and, as most of them were made two years ago, the sides of the cuts in many places have fallen in, thus making it difficult to examine the bottom. The most westerly cut shows a width of 6 feet of nearly solid hæmatite. A sample cut across this 6 feet returned the following assay:—

Iron	47.6 per cent.
Sulphur	*Nil.*
Phosphorus	Trace.

Another sample taken to be an average of the dump from this cut assayed:—

Iron	48.4 per cent.
Sulphur	*Nil.*
Phosphorus	Trace.

There are several cuts exposing ore which are stretched along the route of the tunnel. None of these cuts show any great width or length of ore, and in most of them it is doubtful if the bottom shows rock in-place. All the dumps from these cuts show hæmatite mixed with argillite and granitic rock. A sample of selected ore from one of these dumps assayed:—

Iron	57.0 per cent.
Sulphur	Trace.
Phosphorus	Trace.

Besides the open-cuts, the main development has been by means of a tunnel 600 feet long. This tunnel shows practically no iron ore, with the exception of a little near the portal, which is, however, of a poor grade and much inferior to that seen in the surface cuts.

At a point 40 feet in the tunnel there is a winze down 18 feet following an irregular contact between argillite and granite, but, contrary to expectations, no hæmatite of commercial grade was found. The tunnel continues through granitic rock for some distance, when another band of argillite was encountered and crosscut through. Beyond this the tunnel continues through 200 to 300 feet of granite to where a schistose rock was encountered. The tunnel was continued on into this schistose rock for some distance, and this is the rock at the face of the tunnel. This schist carries a considerable percentage of iron pyrites.

It is unfortunate that so much work was done in this tunnel without producing any material results in the way of proving the property. In the opinion of the writer, some further development of the iron showings on the surface would have given better information as to how the lenses of ore occur, and, with more complete information as to dips and strikes, the tunnel could probably have been driven to better advantage. With several open-cuts showing iron ore on the surface along the route of the tunnel, it would be reasonable to suppose that, had these lenses of iron ore any great downward extension and areal development, iron ore would have been exposed in the tunnel.

Conclusion.

This deposit of iron ore is as yet an undeveloped prospect, without much proved for or against it. There is no possibility of estimating, at the present time, any appreciable tonnage of reasonably assured ore, or even of probable ore. At no place is there more than a few tons of ore proved up. It is possible, however, that further development would reveal a continuity between the different outcrops and so show a considerable tonnage of ore.

The geographical situation of the property is such that the property, even with a large tonnage of ore proved, would be only of potential value. Iron ore could only be taken to a possible market by means of rail transportation. With this iron-deposit a very large tonnage would have to be proved before it would be worth while building a railroad for the hauling of the ore. It is, of course, possible that in the future a railway may be built to develop the natural resources of this section, and in that case transportation would be provided for any deposit of iron ore.

TATLAYOKO LAKE IRON SHOWINGS.

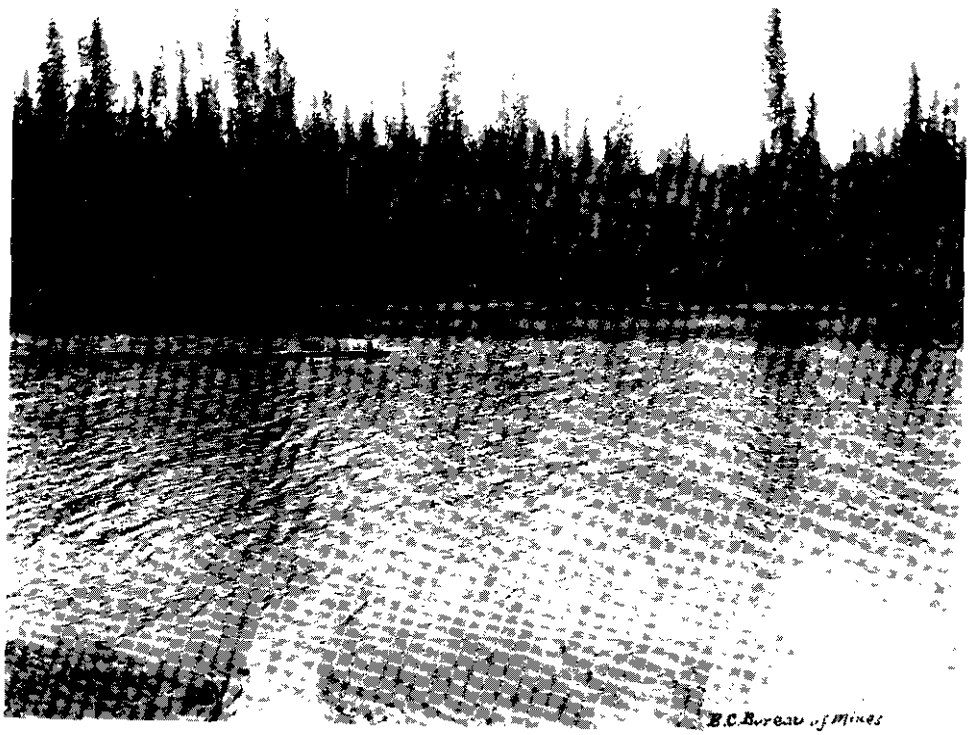
It had been reported to the writer that some claims had been staked near the northern end of Tatlayoko lake and on the western side of the valley, which had good showings of iron ore. These claims are, or were, owned by Mrs. Hance, of Hanceville, but it is believed they have been allowed to run out. Mr. Wilson, who has a ranch at the northern end of the lake, had a fair knowledge of where these claims were, although he had never been to them, and accordingly he guided the party to them.

The claims are situated at an elevation of 7,500 feet and nearly at the top of a mountain ridge forming the western side of Tatlayoko Lake valley. The claims are a mile or two miles north of the end of the lake. To get to the showings from Wilson's ranch and back in one day provides a very generous day's work, sufficient for the most ardent mountain-climber. The so-called showings of iron ore are near and on the sides of a small rock-bound lake or tarn well above timber-line.

The rock formation here consists of quartzites and interbedded volcanic rocks, which are intruded by granitic rocks consisting of granodiorite, diorite, and granite porphyrys, generally in dyke-like masses.

In places through the older rocks wide sheeted zones have been formed in which there are some seams or fissures filled with iron sulphides, principally pyrrhotite. This pyrhotite in small seams is scattered over a considerable area, and on the surface it has been partially and in places entirely altered to iron oxide—limonite. This iron oxide has been transported here and there by the action of surface waters, so that the whole country has a rusty iron-stained appearance.

Tetachuck Falls, *Omineca Mining Division.*



Trail Crossing at Cheslaslie River, *Omineca Mining Division.*

This led to the idea that there was here a valuable deposit of iron ore and so the claims were staked. It is, of course, quite evident, though, that there is no quantity of iron ore nor will there be any found. So that as a possible iron-mine consideration of the property may be dismissed at once.

It is, however, quite possible that in this area of sedimentary measures intruded by granitic rocks some minerals more valuable than iron might be found. That mineralizing solutions were active at one time in the region is evidenced by the amount of pyrrhotite scattered around. And it is quite possible that these solutions carried other minerals besides iron, and that somewhere in the vicinity these have been deposited. No other minerals were noted by the writer, but the region is well worth serious prospecting.

MORRIS PROPERTY.

A number of claims were staked some years ago near the southern end of Tatlayoko lake. These were examined and reported on by the Provincial Mineralogist in 1910, at which time the claims were under option and were being developed by A. H. Sheppard. Some further work was carried out in 1911, but since that time nothing has been done. Some of the claims have been Crown-granted, and it is believed that they are now owned or controlled by Mr. Morris. The claims were divided originally into two groups—the *Copper Camp* and the *Gold Camp*. It soon became apparent that the latter group was the more important, and it was the showings on this which were examined by the writer. The writer was guided to the property by Mr. Wilson, who had some knowledge of where the workings were.

The claims are situated on the eastern side of the valley in which Tatlayoko lake lies and about two miles south of the southern end of that lake. The East branch of the Homathko river —for which the name Tatlayoko river is suggested—is formed by the drainage from Tatlayoko lake and Matthew and Finnie creeks, which three streams unite a short distance from the end of the lake and from the river. Hudgin's pre-emption is situated about a mile south of the end of the lake, but its principal value at the present time is a good cabin on it. From this cabin a trail leads up to the Morris property, going in an easterly direction. It required two hours and a quarter to go from Hudgin's cabin, which is at an elevation of 2,750 feet, to the mine cabin at 5,300 feet, and a distance of about four miles. The mine-workings are a short distance above the cabin at an altitude of 5,550 feet. Timber-line is at about 5,300 feet. The property is situated in Nanaimo Mining Division, and via the Homathko river is distant about sixty miles from the head of Bute inlet. Access to the property is, however, obtained from the other direction, as there is no trail to Bute inlet, and this valley of the Homathko is very rough country, as it cuts across the Coast range.

When the property was formerly worked supplies were taken from Alexis Creek to the northern end of Tatlayoko lake. From Alexis Creek a good wagon-road extends to Tatla lake, and from here a rough road extends to the end of Tatlayoko lake. This country is a very easy one in which to make roads, as in many places a wagon can be driven cross-country without any preliminary building. From the northern end of the lake supplies were taken by boat to the southern end, and then by pack-horses up to the property. A small portable sawmill was taken in and erected, but has since been taken out again. By this route supplies would cost for freighting from 6 to 8 cents a pound over Ashcroft prices. There is a trail along the eastern side of Tatlayoko lake which was used by the writer in going to the property, which is now somewhat in disrepair, but could be easily fixed up.

The country-rock here consists of argillites, quartzites, and conglomerates which have been intruded and partially obliterated by a network of granitoid dykes and stocks. The dykes are as a rule of a somewhat basic rock which may be called diorite and cut the larger masses of acid granite. The granitic rock is generally not in dyke form, but occurs as small irregular bodies which may be called bosses or stocks. These igneous rocks are the representatives here of the Coast Range batholithic rocks, which lie but a short distance to the west. The area is on the contact-zone of the Coast range and the granitoid rocks are undoubtedly directly connected with and form part of the main Coast Range intrusion. As might be expected, on the outer edge of the main batholith both acid and basic dykes and apophysal phases of the granitoid formation occur. That these rocks are intrusive into the sedimentary series is evident by the intense metamorphism and alteration which has taken place in the sediments.

The conglomerate, an exposure of which can be seen a short distance below the upper tunnel, is interesting. It consists of large rounded pebbles of granite and argillite cemented with a gravelly material which consists largely of quartz. This conglomerate is older than the dyke intrusions, as is shown by the contact relations and the fact that the conglomerate has been intensely metamorphosed. The argillite pebbles are altered to a cherty material resembling flint, and the cementing material is so hard and resistant to fracture that in breaking the rock it breaks across both argillite and granite pebbles as easily as across the cement. From its general appearance this rock would seem to be at least as old as the argillites which appear above it. It is probably a portion of the basal member of the sedimentaries series which is well exposed on the eastern side of Tatlayoko lake and includes the argillites and quartzites seen on this property. These rocks have been provisionally classified as representatives of the upper portion of the Hazelton fromation, and from fossil evidence are placed as being of Lower Cretaceous age.

The main vein on this property occurs in a fracture-zone in the sedimentary measures, except that in places the foot-wall is formed by a granitic dyke, and also in places the vein is cut by dyke rocks. The strike of the vein is somewhat irregular, but is roughly S. 20° E. and dips to the north-east. Variations in width from a few inches up to 4 feet occur in the vein, but the general average width is about 18 inches. The gangue-filling consists largely of crushed wall-rock, together with some quartz and calcite stringers. The sulphide minerals in the vein are pyrite, arsenopyrite, and stibnite (antimony sulphide). Values are in gold, with a little silver. The amount of stibnite present is too small to make the ore valuable for its antimony contents.

The vein is developed by a tunnel which commences in granite and goes in as a crosscut for 60 feet; a raise was then put up from the tunnel for 18 feet and the vein was found, being here about 12 inches wide. The contact of the granite with the argillite is at 50 feet in, so that the vein at this point lies entirely in the sedimentary rock. By deflecting the tunnel to the left the vein was picked up on the tunnel level at a further distance of 30 feet. From this point the vein has been drifted on for 280 feet, and at a point 40 feet from the face a short raise has been put up. The workings are now in disrepair owing to the soft caving nature of the ground, and at present the tunnel is in a decidedly unsafe condition to do much picking in. Large slabs have dropped from the sides and the roof and others are already to come down. At a point about 200 feet in from the portal of the tunnel the foot-wall of the vein is granite, and this rock continues on to form the wall for a distance of 50 to 75 feet. It is evident that the vein is nowhere far distant from the granite, and on closer examination the foot-wall may be granite in many places. The face of the tunnel is in argillite and shows no vein, but 5 feet back from the face the vein goes into the roof. It has here a dip of 45 degrees, and by deflecting the vein to the left or into the hanging-wall the vein would be picked up again.

Four samples were taken and assayed, with the following results:—

Description.	Gold, Oz.	Silver, Oz.
Across 6 inches at point 15 feet from face of tunnel	0.08	0.8
Across 18 inches at point 170 feet from face of tunnel	0.50	10.3
Across 18 inches at point 100 feet in from portal of tunnel	0.08	0.9
Picked specimen from dump showing high percentage of antimony.	0.02	4.2

Much better values than these have been claimed for the ore, and it is quite possible that the ore is variable in its gold contents. The above assays therefore are not likely representative of the average of the vein. It is known that the outcrop of the vein carried some ore assaying $50 to $60 to the ton.

At an elevation 150 feet lower than the upper tunnel a drift-tunnel has been put in about 250 feet, following another small quartz vein. The tunnel goes in nearly straight for 105 feet and the vein is throughout from 6 to 8 inches wide. The tunnel then deflects to the right, following a change in strike of the vein for about 50 feet.

The tunnel here deflects again to the right, leaving the vein, which apparently continues on disappearing in the roof as the tunnel turns away from it. This part of the tunnel may have been intended as a crosscut to tap the main vein, but has not yet been driven far enough. A sample across 8 inches, the full width of the vein at a point 150 feet in the tunnel, assayed Gold, 0.5 oz.; silver, 6.3 oz.

NEWTON PROPERTY.

This property is situated some twenty-five miles south-west of Newton's ranch. This ranch, which is quite an extensive stock-farm, is situated on the wagon-road between Tatla lake and Alexis Creek, about twelve miles west of the latter place. A few years ago Mr. Newton secured some meadows about twenty-five miles from his main farm at which to cut hay and to winter stock, etc. Not far from these meadows, which have thus been converted into a stock-ranch, there is a low, long, oval-shaped hill, rising above the general level of the country, which attracted Mr. Newton's attention. After prospecting a little he staked some claims and since then some development-work has been carried out.

The elevation of the meadow ranch is 3,500 feet and the top of the hill is 3,800 feet. Showings on which development-work has been done are scattered over the hill in a number of places, the main workings being at an elevation of 3,600 feet.

Geologically, the formation here is rather complicated and obscure. Granite porphyry dykes, which are very thoroughly kaolinized, would seem to make up the greater part of the rock-outcrops seen. But in some of the workings rocks can be seen which are apparently rhyolites and diabases, but the relations between the different rocks were not learned. No definite veins or mineralized zones can be seen, but the whole rock formation would seem to have carried a certain amount of primary pyrite which is now almost entirely changed to iron oxide. Some of the cuts lower down the hill have been made in a semi-solid formation which apparently consists of a talus-deposit cemented by iron oxide which was brought down in solution from the higher parts of the hill. In local hollows and depressions where the surface waters have stood a considerable percentage of the surface rock is iron oxide. It may be that these places where a high percentage of iron oxide is noted are places where the original rock (possibly a volcanic breccia) carried a considerable percentage of pyrite. No other metallic minerals can be seen in any of the workings.

It has been considered by Mr. Newton that this whole formation, showing over a wide area iron oxide, carried in it low gold values. It is known that assays have been taken which yielded from $1 to $3 in gold. It was considered that if the values were persistent a large low-grade mine was a possibility. The writer regrets that he cannot see any such possibility. Ten samples were taken with a view to getting average samples representative of the mass of the rock taken out of the workings. Eight of these, including a picked sample selected by Mr. Newton, returned *nil* results in gold and silver, and the other two gave traces. This does not necessarily prove that none of the rock carries gold, but it does prove that a great deal of it where exposed in the present workings is barren. It may be pointed out that it is impossible to select any specimens, as all the rock looks about the same and there is no guide as to what might contain the gold.

As the average of the samples showing values as obtained by the owner is somewhere in the vicinity of $1 to $2, it is evident that for the property to be considered at all, the whole hill would have to be persistently auriferous and the size of the ore-body measured in millions of tons. The writer considers that his samples show that a large portion of the rock does not carry gold values, and hence selective mining to get at patches or zones that carried a dollar or two in value could not pay.

A considerable amount of development-work has been done, including several long deep open-cuts and two shafts 30 feet deep, besides several shallow shafts and pits. At one place a considerable quantity of rock has been moved from a long open-cut, from which at places a short distance apart two shafts were put down.

In the long cut a very distinct but highly decomposed granitic dyke is seen cutting across an iron-stained soft, altered rock which has possibly been a volcanic breccia. A sample was cut across 15 feet in this cut and other samples were taken of the various dumps, but *nil* results were obtained. This working looks the most promising of any on the hill, and it was expected some gold values might be obtained.

Mr. Newton has had many assays made, and he seems to think that from the low-grade values obtained in many places somewhere a concentration of values might be found which would provide pay-ore. In a case like this, which is entirely dependent on assay values, the opinion of the owner, if based on intelligent sampling, is of more value than that formed by anybody else on a short hasty examination. But on the owner's statements no rock has been yet found on the hill which can be considered as pay-ore in this locality. Whether or not it would be wise

to do any further work looking for areas which might carry values is doubtful, and in the opinion of the writer such work is entirely unwarranted.

GENERAL REMARKS ON AGRICULTURE, ETC.

The area under consideration lies between the Grand Trunk Pacific on the north and the Chilcotin country on the south and directly east of the foot-hills of the Coast range. This portion of British Columbia is not opened up by any railway or trunk wagon-road, but has a few local roads and many trails. The country contiguous to the Grand Trunk Pacific Railway is fairly well known throughout Canada. The Skeena and Bulkley valleys have been well advertised and much has been written concerning their agricultural features. The advent of the railway has been a great boon to this district and farming is steadily growing in importance.

South of the Bulkley valley between the Morice river and Fraser lake lies the Francois-Ootsa Lake district. A wagon-road running in a south-easterly direction from Houston, on the Grand Trunk Pacific Railway, crosses the Nadina river close to where it empties into Francois lake. The road then continues on to Ootsa lake, passing through the upper settlement, of which the post-office is called Wistaria, and on to Ootsa Lake settlement. Wistaria is sixty miles from Houston and Ootsa Lake fifteen miles farther. From this latter place, which is about the centre of the lake on the north shore, the wagon-road runs in a northerly direction back to Francois lake, which is crossed by means of a ferry, and then on to Burns Lake, where it connects again with the railroad. This road, which is about 120 miles long and in very fair condition, is of great value to the settlers. Until the advent of the railway this locality had a very slow growth, as all supplies had to be packed in nearly 200 miles over the trail from Bella Coola. Since then, however, many new settlers have come in, supplies are very much cheaper, and this section is progressing rapidly.

Mixed farming is carried on in this district, but, as most of the land is at an elevation of between 2,500 and 3,000 feet, the summer frosts sometimes affect the crops. The country, however, is well adapted to stock-raising and has a good future in this industry. Sheep would also do well if it were not for the coyotes, which are numerous. The long hard winters necessitate from three to four months winter-feeding of cattle. Wild hay grows in abundance, however, and is cut and stacked for winter feed. The vegetation is really remarkable, the general growth of peavine, rye-grass, and fireweed being from 4 to 5 feet high. A yield of 4 tons to the acre is not uncommon, but a yield of 2½ tons is about the average. Practically the whole district is good summer range, the peavine reaching its greatest growth in amongst the poplar-trees, with which the country is sparsely timbered in groves, with many open spaces alternating.

The Owen Lake section is at the headwaters of the Nadina river, which flows into the west end of Francois lake. This area, while not extensive, deserves mention for its very fine stand of wild hay. Low rolling hills and large flat stretches are often entirely free of timber. When the land is timbered, the trees are mostly poplar from 3 to 6 inches in diameter. Many claim the average acre in this district can be cleared for $25, and picked areas as low as $15 per acre.

The luxurious growth of peavine and rye-grass continues in many places for a distance of about ten miles west of a line joining the west ends of Francois and Ootsa lakes. Westward from here to the mountains, however, the growth is practically confined to the meadows. There are occasional very large meadows and many small ones, generally more or less flooded by the work of the industrious beaver. This strip of country is dotted with innumerable lakes and is badly broken up by creeks and small hills which rise from 1,000 to 1,500 feet above the plateau.

A few words on the geography of this section might not be amiss. This is undoubtedly British Columbia's lake country. There are innumerable small lakes and many large ones, Francois and Ootsa being the best known of the larger lakes. They all lie practically east and west, being fed from the Coast range and draining easterly into the Nechako, which flows into the Fraser at Prince George. A large river named the Tahtsa flows into Ootsa lake at the west end. This river flows in an easterly direction and is about thirty miles long, draining Tahtsa lake, which is in the heart of the Coast range. There is a low pass at the head of Tahtsa lake through to the Coast, a distance of about thirty miles. About four miles from its mouth the Tahtsa river is joined by the Whitesail river, which drains Whitesail lake, another large lake, the head of which is in the Coast range. Whitesail and Tahtsa waters are separated by the Whitesail mountains, a spur of the Coast range; Eutsuk lake lies to the south of Whitesail, and at

one place the two lakes are scarcely a mile apart. Eutsuk lake drains into Tetachuck lake, thence by the Tetachuck river into Nechako waters. Eutsuk, which is nearly sixty miles long, is probably the largest lake in this district—i.e., has the most water in it. It is not as long as Francois lake, but it has many large bays and inlets. Eutsuk lake is 85 feet higher than Whitesail lake and could easily be drained into Whitesail where the two lakes are about a mile apart, thus providing enormous power, if ever required.

The shores of Eutsuk and Whitesail lakes are thickly timbered with hemlock and balsam. The trees, however, are small, of poor quality, and of little economic value. There are occasional meadows in this vicinity, but for the most part the land is barren, being too high and situated too close to the mountains. The scenery, however, is very fine, quite the equal of anywhere in the Province. Any person seeking scenery cannot do better than take a canoe trip from Ootsa lake into Whitesail lake and then portage the mile across into Eutsuk lake. He can then go down Eutsuk to Tetachuck lake, and then by the Tetachuck river to the Ootsa river, and then back into Ootsa lake, making a round trip of nearly 200 miles.

The landmark of the Francois and Ootsa Lake district is Nadina mountain. The bend of the Morice river where it changes its course from east to north occurs at the foot of this mountain. Nadina is a lone mountain 7,000 feet high. There are no other mountains close to it, and the average elevation of the surrounding country is from 3,000 to 3,500 feet. Thus it can be seen a long distance from all directions.

A point worthy of mention is that no salmon ever got into these lakes. The reason is that the fish cannot get past the falls on the Nechako river. If a fish-ladder were installed on the Nechako, the lakes would provide a wonderful spawning-ground for salmon. The lakes and rivers are otherwise well stocked with the usual inland fish. This is also a good fur-producing district; fox are quite common, several fox-farms being in operation. There are also large numbers of marten, fisher, lynx, and beaver. The coyotes are too numerous for the good of the country, but considerable revenue is obtained by the settlers from the bounty and hides. There are also moose, caribou, and mule-deer, providing good hunting.

South of Ootsa lake there is a marked change in the character of the country. The last traces of peavine and rye-grass disappear when the Tetachuck river is crossed, and the poplar-trees also cease, to be replaced by jack-pine. The feed here is mainly in the meadows and along the creeks. For the most part this country is barren, by far the greater area being dry rocky benches between 3,500 and 4,000 feet in elevation and thickly timbered with small jack-pine of no value. The Indian village of Algatcho at an elevation of 3,900 feet, is situated about forty miles southerly from the Tetachuck river. This village is in a barren locality, and is used entirely for winter hunting purposes. In summer it is generally deserted, many of the Indians being engaged at the canneries around Bella Coola. Continuing south from Algatcho about ten miles, the Dean river is reached, which flows into Dean channel, and is locally better known as the Salmon river. There are many large meadows along the Dean River valley, extending along the river to its source. After crossing this river the country is much the same as between the Tetachuck and the Dean rivers. Thus the Dean River valley appears as the one bright spot in an otherwise barren country.

This district has a considerable output of furs, the Indians doing practically all the hunting and trapping. The landmark of the section is Anahim peak. This is a lone black hill about 6,000 feet in elevation, situated about fifteen miles south-easterly from Algatcho. It rises about 2,000 feet above the surrounding country and, like Nadina mountain, has no other mountains close to it.

Going south from the Dean river through barren country for about fifty miles, the Bella Coola valley is reached. This valley is about sixty miles long and is very narrow, some places being only a mile wide. The sides of the valley are high, rugged mountains, the river cutting through the Coast range. There is a nice stand of timber here, fir, cedar, spruce, hemlock, cottonwood, and poplar growing in merchantable size and quality for forty miles from the salt water. Many timber claims are held in the valley, most of the cottonwood and poplar being held for the pulp industry. The soil is very rich, being an alluvial deposit, and is well adapted to truck-gardening and fruit-raising. The large thick growth of timber makes land-clearing very expensive, the average acre costing about $300 before it is ready for the plough. There are no very large clearings, but many small farms are in operation for a distance of fifty-five miles up the valley. The rainfall is fairly heavy, producing a luxurious growth. The valley seems to

suffer slightly, however, from the lack of sun, owing to the high mountains on either side. There are two main settlements, one at Bella Coola near the salt water, and one at Hagensborg, about twelve miles up the river from Bella Coola.

In rising out of the eastern end of the Bella Coola valley and continuing southwards, the country passed through is partly barren and partly meadow land, supporting several small cattle-ranches. On approaching the headwaters of the Dean river again the country improves considerably, and there are many large meadows between the Dean river and the Klinaklini river. The Klinaklini section has been attracting considerable attention the last few years. There are quite a few settlers now in the vicinity of One Eye lake, which is about twenty miles from the source of the Klinaklini river. South of here are Tatla and Tatlayoko lakes across the western end of the Chilcotin country. There are several cattle-ranches in operation at present between the Klinaklini river and Tatlayoko lake, and the summer range would accommodate many more cattle. The drawback is that in many cases some land would have to be cleared to grow hay for winter feed. This would not be a very serious matter, however, as it is claimed that land in that vicinity can be cleared suitably for growing hay at a cost of $20 an acre. There are also quite a number of meadows that are not taken up on which some hay could be cut. The average elevation of this district is about 3,000 feet, so that most of the land is too high for a good agricultural district. Tatlayoko lake is lower, however, and there is an area around it at an elevation of 2,500 to 2,800 feet.

It thus appears that from the Grand Trunk Railway south to the Chilcotin country there is east of the Coast range a strip of country varying from twenty to forty miles which is, for the most part, practically barren land. East of this, however, there is a country specially adapted to stock-raising, and, for the greater part, low enough in elevation to allow sufficient farming to be carried on for local needs.

APPENDIX.

DETAIL DESCRIPTION OF ITINERARY.

The starting-point of the trip was at Houston, a flag-station on the Grand Trunk Pacific Railway, thirty-one miles east of Telkwa and at an elevation of 1,941 feet above sea-level. Houston is a pleasantly situated place, as here there is a large flat extending for several miles in an east-and-west direction through which the Bulkley river flows; this flat was named, many years ago, Pleasant valley. There is no hotel at Houston, but a small stopping-place is run by Mrs. Brown which is especially characterized by most excellent "home-made" meals. A general store is kept by Law & Mosher. There are a few ranches in the vicinity, but agriculture has not been developed nearly as much as might have been expected, as there is apparently a large area of land suitable for farming.

The four members of the party, ten horses, and supplies were all assembled at Houston by the night of August 5th. The next day was spent in adjusting everything, checking over lists, and making everything right for the long trip.

On August 7th the actual start was made and twelve miles was travelled, arriving at Buck flats (elevation 2,675 feet), where camp was made. The route followed was along the wagon-road which runs from Houston to Francois lake.

This road as far as Buck flats runs through fairly good ranching country which is as yet but little cultivated. A light frost occurred at night, so that it is apparent that farming would be confined to hardy cereals. Possibly the country is better adapted to stock-raising and dairying than anything else.

Fifteen miles from Houston the wagon-road was left, a trail being taken into Owen lake. The second camp, on the night of August 8th, was made at the camp of O. W. James (elevation 3,150 feet), some twenty-six miles from Houston. Here Mr. James has a very comfortable tent camp and he and his partner, A. Martinson, were engaged in prospecting some near-by claims recently staked.

The party remained here for three days and all the claims in the vicinity were examined. During the time, Nadina mountain was climbed by D. A. MacKinnon and J. R. Galloway and much useful information about the country thereby obtained.

The detail descriptions of the claims will be found under the subdivision of this report entitled "Economic Geology."

James camp is situated about three miles from the north-eastern shore of Owen lake and near the southern end. Owen lake is about five miles long and from one to two wide.

The country around Owen lake is very fine grazing country, the growth of peavine and other wild grasses being most luxuriant. During the summer a cattleman from Montana took in a herd of cattle and forty to fifty young horses with the intention of wintering them there. The feed for summer grazing is plentiful, and a mower was taken in to cut wild hay, it being anticipated that there would be no difficulty in putting up sufficient hay for winter feed. Practically all the land in this section is, or has been, held under land purchase, but very little use has been made of it. The trail to Owen lake leaves the wagon-road fifteen miles from Houston and rises on a low divide to 3,350 feet. It then swings around the end of Trout lake, coming down to 2,800 feet; then up again to 3,875 feet on another low divide, and finally down to 3,150 feet at James camp. This last divide is about half-way between Trout and Owen lakes.

Trout lake really consists of two or three small lakes joined together by short creeks, and its name indicates the fact that in it particularly good trout-fishing can be obtained, although this cannot be vouched for by the writer, as no stop was made there.

Nadina Mountain.—Nadina mountain is the most prominent mountain in this section of the country and is visible from many places in all directions, up to distances of from 50 to 100 miles. It is not due to any great height that this mountain is such a pronounced landmark, but because it is an isolated mountain mass of considerable magnitude which is much higher than the immediately surrounding country, which is, relatively speaking, of a flat rolling nature. Dawson refers to this mountain as Nadinaka mountain in his report in 1875-76.

In order to ascend the mountain a raft was made which was used to cross Owen lake to a point near the foot of the mountain. Although it was expected that the trip from James camp to the top of the mountain could be made in one long day, it proved to be quite sufficient to occupy two days, so the climbers spent the night near the top of the mountain.

Nadina mountain is easy to climb from the south-eastern side, but the other slopes appear to be so steep as to present considerable difficulty. The western and south-western slopes in particular are very rugged, and in many places there are sheer precipitous bluffs which are unscalable; here the rock is apparently basalt, showing in places the typical columnar jointing of basalt. The top of the mountain is a plateau, possibly three-quarters of a mile long and somewhat less in width. The south-east end of this plateau has an elevation of 7,000 feet and the west end is 7,320 feet.

From the summit a magnificent panorama of the country is obtained, it being possible to see for miles in every direction. From the summit no less than seventy lakes were counted of all sizes, from thirty miles in length down to mere ponds. The most of these lakes are unnamed and many of the smaller ones are unmapped. From the top of the mountain a number of bearings were taken which assisted in making a sketch-map of the country travelled. Notes were made of the rock formation of the mountain and rock specimens collected. The geological features will be found discussed under the subdivision of this report entitled "General Geology."

August 12th. James camp was left and travelling easterly for about seven miles camp was made at Alexander's Indian reservation. This proved to be our "bad day," as everything went wrong from the start. The horses were unmanageable, the "cussedness" of some of them becoming very much accentuated on having to leave an excellent feeding-place, and one pack was scattered over a few hundred yards of trail in a most beautiful bucking exhibition. After straightening things out the trail was taken for three miles easterly to Tayton's pre-emption. The continuation of the trail beyond this could not be found, and it was necessary to ride back to James camp and secure Martinson as guide, who after some trouble succeeded in locating the trail. To find the trail it is necessary to go a good bit to the left of Tayton's cabin and go down into a timbered swamp. The number of cattle-paths around the place make it difficult to find the right trail.

Half a mile beyond Tayton's the trail becomes well marked, and from there on there is no difficulty in following it. All the country travelled through to Alexander's is flat rolling country and should prove to be suitable for stock-raising. The reservation at Alexander's is a small affair, with only a few old shacks and no Indians were seen there. Alexander has some horses and cattle ranging around and cuts a very little wild hay for winter feed. No attempt is made to grow anything.

An alternative trail from James camp crosses near the foot of Owen lake and joins the other one just beyond Alexander's. This was reported in bad condition, so was not taken, although it may be a little shorter.

August 13th. From Alexander's camp was moved to Poplar lake, a distance of about fifteen miles, and occupying six and a half hours' steady travelling by the pack-train. The elevation at Poplar lake is 2,950 feet, and between Alexander's and this point no elevation higher than 3,000 feet was noted.

August 14th. Left Poplar Lake camp at 8.50 and travelled steadily till 7 p.m.; distance travelled, twenty miles. The reason for travelling so late was inability to get water sooner, and so Dry camp became the name of our camp that night. After leaving Poplar lake two small unnamed lakes were passed. Then the foot of a larger lake is passed; from this lake the main branch of the Nadina flows out and the trail crosses this on a rough log bridge. The trail then runs along the bank of a small river connecting this lake with another small lake above, the ultimate source of the Nadina river. At this place the party should have crossed this river to where there is a small meadow on the other side, which would have provided feed for the horses for the night. For some distance beyond this on the trail there is no horse-feed, the country being covered with scrubby jack-pine. Scanty grass and lupine then gradually begins to be noticed, but then there is no water, which is also a necessity. In the spring there would be plenty of water, but in August all the little meadows and small watercourses were dried up. Finally, Star lake was sighted and camp was made on the trail about a quarter of a mile from the west end of the lake. There was sufficient grass in the vicinity for horse-feed, but it could hardly be called a good camping-place. A mile farther along the trail there is a much better place for a camp. All the country travelled through that day was fairly level and rolling. The elevation at camp was 3,650 feet. Rock-exposures were frequent along the trail.

August 15th. Dry camp was left without regret, and Maxwell's cabin on Sibola mountain was reached after four and three-quarters hours' travel. The trail goes south-west to the foot of Sibola mountain and crosses Sibola creek at an elevation of 3,800 feet. A few years ago some placering was done at this point by "Kid" Price, and the sluice-boxes, whipsawed lumber, and a good cabin which can be seen are standing evidence of the hard work spent in searching for the elusive "colours."

Up to the foot of Sibola mountain the country is sparsely timbered with spruce, pine, and balsam trees, but along Sibola creek and going up the side of the mountain the timber improves in quality and size. Many of the balsam-trees here reach 2 feet in diameter.

After crossing Sibola creek the trail rises very fast, with some very steep pitches, which are just about all that a pack-horse can manage to get up. Above these steep places the trail rises steadily but more gradually until timber-line is reached at about 5,400 feet elevation. Still rising, the trail goes south for about two miles along the eastern side of Sibola mountain, the highest elevation recorded being 6,700 feet. After this the trail turns easterly and goes down to Maxwell's cabin, situated at an elevation of 5,000 feet. The trail on the mountain-side above timber-line is very indistinct and it is not easy to follow, nor is it easy to find the cabin, as it is hidden behind a shoulder of the hill.

On Sibola mountain a number of claims have been staked on small veins of quartz which at one time were supposed to be very rich in gold. Three years ago there was quite a stampede into the district and claims were staked far and wide, most of which have since been allowed to lapse.

A few days were spent here examining the various claims, taking notes on the general character of the country, and getting a rough sketch-map of the route travelled from Owen lake. The claims are described elsewhere in this report.

Sibola mountain joins on to Sweeney mountain to the east, and both form the end of a spur of the Coast range running out on the north side of Tahtsa lake. There is another cabin on Sibola mountain—Price's cabin—situated on Comb creek, a small creek occupying a deep east-and-west gash in the mountain, and flowing into White river. This latter river occupies a deep gorge separating Sweeney and Sibola mountains, and flowing generally easterly joins the Tahtsa river. From Maxwell's cabin the trail goes down Sibola mountain, going a little east of south and crosses White river at an elevation of 3,500 feet. The trail keeps along level for a mile or two and then comes to a camping-place known as Mosquito pass, which is well named. From here the trail goes up to Benson & Sweeney's claims on Sweeney mountain.

Colwell's Ranch, Klinaklini River, Nanaimo Mining Division.

Telegraph Cabin, Klinaklini River, Nanaimo Mining Division.

On August 18th camp was moved to Mosquito pass (elevation 4,500 feet), distant about seven or eight miles from Maxwell's cabin. From this camp the claims on Sweeney mountain were examined, and some other claims on Sibola mountain which could not be found before were discovered through the courtesy of Mr. Sweeney in volunteering to guide the writer to them.

Near timber-line on the mountain in a good tent camp were found Messrs. Benson, Madigan, and Fowler, who were at work on their claims. Sweeney also has a tent camp on his claims. The weather, which had previously been good, turned stormy, with rain, sleet, and wind.

From this point the next objective point was Ootsa Lake, to reach which there were two alternative routes. First, by taking the same trail back to the wagon-road near Houston, and then by that wagon-road, in past the end of Francois lake to Ootsa Lake. It was not desirable to do this, and fortunately an alternative route which would enable us to travel through new country was possible.

In 1905 a rough trail was put in from the head of Ootsa lake to within a couple of miles of the foot of Sweeney mountain by Barclay Bonthrone. This trail roughly follows the Tahtsa river—which flows past Sweeney mountain and enters the head of Ootsa lake—but is from three to ten miles to the north-east of the river at all times. In the summer of 1916 Benson and partners came in by this trail and found it to be in very bad condition. It took them two or three weeks to come in, as they had a lot of cutting to do—practically making a new trail in places for several miles at a stretch. A very complete description of the trail and sketch of it showing camping-places, etc., was obtained from Mr. Fowler before starting, which helped considerably. Owing to the damming-up of a meadow by beavers it was not possible to follow the Benson blazes at one place, and here a few miles of new trail had to be cut by the writer's party. All along the trail more blazes were put in and cutting done in places, and it is believed that anybody could now follow the trail.

By August 21st all the examination of claims on Sweeney mountain and work in that section was completed, but the next day the weather was so bad that it was deemed inadvisable to move camp. The old Bonthrone trail came to the head of Lake Lyster—a lake lying at the foot of Sweeney mountain and a few miles long—which is about two miles from Mosquito Pass camp and 850 feet lower in elevation. Accordingly, on August 22nd a trail was cut out and well blazed from Mosquito pass down to where the old Bonthrone trail was connected with. It proved to be a lucky thing that camp was not moved this day and that the trail was cruised out, as it would have been practically impossible to get a heavily laden pack-train down to the lake without first picking out a suitable route.

August 22nd. Camp was struck at Mosquito pass and the start made. It took two hours to reach the old Bonthrone trail at the end of Lake Lyster. In another two and a half hours the meadow was reached, where, owing to flooding, it was impossible to cross. Camp was made by the side of this meadow and new trail cruised out. The trail had to be made around the edge of a low bluff abutting on to the meadow. After this the route followed by the Benson party could not be found, but the old Bonthrone trail was picked up, and this was followed for some miles to where the Benson trail was again found joining the Bonthrone trail. The meadow camp was distant about seven miles from Mosquito pass. The country between is timbered with jack-pine, spruce, and balsam, some trees up to 2 feet in diameter being seen. Horse-feed is plentiful all along the trail.

August 24th. This day was spent in cutting new trail, cleaning out the old Bonthrone trail, and in moving camp to a point half a mile beyond White river, which was forded. The total distance travelled was only three or four miles, but nevertheless a long day was put in. The position for the camp was decided by running into a burned area in which all trace of the old Bonthrone trail was obliterated. It was not a satisfactory camp, as evidenced by the diary notes, which say: "Poor horse-feed; bad water; bad camp."

August 25th. It was decided that nothing further could be done in trying to follow the old Bonthrone trail, so a search was made for the Benson trail; this was finally found where it crossed the White river some distance below where we had crossed it. In the late afternoon a trail was cut out from camp to join the Benson trail by recrossing the White river. It is interesting to note that at this point on the south-east bank of the river a 20-inch spruce-tree was found with an old survey blaze on it. The tree had been faced up on one side, and the following inscription put on with some kind of dark-red paint, which evidently was of a very durable nature:—

C.P.R.S.
Camp 10.
September 6th,
1876.
J. CAMBIE.

The tree had grown steadily during the forty years since the writing was put on, and the wood had grown partly over and covered up some of the letters. On cutting away this growth of wood the letters were found underneath. All the letters were quite legible excepting the first C, which is doubtful. It is believed that this marks the site of an old camp on one of the first preliminary surveys run across British Columbia for the route of the Canadian Pacific Railway.

August 26th. Left camp at 9 o'clock; crossed White river about one mile from camp, and joined Benson trail, which recrosses White river a short distance beyond. The trail continues down the side of White river to Sibola creek, which is forded about 50 feet above where it joins the White river. Two and a half hours' travel brought the party to Sibola creek, which is easily fordable, and in another hour's travel a large meadow was reached. Here some difficulty was encountered in finding the trail, so camp was made. After some search the trail was found; it does not enter the meadow, but keeps on up the west side along a slightly raised ridge which is covered with very small jack-pine trees. The country between Sibola creek and this meadow at which camp was made is covered with burnt pine-trees and small second-growth jack-pine.

August 27. Left camp at 8.20; reached first meadow at 10.15; first lake at 12; second lake at 1.30; and summit at 3.15. From the camp of August 26th the trail goes east for two miles, then south to the first lake, then east to the second lake, and then north-east to the summit. The trail goes first of all through burned and second-growth jack-pine, then green timber at the meadow, then more burnt country, then green timber at the first lake, then burnt country around the second lake, and green timber up to and on the summit. The first lake is small; the second is about a mile in length and is at an elevation of 3,500 feet. Between the Tahtsa river and the mountain to the north there is a large area of rolling country which is timbered with scrubby trees, mostly jack-pine, and burnt here and there in numerous places by recent fires. The most prominent feature is a ridge of low, rounded, wooded hills lying about ten miles north of the Tahtsa river. It is over the northern edge of these hills that the Bonthrone trail passes, and the summit mentioned before is the highest point on the trail where it passes over this low range of hills. The elevation of the summit is 4,180 feet and the highest hill might be 5,000 feet. Just past the summit, a few hundred feet (going towards Ootsa lake), a branch trail a quarter of a mile long leads to a meadow where there is a good camping-ground. This camping-ground should be utilized by anybody going in either direction, as it is a long distance to good horse-feed either way from this point. Near the summit there is a blazed tree giving directions how to find the meadow camp. From the appearance of the country there it would hardly be expected that a good meadow was so close at hand, but travellers should keep a close watch for the inscribed tree, as it will save trouble. From the meadow camp of August 26th to the summit is a distance of about fifteen miles and occupied a little over six hours' steady travel.

August 28th. This morning a good start was made, being packed and on the move at 7.45. The trail gradually descends from the summit and is here very much blocked with windfalls, causing many detours and consequent slow travelling. The timber here is of a fair size, but hardly of commercial value. By 12 o'clock a point was reached on the trail opposite a large lake at least five miles long, and at 2.15 a creek flowing out of this lake was crossed. The trail then runs along a ridge on the north bank of this creek for several miles. Camp was made at 4.45 in a nice park-like meadow in the valley of the creek—a particularly pretty place for a camp. The creek has incised a valley a quarter of a mile wide down into the gravels and clays which here cover the country. The valley-bottom is sparsely timbered with clumps of spruce, pine, balsam, and poplar trees of small size, and everywhere there is a luxuriant growth of wild grasses, excellent for horse-feed. The valley is quite regular, with a grassy slope of 35 to 40 degrees up to the bench land, 75 feet above. In coming from the summit the general direction travelled was easterly, with a little southing. Camp was at an elevation of 3,125 feet.

August 29th. Some regret was felt at leaving our nice camp, but in a short time the sight of Ootsa lake in the distance, glistening in the morning sun, soon put everybody in good spirits. By noon a point on the trail was reached opposite the west end of the lake, and camp was made on the beach about four miles from the western end. About fourteen miles had been travelled, taking about six hours' time.

The Bonthrone trail on approaching Ootsa lake merges into some very old Indian trails, and on getting opposite the lake becomes lost altogether. It is probable that Bonthrone in going into the Tahtsa district from Ootsa lake followed Indian tracks as much as possible, and only started to cut trail after getting some miles beyond the lake. However, there is no difficulty in getting along, as many trails can be found along the shore of the lake, all leading towards the settlements farther along. Some pre-emptors' cabins were seen near the head of the lake, but they were not being occupied at the time.

August 30th. On leaving camp a trail near the shore-line was followed for two miles, and then the beach was taken for two miles. Then a well-marked cattle-trail was taken which led straight back from the shore to Shelford's ranch, about three miles away. From here a trail two miles and a half long led to the main wagon-road from Houston, and three miles easterly along this and Brunell's ranch was reached. This was virtually back into civilization again. The next day, August 31st, was declared a "Sunday," with the usual acceptance of its meaning as a day of rest, which, however, did not prevent some very necessary washing of clothes being done. The packer had developed a sore foot from a well-placed kick of one of the horses, but the day's rest brought him around all right. On the next day camp was moved to Bennett's, some fifteen miles down the lake, where Ootsa Lake Post-office is situated.

During the next two days two members of the party went to Bostrom's store (sixteen miles away) for supplies, notes were written up, information about the country obtained, and arrangements made for a trip up Ootsa, Whitesail, and Eutsuk lakes.

Through the courtesy of Messrs. Allen and Chettleburgh, of the Forestry Department at Hazelton, the use of the Forestry boat at Ootsa Lake was obtained for a trip on the lakes. The boat is a Peterborough boat, 18 feet long, and equipped with a small Evinrude motor. James Morgan, the Forest Guard at Ootsa Lake, who had been up the lakes before and also knew the idiosyncrasies of the motor, was engaged for the trip, and as the packer was left behind to take care of the horses, the party as before consisted of four. In portaging the boat between Whitesail and Eutsuk lake four men are required to handle it.

Some description of the settlements and farming around Ootsa lake will be found under the heading of "Agriculture," so all that will be said here is that there is apparently a large area along the north shore of the lake which is suitable for stock-raising and possibly some kinds of farming. There are two post-offices on the lake, one at Bennett's (Ootsa Lake Post-office) and one near Brunell's (Wistaria Post-office). The nearest store is at Bostrom's at a small lake sixteen miles away and on the road to Francois lake.

Lake Trip.

The Forestry boat was loaded down with supplies for two weeks; blankets and, last but not least, several guns and plenty of ammunition were taken for the big game we confidently expected to see. Loaded in this way the motor drove the boat at a speed of three to four miles an hour, depending on the wind. A headwind was encountered at the start which threw lots of spray, necessitating putting into shore before long to bail out. About two miles up the lake from Bennett's there is an outcrop of diabase and volcanic breccia which at one time was staked or prospected for mineral. It was examined, but no valuable minerals could be seen.

Lunch was taken opposite two small islands, and by 5 o'clock camp was made on the beach at Harrison's ranch. This is sixteen miles from Bennett's.

September 5th. Left Harrison's beach at 9 o'clock and again had a headwind to buck against. Arrived at the end of the lake, where the Tahtsa river joins it, at 12.30. About two miles up the Tahtsa river from the lake Whitesail river joins the Tahtsa. Both rivers are about the same size and are here broad, sluggish streams. Above where they join they flow along parallel for a mile, separated by a narrow strip of flat land. In another mile or so Whitesail river opens out into a long, narrow lake expansion which is called Long lake or Sinclair lake. At 5 camp was made at the foot of rapids on the Whitesail river. These rapids are not very severe, but here the river flows quite rapidly and spreads out in swift, shallow channels which

make the ascent troublesome for such a boat as ours. At this time of the year the water in the river was at its lowest, and in places there was hardly enough water for the boat, which, loaded, drew 2 feet at the stern. In high-water time the speed of the current would probably be from six to eight miles an hour, and so a more powerful engine than the Evinrude motor would be required to drive the boat up-stream.

September 6th. Left camp at 8.45 and worked up-stream slowly for a mile and a half. Here poles were cut, the motor unshipped for fear of damaging it against the rocks, and the heavy work of poling the boat up-stream commenced. It was soon found that there were no experienced "polers" in the party, and that by getting out and shoving the boat with one man leading with a long line was more effective than poling. As it was a nice warm day, the cold water did not trouble anybody, and the work was sufficiently arduous to keep everybody "warm." A picture taken at the time is appended to this report.

These rapids continue for about five miles, and at the upper end the river opens out into Whitesail lake, which was reached at 3 o'clock and a stop was made for lunch. Another eight miles up Whitesail was negotiated that evening and camp then made on the beach on the north side.

September 7th. Harrison's camp on the south side of the lake was reached by 11, and here camp was made for the purpose of examining the showings of zinc ore staked here. The showings outcrop right on the edge of the lake, which has here a rocky bluff from 50 to 100 feet high, broken, however, in places. The work done consists of a drift-tunnel which starts a few feet above the water's edge, and the rock from which is dumped into the lake. A good cabin has been erected about a mile farther up the lake-shore and back from the water about 250 feet. The afternoon was spent in the examination of the property.

September 8th. Left Harrison's cabin at 10.30 and went back down the lake a few miles to the big bay, from the most southerly point of which there is a portage to Eutsuk lake. On the Eutsuk side a long narrow arm of the lake runs in to the north towards Whitesail lake. The portage is made up of two portages with a beaver-pond in the centre. The length on the Whitesail side is 2,050 feet (by pacing), then a quarter of a mile across the beaver-pond, and then 3,000 feet portage to Eutsuk lake. From Whitesail lake to the beaver-pond there is a rise of 60 feet, and from there to Eutsuk lake a further rise of 25 feet, making 85 feet difference in elevation of the two lakes. It took five hours to portage the boat, camp equipment, etc., across. Camp was made three miles from the portage a short distance beyond where the narrow arm of the lake comes out on the main lake.

September 9th. This day there was a strong breeze blowing down the lake, which made it impossible to go far in the boat on the lake. Left camp at 10 and went two miles up to the lake and from that point climbed Mount Morgan.* This mountain lies between Eutsuk and Whitesail lakes, and from it a good view of the country is obtainable. Timber-line is at about 5,000 feet, and above this there is a large flat area from 6,200 to 6,500 feet elevation. From this surface at one end there is a sharp-pointed peak rising 2,000 feet more, but it was too late in the day to climb this. In any case there was no object, as the country could be seen just as well from the elevation attained. Nadina mountain and Anahim peak could both be distinctly seen, the latter being at least eighty miles distant.

September 10th. Very stormy day with a strong wind, making it impossible to go far on the lake, as where the wind had a full sweep the water was too rough for a small boat. The large bay was crossed, however, into which the St. Thomas river comes, but it was not possible to round a point beyond which the river enters. It had been intended to do this and run up the river some distance, but this could not be done. After beaching the boat the beach was followed round to where the river comes in.

On some of the maps it has been represented that there are several thousand acres of good land along this St. Thomas valley. This is evidently a mistake, as the whole valley of the river could be seen from Mount Morgan, and no appreciable amount of open land can be seen. The river rises in the mountains lying between Eutsuk and Ootsa lakes and flows in a narrow valley flanked by steeply rising wooded hills. A few beaver meadows occur in places along the valley.

September 11th. Went to the head of Eutsuk lake, distant about ten to twelve miles from camp. A small river with milky glacial water comes in near the head of the lake on the north

* The name Mount Morgan has been applied to this mountain lying between the two lakes. No name had been previously given to it, but since writing the above another name has been suggested. The name is therefore provisional, and it is not intended to try to fix it permanently if another name is better.

side. A quarter of a mile from the mouth there is a 50-foot fall, and 100 yards farther up there is another fall about the same height. This stream rises in the Eutsuk mountains. There is good fishing at the foot of the falls, some trout up to 2 lb. in weight being caught. The head of Eutsuk lake is virtually in the heart of the Coast range, precipitous mountains rising abruptly from the water's edge, and in some places glaciers coming down within 500 feet of the lake. The scenery is grand and rugged, abruptly fronting the lake is a square massive mountain which is probably 8,000 feet in height. To the south of this there is a pass which is occupied by a small stream, and it is said that a route out to the salt water exists through this pass, but in any case it would be a rough one. Through this pass and distant approximately ten miles can be seen a magnificent peak, which rises in a sharp cone above a sea of snow-fields and glaciers. This peak must be at least 9,000 feet high and may be 10,000 feet. Camp was reached again at dark.

September 12th. The day was spent in going down Eutsuk lake for some distance and examining the rock formation along the shore. Across from camp and southerly is a prominent point which is stained red with iron-rust and called Iron point. The lake was examined as far as Bear island, and then the return to camp made by 8 o'clock.

September 13th. The return journey was commenced. At one time it had been intended to continue down Eutsuk lake, Tetachuck lake, Tetachuck river, and into Intahtah lake, and up the Ootsa river and lake back to Ootsa Lake settlement. But this was given up, as the portaging of the boat around five miles of rapids and falls on the Tetachuck river would have been difficult and taken a long time. The portage back into Whitesail lake was made and camp made again in Harrison's cabin.

September 14th. Went up to the head of Whitesail lake, about eight miles from Harrison's cabin, examining the formations along the shores. Near the head of the lake and on the northern side there is a small channel opening out into a large bay which is never noticed when on the lake. This has been called the "Hole in the Wall," and for lack of a better name it is so called here. The channel going in is only about 50 yards wide and winds a little, and with the cloaking effect of the trees it would never be suspected that a large bay a mile or more in diameter lay inside it. The return to Harrison's was made by 2, and leaving again at 4.30 the foot of the lake was reached at 8.40, where camp was made.

September 15th. Aided by the current in the river and the wind on the lake, and by putting in a long day, Ootsa Lake settlement was reached by 9.30 at night. The different speed in going and coming is largely accounted for by the wind. The prevailing wind is westerly, and all the way going westerly up the lakes progress was slow, and at times it was impossible to make any headway.

The total distance covered is estimated at about 225 miles, without counting side-trips into bays and islands. Twelve days were occupied in the trip, which meant an average of about twenty miles a day of travel.

September 16th. Camped at Ootsa Lake. Outfitted and arranged packs all day, preparatory to taking the trail for Bella Coola. J. R. Galloway left the party, taking stage to Burns Lake, on the Grand Trunk Pacific Railway. James Morgan engaged to take his place.

September 17th. Moved camp to Harrison's ranch, distance eight miles, taking three hours' actual travelling-time. The trail is fairly good, but goes up and down small hills a great deal. This is all fairly good stock-raising country and is rolling country with no prominent hills.

September 18th. Moved camp to Ootsa Crossing, a distance of sixteen miles, taking nearly seven hours' travelling-time. Hanson's horse-ranch is distant one mile from the crossing, and Mr. Hanson kindly loaned his boat in which to ferry the pack outfit across, thus saving the labour of constructing a raft.

September 19th. The horses were made to swim the river and the outfit taken across in the boat. The Ootsa river as it comes out of the lake is a broad, sluggish current. There is said to be a ford which is passable at extreme low water, but very few in the district even have ever been able to find it. Everything was across and the horses packed by 10.45. White Eye lake, a small one, was passed at 2 o'clock, the elevation being 3,150 feet. Travelled south for four hours; then south-east to Cheslaslie lake, the west end of which was reached about 4 o'clock. Travelled down the north side till 5.30, when camp was made about three miles and a half from the east end. The total distance travelled is estimated at seventeen miles. The country between Ootsa Crossing and this lake is timbered lightly with spruce and jack-pine, with a good portion

of stock-range, with plenty of grass, along the Cheslaslie valley. Our camp here was a very pretty one, being in a beautiful park-like area close to the lake, in which a luxuriant growth of grass was studded here and there with trees.

September 20th. Went three miles and a half to Cheslaslie Crossing, made raft, ferried outfit across, and swam the horses. Camp was made on the other side. The Cheslaslie river flows out of the lake of the same name, and the trail crossing is just below the end of the lake. The river is slow and deep and about 75 yards wide, but would be a good deal more at high water.

September 21st. Went five miles to the Tetachuck river, passing an old Indian village a mile or more from the crossing. There were two or three houses here, but nobody living in them recently. On arriving at the point where the trail crosses the river an attempt was made to ford the river, but it was too deep. The river is fairly rapid and possibly 200 yards wide. Camp was made and the afternoon spent in looking for a ford; a heavy rain-storm came on.

September 22nd. The day was spent in looking for a ford, which was finally found; the falls on the river were photographed and the rocks in the vicinity examined. The falls are a little over a mile above the camp-site. The main fall is about 15 feet high, with some rapids above and below. There are other falls on this river farther up; in a distance of five miles there is a total drop of about 100 feet. This would provide a valuable power-site if ever any use could be made of the power. A picture of the falls is shown in this report.

September 23rd. Left camp at 10 o'clock, went up the river one mile to where the ford was found, and crossed without difficulty or getting a pack wet. Got back on the Bella Coola trail on the other side at 12.10. Frog lake—a mere pond—is three miles from Tetachuck river. Camp was made at 5 o'clock at a customary stopping-place on the trail called Cold camp. The camp is on a small knoll very slightly above the rest of the country, with a small creek occupying a little gulch just before coming to the knoll. Firewood is somewhat scarce in the immediate vicinity of the camp, showing that the camp has been used for a long time. Leaving Tetachuck, the trail goes nearly due south to Cold camp. Two miles before reaching Cold camp the trail climbs gradually a low, irregular ridge, with a small valley falling away to the east, the highest elevation recorded being 3,625 feet. Cold camp is at 3,550 feet and distant about twelve miles from Tetachuck Crossing. The country from Cheslaslie Crossing to Cold camp is flat, rolling plateau country, with a fairly heavy growth of small jack-pine. Occasional spruce-swamps are seen and rarely a few poplar-trees. Meadows with beaver-grass are not frequent, but are plentiful enough to provide feed for horses on the trail. There is quite a large meadow beside Cold camp, a large part of which is swampy and under water, probably due to damming-up of parts by beavers. This meadow at some distance from the camp gradually merges into a small lake.

September 24th. Left Cold camp at 9 o'clock and arrived at Majuba Hill camp at 4.40, the distance travelled being eighteen to nineteen miles. This camp is also an old well-established camping-place on the Bella Coola trail, and was named by Harry Morgan, a Boer War veteran, the first white packer on the trail. There is nothing very prominent about the camp to entitle it to such a distinguished name, but the name is well established now. On leaving Cold camp the trail swings to the north-east and east and circles the lake previously mentioned. After five miles of trail the far end of the lake from Cold camp is reached, the distance across the water being about two miles. In another mile the Algatcho river, a small stream, the headwaters of the Entiako, was reached. Here a small creek joins the river, coming in from a small lake. At twelve miles from Cold camp there is another fork of the Algatcho, with a small creek coming in from a small lake. Apparently this Algatcho river flows into the lake situated near Cold camp. This lake is probably Entiako lake, the head of the Entiako river. Both small creeks going into the creek are crossed by the trail, but not the main river, which, however, is small enough to be easily fordable.

At sixteen miles from Cold camp another lake is reached which lies a short distance west of the trail, and which is apparently the head of the Algatcho river. The trail then swings east two or three miles to Majuba Hill camp, which is at an elevation of 3,560 feet. Near this camp is a narrow arm of a lake which may be part of the lake seen a few miles back, but if so it forms a right-angle bend. Plenty of meadows with good horse-feed occur along the trails.

September 25th. Left Majuba Hill camp at 8.45 and camped at Salmon river at 3.15, distance travelled being about sixteen miles. The Indian village of Algatcho is about five miles

along the trail from Majuba Hill. One mile before reaching Algatcho the trail runs over a knoll with an elevation of 4,150 feet, from which a most excellent view is had.

Algatcho, which is at an altitude of 3,900 feet, is the meeting-place of the summer and winter trails coming from the Bella Coola valley, and in going to the Bella Coola valley from Ootsa lake here is where the choice of trails is made. Generally there are some Indians living at the village, but only one was there at this time of the year, the others being away fishing.

The summer trail, which was the one followed, turns down through the village to the right, going past the church, while the winter trail swings to the left. Indian trails are numerous in this part of the country, but it is not difficult to follow the main Bella Coola trail, which is well-travelled and consistently followed by Indians in the district. Meadows with good horse-feed are frequent along the trail, but the country generally is covered with glacial gravel and boulders, with a growth of small jack-pine and spruce.

Some Indians were camped at the Salmon river finishing up the fishing season. It is not believed that where this trail crosses the Salmon river it is the place marked Salmon House on the maps, which is probably ten or twelve miles farther down the river. The ford here at this time of the year is about knee-high.

September 26th. Left camp at 8.45, and forded the river without difficulty. Passed small lake about three miles from Salmon river on east side of trail. Quite a number of windfalls were across the trail, necessitating a little lost time in cutting them out. Another small lake, half a mile long, was passed at seven miles. Arrived at the southern end of Long lake at 4.45, the distance from Salmon river being estimated at seventeen miles.

Long lake is thought to be the lake marked on the maps as Takla lake, which is a much more distinctive name. The lake is about four miles long and is at an elevation of 3,275 feet. This camp is an extensive Indian camp and the meadows around it were eaten bare by the numerous horses running on them all summer.

September 27th. Left camp at 10.30, the late start being due to the horses having travelled some miles back on the trail for feed. During the day a couple of hours were lost cutting out windfalls. Made camp in little meadow—Indian camp—at 3.45. Distance travelled about eight miles. Elevation of camp 4,025 feet. Starting at about Takla Lake camp, the trail enters a very wide pass in the outer foot-hills of the Coast range. There is one long spur of the range to the east of the trail and a shorter one to the west, but the distance between is several miles. The country is, as usual, largely covered with spruce and jack-pine. The lupine—wild bean—is seen growing in places here and there through the jack-pine.

September 28th. Weather has been uncertain and rained all night and in the morning, making a late start. Left camp at 10.10. The trail gradually climbed to 4,200 feet and then dropped again to 3,800 feet. Camped in nice meadow at 4.30 at an elevation of 4,240 feet. The grass in the meadow here showed, besides the customary beaver-grass, a little red-top. The soil looks little better and vegetation generally is improving, due to getting into the sphere of the Coast influence. All day the trail continued in the wide pass between the spurs of the Coast range, which now may be considered as into the main range.

September 29th. Rain and snow during the night of the 28th made things very uncomfortable, and a late start in the morning. The trail gradually rises to 4,350 feet. About four miles beyond this camp the trail forks, each fork representing a different route down into Bella Coola valley. At the forks an Indian was camped, and we were advised to take the left-hand or easterly trail, although either one is passable. The trail gradually rises to 4,350 feet, then descends to 4,000 feet, where a fair-sized creek is crossed; then up the other side to 4,400 feet. The trail was in very bad shape here, being soft and swampy. In a short distance the trail comes out on the edge of the Bella Coola valley, lying 4,000 feet below. The trail runs along the ridge, going easterly for a short distance, and again climbs to get around a bluff rising to 4,500 feet, the highest point on the trail. Below this point stretches the valley in a beautiful panorama. The descent by the trail is very quick, going down in a steady succession of switchbacks. The trail is, of course, very steep, but otherwise is in good condition. The trail reaches the wagon-road in the valley at a point about a mile above Firvale. It was after dark when the party reached Firvale, having travelled an estimated distance of about twelve miles. Accommodation for the night was secured at Kivet's ranch and the horses put in a pasture. On reaching the Bella Coola valley, pasture or hay for horse-feed must be bought. The valley is covered with a heavy growth of Douglas fir of large size, and there is

no wild grass. Small patches of land have been cleared by the settlers, but the labour or cost of clearing is very great. Although it has been settled for twenty-five years, the largest clearing in the valley is not over 20 acres. One acre, however, is as good as about 10 or 15 elsewhere. Potatoes, vegetables, garden-truck, fruit-trees, and flowers grow in a wonderful way, and a very small piece of land will support a family. Until recently there has not been much market for agricultural produce, but now the town at Ocean Falls supplies a good market. The farming in the Bella Coola valley is best described as mixed farming, as everything is done, from raising stock to fruit-growing. The principal settlers in the valley are Norwegians, the valley having been started as a Norwegian settlement about twenty-five years ago. In addition to farming, the salmon-fishing off Bella Coola provides employment and ready cash for the farmers during a portion of the year.

Firvale consists essentially of a store with some surrounding ranches, and this place is beyond the Norwegian settlements. The next town in the valley is Hagensborg, about eighteen miles below Firvale and twelve miles above Bella Coola. Here also there is a good store, church, schools, and a number of residences. From here on down the valley to Bella Coola farms are dotted all along. One striking thing about this colony is the fine farm-houses, neatness, and general air of prosperity. It is evident that these farmers are more than usually industrious, and the customary tumble-down appearance of many farm buildings is entirely absent.

Bella Coola is a substantial little town situated at the end of the Bella Coola river, where it flows into North Bentinck arm. It has a comfortable hotel and a well-stocked general store run by B. Brynildsen. This is a prohibition community, as one of the conditions of settlement by the Norwegian community was that no liquor licences were ever to be granted in the valley by the Government of British Columbia.

September 30th to October 3rd. This time was spent in going down the valley to Bella Coola, where mail was waiting, and in securing a fresh outfit of supplies at Hagensborg and returning to Firvale—a total distance of sixty miles' travel.

October 4th. Left Kivet's (Firvale) and went to Hickman's ranch, some fifteen miles up the valley. This is the end of the wagon-road in the valley, and at the time a road-gang was at work finishing the construction of the road.

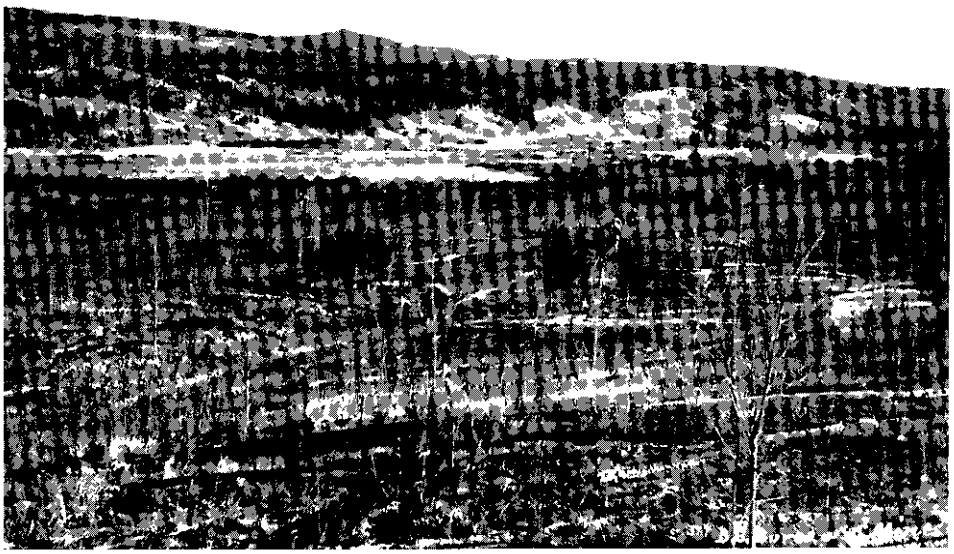
October 5th. Left Hickman's ranch at 10.10 and arrived at Marvin's at 5 o'clock; distance about twelve miles. A road-gang were at work fixing the trail between Hickman's and Marvin's. At Edward's ranch, six miles from Hickman's, there is a telegraph-station which is headquarters for the line for this section. The aneroid was set at 500 feet at Hickman's and read 1,000 feet at Marvin's. This ranch has quite an extent of cleared land and the owner seems to be more than usually industrious. His bachelor-kept house would be a credit to any woman with its neatness and order.

October 6th. Left Marvin's at 9.50. The sudden rise in the trail called the "Zigzag" is about seven miles beyond Marvin's. The elevation at the foot is 1,850 feet, and at the top, after a series of switchbacks, is 2,350 feet. The "Pothole" camp is fifteen miles from Marvin's, and here by going off the trail a short distance good horse-feed is found in the meadows. Just beyond this point there is another quick rise in the trail, accomplished in a series of switchbacks, which is called the "Precipice." The rise is from 2,900 to 3,600 feet. Camp was made three miles beyond at 5.45, at an elevation of 3,750 feet. This was a poor camping-place, but it was a forced one owing to the lateness of the hour.

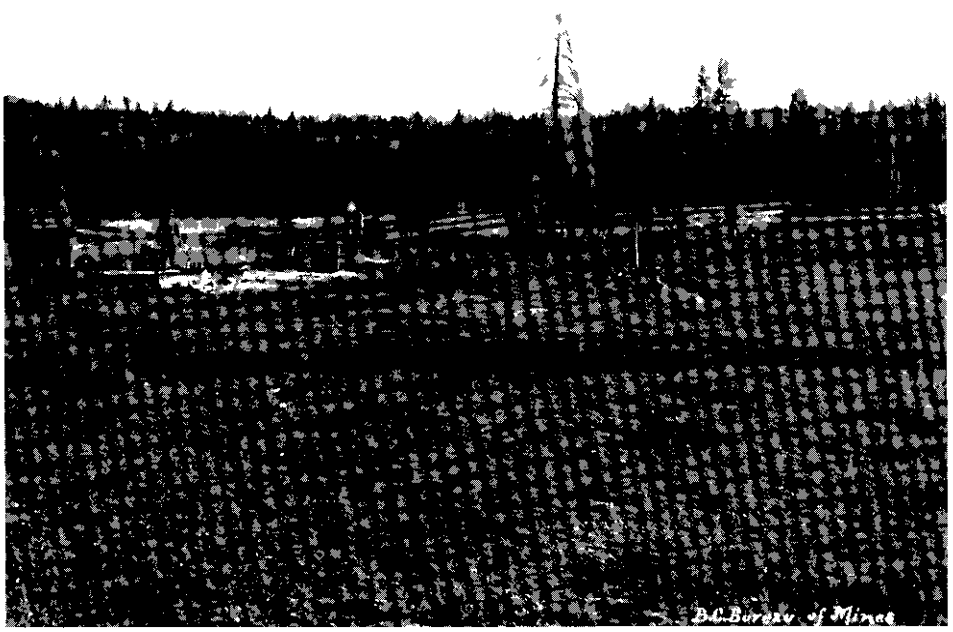
October 7th. Left camp at 10.30—a late start owing to the horses having strayed away. Trail went up 125 feet and then started to descend gradually. Meadows with beaver-hay are frequent, but the rest of the country is, as usual, covered with small jack-pine. Six miles from camp there is a large meadow. Camp was made at 1.45 at a small meadow after nine miles had been travelled. The weather during the last few days was delightful, with beautiful sunny days and frosty nights—typical Indian summer.

October 8th. Left camp at 9.45. Passed Anahim lake at 1.45, at which there is a ranch, probably Indian, but nobody at home. Camped at 4.30 at an elevation of 3,660 feet. Meadows are plentiful through this country and there is no difficulty in getting horse-feed. Pine-grass grows abundantly in many places amongst the jack-pine trees.

October 9th. Left camp at 9.40 and crossed Salmon river—here a small stream—at 11.20. Arrived at Engebritzen's ranch at 3.20, where camp was made. Distance travelled 15 miles.



McClinchy's Ranch, Klinaklini River.



Klinaklini Flats, Nanaimo Mining Division.

Elevation, 3,775 feet. The country is gradually improving in appearance; meadows are very numerous, but the country outside the meadows does not carry enough grass to constitute summer range for cattle. The country is nearly flat, with small rolling hills. The trail in this section runs south to south-east, paralleling a spur of the Coast range some ten to fifteen miles to the west. At Engebritzen's ranch the trail crosses the headwater stream of the Salmon river, which is only a small creek that can be nearly jumped over. This creek is well stocked with small trout, but it was found difficult to get many with a fly.

October 10th. Left camp at 10 o'clock. Cariboo flats was reached at 1.30. This is a long meadow—possibly two miles long—covered with scrubby bushes and grass and said to have been a favourite caribou-ground some years ago. Camp was made on the banks of the McClinchy river at 3.15, the distance travelled being eleven miles. The highest elevation reached on the trail was 4,800 feet, about three miles before reaching Cariboo flats. Elevation of camp on McClinchy river, 3,675 feet.

October 11th. Went to Sam Colwell's ranch at One Eye lake, the distance being about twelve miles. This lake is about five miles long and one branch of the Klinaklini flows into it and out at the end, where Colwell's ranch is located. The elevation is 3,000 feet. The lake is well stocked with rainbow trout up to 1 lb. in weight and Dolly Varden trout up to 12 lb. The trail along the McClinchy river follows for some distance ridges of very pure white quartz sand. The country is covered everywhere with glacial clay, gravel, and boulders, and remnants of terminal and lateral moraines and eskars can be seen. Around One Eye lake the soil is good and there should be no difficulty in growing farm products if frosts do not interfere. The telegraph-station of Klinaklini is situated here, and an operator-lineman is in charge.

October 12th. Accompanied by Sam Colwell as guide, the trail was taken for the Wallace iron-showings situated behind Perkins peak. Camp was made at Render lake at an elevation of 4,200 feet. For a mile or two beyond Colwell's some scrubby fir-trees were seen, but the timber is prevailingly small pine and spruce, with poplars in the bottoms.

October 13th. Arrived at the "Stone Cabin" on the iron property, a further distance of eight miles, or twenty miles in all from Colwell's ranch. The elevation is 6,500 feet, with timber-line at about 6,000 feet. The cabin is built of rock walls 6 feet high and is roofed with poles, dirt, and canvas. The cabin is a rather dark, damp place, but with two stoves it can soon be made comfortable.

October 14th. The day was spent in climbing Perkins peak and examining some claims on the way up. This mountain, although on the outer fringe of the Coast range, is a prominent one and is higher than most of the surrounding peaks, reaching to an altitude of 9,500 feet. Its summit comes almost to a point and the upper portion of it is evidently above the line of glaciation. A fine view can be had from it, but on this occasion the weather was stormy all day and only glimpses of the country could occasionally be seen. This proved a very arduous day's work, as the mountain was descended on the opposite side from camp, and then we came around the flank of the mountain and back into Chromium creek, arriving in camp after dark. On the mountain the wind howled all day, making one very miserable.

October 15th. The day was spent in an examination of the iron-showings.

October 16th. The return journey to Colwell's ranch was started, camp being made for the night again at Render lake. The examination of the iron had been made just in time, as the property was left in the midst of a raging snow-storm.

October 17th. Colwell's ranch and comfortable cabin were reached and provided a welcome change from the snow camp of the previous evening.

October 18th. The day was spent in writing notes and fixing up preparatory to the next start.

October 19th. Left Colwell's at 10. Arrived at Pat McClinchy's ranch at 12. This ranch was taken up by McClinchy about twenty years ago and is now a small stock-ranch. It is pleasantly situated on the branch of the Klinaklini flowing into One Eye lake, a short distance above the lake. Camp was made at Klinaklini flats at 3, the distance travelled being about twelve miles. Here a ranch has been taken up in the spring of 1916 by Parks, and he had just arrived with a load of supplies and was commencing to build a cabin. This will eventually be a stock-ranch.

October 20th. Went to Tatla lake and camped there on Graham's ranch, six miles from Klinaklini flats. Graham is a successful stock-rancher, running about 400 head of cattle. The post-office for the district is at his house. Elevation, 2,900 feet.

October 21st. Left Tatla lake at 10, leaving the wagon-road and taking the trail for Tatlayoko lake. Arrived at Jamieson's ranch at 3. Distance travelled, twelve miles. Elevation, 3,350 feet. This country is all summer range for cattle, but in places the feed is very scanty. The country is sparsely timbered with jack-pine, spruce, and poplar, and a few scrubby fir-trees.

October 22nd. Went to Wilson's ranch, situated at the northern end of Tatlayoko lake. Distance, twelve miles. Elevation of lake, 2,650 feet. Cabin is 150 feet above the lake. The last few miles of the trail descend quickly into the valley occupied by the lake, which is considerably lower than Tatla Lake district. Wilson has a nice piece of land very prettily situated, but has done but little cultivation as yet.

October 23rd. The Hance showings of iron situated near the top of the mountain at the northern end of the lake and on the west side were examined.

October 24th. An attempt was made to go down the lake in a small rowboat in order to get to the southern end, where is situated the Morris property. After a few miles a strong headwind prevented any further progress and it was necessary to land on the beach. It was hoped the wind would die down at night, but instead it increased to a gale, and after staying all night on the beach it was necessary to put back to camp the next day, October 25th. The heavy rollers at the beach at the end of the lake swamped the boat in landing, but outside of a thorough wetting all round no harm was done.

October 26th. Left Wilson's at 9 with saddle-horses and light pack, and, taking the trail on the east side of the lake, Hudgins's ranch at the southern end of the lake was reached at 5.30. Distance, twenty-two miles by trail. This trail is not in very good condition, but could be easily fixed up. The length of the lake is eighteen miles and Hudgins's place is two miles beyond the southern end. This "ranch" has been deserted for a couple of years, but possesses a cabin stocked with beds, blankets, dishes, stove, etc., which is very useful for the traveller.

October 27th. The Morris property, situated four miles from Hudgins's cabin and at an altitude of 5,550 feet, was examined. No work has been done on the claims for about four years, and so the trail is indistinct and grown over.

October 28th. The return was made to Wilson's ranch.

October 29th. Left Wilson's, returning on the trail to Jamieson's ranch, where camp was made. Cold weather with a little snow.

October 30th. After leaving Jamieson's ranch the rough wagon-road was followed instead of taking the cut-off trail which had been used in coming in from the northern end of Tatla lake. This route finally brings you out on the main wagon-road, which runs along the south-eastern side of Tatla lake. The Tatlayoko Lake wagon-road joins the Tatla Lake road seven miles from Graham's, at the end of the lake. Camp was made at 3 after travelling eleven miles, when a snow-storm came on.

October 31st. Started at 8.45 and travelled till 4.15, travelling about twenty-seven miles along the wagon-road, which is good enough for automobile travel. Camp was made four miles east of Chilanko Forks Post-office. Very hard frost at night and flurries of snow. This is all good stock country and many cattle can be seen through the country.

Another day's travel brought the party to Red Stone store, and the next day Newton's ranch was reached. Three days were then spent in going to Newton's property, some twenty-five miles distant from his ranch, examining it and returning.

The following day Alexis Creek was reached. Here the party was disbanded. The horses were taken back to the northern country by Mulvany and Morgan via the Nazko-Blackwater route, and MacKinnon and the writer took auto-stage from Alexis Creek to 150-Mile House on the Cariboo road, then to Ashcroft and on to the Coast by Canadian Pacific Railway. Victoria was finally reached about the middle of November.

NORTH-EAST KOOTENAY DISTRICT.

GOLDEN AND WINDERMERE MINING DIVISIONS.

REPORT BY W. W. BRADLEY, 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 1916, which may be attributed to the general revival in mining throughout the Province, caused by the increase in the price of metals.

Paradise. This property was staked in July and August, 1899, and was ultimately taken over by the late H. C. Hammond, of Toronto, in 1900. Up to 1904 the total development-work amounted to approximately 4,733 feet. The total ore shipped from 1901-1906 amounted to 1,996 tons. The shipments average 51.4 oz. in silver and 59.3 per cent. in lead. Practically nothing has been done on the property in the way of development since 1903. During the past year R. Randolph Bruce decided to reopen the property, and some twenty men have been employed during the year 1916 and twenty teams have been engaged in hauling ore. From a shipment of some 200 tons of low-grade ore obtained on the dump an average of about 25 per cent. lead and 25 oz. in silver was obtained.

On the No. 2 level practically all of the old stopes between Sections 781-885 are being worked, and on the main incline practically all the work has been done in and around Section 591. Generally, the work has been replacing old timbering and cleaning out the mine. At the present period the shipments of ore to the Kootenay Central Railway Station at Athalmer average about 150 tons a week.

The property is situated on the headwaters of Spring creek, a small tributary of Toby creek, and the mine is connected with the main Toby Creek road by a switchback wagon-road connecting with the main wagon-road at Pinehurst. It is understood that the mine will be worked on a larger scale during the year.

Lead Queen. This property consists of five claims, situated on B.B.S. creek, a small tributary of Frances creek (formerly called No. 3 creek). The lead can be traced through the five claims. Considerable work has been done by the original owners, and in 1915 it was bonded to J. T. Burgess, who shipped several cars of ore during the early part of 1916, and the smelter returns were satisfactory. During the year the property changed hands, and the present owners have been working a small crew during the winter, having shipped three cars of ore to the trail smelter, the first car producing a gross value amounting to $3,230. It is understood that the ore is improving in depth. Shipments are made from Brisco, a station on the Kootenay Central Railway.

Isaac. This property is situated on a small tributary of Frances creek and is owned by H. E. Forster, of Wilmer. Mr. Forster has shipped between four and five cars to the Trail smelter, which will run approximately 35 to 40 oz. in silver and from 35 to 50 per cent. lead.

Sitting Bull Group. This group includes the *Alice*, *Sitting Bull*, *Mary G.*, and *Colorado* mineral claims. The property is situated on Boulder creek, a tributary of Horse Thief creek, about nineteen miles from the Kootenay Central Railway. There is a good wagon-road for approximately eleven miles, the balance being a pack-trail. This property was bonded during 1916 to the Sitting Bull Mining Company, an extra-provincial company, registered under the British Columbia "Companies Act." Development commenced late in the fall, under F. C. Stockdale, with a force of ten men, building three miles of new trail, erecting cabins, and packing in supplies. Approximately $6,000 was spent on this property in 1898, which consisted of a shaft on the *Sitting Bull* claim, 50 feet deep, from which some 20 tons of high-grade ore was taken out and piled on the dump. Several open-cuts, exposing the vein for several hundred feet, and a cross-cut tunnel are now under way.

On the *Mary G.*, adjoining the *Sitting Bull*, the vein is exposed for 300 feet, averaging in width from 8 to 9 inches. On the north side of this claim there is a tunnel 35 feet long driven in the ore, showing 20 inches of galena, carrying a very small percentage of zinc.

On the *Alice*, adjoining the *Mary G.*, a tunnel has been driven for 18 feet, showing 18 inches of high-grade galena. Most of the ore taken out has been carried away by slides and only a small quantity remains on the dump. It is understood that the company intends to build a wagon-road from the junction of Horse Thief wagon-road and Boulder Creek trail; thence to the head of Boulder creek, along the south side.

Delos Group. This property is situated on Boulder creek and has been idle since, approximately, 1898. It is one of the easiest properties to work in the district, being approximately three miles and a half from the wagon-road by pack-trail. The property is referred to by the Provincial Mineralogist in the Report of the Minister of Mines for 1898, and again in 1915. The ore is chalcopyrite, carrying some gold and silver values.

Hot Punch. Situated on Toby creek. Considerable development has taken place upon this claim, and it is said to be the intention of the owners to work the property during the year.

Copper Butte. Situated on Rocky Point creek, a small tributary of Bugaboo creek. The property was worked to some extent during the last year, and about two cars of chalcopyrite ore were shipped to the Trail smelter. The property was closed in the fall on account of lack of capital. The C.R.L. Company built a wagon-road up Bugaboo creek during 1915-1916, and the *Copper Butte* trail from Rocky Point basin connects with the wagon-road at the junction on the main Bugaboo creek and Rocky Point creek. This wagon-road will be of great value to the *Copper Butte* and other properties situated on the main Bugaboo and tributaries.

Giant. Situated on the north side of the Spillimacheen river, about seven miles from the Kootenay Central Railway. Very little development was done in 1916, except to ship a small amount of ore. The property is a large body of low-grade silver-lead, owned by the Golden Giant Mines, Limited, and is at this time being examined by a mining engineer representing an American mining company.

Hidden Treasure. Situated in the same vicinity as the *Giant* mineral claim. The property carries a high-grade copper ore, also some silver-lead. Some shipments were made during the year.

Tennessee Group. Situated on Spruce Tree creek, a tributary of the Middle fork of the Spillimacheen river. The ledge averages from 3 to 10 feet in width, carrying values from $3 to $4 in gold and the same amount in silver. Sample assays from the full width of the ledge are said to average 13 per cent. copper. The property is owned by J. W. Conner, of Golden.

Monarch. Situated at Field. This property has been closed during the last six months for lack of sufficient capital, etc. There appears to be no doubt of the existence of substantial ore-bodies.

Couverapee. Situated on Mount Stephen. Twenty-two tons of ore was shipped from this claim to the smelter at Trail in 1916, producing a net value of $548.

OFFICE STATISTICS—GOLDEN MINING DIVISION.

Mineral claims recorded	61
Assessments recorded	14
Free miners' certificates issued	115

Revenue.

Free miners' certificates	$ 600 00
Mining receipts, general	596 90
Mineral-tax	413 43
Acreage-tax	307 50
Total	$1,917 83

OFFICE STATISTICS—WINDERMERE MINING DIVISION.

Mineral claims recorded	47
Assessments recorded	54
Free miners' certificates	61

Revenue.

Free miners' certificates	$323 50
General mining receipts	393 75
Total	$717 25

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 1916.

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

The season of 1916 was not marked by any especial development, although the interest in mining in general has become much stronger all through the district.

The St. Mary copper country came in for some little inspection by outside engineers, but, with the one exception at Marysville, no property was taken up; the *Park* group, the exception mentioned, is being developed by Spokane capital, and so far the results have been satisfactory, shipping-ore being taken out and piled ready for transportation. The claims owned by Evans Bros. have been steadily worked on and one or two new ledges opened up, making this low-grade copper group well worth inspection.

Perry creek was examined by several engineers, the *Homestake* group in particular coming in for attention, but, as the work then done was hardly sufficient to justify a conclusive examination, no deal was made. Evidently this free-milling gold camp appealed to the engineers strongly, as without exception they expressed their intention of making another examination immediately the work in hand was finished.

At Elko the *Burton* group was resuscitated with excellent results, two car-loads of copper ore being forwarded to the smelter at Trail, and it is expected that these shipments will now be regular, as a considerable ore-body has been exposed, rich enough to pay all charges and leave a fair margin of profit.

On the *North Star* hill work has been done on the *Quantrell* mineral claim, and two car-loads of galena shipped, giving good returns.

On Maus creek, near Fort Steele, the *Victor* group is being systematically developed, and it is confidently hoped that this winter's work will prove that the present ore-body is a big one; there is a fair amount of shipping-ore now out, but hardly enough to justify the expense of building a road.

In the Moyie section work has been carried on on the *St. Eugene*, *Society Girl*, and the *Empire*, the latter of which is showing up in a very encouraging manner. The *St. Eugene* has shipped several cars of ore, over 700 tons, during the year, but no systematic development has been attempted, as the property was leased.

Tracy creek, which has been quiet for so many years, is to see a recrudescence of activity, as it is the intention of the owners of the *Swan* group to put in a power plant and push development. This will, or should, give the camp an impetus towards opening up; in the old days it was a very busy place and a great many Crown-granted properties are held there, one of them, the *Estella* group, having had several thousand feet of development put in; the zinc contents in those days militated against its success.

The Consolidated Mining and Smelting Company of Canada, Limited, which owns the *Sullivan* group, at Kimberley, has during the past year extracted and shipped a large amount of ore and has, moreover, improved the plant and buildings very materially.

Handicapped by the flood in spring, which put the power plant out of commission and did other damage, the company buckled down to work; after restoring the power plant and reconstructing and improving the aerial tramway, new bunk-houses were erected, one to house one hundred miners and another for seventy; the ore-bins were extended and wagon-roads built. Meanwhile, although no diamond-drilling was done, underground development and blocking-out of ore was proceeded with, and the main tunnel, now in over 3,000 feet, pushed with all dispatch. The force employed is over 300, which will be increased as the need arises. Approximately 100,000 tons of ore was shipped to the Trail smelter during the year which constitutes a record for this mine.

It is the intention of the company to equip an experimental concentrating plant at the *St. Eugene* concentrator for the purpose of determining the best method of separation for the *Sullivan* ore, and the assembling is being proceeded with.

The floods last spring did so much damage to the various placer camps that little or no work was done beyond repairing dams, flumes, etc.

OFFICE STATISTICS—FORT STEELE MINING DIVISION.

Mineral claims recorded ("B")	56
Certificates of work ("E")	133
Certificates of improvement issued ("G")	6
Conveyances and other documents of title (bills of sale)	33
Partnership agreements	1
Gold Commissioner's permits	1
Documents filed	15
Affidavits filed	146
Mining leases issued	1
Free miners' certificates (ordinary)	183
Free miners' certificates (company)	3
Free miners' certificates (special)	1
Crown grants issued	3

Revenue.

Free miners' certificates	$1,135 75
Mining receipts	855 25

NORTH-WEST KOOTENAY DISTRICT.

REPORT OF ROBERT GORDON, GOLD COMMISSIONER.

I have the honour to submit herewith the annual reports on the progress of mining within the Revelstoke and Lardeau Mining Divisions for the year ending December 31st, 1916.

In both the Revelstoke and the Lardeau Divisions a very noticeable improvement has taken place since my last report.

In the Big Bend a number of properties have been acquired for actual development purposes, and work has been started on several of them.

In the vicinity of the main line of the Canadian Pacific Railway, near Illecillewaet and Ross peak, work has been in progress throughout the year, with very good results.

A number of locations have been made both north and south of Revelstoke, along the banks of the Columbia river; the showings at present are of very low grade, but the extent of ore-bodies is very large and transportation is easy.

In the Lardeau Division work has been carried on quite successfully during the year, and the returns are expected to be quite satisfactory.

To sum up the present situation, we can truthfully say that better times have actually arrived in the mining industry of this district.

REVELSTOKE MINING DIVISION.

REPORT OF R. S. SQUAREBRIGGS, MINING RECORDER.

I have the honour to submit herewith the annual mining report and office statistics of the Revelstoke Mining Division for the year ending December 31st, 1916.

The office statistics show an increase over last year, there being over twice as many free miners' certificates issued and nearly three times as many certificates of work recorded, with a slight falling-off in locations recorded. As regards the general mining outlook, evidence of increased activity is not lacking.

The *Mastodon* group of mineral claims, situated about twenty-three miles from Revelstoke (eighteen miles north along the Columbia river and about five miles east), between LaForme and Carnes creeks, consists of ten mineral claims and includes the property which in former years was known as the *Noble Three* group. A force of men was put to work last summer developing, and worked steadily until Christmas. A comapny has been formed known as the "Mastodon Mining Company," with head office at Lethbridge, Alberta, to take over the properties, and will start work in January of the New Year, and the balance of the winter will be spent in developing. The property has three separate and distinct veins on it, the work thus far having been done on what is called the middle vein.

This vein is enclosed in lime and schists and is from 3 to 6 feet wide, carrying a fine-grained solid sulphide ore as well as carbonates; some coarse-grained galena also occurs in the vein, and the ore consists of an intimate mixture of galena, zinc-blende, copper and iron pyrites, and grey-copper. A sample shipment of 1 ton of the ore was sent to the Trail smelter and showed values as follows: Silver, 23.3 oz. a ton; lead, 46.7 per cent.; and zinc, 15.7 per cent.

The work going on consists of sinking a shaft on the ore. This shaft is now down 60 feet and the ore-shoot varies in width from 1 to 4 feet; the values have improved with depth and the walls are well defined.

The *Montgomery* copper claims, seven in number, are situated about fifty miles from Revelstoke, in the Big Bend district, on Downie creek, a tributary of the Columbia river. An exhaustive examination was made of the above group during the year and a number of samples

collected fpr assay, which gave very good commercial values in copper, gold, and silver. The character of the ore makes it a very desirable ore for smelting, as it carries all of the required fluxes.

The zone in which the ore is encased is about 150 feet wide, and the vein is from 8 to 20 feet. Associated with the copper, which is held in the heavy iron, is a quartz vein which also carries chalcopyrite and excellent gold values. The vein as a whole carries commercial ore, requiring treatment on the ground owing to the low character of the ore and magnetic base. Nature has developed all the necessaries requisite for economic operations, as unlimited water-power can be had in close proximity, with timber for all purposes, and a very easy grade for a road. The Columbia river affords means of transportation aside from the excellent river grade for either auto-trucks or railway.

These claims lie within the zone of mineralization that bears quite a historic placer-gold reputation, and many of the lode locations will become producers when proper facilities for transportation are completed.

On the *98* group, situated on the South fork of Carnes creek, considerable work has been done during the year and the good gold values have been encountered. The owners are confident that this group will yet be one of the producers in the Big Bend district.

On the *Gold Hill* hydraulic claims, at French creek, a force of men have been engaged all summer and a satisfactory clean-up has been made.

On McCullough creek several individual miners have been working all summer and placer gold in small quantities have been taken out, making fair wages for the prospector.

The *Lanark* mine, situated near Illecillewaet, shipped ten cars of ore during the year, which netted about $900 a car. The owners have been sinking shafts and drifting to warrant enough ore for a plant they are erecting. The lower levels are carrying so much zinc that they find it necessary to make a concentration. They are erecting a modern mill of 75 tons a day capacity. The building should be completed and the machinery on the spur ready for installation early in the New Year. They have about 15,000 tons of ore in sight, which is expected to average about 7 to 8 per cent. lead and 12 to 15 per cent. in zinc. On this basis they expect to ship a 40-ton car of concentrates about every three days, or ten cars a month.

Quite a lot of work has been done on the *Galena*, *Bonanzie*, *Blossom*, and *Donald* claims, situated on Round hill, on Cariboo creek.

South of Revelstoke several old properties have been relocated and samples taken out, and it is expected that a company will be formed in the spring to start operations.

OFFICE STATISTICS—REVELSTOKE MINING DIVISION.

Free miners' certificates	297
Claims recorded (mineral)	63
Claims recorded (placer)	5
Certificates of work recorded	46
Payments in lieu of work	4
Placer leases granted	11
Agreements and transfers recorded	26
Leases of Crown-granted mineral claims granted	14
Permissions recorded	20
Powers of attorney recorded	15

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 1916.

Mining operations in this district show a marked increase over last year. A number of properties were examined, but none have been taken as yet; there is one deal pending on a gold property, the *Burneire*.

The Multiplex Mining Company worked a few men during the summer developing a large low-grade gold vein; during December four men were taking out silver-lead ore, and a shipment will be made about January; the ore is of good value, and the vein is from 1 to 4 feet in width. Values, 40 to 80 oz. of silver, 12 to 20 per cent. lead, 12 per cent. zinc, and $2 to $2.50 in gold. There are good tunnel-sites on the property, but a winze is being sunk on one of the ore-shoots from the lower tunnel, and will be continued for 50 feet. At present 2 feet of ore is showing in the shaft.

The *Beatrice* mine worked a force of fifteen men for the past three months and brought down a little over 100 tons of ore, which is ready for shipment; the mine closed down Christmas.

OFFICE STATISTICS—LARDEAU MINING DIVISION.

Free Miners' certificates (ordinary)	53
Free Miners' certificates (company)	1
Free Miners' certificates (special)	1
Certificates of work	55
Payments in lieu of work	2
Locations recorded	53
Agreements and transfers recorded.	15

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, 1916.

This Division has shown a marked improvement over the previous year, notably in the vicinity of Ainsworth, where several old properties which have been idle for years are now being extensively developed. From present indications Ainsworth Division will be a heavy producer for the coming year. In addition to the Florence Mining Company's 200-ton mill, it is reported two more will be under way the coming year.

The *St. Patrick* group, situated on Hamill creek and owned by Brochier & Le Blanc, has a showing of about 4 feet of ore, reported to run high in silver-lead and zinc. Development for the year consisted of 25 feet of crosscuts, 45 feet of tunnel, and 25 feet of drifts.

The *Carey Fraction*, *Nicollet*, and *Early Bird* were operated by the Wolverine Mining and Development Syndicate. Work was principally confined to a double-compartment shaft on the *Carey Fraction* claim, and about 15 feet of tunnel on each of the latter. Eight men were employed on development; a gasolene-engine was used for hoisting and air-compression for drilling and pumping. The results for the year have been satisfactory.

The *Comfort* was operated by A. D. Wheeler, who has stripped an ore-shoot over 100 x 30 feet, and has shipped 500 tons of assorted ore and has piled up 2,000 tons of milling-ore. In order to demonstrate the situation of the ledge they have diamond-drilled two holes, 190 feet and 207 feet. Bunk-houses and office buildings also were erected.

On the *Crow Fledgling* the work consisted of 1,450 feet of tunnel and 600 feet of drifts and crosscuts; some ore was encountered. About twenty men were employed. This property is under the management of A. W. McCune, Jr., who has also installed a 5-drill compressor and erected a residence.

On the *Skyline* group extensive development will soon be under way. Bunk and cook houses, office and blacksmith buildings have been erected. About twelve men were employed. It is the owner's intention to run a 2,000-foot tunnel to develop the group.

The *Silver Hoard* was worked under the management of W. S. Hawley. Development consisted of 100 feet of crosscut and 60 feet of raise; five men being employed. There has also been erected a building for concentrating, and 4,500 feet of flume laid for that purpose.

Since June the *Spokane-Trinket* property has been worked under T. W. Murray, employing nine men, during which 400 feet of tunnel and drifts have been run and cook and bunk houses erected. About 20 tons of ore has been extracted.

The *Florence* was operated by the Florence Silver Mining Company under the management of C. Simpkins. Cook and bunk houses and blacksmith-shop have been erected; a 15-drill Ingersoll-Rand compressor driven by 6-foot Pelton wheel has been installed; 3,000 feet of pipe-line for hydro-electro plant; and 1,500 feet of tramway connecting the lower tunnel with 200-ton mill on Princess creek. The mill is equipped with eight 5-compartment jigs, jaw-crusher, pebble-mill, five Overstrom tables, picking-belt, etc. A wharf is also being built which connects with the lowest floor of mill and which is 15 feet above high water. Approximately 2,000 feet of tunnelling and drifting was done and 5,000 tons of ore stoped for concentration. Forty men were employed on development and thirty on buildings.

The *Bannockburn*, situated on Hall creek, was bonded by the owners to American capitalists, who worked the property until bad weather compelled them to close down. It is reported two or three nice showings were uncovered during the short period work was carried on.

The *Silver Hill* was operated under the management of Mr. McAllister and employed three or four men with satisfactory results.

The *Silver King* group owned by John and J. O. Koski, is situated on Twelve-mile creek, about two miles from the Kaslo & Slocan branch of the Canadian Pacific Railway. On this

group there has been uncovered from 3 to 5 inches of high-grade ore, which can be traced for 200 feet. A cabin has been erected with the intention of working steadily next summer.

On the *Whitewater* Nos. 3 and 7 tunnels are being worked by M. J. Halpin and J. McVicar, respectively, under lease, with encouraging results.

The *Panama* has been worked steadily, two men being employed by the owners, H. Giegerich and J. P. Miller, who have built new camps on the south side of the hill, enabling them to drive on the ledge instead of crosscuts, as heretofore; they have driven 120 feet of new tunnels and stoped 25 tons of ore, which has been shipped.

The *Cork*, owned by the Cork-Province Mines, Limited, closed down in March. I am informed a large block of treasury stock is to be taken up by Colorado capitalists and that work will be started in March.

The *Flint*, owned by James Carter, was worked the greater part of the year, driving the tunnel 150 feet, besides sacking 10 tons of high-grade silver-lead ore, and erected an ore-house.

The *Bell group*, situated on Jackson creek, was operated by V. D. Williamson, A. L. White, and C. F. Caldwell, and employed twenty-seven men; 200 feet of tunnel was driven and 15 cars of zinc shipped to Kusa smelter, Dewar, Oklahoma. They also erected bunk and cook houses, stables, and a two-story ore-house.

The *Crescent-Eden* property was bonded by C. F. Caldwell from the Larson Estate, and rebonded to A. L. White and associates. They have driven the tunnel about 400 feet, erected a dwelling for the foreman, bunk and cook houses, office and blacksmith-shop. Early in the year they shipped one car of ore of fair grade. Eight men were employed most of the year.

The *Utica* group, owned by the Utica Mines, Limited, and situated on Twelve-mile creek, employed twenty-four men during the year; the work accomplished was 112 feet of crosscuts, 158 feet of raises, 51 feet of sinking, 409 feet of drifting, and 103 feet of tunnelling. During operation they shipped 1,128 tons lead ore to Trail and 71 tons zinc to Blende, Colorado.

The *Revenue*, situate on South fork of Kaslo creek, was operated for about five months, during which time they erected bunk and cook houses and shipped 36 tons of high-grade silver-lead ore, giving employment to eight men.

During 1916 the *Highland* mine employed around seventy men on an average, forty underground and thirty above; 12,290 tons of ore was mined and 10,073 tons milled; 2,215 tons of crude ore and 1,083 tons of concentrates were shipped to Trail.

The *Maestro* had four men working for five months taking milling-ore off dump and slopes. The ore went through the *Highland* mill and 62 tons of concentrates was shipped to Trail.

The *No. 1* worked January, February, and March; had about thirty-nine men working, thirty underground and nine above. Shipped 2,103 tons of ore to Trail.

OFFICE STATISTICS—AINSWORTH MINING DIVISION.

Mining leases issued	40
Free miners' certificates	216
Claims recorded	253
Assessments recorded	243
Transfers recorded	34

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, 1916.

I am pleased to state that the year just closed was the most prosperous in the history of the Slocan, both as to the production of the mines and also development. There was also a great demand for properties, either developed or undeveloped; the principal buyers were Americans, many of whom are still in the market for promising properties. The indications are now that the year 1917 will be even more prosperous than the past year. At the present time the greatest drawback we have in this district is the scarcity of miners and of all classes of labour. There is not an idle man to be found in the district, and, if the price of the different metals that are produced here stay anywhere near the present prices, there will be many more mines working before the year is out.

SILVERTON CAMP.

Silverton camp is still in the lead in tonnage shipped, and the *Standard* is the biggest shipper. At the present they employ over 200 men and pay the regular dividend of $50,000 monthly.

The Northland Mines, Limited, known here as the *Galena Farm* and operated by Patsy Clark, of Spokane, has been working steadily all the year and employed about sixty men.

The Silverton Mines property is situated on Four-mile creek, about four miles from Silverton. This company is represented by Monty Davys. The ore is silver-lead and zinc.

The *Echo* group is directly above the *Standard* on the same vein, and adjoining the *Standard* on the north, and is owned by J. H. Thompson, Martin Welch, and E. F. Burns. Since taking the property over about two years ago they have carried on development-work continuously, with the result that they opened up large bodies of ore; in fact, the face of the lower tunnel is all ore. There is no doubt now but they have a big mine.

The *Lucky Thought* is owned and operated by the Consolidated Mining and Smelting Company of Canada, and is situated opposite to the *Standard* and *Echo*, across Four-mile creek. They have also struck large bodies of zinc and galena ore. Dan Tattrie is superintendent, and they are shipping regularly. There are many small properties in the Silverton camp besides the above that have not yet reached the shipping stage, but are nevertheless doing active development-work, and a number of them will be heard from this coming year.

SANDON CAMP.

The Sandon camp is the next largest producer, and the *Surprise* was the biggest shipper. They have just finished a fine concentrator on the site of the old *Ivanhoe* mill, which was destroyed by fire about eighteen months ago; the mill is doing good work. J. P. McFadden is superintendent.

The *Slocan Star* is one of the oldest properties in the camp, and it has been worked with great energy for the last year. They are shipping much ore and at the same time keeping development-work well ahead; they have large reserves of ore blocked out and enough milling-ore to keep the large mill going for a number of years. O. V. White is the manager.

The *Noble Five*, owned and operated by James Dunsmuir, of Victoria, has been developed for the last two years by a system of long crosscut tunnels. They have struck the vein at a great depth and are blocking out ore ready for shipment. The ore in this property is very high in silver and also carries lead and zinc. Paul Lincoln is superintendent.

The *Ruth and Hope* is situated near Sandon and is a steady shipper.

The *Wonderful* and *Sovereign*, both in the Sandon camp, are worked by Clarence Cunningham. These properties are not one group, being situated in different localities, and are two of the old mines that were worked years ago without much success; but Mr. Cunningham has made mines of them both.

The *Noonday* is also above Sandon and is operated by Bruce White, and is turning out to be a big property.

The *Mountain Con* property is very high up and can only be worked part of the season. The ore is very high grade; one car of 40 tons this last summer netted the owners $10,000.

The *Rambler-Cariboo* is one of the oldest mines in the district, having been worked continually for seventeen years. The principal owners are in Spokane, and the property is situated near McGuigan Station, on the Canadian Pacific Railway, and is managed by Wilfred Cameron, who is making a success of it.

Lucky Jim property has had rather a checkered career, having been in the Courts for a number of years. A. Larson, an eminent mining engineer, was put in charge of it a couple of years ago by the British Columbia Courts, and under his guidance it is more than successful, having paid off much of the back debts.

In the Three Forks camp mining has taken on a new lease of life. The *Black Grouse* and the *Alps* and *Alturas*, the latter of which contains antimony ore, are owned and operated by W. J. McMillan, of Vancouver.

The *Payne*, in the Sandon camp, is being vigorously developed by Spokane capital.

Besides those above mentioned, there are many more small properties operated in the Sandon and Three Forks camps.

The *Mollie Hughes* and the *Apex*, near New Denver, are working small crews with good results.

Of the bigger deals made during the last few months, Clarence Cunningham takes the lead, having acquired no less than three big properties, all of which were big shippers some years ago.

The *Alamo-Idaho*, *Queen Bess*, and *Van-Roi* groups have been taken over by Mr. Cunningham for New York capital, and he has at least put one of these properties on a paying basis since taking them over, and there is no doubt but they are all big mines. I have not gone into details of work done on the Slocan mines, as Government experts have been looking over these mines and have no doubt furnished the Department these details.

OFFICE STATISTICS—SLOCAN MINING DIVISION.

Free miners' certificates	181
Free miners' certificates (company)	2
Claims staked and recorded	78
Assessments recorded	153
Agreements and transfers recorded	15

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, 1916.

Beyond the keeping-up of the yearly assessment-work on all the promising claims, very little other work has been done in the district during the year 1916; however, the work which has been done has given encouraging results.

The *Ottawa group*, owned by the Consolidated Mining and Smelting Company, has had a force of men working the whole year on development-work, but has only been shipping the ore that had been taken out in the completion of such work. Things are at present looking exceptionally good for the coming year.

The *Black Prince*, which is under lease to J. T. Tipping, has been working all summer with excellent results; it has shipped a total of 127 tons of high-grade silver-lead ore. Things are also looking very good at this mine.

On the *Alice S.* mineral claim, owned by C. W. Harper and C. M. Hardy, of Hackensack, N.J., considerable development work has been done, not having struck the ore-body, which had been encountered in the upper tunnels, work has been closed down until spring.

The *Inco*, owned by Wafer & Jameson, did considerable development-work and shipped a few tons of high-grade ore, taken out in development.

The *Meteor*, which is under lease and bond to Barber & Taylor, has done extensive development-work and has shipped a total of 29 tons of high-grade ore taken out in development-work; this ore runs in the neighbourhood of 500 oz. silver to the ton.

The *Enterprise* has been worked about seven months out of the year by E. Shannon, lessee, who shipped a total of 104 tons.

Kurt Zimmerman, on the *Anna* group, has done extensive development-work and things are now said to be looking very promising.

OFFICE STATISTICS—SLOCAN CITY MINING DIVISION.

Free miners' certificates issued	64
Certificates of work issued	97
Locations recorded	44
Certificates of improvements recorded	6
Bills of sale recorded	9
Agreements recorded	1
Notices to group	20

TROUT LAKE MINING DIVISION.

REPORT OF A. ST. C. BRINDLE, ACTING 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 1916.

As I only arrived here in September to assume the office of Acting Mining Recorder, I do not feel very well qualified to express, in a definite way, detailed conditions of mining progress as compared with previous years. As far as I may judge in the matter, however, I should say that there has been no material improvement, little development-work having been initiated, and that of a superficial character, with the exception of work confined to one or two properties.

It is not to be inferred, however, that because the camp has been such a low producer recently it is "dead and has had its day," as the very contrary is the case. This district not only has very great intrinsic merit, but, I am quite satisfied, is destined to become one of the best producers of silver-lead ores in the Province.

To those who have been in the camp for many years and know of the large reserves of milling-ores in the various properties that are as yet untouched, but which are plainly in evidence, the fact seems patent. The question therefore arises: What has held it back, and what will rehabilitate it?

As to the first question, lack of reasonable transportation (the bugbear of many a good mining camp), isolation, its ores being chiefly of a milling character, and lack of a proper appreciation of what is required to successfully handle and mill the peculiar (in a sense) complex ores are the chief factors that have had a deal to do with the retarding of development.

To the second question there is only one answer: A thorough testing of the milling-ores, to establish beyond cavil the best methods of extraction, and the "flotation" equipment necessary for these particular minerals, together with the erection of suitable small plants to handle the output along the lines such tests will demonstrate as being required.

With respect of tonnage, it is a fairly safe statement to make that some of the longest-lived mines in the Province will eventually be opened up in this section; for there are ore-zones of such width and persistence, and so many of them, that it would be unreasonable to assume otherwise.

The ore-exposures of *True Fissure-Great Northern* zones; the *Surprise*, *Molly Mack*, *White Quail*, *Nettie L.*, *Ajax*, *Silver Cup*, the *Gold Bug*, and others adjoining; and the fine outcrops on those properties in contact with the big Lime Dyke, both in this district and over the divide on the Duncan River slope—viz., the *Wagner*, *Francis Jewel*, *Bannockburn*, and *Glengarry*—are destined without doubt to become producers of large tonnage; it is simply a question of satisfactory methods to be employed.

It is to be hoped that, with the general revival of the mining industry now apparent, steps will be taken towards a renewed activity in this Division.

The assumption has been, one infers, that because of the failure of the *Silver Cup* mill to satisfactorily handle these ores, failure might ensue in other attempts; but it is practically beyond question that if thorough tests are made, details worked out, and proper treatment accorded, success would surely follow. Complex ores (so called) are complex no longer; recent "flotation" improvements easily handle this class of ores; this is no longer a theory, but an established fact.

I am aware a certain firm of milling specialists in Colorado and Utah saw possibilities along about the same lines there as there are now open here. They grasped the opportunity by quietly making their tests, etc., and securing properties that had been passed over by the larger companies, and placing thereon small mills, costing only from $7,000 to $10,000, with such success that they are establishing a chain of such mills, and are even considering the possibility of coming in to British Columbia on a similar mission. Similar action can be taken here, and I am confident that if one mill starts up, others will quickly fall in line and the problems of this Division be solved.

If the thorough testing of these ores cannot be undertaken by individuals in Kootenay for lack of capital for such work, then it strikes me as a serious proposition that the Government could do no better by the people here than to take up as soon as possible such tests on a good scale, thoroughly demonstrate the correct methods to be employed, and tabulate same publicly, together with approximate costs of milling plant on a small scale as a basis for interested parties that would point out the way for successful action.

Such successful operations would employ a great deal of labour directly, as well as create a large amount of business indirectly that would inure to the great benefit of the whole of the people in this portion of Kootenay and produce heavy revenue to the Government.

Speaking more particularly of the mining development of this Division, I may say that very little has been done in the current year, and that confined to the annual assessment-work.

Silver Cup. On the *Silver Cup* and *Nettie L.-Ajax* nothing has been done; rumours have been rife that negotiations were about completed for the reopening of these properties, an event that was awaited with interest in this community; it seems, however, that owing to the war it has been impossible to get negotiations closed in England, the parties interested being at the front. It is expected, though, that the properties will be reopened before long.

Triune. At this mine operations were commenced some time in the summer under the superintendency of Mr. Battey, who came from the Eastern States for that purpose; development was continued until the heavy snow came, when operations ceased. Shortly before closing down a fine shoot of high-grade clean ore was struck and about 30 tons packed down for shipment. It is stated that Mr. Battey will reopen this mine as soon as weather conditions will permit.

Florence. In the meantime Mr. Battey is expected back to commence work on this property, which lies below the *Ajax*, and between that property and the *Silver Cup*, on the same zone. Some work was done here in the summer, consisting chiefly of surface stripping, cuts, etc., as a preliminary to the operations now proposed.

True Fissure. At this mine steady development was proceeded with, large bodies of milling-ore being opened up. This property will without doubt be one of the best producers of silver-lead ore in this Division, having already demonstrated heavy tonnage in reserve. No information is being given out by the management, but it is rumoured that plans are being made for the erection of a good mill, and there is little doubt that before long operations will be actively increased.

Elesmere. This property owned, by Hillman, Kennedy, and Fraser, and situated near Circle City, on the North fork of the Lardeau above Ferguson, was bonded by American investors, a company being formed for that purpose. R. D. Featherstonhaugh represented them in this Division. About four men were engaged in the preliminary work; this was commenced about September, and early in November a fine body of ore was struck, 36 inches in width, over a third of which was clean galena, the balance being almost of a shipping grade. The prospect for this group of claims is very bright, as it lies in a zone of heavy mineralization. Next season's development is expected to be most successful.

Old Gold. Strictly speaking, the greater portion of this property lies over on the Duncan River slope, and therefore in the Ainsworth Mining Division, but it has always been operated from the Trout Lake side, there being no transportation up the Duncan River valley. A new trail was constructed from the summit (above Circle City) on, keeping on the level fairly well to avoid packing ore up hill from the other side. The property was operated under the personal supervision of Judge Miller, of Bellingham, one of the owners; some 30 tons of the usual high-grade steel galena was packed down to Ferguson and shipped, and, as it was impossible to continue work over the divide during the winter, the property was closed down till next spring. The outlook for the future is bright, but the best results from the mine will be available only when transportation is supplied up the Duncan valley.

Parrsboro. This property, situated above Ferguson, on the South fork of the Lardeau, and owned by Kirkpatrick, Thompson, *et al.*, was also taken under option by R. D. Featherstonhaugh in the late fall, a small force of miners being put to work. Operations ceased upon the advent of winter.

Rainy Day. A comfortable new cabin was erected on this group by S. Woods, the chief owner, who spent most of the summer on preliminary work. He states that he has a large iron-capping, which contains small quantities of chalcopyrite. It is his intention to drive an adit under the "capping" in the hope of striking commercial ore; two men are now engaged in this work for the winter. This ledge is along the strike of the *Beatrice* vein or zone, and adjoins this property on the Ferguson side of the divide.

Ethel. Work on this group has gone steadily forward since last June under the superintendency of J. Lamphere, of Trout Lake. From three to four men have been employed developing it, and, at the time of writing, a car of high-grade ore is being rawhided to Trout Lake for shipment. The property is stated to be looking better than at any previous time.

Copper Chief. On this group of claims, situated on Ethel mountain, about four miles south-west of Trout Lake, the chief owner, W. J. Livingston, gave a bond to R. D. Featherstonhaugh, of Ferguson, early in November, with a 10-per-cent. cash payment down. Work was commenced at once with a small crew under George Yuill as foreman. Mr. Featherstonhaugh states that new quarters will be erected, so that the force may be increased as quickly as convenient. It is his intention to drive an adit along the big pyrrhotite-exposure for some distance and then crosscut that body, in the meantime keeping in close contact with the smaller high-grade grey-copper cross-ledges, or so-called feeders. It is hoped that there may be developed a large and important body of copper ore of a commercial grade under the pyrrhotite-capping mentioned, and meanwhile ore of extremely high grade is being sacked for shipment from the smaller veins. The results of these operations are being watched with great interest by the people of Trout Lake, as a successful outcome would create a good deal of business for this place.

Both properties just mentioned are in the South Belt and are practically the only ones working south-west of the lake.

Gold Bug. Mr. Livingston, having bonded the *Copper Chief*, has now turned his attention to developing the *Gold Bug*, situated above Ferguson, about three miles on the wagon-road up the South fork of the Lardeau. Here he has a large exposure of milling silver-lead ore, 15 to 20 feet wide; this is close to the creek-bottom, and it is his intention to try and get this ore-body farther up the hill towards the *Nettie L.*, as it is accepted as a fact that this is the same ore-zone as that worked in that mine. From indications of float-ore and having proven the same dyke rock in-place, he is confident of developing a valuable property here. This property is below the *Florence*, previously mentioned, that Mr. Battey is going to operate, and these two and some five other groups lie in a line along the strike of the *Nettie L.-Silver Cup* ore-zone. As good ore has been found on most of these groups, it is hoped that development will demonstrate one of the best zones of ore reserves in this Division, more especially of milling-ore.

POPLAR CREEK SECTION.

As far as I am aware, there has been nothing more than the usual assessment-work done on the claims in this portion of the Division.

The properties in this section give every promise of becoming important gold-producers, as far as the development has so far progressed. It will be necessary, however, to establish mills to handle the ores from this section; a double process of amalgamation and probably cyanidation may quite satisfactorily do this.

OFFICE STATISTICS—TROUT LAKE MINING DIVISION.

Assessments recorded	131
Locations recorded	70
Agreements and transfers	12
Notices to group	24
Free miners' certificates issued	48

NELSON DISTRICT.

NELSON MINING DIVISION.

REPORT OF 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, 1916.

The progress made in the district during the past year has, on the whole, been satisfactory, and extensive development has been done to prove the value of different properties.

NELSON CAMP.

Silver King.

Development-work by contract has been resumed at the *Silver King;* 116 feet of drifting has been done, 59 feet being on the seventh level and 57 feet on the ninth level. Six men have been working, five underground and one above. Until November there were two men keeping mine pumped out and getting things in shape. The electric pump was in use all the year to keep the workings free from water.

California.

This mine is owned by Wm. Moore, of Nelson, and is composed of a group of five claims, three of which are Crown-granted—viz., *California, Union,* and *Deadwood;* the other two—*Gold King* and *Clift*—have been surveyed. The claims are situated on Toad mountain, three miles south of Nelson, and Mr. Moore has bonded the group to W. H. Turner, of Spokane, who has taken a lease on the *Athabasca* compressor and laid a pipe-line to No. 2 and No. 3 tunnels of the *California;* two air-drills are now being worked in No. 2 tunnel, and as soon as there is sufficient water, No. 3 tunnel will be operated with air-drills.

Forty tons of ore was shipped to Trail smelter on December 14th last, averaging $25 a ton in gold and 3.02 oz. in silver. Six men have been working steadily for the past three months, and as soon as power facilities will permit more men will be employed.

Athabasca.

This mine is now being operated under lease by A. E. Rand and G. D. Brymner. Five men have been working since the middle of October, doing prospecting and development work. No ore has been shipped during the year.

Granite-Poorman.

During the past year this mine has been the scene of considerable activity. This mine is now being operated by the Kootenay Gold Exploration Company, Limited, and development-work has been carried along two lines: First, the development of the *Hardscrabble* vein, to keep up a steady production; secondly, the development of the *Poorman* vein, distinct from and paralleling the *Hardscrabble.*

The first-mentioned work, done by Crilly & Willson, lessees, and continued by the present company, consisted of sinking a shaft 113 feet in depth and driving some 400 feet of drifts, both north and south along the vein at the 103-foot level. From these workings the ore extracted has enabled the 20-stamp mill to run one shift continuously, since, I believe, about March 1st, 1916, to the present time. Both drift-faces are in commercial ore.

The second line of development-work was done entirely by the present company, and consisted of unwatering the old levels, stopes, and 300-foot shaft in the *Poorman* vein, below the main *Poorman* tunnel-level, from which the new *Hardscrabble* shaft was sunk. This permitted operations 300 feet below the present main tunnel and 200 feet below the lowest workings on the *Hardscrabble* vein.

The company is now driving a crosscut, approximately 400 feet in length, from the bottom level on the *Poorman* to tap the *Hardscrabble* vein some 200 feet lower than its present workings, as mentioned above. The crosscut was started November 6th and is expected to be completed by February 1st, 1917. This, if successful, will not only open up more ore-bodies, but will permit of all operations through one shaft.

Regarding the production, the Crilly & Willson output was approximately $35,000 from January 1st, 1916, up to the time the present company took over the property. The present company has, however, extracted approximately $20,000 in bullion and concentrates by operating the mill part time.

New equipment consists of drills, pumps, with all accessories, and considerable repairs have been made on the aerial tramway, pipe-lines, mills, and boarding-houses. The company is employing an average of thirty men in mine and mill.

Queen Victoria. This property is operated under lease by Frank Phillips and Jos. Williams, who have shipped about 1,500 tons of low-grade copper ore, principally derived from cleaning up the old workings. Profitable production was made possible by the high price of copper. Up to September 30th the shipments to the British Columbia Copper Company aggregated 1,581 tons.

Perrier. No ore has been shipped during the year, but considerable development-work has been carried on, as follows:—

Underground Work.—The No. 1 level north drift has been advanced 60 feet. The main shaft was sunk a further 50 feet, at which point an intermediate level has been started. A total of 80 feet of raising has been carried out.

Surface Mechanical Improvements.—A new 50-foot headgear has been erected, and the power pipe-line was increased 600 feet in length. By this the horse-power was doubled.

An average of four men has been employed during 1916. The vein has held its size and value, showing, however, more galena than heretofore.

Gold King. During the year no ore has been shipped. Development-work consisted of a two-compartment shaft, sunk down 53 feet, and a 70-foot tunnel. A contract has been let for sinking the shaft to the 110-foot level, and further development-work may be continued.

Molly Gibson. Up to the end of April there was only one man as caretaker at the *Molly Gibson* mine. In May and June ten men were employed fixing tram. From July on there were nineteen men, eleven underground and eight on surface, and 534 tons of ore was shipped up to December 20th.

YMIR CAMP.

Yankee Girl. This mine, owned by the Hobson Silver-Lead Company, which is controlled by Fort Worth (Texas) people, was operated on a development basis during the year 1916. The manager for the past three years, W. A. Buchanan, resigned in favour of J. H. McDowell from Fort Worth. The property shipped about 900 tons of ore in 1916.

The development-work comprised a long tunnel which tapped the ore-bodies about 700 feet deeper than the upper mine-workings. At present operations are being actively carried out with a view of production from the lower workings during the coming year.

Dundee. This mine has not been operated for the past three years.

Ymir-Wilcox. This property, situated about seven miles from Ymir, which has been extensively developed and has disclosed considerable ore, is not being operated on account of the difficulty of procuring labour and material necessary in the cyanide treatment of the gold ore, which is the principal product.

Fog Horn. Six hundred feet of diamond-drilling at a cost of $4 a foot has been carried out at the *Fog Horn* mine, near Ymir. Wm. Horn, of Spokane, represents the owners in the conduct of the exploration-work. The diamond-drill is being operated from the face of an 1,100-foot crosscut tunnel, which was driven at a cost of about $30 a foot to open up at depth veins exposed in the upper workings. It is estimated that the vein is about 900 feet distant from the face of the tunnel, and that another 300 feet of diamond-drill work should locate it at a depth of 1,100 feet.

The ore is gold-bearing, similar in character to that of the *Wilcox*.

Jennie Bell. This claim is situate on North fork of Wild Horse creek, and is being worked by Poulin & Bremner, of Ymir. Three men have been working for the past four months and development-work has been carried on; 70 feet of tunnelling has been accomplished; 16 tons of ore shipped, which is reported to have been valued at $70 a ton.

SHEEP CREEK CAMP.

H.B. Group. This is one of the most important group of mines in this district. The tonnage, which is shown below, is based on the mine weights and assays, and are dry tons covering eleven months' operation in 1916:—

Zinc-ore, 5,401 tons, yielding 2,910,675 lb. zinc; lead-zinc, 1,118 tons, yielding 461,980 lb. zinc and 182,322 lb. lead; total, 6,468 tons, yielding 3,372,655 lb. zinc and 182,322 lb. lead.

Development: 1,906 feet of tunnel driven; 1,553 feet of diamond-drilling. Average number of men a month, 40.

New machinery installed: Air-compressor, 312 cubic feet capacity; Pelton water-wheel, 280-foot head.

Emerald. One thousand three hundred and forty-six tons of ore was shipped to the Trail smelter, the production being in excess of that of the previous year. An average of twenty men was employed; 150 feet of upraises was run; and 750 feet of drifting and crosscutting. Improvements were made in bunk-houses, buildings, etc., and a small sawmill plant was put in operation at a cost of $1,000.

The mine is owned by the Iron Mountain, Limited, John Waldbeser, of Salmo, being manager.

Queen. About July 15th a cave-in occurred at the shaft and shipping operations ceased. A crew was kept at work repairing the shaft until the middle of October; 145 feet of drifting was done and considerable stoping; about 2,060 tons of ore was milled and 266 tons of concentrates was produced. The value of bullion was $10,500 and the concentrates $5,900.

Vancouver. During the year about 78 tons of ore was shipped to the Trail smelter, and the following development-work accomplished: 207 feet of adit-work; 9,500 cubic feet of stoping.

Motherlode and Nugget. These properties, situated on Sheep creek, about eleven miles from Salmo, have been closed down for the past eighteen months. An option for purchase of the mines, mills, etc., of the two properties has been granted to R. S. Lennie and associates, of Vancouver and Spokane, and it is anticipated that active operations will start in the spring.

Spokane Group. This group, comprising six mineral claims in the Bayonne district, about fifteen miles from Salmo, is owned by the Laib Bros., of Spokane, Wash., and is now under option to the Spokane Mines Syndicate, comprising W. R. Salisbury, of Salmo, B.C., and I. G. Nelson and associates, of Nelson, B.C.

During the early part of last summer the Laib Bros. mined and shipped out by pack-train about 40 tons of ore, which netted about $90 a ton from the smelter. In the fall of the year W. R. Salisbury and associates mined and packed out two shipments of ore of an aggregate weight of 114,415 lb., of a net value of $2,603. The Provincial Government started to build a wagon-road and trail from Kootenay lake up to the property last fall, but the weather conditions interrupted completion.

The main obstacle to the production from this property has been lack of transportation facilities, and, as the option-holders are practically assured that these will be furnished, it is anticipated that before the end of the present year this property will be on a steady production basis from the high-grade ore mined, and that its producing capacity will be added to by the installation of mill and mine plant during the following year.

Molybdenite. The *Molly* mine, which is owned by Bennett, Ross & Benson, of Salmo and Nelson, B.C., is situated about thirteen miles from Salmo, on Lost creek. A Government road has been built to the property. The claims are located on the eastern side of Lost creek in a ridge of slate and granitic mountains trending northerly. The ore-deposits lie about the centre of the claims at or near the contact between the granite batholith with the shales. The ore occurs as lenses and disseminations varying from 1 to 8 per cent. molybdenite content. The property is developed to a depth of about 150 feet by a series of open-cuts and tunnels.

The International Molybdenum Company, of Renfrew, Ont., has an option on the property, and is working it with a force of about ten men. Nine tons of high-grade ore was shipped in September and October and two car-loads of low-grade were shipped November and December.

The property is one of the few producing molybdenum-mines in Canada.

ERIE CAMP.

Second Relief.

An average of twenty-three men has been working steadily at the *Relief* mine; the development-work consisted of over 600 feet of drifting on No. 4 level, and timbered complete for the 1,200 feet. Three stopes have been opened off this drift—one, 120 feet long; one, 170 feet; one, 60 feet; and one, 50 feet.

The new plant has now been completed at a cost of about $75,000. New machinery has been installed as follows: Tube-mill, classifiers, stamp-mills, etc. It is expected that with the new cyanide plant in operation the loss in values in tailings will be fully recovered. About 2,600 tons of ore was extracted this year.

THE FRENCH PROCESS.

The construction of the plant at Nelson was commenced about the end of July and has proceeded steadily. Much difficulty has been incurred in obtaining machinery and materials of construction, but, at the date of writing, the last essential material has been shipped by the manufacturers, and it is expected zinc will be produced early in 1917.

The buildings have been extended and cover about twice the area of those existing before operations were commenced.

The process is covered by patents granted to the late Andrew Gordon French, and has been referred to in previous reports.

The sulphide, complex ore will be first ground in a tube pebble-mill, and then conveyed by a belt elevator to a McDougall roasting-furnace, with six hearths, for the removal of a large part of the sulphur. The sulphurous acid and dust from the furnace are passed through a special condenser.

The roasted ore is then elevated to the lower of two very large dissolvers to completely neutralize the acid in the zinc liquor. The manganese in the liquor has the effect of precipitating the iron and other impurities, leaving a solution free from all but minute traces of impurities. The liquor settles very rapidly, and is passed through a vacuum filter-press to completely clarify it before it is pumped to the electro-vats. The sludge from this operation is elevated to a second dissolver, where all but a small quantity of zinc, which remains in the residue, is extracted by fresh acid liquor from the electro-vats.

The sludge remaining is filtered and is ready for the extraction of its lead, silver, gold, or copper contents by smelting or otherwise. The clear zinc and manganese liquor is then passed through a purifier with metallic zinc for the purpose of removing the last traces of impurities, and thence passes through a series of thirty-six vats, which are placed in rows of six.

The direct current for electrolysing the solution is obtained from a motor-generator with a capacity of 375 kw. The motor end is supplied with alternating current from the City of Nelson plant at a voltage of 2,200; the generator end gives direct current at 125 volts.

The zinc will be deposited on sheet-zinc cathodes made by a special rolling-mill, and when sufficiently heavy will be melted in a furnace and cast into bars. As the zinc deposits, the acid with which it was combined is set free and flows into a large storage-vat, from which it is again pumped to the dissolvers.

Part of the manganese in solution is deposited at the anodes as manganese dioxide, and any excess over that required in the process will be sold.

A plant for the treatment of the residues containing lead, silver, gold, and copper will be proceeded with as soon as the main plant is started.

PLACER.

On the forty-nine creek leases which are under bond to F. Keffer and Harry Johns, prospecting-work has been carried on by three men, with Chris Jensen, an experienced placer miner, in charge.

A tunnel 230 feet has been driven on the No. 3 lease, and quite a lot of open-cut work has been done on the No. 4 lease. A small house has been erected and half a mile of wagon-road built so as to connect with the main Granite road. In the near future Keffer & Johns contemplate putting in a hydraulic plant with a capacity of 200 yards daily.

OFFICE STATISTICS—NELSON MINING DIVISION.

Free miners' certificates (individual)	565
Free miners' certificates (company)	4
Claims recorded (mineral)	408
Claims recorded (placer)	2
Certificates of work recorded	481
Agreements, transfers, etc.	126

Revenue.

Free miners' certificates	$2,838 25
Mining receipts, general	3,533 50
Total	$6,371 75

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, 1916.

The *Paladora* group, comprising the *Paladora*, *Summerset*, and *Meadow View No. 2* mineral claims, has been bonded and work started on the claims. Character of ore is free-milling gold, giving assays of $30 in gold a ton.

On the *Millie Mack* development-work has been carried on all summer. Twenty tons of ore is sacked up to be sent to the smelter as soon as the snow makes good hauling; the ore assays: Silver and lead, $80; gold, $20 a ton.

On the *Big Ledge* no extra development has been done, further than the ordinary assessment-work. This vein shows a large outcrop of zincblende.

OFFICE STATISTICS—ARROW LAKE MINING DIVISION.

Free miners' certificates issued	45
Certificates of work recorded	16
Mineral claims recorded	27

ROSSLAND DISTRICT.

TRAIL CREEK MINING DIVISION.

REPORT OF H. R. TOWNSEND, GOLD COMMISSIONER.

I have the honour to submit the report of mining operations in the Trail Creek Mining Division during the year 1916.

The principal work done and the ore produced was from the same mines that have been operating for the past several years—viz., the *Centre Star* group and the *Le Roi* group, operated by the Consolidated Mining and Smelting Company of Canada, and the *Josie* group, operated by the Le Roi No. 2, Limited.

Consolidated M. & S. Co.

Centre Star Group.—Tons of ore shipped, 154,221; gross value of ore shipped, $1,738,247.49; average number of men employed, 497. Development: Driving, 6,434.5 feet; raising, 1,148.5 feet; crosscutting, 2,210 feet; winzes, 140.5 feet; diamond-drilling, 11,220.7 feet.

Le Roi Group.—Tons of ore shipped, 117,770; gross value of ore shipped, $1,408,427.23; average number of men employed, 232. Development: Driving, 1,793.5 feet; raising, 584.5 feet; crosscutting, 1,922 feet; winzes, 205.5 feet; diamond-drilling, 2,485.7 feet.

Le Roi No. 2.

Josie Group.—Tons of ore shipped, 16,295.02; tons of concentrates shipped, 128,540; gross value of ore shipped, $357,739.35; gross value of concentrates, $3,800.74; average number of men employed, 85. Development: Driving, 3,163.5 feet; raising, 323 feet; crosscutting, 205 feet; diamond-drilling, 7,915 feet.

Inland Mines (formerly the Inland Empire).—No ore has been shipped during the year from this group, but an average force of seven men has been employed and 800 feet of driving has been done, as well as 50 feet of crosscutting; also $2,000 has been expended in additions to plant.

There were eighteen leases granted of reverted mineral claims under the amendment to the "Taxation Act," but I have been unable to learn of any work of importance being done on any of the leased claims. In a number of cases they were leased by the owners of adjoining ground for the purpose of consolidating the holdings or to afford better facilities should they desire to work the adjoining claims.

A large sum has been expended on the smelting and refining plant of the Consolidated Mining and Smelting Company of Canada at Trail during the year, making it most complete in all departments, and the number of men employed was steadily increased until the coke shortage curtailed operations during the latter part of the year. This shortage also affected the output of the Rossland ores; in fact, shipments entirely ceased for a time in December.

OFFICE STATISTICS—TRAIL CREEK MINING DIVISION.

Mineral claims recorded	48
Certificates of work	60
Certificates of improvement	2
Bills of sale, etc.	19
Leases of reverted claims	18
Free miners' certificates (individual)	131
Free miners' certificates (company)	4
Free miners' certificates (special)	2

TRAIL CREEK MINING DIVISION.

NOTES BY PROVINCIAL MINERALOGIST.

The mining operations of the Consolidated Mining and Smelting Company are the most important in southern British Columbia. The company's principal mines are situated at Rossland, in the Slocan Division, and East Kootenay. At Trail the company maintains extensive and modern smelting and refining plants, where, in addition to treating its own ores, a large tonnage of custom ore is handled.

During the past year many additions, changes, and improvements were made in the smelting and refining plants situated at Trail. The actual production of refined zinc and refined copper was commenced, and this fact is the more noteworthy as this is the only place in Canada where such refining is being done. The company now buys and treats at Trail gold, silver, lead, copper, and zinc ores, and the refined products produced include: Gold bricks, silver bars, pig lead, sheet lead, lead pipe, refined zinc, electrolytic copper, copper sulphate, and arsenic and antimony compounds as by-products.

The erection of the electrolytic zinc-refinery was commenced in the fall of 1915, and by rushing the construction-work the plant was in operation early in 1916. It was designed primarily to treat the complex zinc-lead ore of the Sullivan mine, owned by the company, where very large reserves of this class of ore have been proved. The ore is roasted and then leached with a solution of weak sulphuric acid. This dissolves out the zinc, which is then precipitated in electrolytic tanks. The lead and low silver contents of the ore remain as an insoluble residue from the leaching process and are sent to the lead-furnaces for smelting. This process enables the zinc contents of the ore to be saved (at least, in large part) and also makes a much better product for the lead-stacks than the crude ore. The cost of producing zinc by this method is about the same or possibly a little higher than by fire-smelting, but this latter process could not be used with *Sullivan* ore.

In addition to the *Sullivan* ore, a small amount of high-grade zinc concentrates from the *Lucky Jim* mine has been treated at this plant. The capacity of the plant is from 25 to 30 tons a day of refined zinc, which means that 150 to 200 tons of ore is being treated daily.

The two copper-converters, the installation of which was completed during the year, enabled the matte from the copper-furnaces to be converted into blister-copper at Trail instead of shipping to Tacoma, as was formerly done. An electrolytic copper-refinery, with a daily capacity of 10 tons, was erected and commenced operation during the year. In addition to the company's own blister-copper, some blister-copper from the Greenwood smelter of the British Columbia Copper Company was refined; the refinery is now being enlarged to make a daily output of 15 tons of refined copper. In addition to the zinc and copper refineries, much other equipment of various kinds was added to the smelter, changes and improvements for handling the ore were made, and considerable additions to the Cottrell smoke- and fume-dust precipitating plants were installed.

The expenditure of several millions of dollars by this company in new plant shows the confidence felt by the management in the future of mining in southern British Columbia.

The following excerpts are taken from the annual report of the company covering operations for the fiscal year ending September 30th, 1916:—

"REPORT OF PRESIDENT.

"Your directors submit herewith the Eleventh Annual Report of the operations of the company for the year ending September 30th, 1916.

"The net profit is $996,496.35, after writing off $278,386.44 for depreciation of plant and equipment and charging Profit and Loss Account with $598,745.85 expended in development on your properties. The balance to the credit of Profit and Loss Account now stands at $2,278,458.73.

"The main increase in Property Account has been through the issue of $1,500,000 of stock at par for the $2,000,000 of common stock of the West Kootenay Power and Light Company, Limited. The reasons for this purchase were fully gone into at the special meeting held when the purchase was authorized.

"The new issue (about $2,100,000) offered to the shareholders on November 1st, 1916, has been almost entirely subscribed for. The rights to shares not taken up are largely held abroad.

Subscriptions no doubt will be received just so soon as the shareholders entitled have had time to reply to the circular.

"Your operations at the smelter, refineries, and mines are continually expanding, entailing increased responsibilities on your officials. Especially is this so when the demands for lead, copper, and zinc for war purposes are so insistent. The output of these metals is sold for months ahead.

"Notwithstanding the heavy shipments of ore from your different mines, the ore reserves have been well maintained. Nevertheless, it is the policy of your directors to acquire and develop other properties from time to time, so that if any particular mine should become exhausted a successor would be ready to take its place. With such a large section of the main Rocky Mountain range tributary to your smelter, it should not be difficult to provide at least as large an ore tonnage as has been available in the past.

"The overdraft is abnormally high, but as it is represented by a stock of metals actually on hand at the close of the year, it will be speedily liquidated.

"PROFIT AND LOSS ACCOUNT FOR THE TWELVE MONTHS ENDED SEPTEMBER 30TH, 1916.

"To Smelter product on hand and in transit from smelter to refineries at September 30th, 1915		$ 179,448 47
Ores and metals on hand and in transit to the smelter at September 30th, 1915		966,864 92
Customs ore, lead, and bullion purchased		2,913,426 39
Freight on ore from company's mines		204,545 73
Mining, smelting, and general expenses—		
Molly Gibson mine	$ 10,761 22	
Richmond-Eureka mine	279 65	
Maestro mine	1,255 56	
Highland mine	45,036 25	
No. 1 mine	11,879 72	
St. Eugene mine	21,516 73	
Sullivan mine	244,115 96	
Le Roi mine	379,506 71	
Centre Star mine	615,506 44	
No. 7 mine	1,417 41	
Ben Hur mine	14,996 91	
Lucky Thought mine	16,430 98	
Emma mine	16,377 14	
Ottawa mine	5,757 83	
Trail smelter and refineries	2,496,285 78	
		3,881,124 29
Development expenses—		
Highland mine	$ 12,648 83	
No. 1 mine	22,460 48	
Sullivan mine	82,298 03	
Le Roi mine	93,033 86	
Centre Star mine	370,104 65	
Lucky Thought mine	6,678 86	
Emma mine	9,499 01	
Silver Dollar mine	2,022 13	
		598,745 85
Depreciation		278,386 44
Directors' fees		8,800 00
Sundry items written off, including bad debts		5,040 51
Balance, profit		996,496 35
		$10,032,878 95

"By Sales of smelter product, ore, etc.		$ 7,203,807 34
Smelter product on hand and in transit from smelter to refineries at September 30th, 1916		37,039 97
Ore and metals on hand and in transit to the smelter at September 30th, 1916 (value of metal contents corrected to market quotations)—		
Ores on hand	$1,139,693 62	
Refinery metals on hand	1,424,386 28	
Ore in transit to smelter	81,814 30	
		2,645,894 20
Rents and sundry revenue		62,804 11
West Kootenay Power and Light Company, Limited, dividends		88,333 33
		$10,032,878 95

"MANAGING DIRECTOR'S REPORT.
(J. J. Warren.)

"*Zinc.*

"The electrolytic zinc plant began operations in the month of March, 1916. Before it was completed, at the request of the Imperial Munitions Board, further contracts were entered into for an increased supply of zinc, which rendered necessary very large additions to the plant as originally designed. These are well under way, but delays in deliveries of electrical machinery will prevent much increased production before early in 1917.

"The original plant is now working satisfactorily.

"In the beginning a number of difficulties were met with and had to be overcome. These were perhaps necessarily incidental to the standardization of the production in a large way of electrolytic zinc. Doubtless improvements in methods will be made as the operations proceed.

"*Copper.*

"The completion of the copper-refinery marks an epoch in the metallurgical history of Canada. During the war both refined copper and zinc are readily saleable for munitions purposes; after it is over there is no reason why the entire output of these metals should not be absorbed by the Canadian metal trades and fabricated by Canadian workmen—a condition possible only because these metals will then be available in a refined state.

"*Lead.*

"The production for the year was slightly less than in the preceding years. This is attributable to the unusually severe weather conditions of last winter.

"*Gold and Silver.*

"The production of these precious metals varies more from year to year than the production of the base metals, as the metal content in the gold and silver ores is not stable.

"*Acid Plants.*

"The addition of sulphuric and hydrofluosilicic acid plants makes the refineries independent —and at a time when a supply from outside sources is both unreliable and abnormally high in price.

"While the prices of metals ruled high during most of the year, profits do not show a corresponding advance because of the greatly increased costs of operating the mines, the smelter, and the refineries. Many supplies have doubled in price—all have appreciated very markedly. The workmen have had substantial advances in wages. Labour disturbances in the coal-mines have curtailed the production of coke, which has forced us to restrict our activities and has affected operating costs injuriously.

"Finally, the carrying-on of heavy construction-work while ordinary production was being maintained inevitably increased the cost of ordinary production. This condition will not be a serious factor from now on, as construction (except in the zinc plant) is almost completed.

"*Mines.*

"There have been no extraordinary occurrences. The usual policy of keeping development well advanced has been followed.

"Shipments from the Rossland mines are being confined as much as possible to ores carrying as high a copper content as can be mined to advantage.

"Speaking broadly, the Rossland mines are gold-mines rather than copper-mines. During the war the returns will not be as great as if there were a higher copper content, but after the war and during normal conditions (which will ultimately prevail) these mines will show up to much better advantage.

"*Management.*

"During the year the scope of the company's operations having become much broadened, it became necessary to divide the responsibilities in order to secure the greatest efficiency.

"Since October 1st, 1916, the officers are: R. H. Stewart, consulting engineer; S. G. Blaylock, assistant general manager; E. H. Hamilton, metallurgical manager; W. M. Archibald, manager of mines; T. W. Bingay, comptroller; James Buchanan, superintendent of smelter; J. F. Miller, superintendent of refinery; M. E. Purcell, superintendent of *Centre Star* group of mines; E. G. Montgomery, assistant superintendent of *Centre Star* group of mines; F. S. Peters, superintendent of *Le Roi* mines; J. K. Cram, superintendent of *Sullivan* and *St. Eugene* mines; Fred. Chapman, engineer in charge of construction of the smelter.

"During the year a selling organization for the products of the company was established and W. S. Rugh appointed sales agent for Canada West of the Province of Quebec. Thomas Robertson & Co., Limited, remain selling agents for the territory covering the Province of Quebec and east thereof.

"MANAGER OF MINES' REPORT.

"Ore reserves in the company's mines in Rossland are about the same as last year, there being a slight decrease in those of the *Le Roi*, which is more than offset by an increase in the *Centre Star* and *War Eagle*.

"In the *Centre Star* the ore-body mentioned in last year's report as having been encountered by a crosscut from the sixth level has been further developed on the fourth, fifth, seventh, and eighth levels, *Centre Star*, and on the twelfth, *War Eagle*, with fairly satisfactory results.

"In the *War Eagle* development of the deepest levels was continued without obtaining definitely satisfactory results as to the location of the continuation of ore-bodies existing on the sixteenth level. The possibilities, however, have not been exhausted. Development in the upper levels maintained reserves without opening up new ore-bodies of magnitude.

"In the *Le Roi* development was continued on the lower level, corresponding to the thirteenth, *Centre Star*, where a sulphide-ore body containing copper values principally was opened up. The winze was sunk to the level of the fourteenth, *Centre Star*, and the exploration of this ground is being continued.

"The west drift on the 1,650 has been advanced into the *White Bear* ground, on which a lease has been taken by the company, and a raise is being made to connect with the *White Bear* workings, after which exploratory work in the western section will be continued.

"In the *White Bear* the workings have been unwatered, shaft and head-frame repaired, and new pumping equipment installed, preparatory to development.

"At Kimberley, in the *Sullivan* mine, the new lower tunnel was advanced. Development-work was carried on at the old tunnel-level and on the level 100 feet below. Ore reserves of high-grade lead have not been maintained, but some promising zinc-ore stopes have been opened up and considerable tonnages of low-grade lead-zincky ore developed. Additional development-work is being carried on to increase the reserves of high-grade lead ore.

"At the *St. Eugene* a limited amount of work was done and the upper workings of the mine have been leased.

"At Ainsworth the *No. 1* mine was worked during a portion of the year; the shaft was sunk another 100 feet and the development of the lower levels was in progress when operations were suspended on account of labour trouble.

"Operations at the *Highland* mine were increased during the year and shipments of crude ore made from the ore-body on No. 5 level. Development of this ore-body and the ground between No. 5 and the upper workings is being continued.

"The lease on the *Maestro* was renewed and milling-ore taken to the *Highland* mill for concentration.

"At the *Molly Gibson* a small force of men was employed and some crude ore shipped. The mill was not operated.

"At the *Ottawa* mine, near Slocan City, development-work and stoping was carried on with a small crew.

"The *Lucky Thought* mine, at Silverton, has been developed by a crosscut which intersected the vein 200 feet lower and a connecting raise is now being made to the upper workings preparatory to continuing the development.

"The *Emma* mine, near Eholt, was taken over during the year and equipped. Development of the ore-body is being continued and the mining operation extended.

"No work was done on the *Richmond-Eureka* mine, Sandon; *No. 7* mine, Boundary Falls; *Phoenix Amalgamated* group, Phoenix.

"A controlling interest was purchased in the property of the Quatsino Copper Company near Elk lake, east of the South-east arm of Quatsino sound, Vancouver Island.

"Outcrops and development showed the presence of fair copper values, and deeper exploration of the ore-bodies is now under way."

GEOLOGY AND ORE-DEPOSITS OF ROSSLAND.*

BY EVEREND LESTER BRUCE.

INTRODUCTION.

The Rossland gold-copper mining camp is situated in the district of West Kootenay, southern British Columbia, six miles west of the Columbia river and five miles north of the International Boundary-line. The town of Rossland is reached either by Canadian Pacific Railway through the Crowsnest pass, from the main line by way of the Arrow lakes, or by Great Northern from Spokane.

The field-work upon which the following conclusions are based was done while assisting Dr. C. W. Drysdale, of the Canadian Geological Survey, in the examination of the camp, and to him and to the Director of the Survey the writer wishes to acknowledge his indebtedness for permission to use the data collected. To Professors Kemp, Berkey, and Johnson, of the Geological Department of Columbia University, thanks are due for advice and assistance in the preparation of this thesis.

The earliest geological work dealing particularly with Rossland was done by McConnell in 1894.† In that year he made a brief examination of some of the chief mines and described the character of the ore-bodies. Further work was done by him in 1896.‡ He recognized the great series of fragmental rock and classed them as probably Carboniferous. The igneous rocks he believed to be differentiated from a common magma. He described the ore-deposits, briefly classifying them as replacement deposits along lines of fissuring.

In 1900 Brock examined part of the area, describing the rocks between Sophie and Record mountains. In 1906 the preliminary report on the Rossland Mining District was published by Brock, representing detailed work on the most important area. Besides Mr. Brock's conclusions on the economic geology, those of Dr. Young on the general geological relations were incorporated. Daly's work along the boundary-line has also covered in a general way this area and gives much assistance in correlation.

Other articles on the various phases of the geology and mining industry of Rossland have appeared in the various scientific journals, and a bibliography of these will be found appended.

SUMMARY AND CONCLUSIONS.

The geological history of the area, as described in detail later, may be briefly summarized here.

TABLE OF FORMATIONS.

Recent	River deposits.
Glacial	Silts.
	Till.
Pliocene-Miocenic	Sheppard granite.
	Pulaskite.
	Porphyritic monzonite.
Eocene-Oligocenic	Sophie Mountain conglomerate.
Jurassic	Basic dykes, tuffs, and flows.
	Normal monzonite.
	Diorite porphyry.
	Nelson granodiorite.
Triassic	Tuffs, agglomerates, and flows.
Carbonic	Augite porphyrite.
	Mount Roberts slates and tuffs.

* NOTE.—This report has been kindly submitted by E. L. Bruce, of the Geological Survey of Canada, and its publication is by the courtesy and permission of R. G. McConnell, Deputy Minister of Mines of the Dominion Government.

The Directing Geologist, Wm. McInnes, writes as follows: "Mr. McConnell is quite willing that this paper should be published by your Department, and he agrees with me that the conclusions reached in it are in accord with those held by the Department and published in Drysdale's report. Bruce's paper is very considerably shorter than Drysdale's memoir, and since we cannot very well issue two reports so close together on the same subject, we shall be very glad to have you publish it."

† Annual Report, Geological Survey of Canada, 1894, Part A, page 35.

‡ Annual Report, Geological Survey of Canada, 1896, Part A, page 22.

The ore-deposits consist of: (*a*) Gold-quartz veins; (*b*) biotitic gold-copper deposits. Structurally, the latter occur as fissure-veins, replacement deposits, and impregnations. The ores are chiefly pyrrhotite, pyrite, chalcopyrite, with other sulphides in less amount, and free gold. These have been deposited in two periods of mineralization corresponding to the two great batholithic intrusions. The localization has been brought about mainly by the peculiarities of the fissuring of the granular igneous rocks under torsional stresses and by the influence of the various wall-rocks on precipitation.

PHYSIOGRAPHY.

The Cordillera of British Columbia is believed to have been originally a region of complex, folded mountains with strike-faults. Long-continued erosion reduced the topography to a post-mature condition. Uplift followed, and stream erosion, aided to a considerable extent by glaciation, has carved wide straight valleys along the old fault-lines. Thus the mountain masses are separated by pronounced depressions which Daly has used as boundaries for the mountain systems, each system having a trench of the same name to the west of it. The Rocky Mountain system has to the west of it the Rocky Mountain trench dividing it from the Purcell system. West of the latter is the Purcell trench, occupied by the northward flowing Kootenay river, marking the boundary between the Purcells and Selkirks. To the west of the Selkirks is the Selkirk trench, in which the Columbia river flows southward, dividing the Selkirk system from the Columbia system. In this latter division Daly has made a subdivision of the group of mountains between the Kettle river and Lower Arrow lake. These are the Rossland mountains and surround the mining district and town of Rossland.

This whole area has been subjected to many and complex changes. The crumpled and altered older rocks present evidence of the mountain-making epochs through which they have passed, while the great masses of coarsely crystalline igneous rocks now exposed at the surface show that much material must have been removed by erosive agencies. Consolidated stream-gravels mark the courses of old rivers, and the smoothed and rounded mountain outlines show the work of a glacial period in which all but the highest peaks of the Rossland mountains were covered with ice.

As a result, the topography is marked by an upland surface of gentle curves and low gradients beneath which the recent streams have incised deep valleys. The work of the streams, assisted by the work of the valley glaciers, has largely destroyed the old upland surface, but from high points, by imagining the deep recent valleys filled in, the old slopes can be approximately restored and a mental picture obtained of a gently rolling surface broken by a fairly large number of residual hills rising above it.

Over a large area in eastern British Columbia and the adjoining States the concordance of summit-levels, when viewed from an elevation, is a striking feature. When seen from the top of mountains reaching 6,000 feet or over, the ridges and rounded peaks of the Rossland mountains fall into an upland that, while by no means absolutely flat, yet presents a rather smooth surface. The slopes are always less than 10 degrees, except where isolated mountain masses rise above the surface. Beneath these gentle slopes the rivers have cut deeply. The Columbia has cut 2,000 feet below the point where the slope increases, and Sheep creek has intrenched itself nearly to the same extent. The rocks underlying the upland are of varying resistance, but the undulating surface is only locally affected by the kind of rock underlying. Granites, slates, and shales have alike been bevelled across without the general smoothness of the outlines being lost.

It has been suggested by Daly* that this accordance of summits is due to Alpine glaciation and to the position of the tree-line. Wherever peaks were high enough to support glaciers, erosion by that agency would tend to reduce the higher points more rapidly than the lower and so produce a more nearly uniform surface. Erosion above the line where rocks are protected by forest-growth is more active than on the surface covered by vegetation. Hence because of glacial erosion in high altitudes and more active weathering the higher points will wear down more rapidly than the lower and so reach an approximate level.

The theory more widely appealed to is peneplanation or the reduction of a land area approximately to sea-level. Elevation, with the resulting rejuvenation of the streams, would lead to the incision of steep-sided valleys below the level of the old surface.

* Journal of Geology, Vol. XIII., page 105.

In the regions adjoining that under particular consideration an erosion surface of Eocene age has been described by various writers. Dawson* considered the interior plateaux of British Columbia an elevated peneplain of Eocene age. Lindgren† describes the Salmon River district as an area worn down to a gentle topography and then elevated. Calkins‡ describes the Cabinet and Purcell ranges of western Montana as appearing like a "maturely dissected plateau." Smith§ recognizes a peneplain in the Cascades which he believes is Pliocene, and he is of the opinion that in that district there never has been an earlier one. Willis recognizes a peneplain over the Galton range, and Umpleby‖ describes one in Idaho, which he refers to the Eocene. From these views it seems that an Eocene pepeplain was developed in the interior which was not developed, or was completely destroyed by a Pliocene peneplain, in the Cascades.

If any peneplain of Eocene age was ever developed over the Rossland mountains no remnants of it are to be found. The Cretaceous and probably the early Eocene represent a period of erosion which was ended by the deposition of river-gravels. These are believed to be Eocene-Oligocene in age. They may represent the deposit of rejuvenated streams carrying down great loads of material from a newly uplifted land surface that had suffered deep sub-aerial decay and had been approximately base-levelled. Such a sequence of events seems quite possible, but, so far as observed, no physiographic proofs of it remain.

The early Tertiary sediments are intruded and tilted by granite rocks which now underlie most of the conglomerate remnants. The tilted beds are bevelled by the upland surface, a large part of which consists, however, of the granite of these Tertiary batholiths. The coarsely crystalline character of the igneous rocks shows that a considerable depth of overburden has been removed since their consolidation. It is evident, therefore, that the age of the upland cannot be earlier than Pliocene.

This long period of base-levelling was closed by uplift and the rejuvenated streams began to incise narrow steep-sided gorges in the old surface. It seems as if the uplift was progressive with temporary base-levels which allowed the streams to broaden out their valleys. Further uplift left the former valley-bottoms as rock benches. The gorges were cut to a considerable depth, but before much dissection of the interstream areas occurred, climatic changes brought on glacial conditions. The beginning of this period was, no doubt, marked by valley glaciers which finally became large enough to unite into a continental glacier covering all but the highest mountains. The close of the period was again marked by valley glaciers.

The effect of the continental glacier was to round and smooth the surface The valley glaciers, on the other hand, deepened the gorges already cut, leaving an evidence of their activity in hanging valleys. McCambridge creek, a tributary of Trail creek which joins it half-way from Rossland to Trail, has a decidedly hanging relation to the main stream.

At the close of the glacial period large supplies of debris were emptied into the rivers from the valley glaciers still existing about their headwaters, and, as a result, their beds were aggraded. The Columbia was filled to a depth of probably 400 feet with stratified gravels. With the disappearance of the glaciers, the supply of debris diminished and the river began to cut into this deposit, and, as it swung from side to side, terraces at different levels were produced. This process is still active in parts of the Columbia's course. The terraces of Trail creek are cut in fine white silt, with a thin surface layer of pebbles on each terrace. These terraces are found almost to the altitude of Rossland. The formation of deposits in the Columbia would normally produce a ponding of water in its tributary, but, as the terraces occur almost 2,000 feet above the Columbia, this explanation is insufficient. It is possible that a tongue of ice occupied the main valley after Trail Creek valley was free, and in the lake thus formed the white silts were laid down. The withdrawal of the barrier was followed by the production of terraces in the usual way.

A peculiarity in the drainage relation of Trail creek and Little Sheep creek may be related to the same phenomenon. The headwaters of these two streams are fairly close together and for a little distance they flow in nearly parallel valleys. At the town of Rossland the divide is notched by a low and fairly wide gap. If we assume that the ponded lake in Trail Creek valley

* Transaction, Royal Society of Canada, 1890, L.
† Professional Paper 27, United States Geological Survey.
‡ Bulletin 384, United States Geological Survey.
§ Professional Paper 19, United States Geological Survey.
‖ Journal of Geology, Vol. XX., page 139.

rose high enough to flow across the divide into Little Sheep creek, the occurrence of this depression is easily explained as due to valley-cutting when the Trail Creek lake emptied by way of Little Sheep creek.

The regional events affecting the physiography may be summarized as:—

1. Cretaceous-Eocene erosion cycle possibly carried to late maturity.
2. Early Pliocene cycle carried to late maturity or old age.
3. Late Pliocene—early Pleistocene gorge-cutting.
4. Pleistocene glaciation.
5. Recent terrace-cutting.

The forces of erosion acting on rocks of unequal resistance have produced certain physiographic forms of local importance. Hard rocks are exposed as ridges standing above the general level, while easily weathered rocks are marked by gulches with but small streams.

One of the very prominent ridges forms a cliff on Columbia avenue at the west end of Rossland. It rises about 50 feet above the rock bench on which it stands, and where the excavation has been made through it for the street it is about 150 feet wide. It consists of an elliptical mass of pulaskite intrusive into monzonite. The latter weathers more rapidly than the younger alkali syenite, leaving it standing out as a prominent ridge. Similar pulaskite ridges are found near the *O.K.* mine and at several points on the road from Rossland to Trail.

The *Centre Star* gulch and that in which the *Josie* tramway is built owe their positions to soft mica dykes. The streams in both these valleys are small, while the valleys are deep and steep-sided. In the *Centre Star* gulch vertical rock-faces 20 to 25 feet in height rise from the valley-floor. These walls are monzonite, while no doubt the rock between them is mica lamprophyre, since the mine-workings show a dyke of almost the exact width of the gulch which would project to the surface at that point. The weathering of mica dykes can be observed at many places. In the railroad cuttings monzonite shows no weathering, while mica dykes already show a tendency to take spheroidal forms.

GENERAL AND STRUCTURAL GEOLOGY.

PALÆOZOIC.

The early part of the geological record is missing in the Rossland district, the earliest formation being late Palæozoic. The basal group includes several types of rocks of different origins and doubtless of different age. All have, however, passed through severe regional metamorphism and form such an intricate complex that, for the present, they are grouped under one name. They are in part igneous, in part marine sedimentary. No later marine sediments occur. The only other sedimentary beds are the early Tertiary conglomerates and the Pleistocene gravels, sands, and silts of fresh-water origin. The dominant rock types are igneous, including deep-seated intrusions of batholithic and possibly laccolithic structure, dykes, surface flows, and volcanic fragmentals. The absence of sedimentary deposits of known age makes the correlation of the great series of igneous rocks a matter of much uncertainty. Some types are so similar in composition that a slight variation might produce a facies in one very nearly resembling a rock type which is ordinarily quite distinct and possibly of different age and origin. Added to this, the action of mineralizing solutions has so altered the rocks that similar end results have been produced from rocks that were no doubt originally quite different.

Mount Roberts Formation.

As mentioned above, this is not a single rock type, but consists of many whose intricate structure and rather severe metamorphism has, as yet, made their separation impossible. Some of these types are quite distinct and they will be described, but no attempt will be made to outline the distribution of each.

The largest exposure of this complex occurs as a broad band on the western slope of Red mountain, and, excepting for a band of igneous rocks occupying the valley of Little Sheep creek, extends well up the eastern slope of Mount Roberts, from which the formation takes its name. Other small outcrops are found in the Deer Park range and on Monte Christo and Columbia and Kootenay mountains.

Three types are found with gradations from one to the other which seem to argue for a close relationship in deposition, although the end numbers may be deposited under very different conditions. These types are:—

(*a.*) A soft black, possibly carbonaceous, slate:
(*b.*) Lighter coloured, harder, and more arenaceous slate:
(*c.*) Tufaceous beds, with possibly intercalated flows.

The first two types often show a distinct gradation from one to the other, and this seems to be due to original differences rather than to alteration since deposition. The black slates are soft, very fine-grained, and dense. The lighter slates are more arenaceous, and, at times, calcareous. The arenaceous forms are finely banded, due both to differences in colour and in size of grain. It is possible that they are, to some extent at least, tufaceous. The calcareous varieties often contain cherty concretions, and it was in such a variety above the *O.K.* mine that Mr. Brock discovered the only fossils yet found in this formation in this area. In all the slaty types the parting seems to be always parallel to the original bedding. A tufaceous rock, very probably belonging to this same complex, outcrops on the road to the Columbia and Kootenay. It is light buff in colour, but little altered, and shows indistinct bedding. In a great part of the area where these rocks are exposed silicification and the alteration of the sulphides disseminated plentifully throughout them has so altered the original character as to make the recognition of their nature and structure very difficult. The dip is by no means constant. There seems no doubt that part at least of the sediments are underlain at a slight depth by the intrusive batholiths. These intrusions have to a greater or less degree disturbed the strata above them, and where erosion has reached down almost to the igneous rock the sediments exposed are tilted and twisted out of the normal dip and strike of the rocks farther from the contacts and not so directly affected by the igneous body. The average strike is nearly north and south, and on the western slope of Red mountain the dip is to the west at low angles. On the eastern slope of Mount Roberts the beds are tilted up sometimes into vertical positions. Apparently the igneous rocks separating the two areas were intruded along a line of structural weakness, probably an old fault.

The effect of the various igneous invasions on the Mount Roberts formation has been very considerable. The mechanical effects have been the fracturing and tilting of the older rocks; the chemical effect is expressed by their severe alteration. The amount of pyrite, pyrrhotite, arsenopyrite, and chalcopyrite disseminated through the rock is sufficient to give the surface a reddish colour in many places from the oxidation of these minerals. Sulphides can be deposited contemporaneously in sediments, but the localization of the disseminations at Rossland along certain zones, rather than in certain beds, is evidence that they are introduced rather than original. Sulphides were deposited in the veins from igneous sources, and the disseminated sulphides of the sediments probably come also from igneous sources. Silicification also accompanied the ore-deposition and the same process affected the sediments. The effect does not seem to be any more pronounced near the intrusives than farther away. However, over a large part of the area the layer of Mount Roberts formation that covers the batholithic rocks is rather thin, and so no part is any great distance from igneous rocks even where the surface distance is considerable. Also the igneous rocks often cut across the bedding, and hence impregnating solutions have had a favourable opportunity to enter and diffuse through the beds for long distances.

The conditions under which the various rocks of this period were deposited must have varied considerably. Argillaceous, arenaceous, and calcareous shales, possibly with conglomeratic members, are associated with volcanic fragmentals. The lower beds are almost entirely shales and were deposited probably under subaerial delta conditions and in shallow water near shore. The occurrence of marine organisms shows that at some periods the sea covered this area, and the presence of some limestone marks an interval of fairly deep and quiet waters. At different times and becoming more frequent in the latter part occurred volcanic eruptions. The fine ejectamenta were well assorted, probably by falling into the sea, and now form well-banded tufaceous layers. These become more and more frequent until the conformable beds referred to the Triassic consist largely of such material. Thus the rock record of the Mount Roberts formation is that of a land area of slight enough relief to produce fine-grained delta deposits with which are associated marine beds. There was considerable contemporaneous volcanic activity, and as an end stage either the land disappeared entirely or became so low that tufaceous material constituted the whole supply of debris.

The determination of the age of the Mount Roberts formation depends on its lithological character and on a few poorly preserved fossils. On the basis of the organisms it has been

believed to be Carbonic. Lithologically, it is very similar to the Lower Cache Creek series, described by Dawson.* His description of such rocks on the Thompson river is perfectly applicable to the Mount Roberts formation at Rossland. He recognized the shallow water or continental character of the sediments in southern British Columbia. He says:—

"In the southern part of British Columbia the Cache Creek group shows some evidence of littoral conditions toward the west slope of the Gold ranges, probably indicating the existence of land areas there."

Umpleby† also describes a similar series in Washington and assigns it provisionally to the Carboniferous. This late Palæozoic series apparently covers a large area in southern British Columbia and Washington, but how extensive the original area of deposition was is unknown. The present outcrop of strata referable to this period forms a broad north-and-south belt extending north of the Thompson river and south of Republic, Washington. Eastward it thins out against the Archean of the Selkirks, and westward it disappears under the Columbia lava plains.

TRIASSIC.

The rocks referred to the Triassic are volcanic fragmentals, with associated flows and intrusive masses of augite porphyrite with accompanying dykes. No fossils occur in the clastic rocks and the correlation is purely lithological.

The Clastics.

It is believed that in the highly inclined beds forming the slopes of Mount Roberts the beds rise in the time-scale going westward. The lower slopes consist of the slates with interbedded tuffs assigned to the Mount Roberts formation. Higher up the mountain, and presumably younger in age, the volcanic fragmentals become the dominant rocks and finally entirely replace the slates of the typical Mount Roberts formation. These latter beds are placed as Triassic. They are made up of fragments of volcanic material of all sizes; some of the beds are agglomeratic, but most of the series consist of finer material, in some places so fine that the rock is very dense with a conchoidal fracture. The material is usually rather perfectly sorted, producing a well-marked banding often with very thin laminæ. The colour varies from light to dark grey. The beds are nearly vertical at times, but ordinarily the dip is steep to the west. So far as can be seen, the upper beds are absolutely conformable on the lower Mount Roberts beds up to a point about 100 feet below the summit of Mount Roberts. The effusive rocks capping the peak are horizontal, and for this reason have been assigned to a later period. Associated with the clastic beds are thin dykes and possibly interbedded flows of rocks with about the composition of andesites.

Augite Porphyrite.

The parent rock of these small intrusives and flows forms one of the important rock-masses of the district. This is the augite porphyrite which is the surface rock on Columbia and Kootenay mountain, on Red mountain, and at several other points.

In appearance there is some variation in these different localities, but in general the rock is fairly constant in its characteristics. On Red Mountain it is deep green in colour, with stout greenish-black prisms of pyroxene usually visible to the naked eye. Hornblende needles and laths of feldspar are sometimes present. The size of the individuals varies greatly, and often in short distances the rock will change from a type crowded with large well-formed phenocrysts to a dense, deep green variety with no phenocrysts visible. This may be due to the agglomeratic structure that can often be seen on weathered surfaces, oval patches then showing with a lighter colour than the surrounding rock. These seem to be of the same composition as the rock between them, and probably represent fragments produced by a slight movement after the first crystallization, the fragments being recemented by the same magma, but the new crystallization having a finer texture.

In all types of the porphyrite a platy jointing is at times rather pronounced, but the direction of these master-joints is not constant. In the north-east drift of the fourteenth level of the *Centre Star* the strike is N. 14° E., dip 65° E. East of the shaft on the same level the strike

* Annual Report, Geological Survey of Canada, Vol VII., page 41B.
† Geological Survey of Washington, Bulletin No. 1, page 17.

is N. 75° E.; while still farther east in the same drift it is N. 55° E., dip 85° S.E. In the same workings a contact between augite porphyrite and diorite porphyrite is exposed. The platy jointing passes from one rock into the other without any apparent change.

The relation of the augite porphyrite to the Mount Roberts is that of an intrusion which along the borders sends out sills into the sediments, but on the whole has an irregular contact and breaks across the bedding. It seems to have a laccolithic relationship to the beds, which are found both above and below the porphyrite in some of the mines. Apparently the augite porphyrite is the deep-seated rock representing the volcanic period in which the tuffs lying above the Mount Roberts slates were ejected. Its consolidation thus represents a considerable length of time, and the production of the agglomeratic structure found in the porphyrite is more easily understood.

The contact between augite porphyrite and other igneous rocks is seldom sharp, but the typical rocks are usually separated by a zone of hybrid rocks several feet wide. This is the case between diorite porphyrite and augite porphyrite and between monzonite and augite porphyrite. Silicification by mineralizing solutions has also served to mask contacts. Diorite porphyrite occurs in bands in the augite porphyrite in a way that suggests dykes, but often a gradual transition from one to the other seems to argue for differentiation. Thus typical diorite porphyrite with needle-shaped plagioclases and hornblendes gradually acquires stout augite prisms, and finally the rock becomes typical augite porphyrite. However, the closely similar composition may make possible the crystallizing of pyroxene from a hornblende rich magma near the contact with pyroxene-bearing wall-rocks, and so the border-zone may have the appearance of a transition rock when in reality the diorite porphyrite is younger.

Again, in the case of the monzonite and augite porphyrite, the contact is a zone rather than a definite line. Wherever typical representatives of the two are in sharp contact a fault is the explanation. The contact between the eastern mass of monzonite and the augite porphyrite of the central area has a varying pitch to the west. In the upper workings of the *War Eagle* the pitch is very low and the contact surface is undulating. The result is that the drifts follow the contact-zone for considerable distances, and it seems wider than is actually the case. Rocks later than the monzonite have sharp contacts with the augite porphyrite.

As has been shown, the augite porphyrite is intrusive into the lower conformable beds that are of late Carbonic age, and for this reason it has been considered to be Triassic. The flows interbedded with the purely volcanic fragmentals have compositions very nearly that of the augite porphyrite and are believed to be of the same age, and hence the upper part of those beds may also be Triassic. Triassic beds of great thickness are found both to the north and south, and in lithological character the Rossland beds are very similar to the Nicola series, for which Dawson* gives the following section:—

	Feet.
Limestone	20
Fine-grained feldspathic rocks sometimes well bedded, generally grey	1,800
Tuffs or ash rocks passing into agglomerates with some fine-grained felsites, grey, purplish, and green	7,840
Chiefly diabase agglomerate; several calcareous beds. Dark felsites	3,930
	13,590

Since there are at Kamloops, 160 miles to the north of Rossland, nearly 15,000 feet of Triassic and 3,000 feet on the Snake river to the south,† the Rossland rocks of similar character have been assigned to the Triassic, although no palæontological evidence has been found.

JURASSIC.

The rock types referred to the Jurassic are all igneous. They are of three chief varieties, with some smaller associated masses of other types. The important rocks are: (1) A representative of the widespread grey Nelson granodiorite; (2) dykes and interfingering masses of a diorite porphyrite that is believed to be closely related to it; and (3) the normal monzonite. The minor rock types are lamprophyric dykes. Besides these, some flow-rocks may also belong to this age.

* VII. Annual Report, Geological Survey of Canada, Part B, page 54.
† XXII. Annual Report, United States Geological Survey, Part 2, page 580.

Nelson Granodiorite.

The Nelson granodiorite occurs as two separate, roughly oval areas just west of Rossland, on Little Sheep creek. Three other small exposures cut up through the stratified rocks on the western slopes of Red mountain. Outside of the immediate vicinity of Rossland it forms the extensive mass which Daly has called the Trail batholith. The edge of this main batholith lies about half-way from Rossland to Trail and forms the surface rock on both sides of the Columbia at the latter place. The type receives its name from its development around the city of Nelson, on Kootenay lake. The usual rock as occurring at Rossland is rather coarsely equigranular in texture and light to dark grey in colour. Sometimes it develops a porphyritic habit, but only rarely shows the gneissoid tendency that characterizes the Nelson granodiorite in many localities.

The main mass of granodiorite west of Rossland is distinctly intrusive into the slates and tuffs of the Mount Roberts formation. The small oval exposures are completely surrounded by stratified rocks and seem to indicate that the batholith underlies a large part of the older rocks at comparatively shallow depths. In the mine-workings some of the deeper levels are in a granular greyish rock which, although sometimes appearing as a very old rock, probably represents the top of the Nelson granodiorite batholith. The contact of the Trail batholith with the Mount Roberts sediments is a brecciated belt that Daly has called a "shatter-zone." This zone grades from sediments cut by stringers of igneous rock to igneous rock with inclusions of sediments. Daly's explanation of the zone is that, as the batholith invaded the enclosing rocks, the main mass was preceded by a network of dykes and stringers working out along joints, fractures, and bedding-planes. These separated the roof into individual blocks which sank into the depths of the magma and were absorbed. In this way the intrusive prepared its own chamber. As the magma cooled the borders became more and more viscous and the freeing of blocks less rapid until as the end stage the border-zone solidified, retaining the rifted blocks in the position in which they happened to be. The width of the zone in this case is probably due to the present surface being almost parallel to the contact of the batholith with its roof.

The relationship of the granodiorite to the monzonite is rather obscure. No good contacts with the normal monzonite are exposed, but near the big loop of the Great Northern Railway, west of Rossland, granodiorite and porphyritic monzonite are in contact in one of the cuts. The interfingering of the two rocks is so intimate that the relative age is uncertain, but the monzonite is believed to be the younger. The tongue-like mass of monzonite in the area south of Little Sheep creek has the appearance of a real intrusion into the granodiorite. Pulaskite and a number of later basic dykes also cut the granodiorite.

From these relations the Nelson granodiorite appears to be younger than the Palæozoic and probably was intruded at the time of the tilting of the Carbonic and Triassic beds. Its age is probably Jurassic, as suggested by Brock.* Similar rocks have been described from various other localities, the Jurassic having been over a large part of the Cordilleran region a mountain-making epoch with immense accompanying intrusions of granitic rocks.

Diorite Porphyry.

Occurring as irregular tongues and masses, especially in the augite porphyrite, is a rock which, while somewhat similar in appearance to that rock, yet has certain distinctive characteristics. On the weathered surface it is quite easily recognized, needle-shaped hornblende crystals and lath-shaped feldspars standing out prominently. Augite is occasionally present, more commonly on the borders of the mass. The rock shows a rather well-marked flow-structure, and this orientation of the feldspars gives it an almost silky lustre on a fresh fracture.

The diorite porphyry is intrusive into the Mount Roberts formation, and, underground, blocks of the stratified rock sometimes of large size are found entirely surrounded by the porphyry. Evidently they have been torn off by the intrusive and carried to their present position. It is also apparently intrusive into the augite porphyrite, although at many of the contacts one seems to grade into the other. This may be due either to assimilation of the older by the younger rock, or, as previously suggested, to a sort of mass action of the pyroxene-bearing augite porphyrite on the normally hornblendic diorite porphyry, resulting in the formation of pyroxene instead of hornblende.

* Summary Report, Geological Survey of Canada, 1900, page 74A.

The correlation of the diorite porphyry as Jurassic rests on its apparently close relationship to the Nelson granodiorite. Mineralogically the two are not unlike, although the usually porphyritic diorite porphyry with flow-structure is quite different in appearance from the massive equigranular granodiorite. The former, however, by a variation towards a more feldspathic and granular rock becomes very similar in appearance to the granodiorite. The evidence of this variation is clearly shown on the seventh level of the *Le Roi*. The first crosscut to the north from the main workings west of the shaft passes from augite porphyrite into diorite porphyry. Horizontal drill-holes show that the mass is oval in section, 200 x 250 feet in diameter. The first 40 to 50 feet of the drill-cores show typical diorite porphyry. This gradually changes to a light greyish granular rock as the central part of the pipe-like intrusion is reached. In deeper levels larger masses are encountered, and these unite so that in the deepest workings a large part of the country rock consists of a greyish granitic rock that is probably Nelson granodiorite. From this gradation it seems that the diorite porphyry is a border facies of the batholith of granodiorite, representing the fingering out of the magma into the older formations. The flow-structure may be due to a part of the magma having reached the surface, but, in part at least, may be the result of convection currents, since it is often developed in tongues which certainly did not connect with surface flows.

The relationship between diorite porphyry and monzonite is a doubtful one. The two are often found in contact in the mine-workings, but so intimately associated and so like in appearance that the relative age is uncertain. The diorite porphyry is very frequently found lying between augite porphyrite and monzonite, but so far no intrusions of diorite porphyry into monzonite have been found underground. A dyke-like mass of it on the surface near the drill-hall is possibly a roof pendant unabsorbed in the monzonite batholith. Both mica and non-mica dykes cut the diorite porphyry, and it is also intruded by dyke representatives of the later granitic intrusives.

Normal Monzonite.

Occupying an irregular oval area five miles long by one and three-quarters wide is a mass of monzonite. The greater diameter is east and west, with the city of Rossland near its western end. The outline of the mass is very irregular, and it is broken by many intrusions of later rocks. A broad belt of alluvium hides the rocks in the valley of Trail creek, but they are probably mostly monzonite.

This area is not occupied by one constant rock type, but shows wide variations in appearance and in composition. The most easily recognized variety is a coarsely granular dark-grey rock made up of feldspar, pyroxene, hornblende, and usually some mica. Variations consist in differences both in relative quantities of the various minerals and in size of grain. The different varieties are not all strictly of the same period, but are often found as intrusions into or inclusions in other types. Usually the more coarsely crystalline and more feldspathic seem to be later than the darker finer-grained rocks. Sometimes definite fragments of one are found in the other, as if entire solidification had taken place before the later rock appeared. At other times the included types seem to be segregations or possibly earlier crystallizations resorbed. On the whole, however, all these are rather similar rock types and are no doubt merely facies of the same intrusion.

Although the borders of the monzonite mass are very irregular, it sends very few definite dykes into the enclosing formations. On Columbia and Kootenay hill a dyke-like mass cuts across augite porphyrite, and at a few other places dykes from the monzonite intrude the Mount Roberts. The later age of the monzonite is best shown by the truncation of the alternate bands of slate and augite porphyrite on the southern border of the monzonite. Underground the evidence is not always satisfactory. The very flat and undulating nature of the contact as the monzonite plunges under the cover of augite porphyrite allows the drifts to follow the contact-zone for a considerable distance and makes the location of the point of contact difficult.

The normal monzonite is cut by a porphyritic monzonite that seems to be very similar to it, and also by an immense number of basic dykes, some of which may represent basic residuals from the monzonite magma, while others belong to later periods of intrusion. It is also cut by pulaskite dykes from the alkali syenite and by well-marked dykes of granite porphyry. A large dyke of this character is found south of Trail creek, and others are found at the *Le Roi*, one outcropping just below the headworks.

These latter dykes were formerly believed to be related to the Nelson granodiorite, since the largest of them seemed to be connected with a mass of that rock. For this reason the granodiorite was mapped as later than the monzonite. Building operations have exposed the contact of this dyke with a pulaskite dyke which it cuts. Evidently it does not belong to the granodiorite but to a much later intrusion. The other evidence seems to point to the monzonite being later than the granodiorite, and as no definite intrusions of diorite porphyry into monzonite have been proved, the monzonite is considered to be younger than the porphyry. The rather similar mineralogical character of the monzonite and granodiorite suggests that they belong to the same period of activity, the monzonite representing a later, the granodiorite and diorite porphyry an earlier intrusion.

Jurassic Effusive.

One representative of the effusives connected with the igneous activity of Jurassic age is believed to still exist. As previously described, volcanic tuffs and possibly lavas form a large part of Mount Roberts. The greater part of these are tilted at high angles. One hundred and twenty-five feet below the summit the dip is 54 degrees west. At the summit, however, is a lava-flow that is horizontal, with its basaltic jointing showing as vertical columns. It has the appearance of truncating the edges of the lower beds. Its composition is that of an augite latite and it probably is the surface representation of one of the Jurassic batholiths.

TERTIARY.

Eocene-Oligocene.

Although not occurring within the limits of the special Rossland map-sheet, the later conglomerate, believed to be early Tertiary, is here described, since the relation of the igneous rocks to it in a measure fixes the age of the intrusives. Two areas of this conglomerate are found near Rossland. The larger lies ten miles to the west on the top of Sophie mountain, the other about four miles south-east on the top of Lake mountain. It is likely that these are remnants of a once continuous deposit.

The conglomerates of the two areas are lithologically identical. As a rule they are coarse, with some lenticular bands of finer material. The pebbles range from grit particles in the finer bands to boulders of a foot or over in diameter. The larger part of the conglomerate has pebbles averaging an inch or less. Quartzite, chert, slaty material, serpentine, grey granite, gneiss, sandstone, jasper, and quartz are all represented. Towards the base greenstone pebbles and a few angular limestone fragments are present. Mr. Brock* also reports pebbles of an earlier conglomerate. The binding is siliceous. The beds on Sophie mountain now dip at rather high angles. They were probably laid down with a considerable initial dip, but their present attitude can have been attained only by a considerable tilting even if the initial dip is given a maximum value. The strike is nearly north and south, with the dip to the east.

The character of the sediments points to deposition by stream-action and the two remnants probably lie in the same old stream-valley. The heterogeneity of the materials is evidence that the stream was rapid, the finer grit-lenses representing deposition in the eddies of the stream. The thickness of the conglomerate is considerable and the supply of detritus was evidently large, probably due to the uplift of an old deeply weathered land-surface. The character of the surface upon which it was deposited is unknown, since it is now mostly underlain by igneous rocks intrusive into it.

The pebbles of the conglomerate are derived from the slates and greenstones of the Mount Roberts formation and from granitic rocks of the type of the Nelson granodiorite and the associated series. Many of the fragments come from rocks not known in the immediate neighbourhood. On the western side of Sophie mountain a 50-foot dyke of porphyritic rock occurs in the conglomerate. Brock* mentions such dykes and refers them to the Rossland granite. The Lake Mountain conglomerate is cut by a fresh granitic rock which Daly calls the Sheppard granite.

On the basis of a rather scanty flora Daly has referred these beds to the early Tertiary, and from their general character they seem to be similar to the Kettle River conglomerate and

* Summary Report, Geological Survey of Canada, 1900, page 67A.

to the Coldwater group described by Dawson in the Kamloops district, both of which have been considered of Eocene-Oligocene age.

Miocene-Pliocene.

Intrusive into the early Tertiary sediments are batholiths of two distinct types of acidic rocks. The earlier of these is represented in the Rossland area by the pulaskite dykes which are believed to be tongues from the Rossland alkali syenite, the main mass of which lies three miles north-west of Rossland. The later intrusive is the Sheppard granite occurring on Lake mountain, and to it are supposed to belong the granite-porphyry dykes found near Rossland.

Three large tongues of pulaskite lie close to the important mines. One lies west of Red mountain, striking north and south, another forms the ridge at the western end of Columbia avenue in the town, while a third lies south of Trail creek on the slopes of Deer Park mountain. Many other dykes are exposed along the upper road to Trail, the first of these forming a well-marked ridge as far north as the *Columbia and Kootenay* mine.

The pulaskite is usually a coarse-textured pure-white to deep-pink rock, made up almost entirely of large lath-shaped feldspars with some hornblende and biotite. In the typical rock the dark-coloured minerals are very subordinate in amount. The pulaskite has been little affected by metamorphism and resists weathering agents well. As a result, the outcrops of the dykes form prominent ridges with a thin soil cover.

The pulaskite cuts all the previously described formations. The broad band west of Red mountain intrudes Mount Roberts sediments, the elliptical mass in the town is intrusive into normal monzonite, and the dykes on the Trail road cut porphyritic monzonite. Near the *Le Roi* mill, in a rock-cut on one of the railway spurs, a narrow pulaskite-porphyry dyke of peculiar spotted appearance also cuts porphyritic monzonite. The pulaskite is cut by very few dykes of any kind. On the Trail road a basaltic dyke a foot wide cuts a pulaskite dyke about 50 feet wide. The strike of the two is the same. Formerly the pulaskite was thought to be the youngest important formation in the district. Building operations in the part of the town south of Trail creek have, however, exposed to better advantage the pulaskite tongue and the granite porphyry with which it is involved. The latter cuts across the pulaskite and shows a chilled zone along its borders.

Granite Porphyry.

The granite porphyry is a light-coloured distinctly porphyritic rock with phenocrysts of white feldspar set in a ground-mass that is sometimes a faint pink. It is very fresh and unaltered even in the vicinity of the ore-deposits. Two dykes of this rock of some size occur. The larger of the two is found with the pulaskite south of Trail creek, exposed as a small bluff on the street. The second is just below the *Le Roi* head-frame. This and several smaller ones are cut by diamond-drill holes underground. The strike of dykes of this intrusion is unique, being always nearly east and west, while the strike of all others is north and south.

The granite porphyry is very similar to what Daly has called the Sheppard granite, a small exposure of which occurs on the top of Lake mountain. This is intrusive into the early Tertiary. The relation of the pulaskite to this conglomerate is also intrusive, and hence these two igneous rocks are Miocene or Pliocene in age. No basic dykes are found in the granite porphyry, and hence the succession of these late Tertiary rocks seems to be: (1) Rossland granite and associated pulaskite; (2) basaltic dykes; and (3) Sheppard granite and associated granite porphry. The physiographic relations previously discussed make the age of the porphyry late Miocene or early Pliocene.

Dykes.

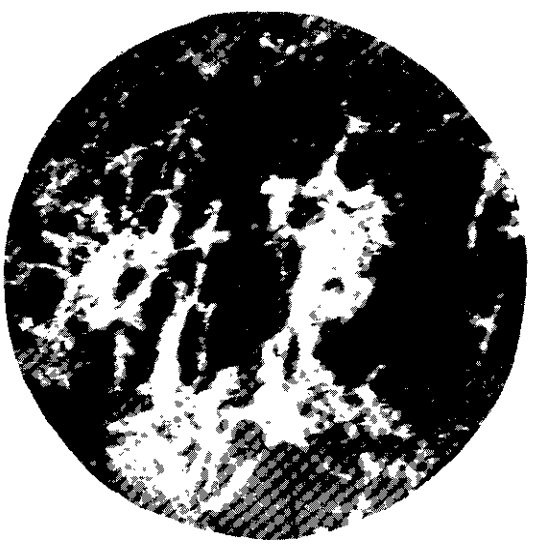
Besides the dyke-rocks just mentioned which can be referred to batholithic masses, there are an immense number of dykes of various kinds, many of which likely are the final expression of Jurassic igneous activity, some of which are of earlier age, while others are undoubtedly Tertiary.

Porphyritic Monzonite.

Many bodies of this rock, both as pipe-shaped intrusions and as more or less regular dyke-like forms, are found in the augite porphyrite, Nelson granodiorite, and normal monzonite. The rock is dark grey and very fresh. It makes a rather handsome building-stone and has been used

Basaltic Dyke cutting Pulaskite on Trail Road.

Granite Porphyry showing Reabsorption of Quartz Phenocrysts. Crossed Nicols.



Pyrite (white) cutting Pyrrhotite (black).

in some of the Rossland public buildings. Mineralogically, it is much like the normal monzonite, but in the Ymir* district a gradation from a very similar porphyritic monzonite into a pulaskite has been observed. In the case of the Rossland rock, however, no such gradation has been seen and dykes of pulaskite are found cutting the porphyritic monzonite. The most prominent minerals of the rock are pyroxene, feldspar, and biotite. The pyroxene occurs as well-formed blocky crystals up to a quarter of an inch in length. The feldspar is usually white and a little smaller than the pyroxene.

Lamprophyre Dykes.

These dykes occur by hundreds in the mine-workings. In some parts they are so closely spaced that more dyke-matter than country-rock is to be seen in the drifts. The strike of all the lamprophyres is almost due north and south, the variation being so slight that the strike of the dykes can be taken as a guiding direction underground. The size of the various dykes varies from the width of a knife-blade up to the immense *Josie* and *Nickel Plate* dykes, the latter measuring 225 feet on the eleventh level of the *Centre Star*. The dip varies, but whether to the east or west is usually high, although almost flat dykes occur. Faulting has so dislocated the dykes that correlation, even for distances of a few hundred feet, is impossible except in the larger ones. There is also often a change in character in what seems without doubt to be parts of the same dyke. Thus mica dykes in depth sometimes become non-mica higher up, and large dykes carrying mica divide into smaller dykes that show no mica. Thus the distinction commonly made between the dykes as "mica" and "non-mica" does not always hold, although it serves as a useful field classification. A few of the more striking types will be described.

Dykes of the Josie Type.

Dykes of this type are by far the most numerous of all the occurring types. Some of them are large and traceable for a considerable distance on the surface and in depth. They consist of soft black rocks with very abundant biotite. They are very easily eroded and the outcrop is marked by gulches. Faults are localized along them, and this along with their softness gives considerable trouble in mining, and wherever the dykes are large the drifts have to be timbered. Usually columnar structure does not show, nor are the dykes noticeably finer-grained against the wall-rock. Later dykes, usually non-mica varieties, are sometimes intruded along the walls of mica dykes, or, as in the *Nickel Plate*, in the mass of the dyke itself. At times a later dyke can be seen following one wall for a distance, then cutting across and following the other wall.

The prominent representatives of this type are the *Nickel Plate* dyke, named from its occurrence at the *Nickel Plate* mine, the *Josie* dyke cut by the *Josie* shaft, and its offshoot the *Tramway* dyke. The rock in all these has a practically identical appearance. All dip at steep angles, the *Nickel Plate* being almost vertical, while the *Josie* dips steeply to the west. The *Tramway* is a smaller dyke and joins the *Josie* both horizontally and in depth.

War Eagle Type.

In this group are included dykes with a rather wide petrographic range, but apparently rather closely related in origin. They are dark grey to black, depending on the relative amount of feldspar, which is usually the only macroscopic mineral and as a rule has needle-shaped forms. These dykes have marked columnar jointing and so are easily distinguished from the dykes of the *Josie* class. They are later than the *Josie* dykes. The chief large and persistent representatives of the *War Eagle* type are the *East* and *West War Eagle* dykes, which consist of a band of parallel and rather narrow dykes which unite and divide along both strike and dip in the most intricate fashion.

Centre Star Dyke.

The *Centre Star* dyke, like the *East* and *West War Eagle* dykes, is in the upper levels a zone similar to those described above. Below the sixth level these separate tongues unite into one broad strong dyke so different in appearance that it merits a separate description. It is traceable to the deepest workings, attaining a width of 25 to 30 feet. It has marked columnar structure. The rock consists chiefly of feldspar, pyroxene, and mica, and in general appearance is very similar to the porphyritic monzonite previously described.

* Ymir Mining Camp, Memoir 94, Geological Survey of Canada, page 39.

Spokane Type.

A rather peculiar dyke is one of the later intrusives. It is conspicuously porphyritic. The ground-mass is fine-grained in texture and dark grey in colour. The phenocrysts are very large, consisting of feldspars and brown hornblendes sometimes half an inch in length. The hornblendes are well-formed crystals with a diamond-shaped cross-section. The feldspars are stout square individuals with a white to slightly greenish colour. Plates of biotite are sometimes present. These dykes have a pronounced columnar structure and are apparently later than the previous types.

Conglomerate Dyke.

In the *Josie* workings there is a prominent dyke known as the "white" dyke, from the large number of inclusions of a light-coloured granite which it contains. It outcrops on the surface near the *Le Roi* mill as a dyke about 10 feet wide cutting porphyritic monzonite. It has been observed to a depth of at least 700 feet. It consists of a large number of fragments of all sizes with a ground-mass of fine-grained, sometimes porphyritic, igneous rock. The foreign material is mostly rock of granitic types, sometimes gneissoid, but other more basic types are also present and some pure quartz pebbles. The shape of all these is flattish to oval and they have the appearance of forms produced by water-action. Some have striations and most of them are arranged with their long axes parallel to the walls of the dyke. The east wall is formed by a dyke of the *Spokane* type and the ground-mass is somewhat similar.

An explanation of the origin of this dyke offers some difficulties. The usual explanation for such forms is that the inclusions represent fragments torn from older formations and carried up by the molten magma.

The rounding is explained by rubbing against the walls and against one another, and also by the absorptive effect of the magma. The appearance of the inclusions, however, is that of ordinary water-worn boulders, and the alteration is so slight that rounding by the molten magma seems unlikely. Even the gneissoid varieties are not attacked along their structure-lines. Further than this the heterogeneity of the material requires some other explanation.

The one suggested is briefly as follows: Older formations in the district contain conglomerates, and if this later dyke has cut through such a layer it might easily have carried along a part of the conglomerate bed, the fine matrix of which could be easily absorbed by a magma which would have such slight action on larger particles that striations would still be retained. Umpleby describes a flow conglomerate in the Republic district which involves but little difference in the nature of the problems concerned.

QUATERNARY.

Mantling the solid rock over a large part of this section with a very continuous cover lie the deposits of Glacial and Post-Glacial times. This drift-cover extends far up the sides of the mountains, and only where cliffs occur and on the highest peaks does solid rock appear above the unconsolidated material. This material consists of the debris from the great Cordilleran glacier which overrode all but the highest peaks, material from the valley glaciers that filled the stream channels in the later stages, and the alluvial deposits of recent stream-action.

The deposits of the first class are found filling the hollows up to an altitude of about 6,500 feet. Large erratics are found even on the top of Sophie and Lake mountains. As a rule the deposits consist of fairly coarse till in which the boulders are not at all sorted. These are of various kinds, with the granite rocks common in the district predominating. The work of the valley glaciers is recorded in the white and yellowish silts of Trail creek. These are exceptionally fine and apparently represent the finely comminuted material from the glacier that filled upper Trail Creek valley and tributary streams while the mouth was still blocked. The evidences for this are considered in dealing with the physiography. The stream deposits found immediately after the glacial period are well preserved in terraces along the Columbia river. They consist of mediumly coarse well-assorted gravels that are evidently the product of rather rapid overloaded streams. The pebbles are well rounded and consist of all varieties of rocks known to exist in this drainage-basin, with the hard kinds naturally predominating.

The recent deposits of the region consist of the fans building at the present time wherever the gradient of the mountain streams decreases sufficiently to allow them to deposit their loads.

The character of these fans varies with the character of the depositing stream, being coarse in the case of rapid streams, finer in the case of less rapid streams, and varying also with the character of country through which the stream flows. Trail creek is building a delta in an eddy of the Columbia river which is made up of the very fine silts previously mentioned, which it is eroding in its lower course.

SKETCH OF GEOLOGICAL HISTORY.

The geological history of the region as interpreted from the preceding descriptions is recorded only from late Carbonic times. The conditions then obtaining were marine, as shown by the limestones, occasionally developed, and by the presence of marine fossils. The predominance of the clastic sediments that form the shales is evidence that the area lay near enough the shore of that age to receive the finer sediments brought down from the old land. There was considerable volcanic activity as shown by the tuffs interbedded with the marine sediments, and this increased steadily throughout the Triassic, which is almost completely represented by tuffs and flows. The intrusive representative of this period is the augite porphyrite which seems to have a roughly laccolithic form in the older part of the sedimentary series.

A period of disturbance tilted the clastic beds, and these were truncated by an erosion period, since the volcanic fragmentals of the latter period do not seem to be conformable on the lower strata. The first great batholithic intrusion of rocks of granodioritic composition was probably the deep-seated phenomenon which accompanied the extrusive volcanic activity represented by these later tuffs.

A long period of denudation, lasting through the Cretaceous and probably part of the early Tertiary, cut deeply into the clastics, flows, and intrusives, possibly reducing the whole region to a condition of post-maturity. This period of active degradation of the land-surface was followed by river deposition in the Eocene and Oligocene. The deposits, as shown by the remnants still left, are conglomerates with great and sudden variations in the size of the pebbles. They seem to have been laid down in fairly rapid streams.

This second period of sedimentation was followed by the intrusion of a series of batholiths of alkaline character represented by the pulaskite and by the Sheppard granite. There are no extrusives recognized as belonging to these, since the erosion periods that followed have scoured off great thicknesses of overlying rock. The last of these intrusions may have been in Pliocene times, and it was followed by a period of erosion long enough to allow a surface of low gradients to develop, bevelling the formations and exposing the latest granitic rocks, so that they now form the surface formation over wide areas.

Uplift of this post-matured surface as a unit rejuvenated the streams which incised themselves in steep-sided valleys to a depth greater than that of the present valleys. This period of gorge-cutting occupied the late Pliocene and must have been of long duration, probably extending into the Pleistocene period. The climatic change which brought on the glacial period probably had as its first effect a period of valley glaciation. As the conditions became more extreme the amount of ice increased until the whole Cordilleran area was covered, excepting the higher peaks. Return of more normal conditions again brought on valley glaciation. One of these tongues occupied the Columbia valley for some time after the disappearance of the ice from the neighbouring country. The heavy erosion by these valley glaciers supplied the main streams with abundant debris, which filled the old valley to a considerable depth. Excavation of this is still going on, and the amount of material already removed can be estimated by the terraces at several elevations on the Columbia and its main tributaries.

In recent times the streams have built small deltas at favourable places. Trail creek is at present forming such a deposit in the eddy where it joins the Columbia.

ECONOMIC GEOLOGY.

HISTORICAL REVIEW.

The earliest mining in the West Kootenay District was that done for lead by the Hudson's Bay Company on Kootenay lake in the early twenties of the last century. The industry, however, did not develop. At the time of the Cariboo placer activity some of the prospectors worked along the West Kootenay creeks, and in 1885 the Dewdney trail, passing down Trail creek past the present site of Rossland to the East Kootenay placers, was built. In the eighties

the Boundary District was staked. In 1883 ore was discovered at Ainsworth, on Kootenay lake, and in 1886 discoveries of rich ore near the present town of Nelson led to its establishment as a trading-post. The first claim to be staked in the Rossland district was the *Lily May* in 1887. It was relocated in 1889. In 1890 two miners from the *Lily May* crossed the valley of Trail creek and in one day located the *Centre Star*, *War Eagle*, *Idaho*, *Virginia*, and *Le Roi* claims. The *Le Roi*, which afterwards became such a wonderful producer, was given for the payment of $12.50 for recording fees.

Development was at first slow owing to lack of transportation facilities, but the building of a wagon-road to Trail in 1893 led to enough ore being shipped to encourage investments. In 1895 the Trail smelter and a tramway to the mines were started, the smelter beginning operations in 1896. In that year came the first railway connection, the Red Mountain Railway to Spokane. A period of inflation followed by the usual depression retarded development to a considerable extent. As a result of the failure of the small original companies, strong corporations were formed and up-to-date plants were installed, with a great reduction in working costs. A further step in this direction was the construction of a power plant at Bonnington Falls, on the Kootenay river. In 1899 a sudden decline in War Eagle stock had a bad effect on the reputation of the camp, and labour troubles closed some of the mines for a part of 1901. Litigation over the troublesome apex law under which the claims were staked added to the difficulties, but this was finally settled by the amalgamation of the companies, and the development of the camp in recent years has been steady and uninterrupted.

TYPES.

The Rossland occurrences are of two classes, gold-quartz veins and biotitic gold-copper deposits. Brock has classified the latter on the basis of structure as: (1) Fissure-veins with or without replacement of the country-rock; (2) lodes or zones of fissuring or shearing with the ore-minerals forming a network of veinlets in the fractures and eating into and replacing in whole or in part the intervening fragments of the country-rock, replacing the wall-rock or developing along particular fractures; (3) irregular impregnations in the country-rock.

FISSURING.

The more important ore-deposits are of the first two of these types, and the fissure systems seem to have controlled almost entirely the payable ore. The fissuring is extremely complex and of different ages. It may best be considered as (1) fissuring taking place before mineral deposition and (2) fissuring after deposition. Not all fissures of the first class are mineralized, and no doubt there are fissures later than the earliest ore-deposition and earlier than the last important introduction of minerals. Of the earlier fissures there are then two varieties—(*a*) mineralized and (*b*) non-mineralized. Even the mineralized fissures are not simple in history, but probably represent two or more periods of movement, with a distinct character of mineralization connected with each movement.

The area of most intense rock-dislocation lies on the western slope of Red mountain, mostly between the *Josie* dyke on the west and the *Nickel Plate* dyke on the east. Within this limit the most important ore-deposits so far discovered are situated. The most pronounced fissure is probably that of the *Le Roi-Centre Star* vein system. The strike of this is approximately N. 60° E.; the dip rather steep to the north, with an average between the second and twelfth levels of 80 degrees. In the *Centre Star* workings it is a fairly definite single zone, but in the *Le Roi* it divides into three known as the main, north, and south veins. The *War Eagle* is much less regular. Its general trend is about N. 65° W., the dip to the north-east. Between the first level and the eighth the dip averaged 62 degrees. The continuation was not found on the ninth level, but a diamond-drill hole ran into ore 570 feet to the north-east of where the vein should have been. This has been followed downward to the sixteenth level with an average dip of 38 degrees. It has been considered that a flat fault had thrown the vein to the extent indicated. Recently, however, what seems to be the continuation of this lower zone has been found above the ninth level, and it seems likely that the two are separate parallel shear-zones.

Three other vein systems are recognized, but both the dip and strike of these are variable. The *Josie* system is approximately east and west. The *Hollywell* parallels the *Centre Star* 450 feet north of that zone. The *Peyton* has a strike of N. 30° W. A peculiar feature well marked

in some parts of the *Hollywell* vein is an opening of the platy jointing of the rocks. The filling of these wedge-shaped openings from the main fissure gives an irregular serrated margin to the deposit. The character of the fissure in the igneous rocks remains fairly constant, but a rather general association of the fissures with the contacts between diorite porphyry and the other rocks is to be observed. Wherever the fracture-zones pass into the slaty rocks of the Mount Roberts formation the fissures lose their clean-cut definite nature and become zones of mashing and crumpling in the soft, yielding clastic formations.

Fissures previous to the mineralization but not themselves carrying mineral are numerous. They are characteristically nearly due north and south in strike, and the dip may be either to the east or west, but is usually at high angles. The majority of these have passed through more than one period of movement. The earliest dislocations were associated with the intrusion of a great number of lamprophyric dykes mostly carrying large amounts of biotite. These soft dykes have localized all later fissuring tending to anything near parallelism with themselves. Nearly every one of them has well-marked faults either within its own mass, along one or both walls. The slickensides show that these subsequent movements have sometimes taken place in two directions. On the third level of the *War Eagle* two sets were observed on the wall of a mica dyke, one of which was vertical, the other dipped 20 degrees to the south. Later fractures cutting across the dykes lose their clear-cut identity in the dyke material, while those that meet them at a small angle are deflected, in some cases never emerging on the opposite side, in other cases only after having run parallel to the dyke for some distance. This phenomenon sometimes gives the dyke the deceptive appearance of being younger than the faults crossing it.

The age of the fissures is fixed in a general way, since they cut the formations as late as the monzonite and are believed not to cut the pulaskite. Only a few basic dykes, and these not of the kind associated with the fissures, are found in the latter rock. The mechanics of the complicated system of premineral fissuring and its localization may be explained in the following manner: The north and south movements would naturally be along the previously intruded lamprophyric dykes, and the amount of movement would be roughly proportional to the size of the dyke. There are two very large mica dykes, the *Josie* and the *Nickel Plate* bounding the area of greatest fracture. If the movement along these was of a differential nature the stress developed in the block between would be rotational, and would be relieved by a set of fractures corresponding to the ore-filled fissures described.

The number of fissures later than the ore-deposition is large, but their effect on the ore-bodies is not important. The displacement is in most cases only a few feet and from a practical standpoint is negligible. In many cases these seem to have been merely an oscillation, often along an old fault-zone, which left the opposite sides of the fault in about the same relative position as before the movement. The strike of these later fissures is usually northerly. The dip is either to the east or west and usually fairly steep. Only a few of them can be traced with any degree of certainty for any great distance either along the strike or down the dip. A definite single fault in one drift may break into a large number of small ones in workings only a few hundred feet away. Some of the major faults can be traced downward for three or four levels, but below that it is impossible to be sure of the identity of any excepting those associated with the larger dykes.

THE ORES.

The ores of the Rossland district fall into two large classes. The important type consists of a mixture of sulphides. The other consists of free gold in quartz. This latter type, while less important than the first, has produced considerable gold, although none of the deposits are now being worked. The best example of this kind of deposit is at the *O.K.* mine, where the vein consists of quartz with free gold and only a small amount of sulphides.

The minerals appearing in the sulphide type of ore-bodies are pyrite, pyrrhotite, chalcopyrite, arsenopyrite, molybdenite, bismuthinite, galena, sphalerite, and magnetite. Pyrite occurs disseminated throughout the country-rock, especially in the Mount Roberts formation, and this variety is only slightly auriferous. It is also found as a prominent constituent of the vein-fillings and there may carry considerable gold. Pyrrhotite is apparently of two generations, the later variety being auriferous, while the first is, at best, low grade. Chalcopyrite is much less in amount than pyrrhotite in the ordinary ore, but sometimes predominates. It is auriferous.

Arsenopyrite occurs both as impregnations and as a minor constituent of the large ore-bodies; molybdenite, sphalerite, galena, and magnetite are occasional minerals.

The mineralogical character of the ores even of the sulphide type varies widely. Even in parts of the same vein the relative amounts of the various constituents are not at all the same. In general, however, it may be said that, in the mines on Red mountain, pyrrhotite is the most abundant ore-mineral, followed in order by pyrite and chalcopyrite. In the working mines arsenopyrite, molybdenite, galena, and sphalerite are rare, but in some of the smaller prospects, especially in the Mount Roberts formation, these latter minerals become the more prominent, and magnetite is also commonly present.

The details of the minerals occurring in some of the important stopes will show more clearly this variation. Samples from the *Josie* system of veins show only pyrrhotite from the fifth and thirteenth levels, while samples from the fourth and seventh levels show pyrrhotite and chalcopyrite, but in varying proportions. On the fourth level pyrrhotite predominates, while in one stope of the seventh level chalcopyrite is the more abundant. In the *Centre Star-Le Roi* vein system the same variation is observed, but pyrrhotite is always in excess of chalcopyrite and varying amounts of pyrite appear. In the *War Eagle* veins a sample from the third level shows pyrrhotite alone. One from the fourth has pyrrhotite, chalcopyrite, and some sphalerite. In the deepest stope at present opened pyrrhotite, pyrite, and chalcopyrite are the ore-minerals. Surface samples from veins in the Mount Roberts formation show a wider mineralogical range. The *Coxey* vein, parallel to the *Centre Star* system but farther north, carries magnetite, pyrrhotite, molybdenite, arsenopyrite, and chalcopyrite in differing proportions at various points. At the *Lily May*, south of Rossland, the constituents are galena, sphalerite, chalcopyrite, pyrrhotite, and stibnite in about this order of abundance.

The gangue accompanying the ore-minerals in the sulphide-deposits is chiefly more or less altered country-rock. A subordinate amount of quartz is usually present and some calcite. In some of the veins calcite becomes more important with depth. In small amounts a large variety of minerals is found, such as wollastonite, garnet, epidote, chlorite, biotite, serpentine, actinolite, and zeolites.

In the gold-quartz veins along with free gold some sulphides are found. These are, however, very subordinate in amount. The gangue in this case is entirely quartz.

The metals recovered from the Rossland ores are gold, silver, and copper, with gold as the most important. The gold content to the ton of ore decreased steadily to 1907, falling from 2 oz. a ton in 1894 to 0.33 oz. in 1907. Since then it has risen to 0.44 oz. and for the last few years has remained fairly constant. Silver has dropped with many fluctuations from 2.88 oz. in 1894 to 0.30 oz. in 1911, while copper has fallen from 56.6 lb. a ton in 1894 to 13.5 lb. in 1911. The decrease is due less, probably, to failure in the ore value than to decrease in mining, transportation, and smelting costs, which allows much lower-grade ore to be treated than formerly. The values to the ton plotted for the three metals give curves which, in the case of copper and silver, show a rather marked sympathy. The gold curve does not follow the others very closely. Thus it seems likely that silver is mainly associated with the chalcopyrite, while gold may occur with the other sulphides or as free gold in altered and silicified country-rock. It is certain, at any rate, that a varying percentage of the gold does exist in the free state, but whether in the sulphide or in the wall-rock is less certain. Molybdenite, bismuthinite, and arsenopyrite, are auriferous, sometimes highly so, as in the impregnations near pulaskite dykes at the *Giant* and *Jumbo*. Galena and sphalerite carry considerable silver.

PARAGENESIS OF THE ORE-MINERALS.

Not only does the relative amount of the different ore-minerals vary in different vein systems, and even in different parts of the same system, but also the order of deposition. Examination of ore samples reveals a rather complex sequence in mineralization, and it is quite evident that there are at least two periods of sulphide-deposition. The first period consisted chiefly of the introduction of pyrite and pyrrhotite relatively poor in the precious metals. Later disturbances were followed by a second sulphide period characterized by chalcopyrite, pyrite, and pyrrhotite, with possibly other minerals, all of which carried considerably more gold and silver than the first mineralization. The considerations upon which these statements are made are as follows: (1) It is evident from the ore associations to be given in detail later that pyrite and pyrrhotite occur as the earliest of the sulphide minerals cut by chalcopyrite, and that there are instances

in which pyrrhotite is found undoubtedly later than chalcopyrite; (2) at some places at least the pyrite and pyrrhotite are very low grade, while in other places they rank as important ore-minerals; (3) some of the large stopes of solid sulphides do not carry their values uniformly distributed, but in streaks which may possibly be due to a later sulphide period; (4) veins are known carrying mixed sulphides with good values up to a cross-dyke, beyond which one mineral, and that very low grade, forms the fissure-filling.

Polished specimens of ore from the *Centre Star* fourth level stope 410, fifth level stope 588, and thirteenth level, *Le Roi* eighth level stope 895, and *Josie* 900-foot level show only pyrrhotite. Specimens from *Centre Star* third level, Josie 1,300, and *Le Roi* 1,200 show pyrrhotite and chalcopyrite, the pyrrhotite being the older mineral. Another sample from the 1,200-foot level of the *Le Roi* has pyrite cut by chalcopyrite. Ores from the 1,100- and 1,200-foot levels of the *Centre Star* and the eighth of the *War Eagle* consist of pyrite cut by pyrrhotite. In the *City of Spokane* tunnel, *Centre Star* stope 426, *Nickel Plate* 300, and *War Eagle* 1,452 the order is pyrite, pyrrhotite, and chalcopyrite. Ore in the *Hamilton* vein, however, shows pyrite cutting pyrrhotite, and in the 737 stope of the *Josie* chalcopyrite is cut by stringers of pyrrhotite. A small stringer of sphalerite cuts chalcopyrite in ore from *War Eagle* stope No. 1152. A sample from the surface exposures on the *Coxey* has pyrrhotite cutting magnetite. Determination of a general order of deposition from such scattered samples is liable to introduce errors, but as there is evidence from the ore values for at least two periods of pyrite and pyrrhotite deposition the following order is suggested:—

1st. 1. Pyrite and magnetite.
2. Pyrrhotite.

2nd. 3. Pyrite.
4. Chalcopyrite.
5. Pyrrhotite, sphalerite.

The relation of pyrite and magnetite and pyrrhotite and sphalerite is not shown in the samples examined. The paragenesis of the accessory ore-minerals arsenopyrite, molybdenite, bismuthinite, and galena is also unknown, but as they are all of rather high gold and silver content they probably belong to the period represented by Nos. 3, 4, and 5.

The mineralogy and order of deposition is somewhat similar to that at Ducktown, where Kemp* found pyrite, pyrrhotite, chalcopyrite, and finally a coarsely crystalline variety of pyrrhotite associated with later quartz veins which cut the chalcopyrite.

The sulphide-deposits occur as well-defined fissures or as intersecting veinlets replacing fractured wall-rock. The straight and persistent *Hamilton* vein to the west of the *Josie* dyke is of the first class, and the chalcopyrite vein in stope 737 of the *Josie* is a particularly good example of the simple fissure. It also lies to the west of the *Josie* dyke. It has a fairly regular width of 12 feet and is almost vertical. The country-rock is diorite porphyry but little attacked and not much fractured. At places the almost solid chalcopyrite which forms the filling may penetrate for a short distance into the wall, but the boundary between clean ore and barren rock is remarkably sharp. At various points a thin layer of rock, consisting mostly of secondary biotite, separates fresh diorite porphyry from solid ore.

The predominant structure of the deposits is that of zones of crushing with replacement of the country-rock. Sometimes this replacement is so complete that none of the friction breccia is left, while at other places pieces of altered rock still remain. Only parts of a fragment may be replaced, and samples are sometimes found in which the augite phenocrysts of augite-porphyrite country-rocks are perfectly retained in a ground-mass of sulphides. Along the borders of solid sulphide masses ore stringers are found working outward into the enclosing rock in a network which becomes less distinct as distance from the main mass increases until only the merest threads of sulphide are observable. Alteration processes extend still farther into the country-rock. As a rule no open fissures are found, but some small openings exist. These are lined near the vein with well-crystallized calcite and zeolites evidently belonging to the last stages of mineralization.

The minerals commonly found metasomatically replacing country-rock are pyrite, pyrrhotite, chalcopyrite, molybdenite, sphalerite, galena, arsenopyrite, quartz, calcite, actinolite, and biotite. Pyrite and arsenopyrite are found both massive and as well-formed crystals, especially in the

* *See* Ducktown, Tenn. (Kemp), Transaction A.I.M.E., Vol. 31, page 244.

Mount Roberts sediments. Of the non-metallic minerals produced by the vein-forming solutions biotite is the most prominent. In the wall-rock near the ore a brownish radiating variety of this mineral is often abundantly developed, sometimes forming a layer 3 to 4 inches thick of almost pure biotite. Quartz and calcite are also found in considerable amounts bordering the sulphides and working out into the unaltered rock, but on the whole the effect of the solutions seems to have been to remove both silica and calcium from the rocks affected. This is very well shown in analyses of fresh and altered monzonite and augite porphyrite.

	20.	21.	34.	35.
SiO_2	50.89	40.02	54.49	37.32
TiO_2	0.80	0.46	0.70	0.87
Al_2O_3	17.00	16.13	16.51	19.30
Fe_2O_3	0.97	...	2.79	...
FeO	7.60	14.98	5.20	16.10
MnO	0.14	0.11	0.10	0.10
MgO	5.41	12.90	3.55	10.81
CaO	9.82	1.05	7.06	1.47
CuO	...	...	...	Trace.
K_2O	1.31	8.17	4.36	8.55
Na_2O	3.35	0.67	3.50	0.33
H_2O-	0.06	0.13	0.07	0.14
H_2O+	1.14	2.82	1.18	3.01
P_2O_5	0.19	0.03	0.20	0.19
S	0.43	0.39	0.23	0.36
CO_2	0.28	0.24	0.10	Trace.
	99.39	98.37	100.04	98.75

NOTE.—Analyses taken from reports of the Department of Mines, Canada.

No. 20—Augite porphyrite, *Josie* drift, *War Eagle*, 10 feet in foot-wall side. Fresh.

No. 21—Augite porphyrite altered to biotite in the vein.

No. 34—Monzonite east of mica dyke, 700-foot level, *Le Roi*.

No. 35—Monzonite altered to west of mica dyke, 700-foot level, *Le Roi*.

The samples were evidently taken as free from sulphides as possible, and the change shows clearly the character of the alteration. Iron, potassium, and magnesium have increased while silica, calcium, and sodium have diminished. At other points in the vein different conditions might give different reactions with precipitation of the elements here removed, and hence silicification and the introduction of calcite.

The existence of contact-metamorphic conditions in the deeper zones is marked by small amounts of a deep-red garnet in the sulphides and the rather abundant occurrence of epidote and actinolite in the wall-rocks of the lower levels. The amount of epidote is sometimes large enough to give the rock a banded appearance, and a sample from the tenth level of the *War Eagle* is at least one-third epidote. Apparently the alterations at depth occurred under high pressure and temperature, while those of the upper part are characteristic of aqueous solutions at moderate temperatures and pressures.

ORE-SHOOTS.

The distribution of values is not uniform, but, as in most ore-deposits, they are concentrated in favourable localities. The size of the ore-shoots depends somewhat on the way in which the term is defined. Lower-grade ore can now be worked than could formerly, and hence the size of a shoot increases with the decreased operating costs.

Probably the largest body of ore ever worked in the camp was that opened up by the *Le Roi*. This was found on the east side of the *Josie* dyke. It had a stope length of 600 feet and was followed down to the 900-foot level. A width of 30 to 60 feet was mined. The values were not evenly distributed, but occurred in zones through the sulphides. The largest stopes now being worked are No. 1452 on the fourteenth level of the *War Eagle* and No. 895 on the *Le Roi* 800-foot level. The former has been opened for a length of about 100 feet and a width of 30 to 40 feet. It has been crosscut 200 feet below the fourteenth level. The ores here are pyrite and pyrrhotite

with some chalcopyrite. The sulphides form intersecting veins 2 to 3 feet in width, in altered diorite porphyry. The *Le Roi* stope belongs to the same type, with a somewhat smaller amount of sulphides. It is being mined to a width of about 50 feet. The ground is badly broken and mining costs, except for timbering, are low. This increases the width of payable ore considerably.

The relation of the ore-shoots to the character of the country-rock is influenced by the different physical properties of the various formations. In all rocks of a hard but brittle character, such as the monzonite, diorite porphyry, granodiorite, and augite porphyrite, the fractures produced are much alike and the ore-bodies are essentially of the same character. On the other hand, the same forces acting on the yielding shales and tuffs of the Mount Roberts formation have produced zones of mashing which are impregnated to some extent, but were evidently too impervious to receive ore-bodies of important size.

The factor of chief importance in the localization of the ore-shoots has been the north-south faulting in large part controlled by the dyke system. Along the basic dykes, especially the soft mica-bearing varieties, there has been considerable movement. The gouge produced has retarded circulation of mineralizing solutions along the intersecting ore-fissures and caused a considerable enrichment of the ore-zone at that point. The fault rather than the dyke seems to be the important element, since there are large shoots not bounded by dykes. As a rule, however, they are found against basic dykes, usually on the under-side if the dyke is not vertical. A striking example is the original ore-body of the *Le Roi*. This has as its western boundary the *Josie* dyke, which has been much affected by faults along both walls. Beyond it the ore has recently been found displaced 300 feet. The cross-fractures are not themselves mineralized to any great extent, and for this reason might at first seem to be entirely later than the ore. The movement along them, especially in the mica dykes, has developed impervious secondary products that prevented the ore solutions from penetrating, and for this reason they are not filled with minerals.* Very often also, as in the example mentioned later, faulting along the old fissure has taken place.

There are also cases where the sulphides have continued on the opposite side of the dyke and associated fault, but where the values have decreased very appreciably. The low-grade sulphides probably represent a first period of mineralization. Later a slight second fracturing followed the ore-zone, but was stopped or deflected at the intersecting dyke or fault, and as a result the later period of richer mineralization affected a fissure in the zone extending only as far as the intersection. On the third level of the *War Eagle* the workings follow a fault-zone K with well-marked walls. This is crossed by a strong fault E with a heave of 30 feet. North-west of fault E pyrite is developed in K, but no values, while south-east of the fault there is good ore that follows the foot-wall of K for 125 feet and then crosses to the hanging-wall. Apparently there was originally a pyrite-filled fissure. This was faulted by E, and at the same time or later a fissure opened south-east of the fault, and this was later filled by sulphides with payable values.

On the eighth level of the *Centre Star* a similar case occurs. A fairly definite sulphide-filled fissure has been cut by a nearly flat fault. The relative movement has been about 15 feet. In the part of the vein above the fault the values are too low to mine, while that part below the fault carries good ore.

It is difficult to estimate the influence of depth in an ore-body of such variable mineralogical character. On the whole, while the fissure systems remain in the same formation, the character of the ores even in the deepest workings remains the same. When, however, they pass either laterally or in depth into the Mount Roberts formation the character immediately changes. The fissures are less distinct and some of them are almost entirely filled with fine granular calcite.

GENESIS OF THE DEPOSITS.

The composition of the ore solutions can be approximately determined from the minerals that have been deposited and the changes produced near the fissures. The main substances are:—

Silica.

In the sulphide-deposits quartz is not a very prominent mineral, occurring only as small blebs. In places, however, the wall-rock is silicified and tiny quartz stringers are observable.

* Ransome, P.P. 62, United States Geological Survey.

The quartz may to some extent be derived from the alterations of the wall-rocks themselves. In the gold-quartz veins quartz becomes an important mineral, and it is evident that these solutions were highly siliceous. In this case the alteration of the adjacent wall-rocks could not supply the large amount of silica, which must therefore have been introduced by the ore solutions from other sources.

Carbonates.

Calcite occurs as an impregnation of the wall-rocks and as well-formed crystals in open fissures. In the deeper levels of the *Centre Star* it appears prominently as a fissure-filling. This arrangement seems to be evidence for precipitation of calcite in the deeper parts of the vein, while the upper parts are filled with sulphides.

Fluorides.

The presence of fluorides in the solutions is marked by the presence of the fluorine-bearing mineral apophylite. It is found always in vuggs and seams.

Sulphides, Sulpharsenides, and Aulphantimonides.

The large quantities of sulphides which are found both in the ore-bearing fissures and zones and as crystals in the rocks show that the amount of dissolved sulphides present must have been enormous. The disseminated character of the well-crystallized pyrite and arsenopyrite, produced by easy diffusion on the part of the sulphur and arsenic compounds, shows how active and far-reaching these solutions must have been. Antimony was present in small amount as recorded by the rather rare occurrence of stibnite.

Iron, Nickel, Cobalt, and Copper.

The iron sulphides and sulpharsenides are by far the most abundant ore-minerals. Considerable copper and a little nickel and cobalt are associated with the iron. Evidently the ore solutions were supersaturated with ferrous compounds, since so large an amount of pyrrhotite has been deposited. Copper is usually much less abundant, probably not exceeding one-fiftieth of the iron content. At times, however, as in some of the *Josie* stopes, chalcopyrite predominates. Nickel and cobalt are present only in small amounts.

Alkalies.

Potassium-bearing minerals are abundant in the altered rock. Biotite is the most common of these and sometimes forms the mass of the altered rock. Evidently alkalies were in considerable amount in the ore solutions. Analysis of altered rock shows that the soda of the original monzonite and granodiorite has been removed and potassium added.

Gold and Silver.

Although minor in amount, gold and silver are the important elements from an economic standpoint. Both are found in intimate association with the sulphides, and it seems reasonable to suppose that they were held in solution in the same manner and precipitated by the same reactions as the base metals. A varying amount of gold even in the sulphides is in the free state, but the larger part is evidently in some sort of chemical compound.

Nature of the Solvent.

The problem of the nature of solutions that could carry the metallic elements mentioned above, together with many that occur in minor amounts, next arises. Becker found that many sulphides are soluble in sodium sulphide solutions and that gold also yielded to such solutions. Silver sulphide and galena differ from the others in this respect, but according to de Senarmont they are dissolved in water, saturated with hydrogen sulphide, at high temperature and pressure. The Rossland ore solutions had a considerable quantity of potassium which may be assumed to act in the same manner as sodium, and hydrogen sulphide no doubt was also present in quantity. Boric acid and fluorine probably aided solution to some extent.

From these conditions it is concluded that the solutions from which the Rossland ores were deposited contained SiO_2, CO_2, H_2S, F, Bo, Fe, Ni, Co, Sb, As, Au, Ag, Cu, Zn, Pb, Ca, Na, K, Mo.

All of these, excepting a small part of the SiO_2 which may be derived from the wall-rocks, are probably contributed by the great batholiths that have at various times intruded the older rocks. There is evidence of various periods of mineralization, and no doubt the ore solutions were different, but at all times the metals were likely present as sulphides in solution in magmatic waters, which contained enormous amounts of alkali sulphides and hydrogen sulphide, with some carbon dioxide, boric acid, and fluorine.

Conditions, Time, and Methods of Deposition.

The presence of garnet and epidote indicates that the lower part of the deposits as now found was formed under contact-metamorphic conditions with high temperature and pressure. The upper parts of the deposits were formed under hydrothermal conditions and medium temperatures. The last minerals to form—namely, the zeolites and calcite—crystallized at fairly low temperatures. Wohler gives a temperature of 180° C. as that necessary for the formation of apophyllite. Apparently then the ores were deposited by solutions at high pressure and temperature which, as they moved upward along the fracture-zones, became solutions of medium temperatures with mineralizers, such as fluorine, hydrogen sulphide, etc. The fall in temperature and pressure resulted in deposition of part of the material in solution. This was no doubt aided by the reactions between the wall-rocks and the ore-bearing solutions. If the retention of the metallic sulphides depended on the presence of potassium in the waters, the removal of that element by the biotitization of the country-rocks would necessarily cause the deposition of part of the ore-minerals.

The origin of these solutions carrying such large amounts of alkaline sulphides along with carbon dioxide and fluorine must have been magmatic. As previously shown, there were at least two periods of mineralization. The first period probably corresponds to the closing activities of the Jurassic batholithic intrusions that ended with the intrusion of the great mass of normal monzonite. The later more alkaline magma of the pulaskite invasion introduced a much smaller amount of sulphides, but by its high alkaline content it would be capable of carrying considerable amounts of gold, and to it is attributed the production of the richer zones in the older deposits and the very rich impregnations that are found near pulaskite dykes.

The history of the ore-deposits may be summarized as follows: The batholithic invasions of Nelson granodiorite, diorite porphyry, and monzonite were accompanied by fracturing of the older rocks by a somewhat torsional stress. In these fracture-zones the solutions and emanations from the cooling magma deposited rather low-grade sulphides. The intrusion of the Tertiary alkali syenite (pulaskite) batholith was accompanied by a second fracturing which largely followed the earlier shear-zones. In these the highly alkaline solutions from this intrusive deposited sulphides which were much richer in precious metals than the Mesozoic sulphide-deposition.

Secondary rearrangement by descending waters has had but little effect on the Rossland deposits. Primary sulphides were found practically at the surface. Along wet seams a little malachite has developed, but as these seams do not extend to a great depth the main mass of the deposits is entirely unaffected. Ground-water stands at about 50 feet, and from that level to about 400 feet the amount of water pumped increases. In this zone flat diamond-drill holes are always wet and same carry a large flow of water. Below the 400-foot level the amount of water steadily decreases until at 1,000 feet the workings are practically dry and no pumping is necessary.

PETROGRAPHY OF THE IGNEOUS ROCKS.

The great batholithic or laccolithic intrusions affecting the Rossland district fall into two groups—the earlier Mesozoic period of augite porphyrite, monzonite, and granodiorite intrusives, and the Tertiary period of more acidic character represented by alkali syenite and granitic rocks with some dykes of a more basic character.

ROCKS OF THE BATHOLITHIC INTRUSIONS.

Augite Porphyrite.

The augite porphyrite in the hand specimen varies considerably in appearance. It is usually greyish to greenish black, with prisms of dark-greenish pyroxene visible to the naked eye. They are usually nearly square. They vary in size and may become so small as to be unrecognizable.

Under the miscroscope the rock is found to be distinctly porphyritic, with relatively large phenocrysts in a fine-grained ground-mass. The primary minerals are pyroxene and plagioclase, with apatite as an accessory constituent. The secondary products are uralite, sericite, kaolin, calcite, and chlorite. Nearly every section shows a trace of introduced sulphides. The plagioclase shows extinction angles measured from the albite twinning lamellæ averaging 20 degrees. The variety is thus near labradorite. The pyroxene is in well-formed crystals of a light-greenish colour and often twinned. They are of an early period of crystallization and are included in the feldspars. The borders show alteration to uralite. The ground-mass consists mostly of very small crystals of pyroxene with some feldspar. The recast analysis shows that feldspar and pyroxene are about equal in amount. The calculated variety of feldspar is rather more acidic than the microscopic examination indicates.

Diorite Porphyry.

Often very similar to the augite porphyrite in appearance, but rather different from it in mineralogical composition is the diorite porphyry. It is a greyish to greenish-grey rock with needle-like phenocrysts of feldspar and hornblende which often have a flow arrangement. Under the microscope it is always porphyritic, in some cases with a striking difference between the ground-mass and the minerals of the first generation. A faint trachytic arrangement is also sometimes noticeable. The phenocrysts are usually elongated crystals of hornblende, plagioclase, orthoclase, and usually pyroxene. The two feldspars vary in amount. Sometimes plagioclase predominates and in other sections orthoclase is developed almost to the exclusion of the triclinic variety. The composition of the plagioclase varies in different specimens from albite to oligoclase, and even in the same crystal strong and peculiar zonal structures are often strikingly developed, probably from changes in the magma. The hornblende is in well-formed needles strongly pleochroic from bluish-green to green to yellowish-green. It is often found about feldspar grains and also shows the rather unusual phenomenon of well-marked zonal growth. The orthoclase in some sections shows a ragged or patchy surface that suggests that it is anorthoclase rather than true orthoclase. The ground-mass consists of hornblende, feldspar, and, in the types where plagioclase is almost lacking, some quartz. Wherever sulphides have been introduced a secondary hornblende has developed along the ore, with sometimes a little biotite.

Nelson Granodiorite.

This is a medium-grained greyish rock with quartz feldspar and biotite or hornblende as the macroscopic minerals. In thin section it shows a granitic texture, with quartz, orthoclase, plagioclase, microcline, magnetite, hornblende, biotite, titanite, and apatite as primary constituents. The feldspars are somewhat altered to kaolin and sericite, while some chlorite is present from the basic minerals. The plagioclase is near andesine in composition. The biotite is a peculiar greenish-brown colour and is often in aggregates. The predominant minerals are quartz, orthoclase, and plagioclase. Biotite is fairly abundant, hornblende less so. Analyses are given on page 239 and a recast analysis on page 240.

Monzonite.

The normal monzonite is a somewhat variable rock. It may be fine-grained to coarse, dark to light grey. Usually granular, it at times becomes faintly porphyritic. A thin section of monzonite from the mass south-west of Rossland shows a granitic structure, with plagioclase, orthoclase, pyroxene, and biotite as the chief primary minerals. The secondary products are magnetite, chlorite, and uralitic amphibole. Plagioclase forms most of the rock. It occurs in lath-shaped twinned crystals whose extinction angles show the variety to be oligoclase-andesine. The orthoclase is untwinned and includes plagioclase and other minerals in a poikilitic fashion. Amphibole is deep green and largely, if not altogether, secondary, filling crevices and surrounding kernels of pyroxene. The pyroxene is in stout, well-formed light-green crystals. Magnetite is in considerable amount. Plagioclase seems to have crystallized in part at least before the pyroxene. A sample from drill-hole 274, *War Eagle* third level, taken 256 feet from the drift, differs only in the relative amount of the minerals present. Orthoclase is less in amount and hornblende almost lacking. The orthoclase shows good zonal structure. In this rock the order of crystallization is normal. Comparison of the analysis of this rock with typical monzonite shows a close agreement.

Pulaskite.

Pulaskite, the dyke representative of the large mass of Rossland alkali syenite just outside of the area, occurs in such large masses that it may be considered as belonging to the deep-seated *rocks. It is light pink to white in colour, but with many variations, with increase or decrease* of the basic minerals. These are not usually abundant. The feldspars are the most noticeable *constituent in the hand specimen, often assuming lath-shapes that may attain a length of an* inch or more. The thin section shows a granitic rock composed of orthoclase, biotite, hornblende, pyroxene, magnetite, and some plagioclase. Alteration has produced kaolin and hæmatite, with some secondary hornblende around the pyroxene crystals. Orthoclase makes up the bulk of the rock. It occurs in lath-shaped Carlsbad twins and also in square plates untwinned, but with a mottled surface. The plagioclase has thin twinning lamellæ and is albite. The pyroxene is in well-formed light-green crystals. The analyses show the alkaline character of the rock. Comparison of this with a sample from the main mass shows that the latter has a somewhat coarser and more granular structure. More hornblende is present and less pyroxene and plagioclase. The hornblende is a deeply pleochroic variety, changing from green to yellowish-green.

Sheppard Granite.

The Sheppard granite is a light grey rather porphyritic rock, with tabular feldspar crystals showing on the weathered surfaces. Microscopically it is porphyritic, with a large number of phenocrysts in a well-crystallized ground-mass. The primary minerals present are orthoclase, plagioclase, quartz, hornblende, pyroxene, titanite, and apatite. The rock is fairly fresh. There is a slight kaolinization of the orthoclase and most of the pyroxene is altered to chlorite. Orthoclase occurs both untwinned and with Carlsbad twinning. Plagioclase is towards the albite end and shows interfingering lamellæ. It is almost equal to the orthoclase in amount. Green hornblende and light-green pyroxene are present, the former rather abundant. Both are included in the feldspars. The ground-mass is largely quartz and orthoclase and has a somewhat granular appearance. *This rock is believed to be the plutonic facies of the magma from which the granite* porphyry to be described later came. The sample described was obtained from Lake mountain. *The analysis quoted is of a specimen collected by Daly four miles east of this point.*

DYKE ROCKS.

The dyke rocks consist of aschistic representatives of the batholithic rocks and lamprophyric intrusions, probably the residuals of the more acidic plutonic masses. The majority of these belong to the granodiorite-monzonite period, but a few are offshoots of the Tertiary intrusives. Minor changes in the mineralogy of these make an almost endless variety. Only the more prominent and characteristic types, however, are described.

Granite Porphyry.

The granite porphyry is a light-greyish fresh-looking rock with numerous tabular feldspar phenocrysts of a white to faint pinkish colour. Under the microscope it shows a decided porphyritic habit. The primary minerals are orthoclase, plagioclase, quartz, hornblende, pyroxene, biotite, apatite, and magnetite. The alteration products are sericite, chlorite, magnetite, and secondary hornblende. The phenocrysts are mostly plagioclase near the albite end with some orthoclase and light-green pyroxene. Some large quartz grains are present showing a very strong resorption effect (Photo No. 12). Most of the orthoclase and quartz, however, are in the ground-mass. Biotite occurs in small foils, with a tendency towards aggregates. Small green hornblendes are rather rare. Chlorite is common and much of the biotite is partially chloritized.

Porphyritic Monzonite.

The porphyritic monzonite is a fresh coarse-grained grey rock with large well-formed pyroxene crystals and somewhat smaller white to greenish feldspars. Biotite is sometimes abundant. In thin section the rock is seen to have a porphyritic habit, with a well-crystallized ground-mass. The primary minerals are plagioclase, orthoclase, pyroxene, biotite, hornblende, and apatite. Pyroxene of a drab colour forms the larger phenocrysts. Some green hornblende is present in irregular grains and much biotite is scattered through the rock. The plagioclase

crystals are smaller than the pyroxene, lath-shaped, and near andesine in composition. Orthoclase is abundant. It has a mottled appearance and contains a great number of inclusions of the other minerals. Alteration has been very slight. A few fibres of sericite have developed in the feldspars and a little kaolin and the pyroxene phenocrysts are bordered by a narrow fringe of secondary hornblende. Some introduced sulphides are present.

Centre Star Dyke.

The deeper parts of the *Centre Star* dyke consist of a rock very similar in appearance to porphyritic monzonite, but less distinctly porphyritic. Mineralogically it is in parts somewhat similar, but in depth it becomes more basic. A slide taken from a specimen on the eighth level of the *Centre Star* consists of plagioclase, biotite, pyroxene, magnetite, and apatite, with a little olivine. Plagioclase and pyroxene make up the bulk of the rock, but biotite is prominent. The plagioclase, andesine-labradorite in composition, is considerably altered to sericite. The pyroxene is in light-green, well-formed crystals twinned and zonally grown. Some chlorite has developed. Most of the small amount of olivine is altered to serpentine. A specimen from presumably the same dyke on the fourteenth level differs in having in it a considerable amount of deep-brown hornblende. Some calcite and green hornblende have developed as secondary products. In both samples there is a tendency toward ophitic structure.

Augite Camptonite.

From rocks like those just described are gradations towards augite camptonite. One of these has been called for reference the *Spokane* type because typically developed in the tunnel of the *City of Spokane* mine. It is strikingly porphyritic, with phenocrysts of brown hornblende and feldspar an inch across. The ground-mass is fine-grained. Microscopically it is seen that the hornblende forms the larger phenocrysts, but plagioclase is more abundant. Pyroxene is also in some quantity and the ordinary alteration products are present. The plagioclase is in stout tabular crystals considerably altered and surrounded by reaction rims. Lath-shaped plagioclase of the variety andesine, pyroxene, and both green and brown hornblende form the ground-mass. A dyke 90 feet east of the *Centre Star* dyke, on the thirteenth level of the *War Eagle*, is somewhat similar. In this case the plagioclase is labradorite and some biotite is present. Alteration has produced considerable epidote, most of which is in radiating aggregates.

A dyke west of the *Centre Star* dyke, on the fifth level of the *War Eagle*, has a few large phenocrysts of white, zonally grown pyroxene and badly altered andesine in a fine ground-mass composed of rods of brown hornblende and feldspar. Considerable magnetite is present. A dyke 50 feet west of the *Tramway* dyke, *Josie* 400-foot level, differs only in having more plagioclase as well as some orthoclase and an extremely fine ground-mass. Other similar dykes are found 250 feet from the west end of the crosscut to the *War Eagle* on the ninth level of the *Centre Star* and 175 feet west of the *Centre Star* dyke in the south workings of the fourth level of the *War Eagle*.

Vogesite.

By decrease of plagioclase and increase of orthoclase, camptonites pass into vogesites. A rock that may be classed as the latter is found in a dyke in the *Iron Mask* tunnel, *War Eagle* fourth level, 340 feet from the portal. It is very fine-grained with rods of brownish hornblende and unstriated feldspar. Magnetite is abundant and alteration has produced calcite and epidote.

Kersantite.

Kersantites are dyke rocks characterized by the presence of biotite and plagioclase. A rock fitting this description occurs as a small dyke cutting the Nickel Plate dyke on the fifth level of the *Centre Star*. It has a strike parallel to the big dyke. It is composed of lath-shaped feldspar crystals that approach labradorite in composition and fibres of biotite. The two form a felt of tiny needles. A little serpentine and calcite are present. A mica dyke from the tunnel of the *Jumbo* mine near the pulaskite-contact consists of biotite, pyroxene, plagioclase, orthoclase, and apatite in order of their abundance. The plagioclase is andesine and the pyroxene a light-green variety. The interstices are filled by orthoclase. A fine-grained specimen of the *Josie* dyke on the third level of the *War Eagle* has a similar composition.

Minette.

By decrease of plagioclase and increase of orthoclase, kersantites pass into minettes. These may have hornblende or augite or may lack those minerals. Dykes of this type are also found. A specimen taken from the *Tramway* dyke on the 400-foot level of the *Josie* consists of biotite, pyroxene, apatite, and a little plagioclase set in a ground-mass of orthoclase. The pyroxene is nearly as abundant as the biotite. The "black" dyke on the same level has the same mineralogical composition. A mica dyke associated with the vogesite described from the *Iron Mask* tunnel is a minette carrying only small quantities of augite.

EFFUSIVE TYPES.

Augite Latite.

A hand specimen of a rock from near the summit of Mount Roberts which is believed to be a Mesozoic effusive shows a few black phenocrysts in a dark-grey to bluish-grey ground-mass. Some blebs of lighter green occur which suggest amygdules. In thin section it is porphyritic with trachytic structure. The primary minerals are orthoclase, plagioclase, hornblende, magnetite, and biotite. The usual secondary products are present, and probably much of the hornblende is secondary after pyroxene. The ground-mass is a felt of altered feldspar needles with pyroxene and much epidote. Some of the feldspar is still recognizable as orthoclase. The cavities are apparently true amygdules filled with quartz and epidote. This rock is no doubt similar to the augite biotite latite reported by Daly on Record Mountain ridge west of Rossland. An analysis of that rock is given.

	MONZONITE.		GRANODIORITE.						PULASKITE.	
	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.
SiO_2	55.25	54.49	65.10	66.46	62.08	50.89	59.06	77.09	61.86	62.59
TiO_2	0.60	0.70	0.54	0.27	0.73	0.80	1.08	0.05	0.15	0.54
Al_2O_3	16.53	16.51	15.82	15.34	16.61	17.00	16.24	13.04	19.07	17.23
Fe_2O_3	3.03	2.78	1.64	1.68	1.53	0.97	0.43	0.82	2.65	1.51
FeO	4.37	5.20	2.66	1.83	3.72	7.60	4.88	0.26	1.49	2.02
MnO	0.15	0.10	0.05	...	0.11	0.14	0.20	Trace.	0.01	Trace.
MgO	4.20	3.55	2.17	1.11	2.44	5.41	3.51	0.12	0.55	1.30
CaO	7.19	7.06	4.66	3.43	5.20	9.82	5.59	0.63	1.47	1.99
Na_2O	3.48	3.50	3.82	4.86	3.18	3.35	2.84	3.11	6.45	5.50
K_2O	4.11	4.36	2.29	4.58	3.29	1.31	3.95	4.50	5.75	6.74
H_2O	0.66	1.18	1.09	0.29	1.00	1.14	0.19	0.07	0.47	0.30
P_2O_5	0.43	0.20	0.16	0.08	0.30	0.19	0.21	0.10	0.08	0.11
S	...	0.23	...	...	...	0.43	...	...	...	Trace.
CO_2	...	0.10	...	...	...	...	...	...	...	...
SrO	...	...	...	...	0.03	0.28	0.12	...	...	Trace.
BaO	...	...	...	...	0.09	...	0.11	...	...	...
$H_2O -$	...	...	...	...	0.16	0.06	0.21	0.03	...	...
	100.00	99.96	100.00	99.93	100.47	99.39	98.62	99.82	100.00	99.83

NOTE.—Analyses I., III., IX. from Igneous Rocks and their Origin, Daly. Other analyses from Reports of Analyses of the Department of Mines, Canada.

I.—Daly. Igneous Rocks and their Origin, page 23, Average Monzonite.

II.—Monzonite, Rossland, 700 feet, *Le Roi* mine.

III.—Average granodiorite, Daly, page 25.

IV.—Nelson granodiorite.

V.—Nelson granodiorite, two miles south of Trail.

VI.—Augite porphyry, *Josie* drift, *War Eagle* mine.

VII.—Augite biotite latite (extrusive equivalent of monzonite), Record Mountain ridge west of Rossland.

VIII.—Sheppard granite, south-east of Rossland, four miles east of Lake Mountain.

IX.—Average pulaskite, Daly, page 22.
X.—Pulaskite, Rossland.

	II.	IV.	VI.	X.	X (Norm.).
Quartz	...	14.22	...	...	...
Orthoclase	19.00	22.20	...	34.10	39.60
Plagioclase, Ab	29.35	40.93	28.39	46.64	44.60
„ An	7.80	4.52	16.70	1.13	0.27
Biotite	9.40	6.55	...	5.86*	1.13
Hornblende	...	8.83	...	7.45	9.00
Pyroxene	23.76	...	34.70	...	...
Magnetite	1.15	1.45	1.41	0.70	3.15
Ilmenite	1.25	0.47	1.50	...	...
Rutile	...	...	...	0.54	...
Kaolin	5.40	0.85	3.68	1.30	2.06
Muscovite	...	...	8.32	...	...
Chlorite	...	...	2.93	...	...
Apatite	0.25	...	0.39	...	...
Calcite	0.20	...	0.45	...	...
Pyrite	0.25	...	0.81	...	...
	97.81	100.02	99.28	97.72	99.81

* Neph.

According to the quantitative classification these would be:—

No. II. Class Salfemane.
Order Gallare.
Range Camptonase.
Sub Range Kentallenose.

No. IV. Class Persalane.
Order Brittanare.
Range Toscanase.
Sub Range Toscanose.

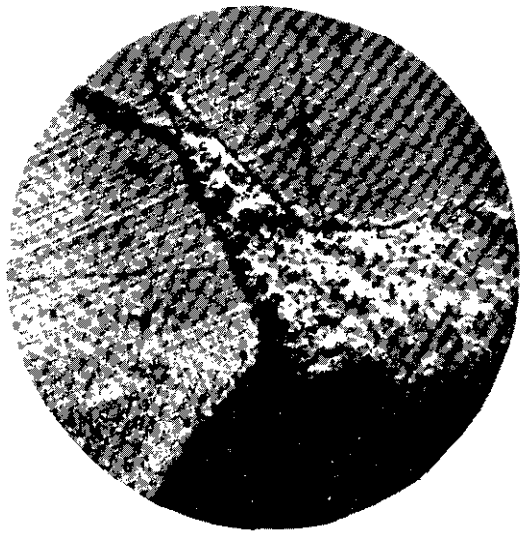
No. VI. Class Salfemane.
Order Gallare.
Range Auvergnase.
Sub Range Auvergnose.

No. X. Class Dosalane.
Order Germanare.
Range Monzonase.
Sub Range Monzonose.

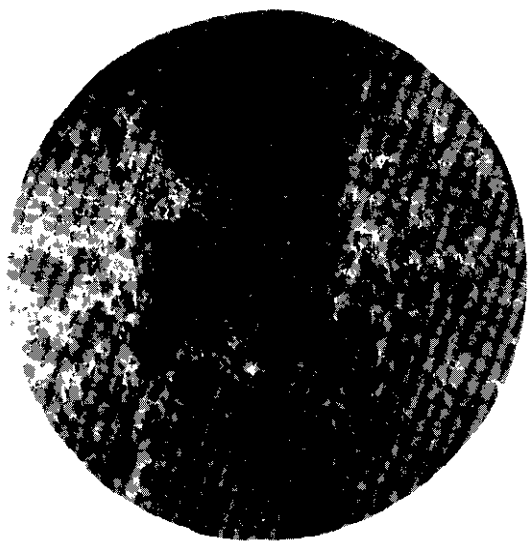
The deep-seated rocks at Rossland range from medium basicity in types such as augite-porphyrite and the normal monzonite to typical granodiorites, and in the later intrusions to rocks of rather alkaline character represented by the pulaskite masses. Comparison of these varieties with average rocks of each class shows a rather close agreement in all cases. The dykes, on the evidence of microscopic work, are in part aschistic representatives of these deep-seated masses and in part basic residuals. The former are augite-camptonites and vogesites, the latter minettes and kersantites. Besides rocks that can be definitely assigned to some of these classes, there are transitional varieties that do not correspond exactly to any type.

MINERALOGY.

In the description of the minerals occurring in the Rossland district those found only as rock-forming constituents are not included. Descriptions of those will be found in the discussion of the petrography.

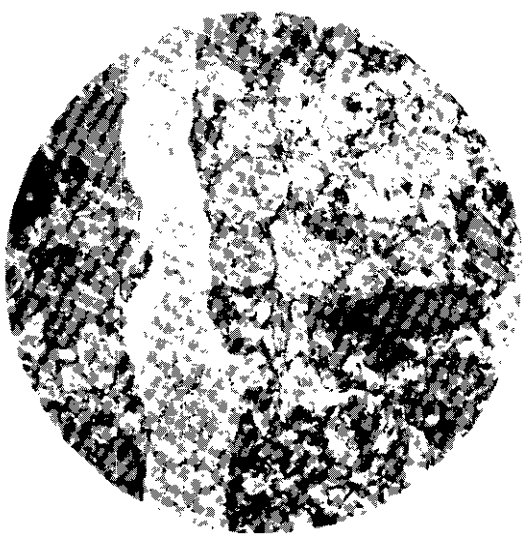


Chalcopyrite cutting Pyrite (lined) and Pyrrhotite (black).



Pyrrhotite (black) cutting Chalcopyrite (white). Josie Mine.

Monzonite, War Eagle, Third Level. Crossed Nicols.



Quartz Stringer in Silicified Diorite Porphyry, Le Roi Mine.

While the variety of minerals found is rather large, well-crystallized species are the exception and the ore-minerals are practically always massive. Most of the minerals of the following descriptions are found in close relationship to the veins. The order of arrangement follows Dana's classification.

NATIVE ELEMENTS.

Gold.—Native gold was found in impregnations of arsenopyrite, pyrrhotite, pyrite, molybdenite, and bismuthinite near alkali-syenite dykes at the *Giant* and *Jumbo* mines. It is also found in small flakes in quartz veins in the mines of the *O.K.* group. A part of the gold of the ordinary sulphide ores is in the free state, the percentage of the free-milling gold varying from 10 to 50 per cent. of the total gold content. Some pockets of gold have been found in the sulphide ores.

Silver.—The ores are always argentiferous, but no native silver has been reported. Wherever galena occurs it is silver-bearing, but even in the ores free from galena, silver is present. It seems likely that it is associated with the sulphides in a relationship similar to that of the gold.

SULPHIDES.

Stibnite.—Stibnite occurs sparingly in a fine-grained massive form at the *Lily May*. It is associated with sphalerite, galena, pyrrhotite, and chalcopyrite.

Bismuthinite.—Bismuth sulphide is mentioned in the preliminary report on this district as occurrying in impregnations near pulaskite dykes at the *Giant* and *Jumbo* mines.

Molybdenite.—Molybdenite occurs in a fine-grained massive form and as scaly aggregates. At the *Velvet* mine, on Sheep creek, ten miles west of Rossland, there is a lens of soft flaky molybdenite 2 feet long by 3 inches across. The mineral is common in the veins of the *Cowey* and *Novelty* claims on the slopes of Red mountain. There it is the massive fine-grained variety.

Galena.—Lead sulphide is found rather sparingly in the *Centre Star*, *War Eagle*, *Josie* group of mines, but in the South Belt deposits it becomes one of the more important ore-minerals. At the *Lily May* mine considerable galena occurs in the massive form, showing cleavage cubes a quarter of an inch in diameter. It is argentiferous and associated with sphalerite, chalcopyrite, pyrrhotite, and a little stibnite.

Sphalerite.—In association with galena, zinc sulphide is one of the prominent minerals in the ores of the South Belt. It is found rather rarely in the deposits of Red mountain. A specimen from the eleventh intermediate level of the *War Eagle* shows a brownish-black variety of sphalerite cutting vein-like through chalcopyrite and pyrrhotite. Massive fine-grained sphalerite of a deep-brownish colour was also observed as small irregular veinlets and blebs in a greenish siliceous rock from the 900-foot level of the *Josie*.

Pyrrhotite.—This is one of the important ore-minerals. It is massive and granular in character, both coarse- and fine-grained, and probably of different ages of deposition. Some specimens show it as distinct veinlets cutting chalcopyrite, but this does not seem to always hold true. The pyrrhotite is auriferous, but the coarse-grained varieties are usually low grade. It nearly always carries a determinable amount of nickel and a trace of cobalt. Dickson states that the Rossland pyrrhotite agrees with the formula $Fe_8 S_9$. In the Sudbury ore he states that the nickel did not replace part of the iron in pyrrhotite, but occurred in the mineral pentlandite. So far no pentlandite has been recognized at Rossland, but Gersdorffite* NiAsS has been reported. Analyses of pyrrhotite from the *Monte Christo* gives Ni, 0.13; Co, trace. Samples from the *Evening Star* show Ni, 0.67; Co, 1.58.

Chalcopyrite.—Possibly the most important ore-mineral of the camp is chalcopyrite. It is always massive and fine-grained, occurring as veinlets and impregnations in association with pyrrhotite and pyrite. It carries both gold and silver values. A large part of the ore contains only a small amount of chalcopyrite, probably less than 1 per cent. Rarely, however, ore-shoots are found in which the sulphides consist largely of chalcopyrite, and the copper content will run up to 10 or 15 per cent.

Pyrite.—Pyrite of several generations is present in the rocks and ores. In the Mount Roberts slates it is a constant accessory, often forming cubes and cubo-octahedra a third of an inch in diameter. In the veins it is usually massive and is probably of different periods of

* Annual Report, Geological Survey of Canada, 1901, page 163H.

mineralization. Some of the pyrite carries but little gold, while in other samples it seems to rank with the pyrrhotite and chalcopyrite as an ore-mineral. As a rule, in the ore it shows no crystal outlines, but samples from the fourteenth level of the *War Eagle* contain large unmodified octahedra.

Gersdorffite nickel sulph. arsenide has been reported as small octahedral crystals from the *Columbia-Kootenay* vein.*

Marcasite.—No definite crystals of marcasite were found, but some of the sulphides are rather pale in colour and may be marcasite rather than pyrite.

Arsenopyrite.—Arsenopyrite occurs with sulphides as impregnations in the country-rocks, and also occasionally as a constituent of the vein-filling. In the stratified rocks of the South Belt and of Red mountain it is disseminated in the same manner as the pyrite, and by its weathering helps to give the rusty colouring to the Mount Roberts formation. Wherever much arsenopyrite is present the gossan assumes a yellowish colour. In the *Coxey-Novelty* vein arsenopyrite is a prominent mineral along with molybdenite and some chalcopyrite. There it is a fine-grained massive variety. In the South Belt crystals were found in the *Deer Park* vein showing the usual combination of the brachydome (011) and macrodome (101). The arsenopyrite is nearly always cobaltiferous, and some of it may approach danaite (FeCo) S_2 (FeCo) As_2 in composition. An analysis of such a specimen gave the following results:† As, 47.60; S, 19.70; Fe, 29.65; Co, 3.05.

OXIDES.

Quartz.—Quartz occurs as a massive milky-white variety in veins at the mines of the *O.K.* group. It carries free gold and some sulphides. The rocks near the main veins in all the mines are often highly silicified and quartz stringers are found in the workings.

Magnetite.—Massive magnetite showing good octahedral cleavage was found on the *Sunset* dump in the South Belt. It is also rarely a constituent of the Red Mountain ores. Specimens from the *Novelty* and *Coxey* claims show rather large amounts of it.

Limonite.—Hydrated iron oxides, mostly limonite, are found abundantly wherever the surface waters have had an opportunity to act. The rusty colour from which Red mountain derives its name is due to the alteration of disseminated sulphides to limonite. Fissures where surface waters have had an opportunity to act. The rusty colour from which Red mountain derives its workings are covered with a thin coating of the mineral. In old drifts stalagmites of limonite are forming, consisting of a hard brownish-black outer shell with a soft earthy filling.

CARBONATES.

Calcite.—Calcite is found in two varieties—a massive granular form filling fissures and as an impregnation in the rocks and as fine crystals in vuggs and open fissures. Some individuals are almost cubes with curved faces which render measurement difficult, but they approach the rhombohedron (0111). These are often twinned. Other specimens show combinations of the base, rhombohedra, and scalenohedra. The scalenohedral faces are dull and striated, while the other forms are bright and smooth. Measurements are not satisfactory, but approximate an index (1232) for the scalenohedron, which the cleavage shows to be a negative form. One rhombohedron has the index 0221, while another doubtful series of faces give the index 0775. Another specimen shows a combination of the basal pinacoid (0001), a scalenohedron with curved and striated faces possibly (1232), a rhombohedron corresponding to M (4041), and a series of rhombohedra the intermediate and best developed of which give angles nearly agreeing with the index (0554). Thus the forms recognized are:—

Basal pinacoid	0001	
Rhombohedra	0111	4041
	0554	0221
		0775
Scalenohedron		1232

Malachite.—Green copper carbonates is the common alteration product of the copper-bearing ores. It forms coatings on cleavage-planes and other openings, and colours the gouge in the upper portions of the fissures. It can be seen in the process of deposition wherever downward-seeping surface waters trickle into the mine-workings.

* Annual Report, Geological Survey of Canada, 1901, page 151H.
† Annual Report, Geological Survey of Canada, 1895, page 13R.

Azurite.—Blue carbonate of copper is not so common, but was observed in a small cavity in quartz at the *O.K.* mine.

SILICATES.

Wollastonite.—Wollastonite has been reported from Rossland, and the optical properties of a greyish bladed mineral from the *War Eagle* indicate that it should be referred to this species.

Actinolite.—Actinolite occurs in a sample of ore from the 600-foot level of the *Le Roi.* It forms rosettes of silky green needles between which chalcopyrite and pyrrhotite have been deposited. Also in a small cavity in monzonite from the *City of Spokane* tunnel small dark-green radiating needles of actinolite occur. It is an associate of the chalcopyrite ore of the *Deer Park* mine, and in general seems to be frequently developed as a secondary mineral near ore-bearing fissures.

Garnet.—Massive reddish-brown garnet occurs in the ores occasionally, and in vuggs small deep-red crystals are sometimes found. The usual form is the trapezohedron.

Epidote.—Epidote is a frequent secondary product of rock-alteration and is found in fissures and irregular masses in all formations, but more especially in the older granitic rocks. In the deeper levels the rocks sometimes exhibit a faint banding that seems to be due to the presence of epidote along certain zones.

Apophylite.—Apophylite is one of the most common of the crystallized minerals in the vuggs and the open fissures. Crystals of three different habits have been noted:—

(*a.*) Crystals of the type common in apophylite, consisting of the almost cubic form of the prism and basal pinacoid. The corners are usually modified by the unit pyramid. The colour of this variety is white with a pearly lustre.

(*b.*) The second type has the prism relatively elongated and the pyramid developed to the exclusion of the basal pinacoid. The colour is a faint pink.

(*c.*) The third type is flat tabular. The prism is only slightly developed and unstriated. The base and unit pyramid are the prominent forms. The crystals are aggregated either in parallel groups with the basal faces in contact or in radiating growths. The colour is pink.

Apophylite of the first type with crystals ⅕ inch in diameter forms an encrustation on brecciated vein-matter on the 1,200-foot level of the *Centre Star.* Crystals from the second level approach the second type, but still retain a small basal pinacoid.

Laumontite.—This mineral is also commonly found among the minerals of the vuggs. It forms delicate needle-like crystals showing the unit prism terminated by the orthodome (201). When first obtained the crystals are bright and transparent, but on exposure to surface conditions they lose water and soon become white and opaque and finally disintegrate.

Chabazite.—Chabazite occurs under the same conditions as and in association with laumontite. It forms almost cubic rhombohedra ⅛ inch in diameter and often forms penetration twins. The variety is white with a delicate pearly lustre.

Gmelinite.—Gmelinite has been reported as reddish white well-formed translucent crystals of rhombohedral habit occurring in the *War Eagle* workings.*

Prehnite.—Translucent prehnite. Olive-green when fresh, but becoming white on exposure, was found in the No. 3 *War Eagle* tunnel. Minute pyrite crystals were found on the surface.

Muscovite.—Muscovite is common as an alteration product and a constituent on the zone of secondary minerals developed by the ore solutions.

Biotite.—The black mica is also produced rather commonly in the neighbourhood of the ores.

Chlorite.—This mineral is found in large amounts in similar relationships as muscovite and biotite.

Serpentine.—Impure serpentine forms a rock type exposed at various places near Rossland. An outcrop is found on the Great Northern Railway near the *O.K.* mine. It is probably a product of the alteration of a pyroxenite or similar basic rock. Serpentine is also common in fissures and along fault surfaces.

Erythrite.—Hydrous cobalt arsenate forms as an earthy alteration product from cobaltiferous minerals. It is found chiefly as a thin coating on pyrrhotite or arsenopyrite.

* Annual Report, Geological Survey of Canada, 1899, page 2R.
† Geological Survey of Canada, Memoir 77, page 82.

Epsomite.—A silky hair-like encrustation frequently covers the walls of the drier workings. In undisturbed places these crystals often reach a length of 1½ inches, usually in curved forms. The substances examined consisted almost entirely of magnesium sulphate. A small amount of alumina was present and may represent a slight admixture of aluminum sulphates.

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BOUNDARY DISTRICT.

NOTES BY J. D. GALLOWAY, ASSISTANT MINERALOGIST.

The term "Boundary District" includes the following Mining Divisions: Greenwood, Grand Forks, Osoyoos, Similkameen, Nicola, Vernon, Kamloops, Ashcroft, and Yale. Of these, the first three are the most important and each year from 40 to 50 per cent. of the total tonnage of ore mined in the Province comes from them. The largest individual shipper is the Granby Company, with mines at Phoenix and a smelter at Grand Forks.

Ashcroft Division has been the scene of considerable mining activity in the past year and promises well for the future. Similkameen Division also has at least one big mining proposition well under way, and should before long contribute a substantial yearly tonnage. All the other Divisions have some mining and development work going on in them, and it seems quite probable that the Boundary District will, in the future, at least maintain its position as the largest tonnage-producer in the Province.

The large tonnage of ore from this district is largely made up of low-grade copper ore, and during the past year this ore has been a little lower grade than ever before; the reason for this being that the high price of copper made it profitable to handle ore of very low grade which it would not pay to work at the normal price of copper. It is indeed noteworthy that some ore from the Granby Company was handled at a profit from which was made a recovery of only 10 lb. of copper a ton and about 60 cents a ton in gold and silver. Similarly, the British Columbia Copper Company handled much low-grade ore.

The output of the district was 1,352,683 tons, which contained: Gold, 76,230 oz.; silver, 285,623 oz.; copper, 18,445,850 lb.; lead, 62,302 lb. As compared with 1915, these figures show an increase in tonnage and a slight decrease all round for the contained metals.

GRAND FORKS AND GREENWOOD MINING DIVISIONS.

Granby Consolidated Mining, Smelting, and Power Company.—Production figures for the year for this company will be found in the Gold Commissioner's report for Greenwood. This company's operations embrace those in the Boundary District, as well as the large mine and smelter at Anyox, Skeena Mining Division, and some smaller properties in Alaska. The fiscal year of this company ends on June 30th, and the annual report issued includes reports on operations at all its mines and smelters. It is interesting to note that in 1916 this company mined and smelted — per cent. of the total ore-production of the Province and produced — per cent. of the total copper-output. The importance of the company's operations are such that it is considered advisable to give some lengthy extracts from the annual report of the company for the fiscal year ended June 30th, 1916, as follows:—

"TREASURER'S REPORT.

"Following is a summary of the year's business:—

"*Mineral-bearing Ores treated.*

Ores of	Ore smelted, Dry Tons.	Lb. Copper recovered per Ton Ore.	Metals recovered.			Value Silver and Gold per Ton.
			Copper, Lb. Fine.	Silver, Oz. Fine.	Gold, Oz. Fine.	
Phœnix mines (treated at Grand Forks smelter)...	1,097,299	14.6	15,992,476	204,779	36,801	$0.779
Hidden Creek mines (treated at Anyox smelter)...	722,630	33.23	24,012,838	186,041	4,928	0.297
Alaska mines (treated at Anyox smelter).....	66,617	32.90	2,192,769	12,424	1,468	0.545
Quartz-mines (treated at Anyox smelter).....	10,705	...	....	84,601	1,651	7.241
Total from all mines owned by the Company.....	1,897,251	22.36	42,198,083	487,845	44,848	$0.624
Customs ores purchased and treated at the Grand Forks smelter.....	8,816	....	77,020	50,329	3,023	....
Custom ores purchased and treated at the Anyox smelter.....	23,138	....	3,356,570	41,346	2,100	....
Totals	1,929,205	....	45,631,673	579,520	49,971	....

"*Amount realized.*

From Ores of	Copper.	Per Lb.	Silver.	Gold.	Value per Ton Ore.
Phœnix mines	$3,585,580 32	$0.22438	$119,525 55	$735,222 38	$4.046
Hidden Creek mine	5,226,500 95	0.2176	116,147 22	98,559 51	7.53
Alaska mines	487,256 06	0.2222	6,966 50	29,356 69	7.36
Quartz-mines	....	....	44,576 76	33,017 48	7.241
Total from all mines owned by the Company	$9,299,337 33	$0.2204	$287,216 03	$896,156 06	$5.525
Custom ores treated at the Grand Forks smelter	14,966 78	0.1944	26,347 95	61,255 90	.....
Custom ores treated at the Anyox smelter	719,712 67	0.2144	23,510 55	41,996 74	....
Totals	$10,034,016 78	....	$337,074 53	$999,408 70	....

"*Profit and Loss Account.*

"To Copper Account costs—for mining, ore, transportation, smelting, refining, and selling charges		$7,262,879 34
Less 487,845 oz. silver sold at average price of $0.59	$287,216 03	
Less 44,848 oz. gold sold at average price of $20	896,156 06	
Less amount realized from custom ores	887,790 59	
		2,071,162 68
	Per Lb.	
Cost of copper produced from mines owned by the Company, 42,198,083 lb. @	0.1230	$5,191,716 66
Interest on bonds	0.0051	213,820 90
Extraordinary expenditures	0.0017	74,504 75
"By Copper Account sales—	0.1298	$5,480,042 31
29,887,601 lb. sold at $0.2298		
7,838,682 lb. en route to refinery inventoried at 0.2157		
4,471,800 lb. on hand at smelters inventoried at 0.1652		
42,198,083 lb. at an average price of	0.2204	9,299,337 33
Profit for year	0.0906	$3,819,295 02
To dividends		899,911 20
Net surplus for year		$2,919,383 82
Surplus carried over from last year		3,668,086 79
Total surplus at credit, June 30th, 1916		$6,587,470 61

"*Balance-sheet—June 30th, 1916.*

"Assets—		
Mine properties		$15,123,568 26
Real estate, timber lands, machinery, buildings, dwellings, and equipment at Anyox, Grand Forks, Phoenix, and Kettle Falls		5,242,747 64
Shares of other companies		575,643 77
Sundry materials and supplies on hand and accounts receivable		1,041,011 68
Cash and metals on hand—		
Ore	$ 96,299 10	
Copper in process	766,963 00	
Metals sold for future payment	188,376 76	
Metals in transit to refinery	1,731,229 60	
Cash in banks	144,448 05	
		2,927,316 51
		$24,910,287 86

"Liabilities—

Capital stock—149,985.20 shares @ $100		$14,998,520 00
Bonds—Convertible First Mortgage 6% Gold Bonds, due May 1st, 1928		3,042,300 00
Accounts payable—		
Wages	$143,582 12	
Sundry supplies	45,075 90	
Interest on bonds	30,423 00	
Reserve for sundry expenses	35,868 68	
Accident reserve	25,825 07	
Liquidator dividends	1,222 48	
		281,997 25
Surplus		6,587,470 61
		$24,910,287 86

"G. W. WOOSTER, *Treasurer.*

"MANAGING DIRECTOR'S REPORT.

(F. M. Sylvester.)

"The accompanying reports for the fiscal year ending June 30th, 1916, of the various operations of your company are respectfully submitted herewith, together with a brief statement of these operations and the results obtained for the year.

"During the fiscal year there were mined and treated at your several plants 1,897,251 tons of ore—

Producing	42,198,083	lb. copper.
Producing	487,845	oz. silver.
Producing	44,848	oz. gold.

"The ore reserves of your various mines comprise the following:—

Of a grade 2 to 2½ per cent. copper	9,947,000	tons.
Of a grade 1 to 1½ per cent. copper	3,718,000	"
Of a grade less than 1 per cent. copper	9,491,000	"
Total	23,156,000	"

"The development-work at Phoenix did not replace with new ore the amount shipped from the mine during the year by 721,400 tons.

"At Anyox the new-found ore exceeded that which was shipped during the year by 182,833 tons.

"At Valdes, Alaska, no effort was made to ship ore from the *Midas* mine during the year, principally because of lack of transportation. At this date, however, one cargo of 2,000 tons has been received at Anyox, and regular shipments are expected from this point, except, perhaps, during the most severe winter months.

"At Phoenix-Grand Forks the operations have proceeded in the usual manner; the efficiency of production of the last two years has been maintained, though the cost per pound of copper has been higher, due to higher wages and higher cost of all supplies and to working 330,000 tons of low-grade ore that could not have been handled except for the prevailing high price of copper.

"At Anyox an unusually severe winter restricted the water-power, curtailing the operations and output of that plant.

"The auxiliary steam-power plant authorized by your Board at their meeting on the 18th day of April last will be in operation by November 1st, and in time to supplement the water-power as it lessens under the approaching winter conditions.

"At the mine it is confidently expected that the development-work of the next year or two will add to the ore reserves.

"At the smelter, during the last year, many of the previous difficulties of operations have been overcome in a satisfactory manner; the tons of ore smelted per furnace-day increased 9.8 per cent.; the length of furnace campaigns increased 73 per cent.; while the time lost due to break-downs and trouble about the smelter has been decreased 66 per cent. compared with

the previous operations. The installation of a mechanical feed system at the level of the feed-floor of the furnaces has added much to the furnace efficiency, as well as to increase the efficiency of the train service, by permitting the trains to operate between the bunkers and the furnaces continuously without having to wait at the furnaces until a charge is needed, before the charge-cars of the train can be dumped, as was the case before the feeding system was installed, and it is expected in the near future that some other elements of the operation will be smoothed out and changed in a manner that will increase the efficiency of the plant and lead to a reduction of costs.

"A number of more or less promising prospects have been examined during the year, usually with negative results, though a few have sufficient promise to warrant the options to purchase, which have been taken on them.

"In the case of Maple Bay property, up to the end of the year enough work was done to keep the agreement in force. Since then more active work has been inaugurated with a view of supplementing the present barren quartz-supply with quartz from this property carrying copper. This is in line with our general endeavour to replace barren fluxes with ores of like nature carrying values.

"Since our last report a research department has been inaugurated at this office and much useful information has been secured during the year. Experiments have been carried on with parts of the low-grade ore-body of the Anyox mine, and this work will be continued from time to time in connection with this ore, so that the simplest as well as the most economical method of concentration may be established.

"Constant attention is being given to the welfare and protection of the men in the company's employ, and very substantial progress is being made in interesting the men themselves in "Safety First" ideas, with a corresponding benefit to them.

"The unremitting efforts of the heads of departments of mines and smelters, of the treasurer's department and their assistants, are commended to your consideration. It is to their efforts, loyalty, and zeal in forwarding the interests of the company that we are largely indebted for the results obtained, as set forth in these reports.

"ANNUAL REPORT OF THE SUPERINTENDENT OF SMELTERS.

(W. A. Williams.)

"*Anyox Smelter.*

"The second year of operations at this plant shows decided improvement over the preceding year from a metallurgical standpoint and in many other ways.

"We operated 1,167.43 furnace-days out of a total of 1,414 days. On account of power shortage during the winter months we lost 141 furnace-days; on account of ore shortage two days, smelter strike eleven days, mine strike five days, making a total of 159 furnace-days lost for reasons not attributable to smelter troubles. We averaged 3.2 furnaces out of four for the year.

"On the lower or tapping floor we have solved a great many problems incidental to handling a large tonnage of corrosive molten material, which has all tended toward the lengthening of campaigns. The molten material handled aggregated 250,000 tons.

"The charging system was changed this year to Anaconda type charge-cars, which dump the ore into pockets, the charge being pushed into furnaces by ploughs operated by compressed air when needed. This has been a decided improvement over the old method, and has been our chief aid in etxending the length of campaigns.

"No. 4 furnace, which has a shaft depth 5 feet greater than the original furnaces, was operated ten months and a half. It was watched carefully to see if the increased depth was an improvement. There seems to be no gain in the grade of matte used, increased tonnage or percentage of coke used. However, there does seem to be some gain in the length of campaign and reduced crust formation due to the increased drop of charge. For this reason, if we install another furnace, we will have it made the same as No. 4, but we do not think there is sufficient advantage gained by the increased depth of shaft to warrant changing the old furnaces to conform to this height.

"In the smelting of our own ores we have made an effort to keep to the proper proportion of No. 1 and No. 2 ore-bodies, both as to quantities and analyses. As regards tonnage, we have smelted approximately equal parts of No. 1 and No. 2 ores, but I believe we have been a little on the low side on silica. The average of the total ore-bodies will be somewhat higher in silica than the average analysis for the year 1915-16. As regards copper content, the ores are about the average of the whole body.

"We have come to the conclusion that true pyritic smelting cannot be done with the main ores as we did in starting up—i.e., with very low coke and no fluxes. This can be done at times, but not frequently enough to say it is the practice. The percentage of SiO_2 free is very small, most of it being present as combined silicates. The Al_2O_3 is also high and will probably exceed in the total ore-bodies the average for this year. We find it necessary to use fairly high coke and limestone as flux. To date, the ores coming to the smelter have varied greatly in their silica content from lot to lot. This has created a tendency to uneven running and the use of a slightly greater quantity of coke and flux than would have been used otherwise. I see no remedy for this condition until the mine is opened more as the development progresses or until such time as a sorting-table and screening plant are installed.

"We have not yet been able to make a converter grade of matte in the first smelting operation, as the degree of oxidation is low, and the matte fall from the ore-smelting is too great for the converters to handle. Therefore we have used one furnace practically throughout the year as a regrading-furnace, which means that three furnaces were operated smelting green ore, while the fourth furnace was used for regrading matte. I believe now that the better method would be to take all the matte straight to the converters, irrespective of grade, and convert direct. This would increase our tonnage of green ore and tend to lower costs all round, and, at the same time, help our recoveries. The reason we are not carrying out this practice at the present time is lack of converter capacity.

"Tons of ore per furnace-day have increased from 630 to 692, and tons of charge from 846 to 929. I would call attention to the fact that during the year we smelted 88,853 tons of foreign ore, which means that one blast-furnace was used 35 per cent. of its time for the total year in the smelting of this ore to the exclusion of our own ores, and that higher cost of mining resulted. due to a lesser tonnage shipped from our own mines. We have 46,480 tons of flue-dust stored awaiting the installation of a sintering plant.

"No changes have been made in the converting department. The converters worked steadily with the exception of the five winter months, during which time they only worked 57 out of 152 days on account of lack of power. Additional converter capacity is needed in this department.

"The cost of smelting and converting was $1.804 per ton of ore. This figure is $0.073 less than the previous year, but it is higher than we anticipated. The increase in wages due to the rise in price of copper added $0.0457 per ton of ore. The use of about 20,000 tons of barren quartz in the regrading and converting of matte (used on account of the scarcity of quartz with values) added $0.068 per ton of ore. At the present time we are endeavouring to take care of this point with the opening of the Maple Bay properties. Lime flux added $0.152 to the costs per ton of ore. Ore carrying excess lime would be advantageous in cutting this cost down. The shipping of 21,428 tons of matte to the Grand Forks plant for conversion into blister-copper, on account of power shortage, added $0.02 per ton of ore. Coke was a few cents higher on account of quality and handling in and out of storage due to the irregularity of vessels' schedules caused by strikes of longshoremen. This added $0.01 to our costs. Owing to the European war all supplies advanced 10 per cent. over normal prices. This meant an addition to our costs of $0.04, making a total increase of $0.335, the greater part of which amount will be eliminated from our costs in time.

"During the past year there was considerable new work which was found necessary to charge to operation. I refer to such items as fire-protection of the 6-foot water-pipe from the dam to the power-house and of the railroad trestles; some agglomerator charges, new roof for main smelter buildings, ore-bin extension, and charge-cars.

"It will be seen from the above that it is reasonable to expect a reduction in our costs for the coming year. Ore costs would have shown $0.06 less had the profits made by the different departments, operating as independent concerns, been credited back. Another large item of expense which shows against our costs for the past year is auxiliary power supplied for five months during the winter. Our new steam plant now under construction will take care of this

heavy expense and allow us to run to capacity throughout the coming winter. The sintering plant, when installed, will take care of our flue-dust and increase the recovery of copper per ton of ore.

"While I think the past year's work shows up fairly satisfactorily, considering the many problems we have had to overcome, I believe the current fiscal year will show a decided improvement in costs, tonnages, and recoveries.

"I wish to express my appreciation of the services of A. J. Bone, superintendent, and the staff as a whole for their loyalty to the company and attention paid to the work during the past year.

"*Grand Forks Smelter.*

"Operations at this plant for the fiscal year ending June 30th, 1916, were characterized chiefly by the handling of nearly 500,000 tons of material which was very low in copper content and highly siliceous. Up to the present time this material has not been taken into the ore reserves, but on account of the very high price of copper which has prevailed during the past year it became profitable to handle. This partially accounts for the high costs of that period. However, for the first six months of the year the costs were the lowest in the history of the plant, being $1.233 for smelting and converting.

"Owing to the high price of copper the increase of wages added 1.7 cents to costs. Coke was 1.3 cents higher per ton of ore, due to the siliceous nature of the ore. Anyox matte added 0.7 cents. The slow running of the furnaces, due to high silica slags, offsets the increase of this year's costs over last year.

"With eight furnaces in blast, there were from 195 to 200 men on the pay-roll.

"There was no new construction during the year, but repairs have been kept up and the plant is in first-class operating condition.

"I wish to give credit to W. B. Bishop, superintendent, and the staff under him for the good work done and the loyalty displayed during the past year.

SUPERINTENDENT'S ANNUAL REPORT ON ANYOX MINES.

(E. E. Campbell.)

"This year has been one of continuous progress, and operations at *Hidden Creek* show a larger and more regular output than in 1914-15. This is due to the further development of the mine and to improvements in mine equipment, whilst the advantage of working larger stopes and distributing operations over a wider area was very evident. The improvement in smelting operations and the increased tonnage requirements at the smelter were also material factors in the attainment of the progress shown.

"*Hidden Creek Mine—Mining.*

"*Tonnage.*—The ore mined and shipped to the smelter during the year ending June 30th, 1916, amounted to 725,821 dry tons. Of this amount, 355,328 tons, or 49 per cent. of the total, came from No. 1 ore-body; 352,238 tons, or 48.5 per cent. of the total, came from No. 2 ore-body; and 18,255 tons, or 2.5 per cent. of the total, came from the siliceous zone on the outskirts of No. 1 ore-body, only a small proportion of which is included in the tonnage estimate of No. 1 ore. The total tonnage shipped to date amounts to 1,270,484 tons.

"*Ore Grade.*—The average grade of ore shipped during the first six months of the year was much lower than that of the succeeding half-year. This difference is most apparent in the grade of the No. 1 ore, and arises from the fact that a considerable tonnage of high-grade ore was developed and mined from the north end of No. 1 ore-body during the period from January to the end of the present year.

"*Haulage.*—After increasing the output of the mine, incident to increasing the smelter capacity, the haulage system was worked beyond capacity, increasing greatly the cost of car repairs and the cost of the general upkeep of rolling-stock. This called for an increase of capacity of the system, which is being made by instituting heavier cars, motors, and track. This change is well under way and will be completed in a few months.

"*Crushing.*—During the first half-year No. 1 crusher handled the mine output. On the completion of the new crushing plant about January 1st, the old plant was shut down for much-

needed repairs, and has not been operated since, except for short periods. The average amount of rock crushed per hour for the year is 205.2 tons, while the total running time was 3,537 hours.

"*Power.*—During the winter months of 1915-16 mining operations were seriously handicapped from shortage of power, caused by intensely cold weather. A small auxiliary steam plant was installed to provide air for the mine, but the capacity of this was too small to permit working more than half the machines that normally should be worked. Ore shipments were kept as high as possible at the expense of development and other necessary work requiring power. This materially affected the yearly mining operations, and imposed working costs far above the average, together with a greatly reduced tonnage.

"*Overburden.*—During the year 35,050 tons of waste have been handled, part of which was from development-work and part from overburden handled from the surface through the mine. The work of clearing the debris from the surface of No. 1 and No. 2 ore-bodies has been carried on steadily throughout the year, with the exception of the winter months. This work shows very satisfactory progress, and sufficient surface of No. 2 ore-body has been uncovered to keep ahead of mining operations for several years.

"A large amount of timber has been cut from in and around the mine townsite with a view to making room for further construction and as an added protection from fire.

"*Development.*

"The underground development done during the year amounted to 2,333 feet, consisting of 1,099 feet of drifting and 1,234 feet of raising. This makes a grand total of 27,439 feet, of which 17,733 feet is drifting and 9,706 feet is raising. The extension of the 150 tunnel was started April 1st. This is a continuation of the smelter train-loading level, and is 235 feet below the next working-tunnel above. In order to make room for a larger train, a further extension of 292 feet was driven 12 x 12, making in all 726 feet of this size. A contract has been let for 1,000 feet extension of 9 x 9 tunnel, which is being driven towards the No. 1 ore-body. This work has been extended 102 feet on June 30th.

"*Diamond-drilling.*

"Diamond-drill exploration-work was not started until December, 1915, when one machine was put in operation and continued work for the balance of the year. During that period 5,873 feet of drilling was done, all of which was carried on in No. 1 ore-body, first at the south end of the ore-body, where some indefinite ground remained to be proven, and latterly at the north end, where the northerly extension of No. 1 ore-body is being determined.

"The total diamond-drilling up to date is 49,464 feet.

"*New Equipment and Construction.*

"The largest item under equipment is the new crushing plant, which was completed January 1st, 1916, and has since been operating most satisfactorily. The new electric hoists were installed on the surface, one at the head of the incline from the 385 level, and the other at the head of the incline from the 150 level. These hoists replaced two air-hoists, the change being made to economize in compressed air, all of which was required in the underground operations.

"A change was made in the type of rock-drill used. Up to this year the large piston machine was used almost exclusively. These are being replaced by the hammer-drill using hollow steel. In speed of drilling and cost of upkeep these drills show a marked advantage over the piston machine, while there are other economies, such as the reduced cost of explosives for bulldozing and decreased handling costs of ore due to the rock being broken finer.

"The new construction completed during the year, exclusive of mine equipment, consists of seventeen cottages, a school-house, a powder-magazine, a small machine-shop, a stable and carriage shed, and a new building of three stories for the use of the employees, including the following: First story, locker-room, wash-room, toilet and shower baths; second story, reading-room, pool-room, shiftboss office, miners' waiting-room, doctor's office, and emergency hospital ward. The third story consists of a recreation-hall.

"Several new buildings are under construction, consisting of ten cottages, a mine mess-house, a carpenter's shop, and a mine office.

"*Costs.*

"The year 1915-16 presented economic conditions that made low operating costs impossible. The cost of all mining supplies shows an advance over that of the previous year of 15 per cent. while the cost of labour advanced 14.3 per cent. for the year. These increases, together with the physical conditions caused by a very severe winter, all helped to add to mining costs that otherwise would have been far below all expectations.

"*Mining.*—The cost per ton of ore mined, crushed, and delivered on the railroad-cars amounted to 99.6 cents. This cost includes all underground development, diamond-drilling, handling of waste and overburden, management, and all other operating charges.

"*Development.*—The development cost per foot was $18.89. The installation of larger cars and motors underground, requiring larger drifts, together with increased cost of labour and supplies, materially increased the cost of underground development.

"*Supplies.*—General mining supplies, with but few exceptions, show a marked increase in price over that of former years, while some articles are hard to buy at any price. The average increase of all supplies is approximately 15 per cent. over the prevailing prices paid in 1914-15.

"Applying the per cent. increase of both labour and supplies, the year's cost per ton under normal conditions would be 86.1 cents.

"*Ore Reserves.*

"The diamond-drill operations carried on during the last six months of the fiscal year make some changes in the ore reserves. The additions made to No. 1 ore-body, amounting to 812,200 tons, are more than sufficient to balance the year's output from all ore-bodies, as well as to make an increase in the grade of No. 1 ore-body from 2.24, which was last year's estimate of the high-grade ore, to 2.37, which is equivalent to 2.6 lb. of copper per ton.

"The estimated ore reserves remaining, after deducting the total shipments to June 30th, are as follows:—

Ore-body.	High Grade.	Low Grade.	Total.
	Tons.	Tons.	Tons.
No. 1	4,064,110	2,846,400	6,910,510
No. 2	3,949,000	4,334,735	8,283,735
No. 3	1,329,020	1,320,000	2,649,020
No. 4	74,255	100,500	174,755
Totals	9,416,385	8,601,635	18,018,020

"*Bonanza Mine.*

"There are no important developments to report on the *Bonanza* mine for the fiscal year. Early in the year plans for the necessary plant and installation were prepared, but up to June 30th construction-work had not been started.

"In general the plant will consist of an electrically driven air-compressor and ore-crusher at the mine. The crusher will feed on to a belt-conveyor, which will serve the double purpose of a sorting-belt and a means of conveying the broken ore across Bonanza creek to an ore-bin, from which it will be carried by an aerial tramway to bins at the Beach. From here the ore will be drawn into railway-cars carried on a special scow, from which they will be lifted to the track at Anyox dock by means of the 50-ton crane at present installed there.

"During the winter months the right-of-way for the aerial tramway was cleared and made ready for construction. With the exception of this item, no other work towards *Bonanza* development was started.

"The tonnage estimates and grade of the ore developed on this property are the same as reported a year ago.

"*Quartz.*

"On January 1st, 1916, the operation of all the properties from which quartz was being mined was turned over to the mining department. Most of the quartz obtained during the year came from Granby point, which produced a total for the year of 31,021 tons. Some additional

quartz was obtained from a property at Alice arm at a time when the smelter requirements demanded more than could be produced at Granby point. This property produced a total of 651 tons in the month of June, making a grand total of 31,672 tons, at a cost of $79,615.92, or $2,518 per ton. Included in the tonnage of quartz shipped from Granby point is 10,460 tons, carrying the following values: Au 0.164 and Ag 6.15, which reduces the cost of this item of flux by about $44.680.

"During the year diamond-drilling to the extent of 473 feet was done to attempt to prove that area from which quartz-carrying values was mined. As this work did not prove anything of value it was stopped after two months' work.

"On account of shortage of power on this property a new power plant, including a larger boiler and an extra compressor, was installed. This plant as it now stands consists of one 80-horse-power boiler equipped for oil-fuel, one compressor delivering 360 and one delivering 280 cubic feet of free air per minute at a pressure of 100 lb.

"In the month of June work was started on the equipment of a quartz property at the head of Granby bay. This property will be producing quartz by August 1st.

"*Limestone.*

"The lime-quarry at Swamp point operated continuously during the year, with the exception of the month of January, when the limited requirements of the smelter permitted closing down for that period.

"The tonnage of limestone broken and loaded on barges at Swamp point totalled 45,157.88 dry tons, at a total cost to the company of 69½ cents per ton.

"A new quarry is being opened up about one-half mile from the Beach, and construction-work in connection with this was started in June, 1916.

"*General.*

"*Labour.*—During the first few months of the fiscal year considerable unrest was evident amongst the employees. Many alien enemies were on the pay-roll, also many enemy sympathizers of different nationalities. To these can be attributed, more than to any others, the troubles experienced at that time. Several small strikes were started, all of which were settled before they materially effected mining operations. The last half-year shows a steady growth of harmony and goodwill between the company and its employees.

"The wages paid during the year show an increase over the normal wage scale of from 25 cents to $1 per day for every month of the year, under the sliding scale based on the selling-price of copper.

"The total increase for the year amounted to $51,991.47, or 7.2 cents per ton of ore shipped.

"In conclusion, the writer wishes to commend all department heads for their hearty co-operation and support, which aided materially in making the year's operations so satisfactory."

British Columbia Copper Company.—This company operated steadily during 1916, and at the Greenwood smelter one furnace was in blast all year, and the second one during part of the time. The company draws its ore mainly from the *Mother Lode* mine and a little from two properties in the State of Washington. Some custom ore is also bought by the smelter.

The production from the *Mother Lode-Sunset* group for the year was 264,717 tons, containing 8,613 oz. gold, 29,906 oz. silver, and 3,360,889 lb. copper. These figures show an increase as compared with the year 1915.

Other Properties.—The *Jewel* gold-mine and cyanide plant was operated under lease for a portion of the year and 2,654 tons of ore mined and treated.

The *Emma* mine, in Summit camp, formerly controlled by the British Columbia Copper Company, but now owned by the Consolidated Company, was operated during the year and 14,000 tons of ore shipped to the Trail smelter. This ore carries a high percentage of iron and is valuable as a flux.

A little work was done on some of the small properties surrounding Greenwood, including the *Argo*, but very little ore was shipped.

There was considerable activity on the Westkettle river, particularly on Wallace mountain, where a number of properties were worked under lease and bond and ore shipments made. Details are given under the Gold Commissioner's report for Greenwood Division.

A few properties on Granby river, mostly in Franklin camp, were examined and some work done on them during the year. The most important mine again was the *Union*, which shipped some 261 tons to the Granby smelter.

From the *Pathfinder* 177 tons of ore was shipped, and from the *Seattle*, near Bannock City, 264 tons to the Greenwood smelter.

OSOYOOS MINING DIVISION.

The *Nickel Plate* mine and stamp-mill, owned by the Hedley Gold Mining Company, was again the main producer in this Division. The tonnage of ore mined and milled in 1916 was about the same as in the previous year, and amounted to 73,491 tons, yielding 35,911 oz. gold and 7,611 oz. silver.

The company has during the year changed the method of treating the ore so as to treat it entirely at Hedley. Up to the present time the mill practice has been to concentrate the ore, sending the sulphide concentrates to Tacoma to be smelted, and then cyanide the tailings. (Amalgamation was discarded some years ago.) By this system the bulk of the values were contained in the concentrates shipped to Tacoma. The new method is to cyanide the whole ore and eliminate entirely the making of concentrates. The main reason for this change is that the character of the ore is changing, the percentage of sulphides increasing, so that now the cost of transporting and smelting the large amount of concentrates is a very serious item in the per ton cost of treating the ore.

GREENWOOD MINING DIVISION.

REPORT OF W. R. DEWDNEY, GOLD COMMISSIONER.

I have the honour to submit the annual report on mining operations in the Greenwood Mining Division for the year 1916.

The British Columbia Copper Company, Limited—

Tons of ore treated at smelter	308,171	
Production—		
Blister-copper, lb.	5,247,503	
Gold, oz.	11,819.0933	
Silver, oz.	47,379.91	
Average number of men employed—		
Smelter	61.8	
Mother Lode	96.2	
Big Copper	5.2	
Principal ore shipments—		
Mother Lode mine	255,087	tons.
Lone Star mine (Washington)	17,243	"
Napoleon mine (Washington)	10,872	"
Queen Victoria mine	1,582	"
Sunset mine	9,629	"
Oro Denoro mine	256	"
B.C. mine	223	"
Big Copper	1,320	"
Other custom ores	11,959	"
Diamond-drilling—		
Footage drilled, Mother Lode	2,022	feet.
Footage drilled, Greyhound	652	"
Total wages paid—		
Smelter	$ 97,662	93
Mother Lode	152,368	30
Big Copper	2,050	25

The Granby Consolidated Mining, Smelting, and Power Company, Limited—

Summary of the company's operations during the year 1916—

Tons of ore shipped (containing 13,795,151 lb. copper, 29,058 oz. gold, 171,936 oz. silver)	982,877
Development, consisting of drifts, raises, etc.	12,020 feet.
Diamond-drill holes	8,402 „

There were no new machinery installations and nothing in the nature of special development of sufficient importance to report.

King Solomon Mine.—Situated in Copper camp, near Greenwood, and owned by D. C. Corbin, of Spokane, Washington. The old open-cut on this claim has been cleaned out and two car-loads of ore are now ready to ship.

On the *Copper Queen*, which adjoins the *King Solomon*, a contract for extending the old tunnel 100 feet has been let; the old tunnel is 116 feet long.

WALLACE MOUNTAIN, NEAR BEAVERDELL.

Bell.—Robert Perry leased this claim from Ralph Smalles *et al.* in June, 1916, and had two men employed continuously till November 1st, when he transferred the lease to Frank Buckless and Duncan McIntosh, the consideration being $6,000.

The following is a summary of ore shipped and values received from June 1st till November 1st:—

Shipped to the Granby Consolidated Mining, Smelting, and Power Company at Grand Forks—	
Low-grade ore	48,310 lb. net.
Gross value	$316 94
Net returns	174 15
Low-grade ore	50,030 lb. net.
Gross value	$386 38
Net value	238 11
Shipped to the Consolidated Mining and Smelting Company at Trail—	
High-grade ore	53,107 lb. net.
Gross value	$5,550 57
Net value	5,105 84

After all expenses were paid Mr. Perry realized $4,595.26 from the car-load shipped to the Consolidated Company. The ore is silver-lead. The present lessees have two men employed and have a car-load ready to ship.

Sally and Rob Roy.—These claims, owned by the Vancouver and Boundary Creek Development and Mining Company, have been worked during the whole of the year under lease to James Drum.

The following is the result of the operations for the year:—

Tons of high-grade ore shipped	106
Gross value	$14,060
Net value	12,323
Tons of low-grade ore shipped	530
Gross value	$8,595
Net value	5,035

These figures include all ore shipped from the *Sally* and *Rob Roy* during 1916. The principal values are silver, with a small percentage of gold and lead, only $19.06 being received for the gold contained in the ore. On the average six men were engaged during the year.

Kokomo.—Owned by G. M. Barrett. Development-work has been done on this claim since October, 1915. In the month of February, 1916, 5 tons of ore was shipped that averaged $200 to the ton. Two hundred and twenty-five feet of drift-tunnel work has been accomplished and a shaft is down 20 feet. The owner is now working in ore and has 8 tons of first-class ore ready to ship. The values are silver and lead.

Napance Group. This property is owned by E. G. Cummings and M. D. Schenck, and comprises the following mineral claims, viz.: *Napance*, *Napance Fractional*, *Cobalt Fractional*, *Nevada*, and *Nevada Fractional*. Development-work has been confined principally to the *Napance*

Fractional and the *Cobalt Fractional* claims, and consists of a shaft 70 feet long, a crosscut from shaft of 75 feet, and a tunnel 72 feet long. The ore is silver-lead. I am informed some rich ore has been struck and the owners intend to ship in the near future.

Rambler Fractional and Standard Fractional.—The owner, W. H. Rambo, is steadily developing these claims. On the *Rambler Fractional* about 45 tons of ore is sacked which will be shipped next month. Former shipments from this property averaged over $100 a ton.

The work performed on the *Standard Fractional* was chiefly open surface-work, and a shaft was also driven. Fifty sacks of ore was taken out and will be shipped as soon as transportation arrangements can be made.

Black Diamond and Standard.—P. J. Kennedy has been working all summer on these claims, and at the present time is doing development-work in the form of a tunnel.

Scandia.—Owned by M. W. Smith and is under lease and bond to parties in Phoenix, B.C. The lessees are now driving a tunnel on a small ledge from which good values in silver and lead have been obtained. A cabin has been built and an excellent trail cut to the property.

Bounty Fractional.—This mine lies to the north side of Dry creek, between the *Sally* and *Rambler* mineral claims. In September Andrew Matuskey obtained a lease and bond from the owners, I. H. Hallett *et al.* Thirty-seven tons of second-class ore was shipped to the Granby Smelter at Grand Forks which assayed 36 oz. in silver. The lessee has drifted in on a shear-zone a distance of 50 feet, all in ore, which gives the following returns: 245.5 oz. silver, 13.3 per cent. lead, and 21 per cent. zinc; he has now commenced to stope the above ore and expects to ship shortly. On the average two men are employed.

CARMI CAMP.

Carmi.—This mine has been closed down for some time. It is generally understood operations will be resumed shortly.

Nipper Group.—This group consists of four claims owned by Dale, Morton & Sheridan. A vein has been stripped for 300 feet and a tunnel is now being driven, which is in 30 feet. The owners have built a trail three miles long to the property.

Annex, Ackworth, Inyo, and Inyo Extension.—These claims are owned by McCelvie, Kingzett, Evans & Gilmour. Surface stripping shows a ledge which is continuous across the four claims; there are also several shallow shafts and pits. The ledge contains values in silver and lead. A tunnel is now being driven. The property is situated about two miles south of Carmi, on the top of a ridge between Westkettle (the West fork of Kettle river) and Cranberry creek.

Tamarack, Alaska, and Alaska No. 2.—Dale & Morton are the owners of the *Alaska* and *Alaska No. 2* and they have a lease and bond on the *Tamarack*. The claims are situated on the Kettle Valley Railway and about one mile south of Carmi. During the summer ore was discovered in the railway-cut and the ledge was opened up by stripping. About 3 tons of silver lead ore has been sacked.

ARLINGTON CAMP.

Bradley & Morton have a group of claims in this camp at the foot of the Arlington lakes, on the Kettle Valley Railway. There is a lead of copper-bearing ore on the property, the owners are driving a tunnel under the railway and are in about 120 feet.

Enterprise and Teresa Fractional.—Situated near Westbridge and owned by Teresa M. Graham. The values are gold and silver. These claims have been leased to Wm. E. George and Timothy Sullivan, who have built a road two miles long to the property from the railway-track. The ore is expected to run about $100 to the ton and shipments will be made shortly.

Emma.—Situated near Denoro. During 1916, 15,870 tons of ore was shipped and forty-five men were employed. The ore is a self-fluxing copper ore. The Consolidated Mining and Smelting Company of Canada, Limited, took over the mine in February, and has rebuilt all the surface buildings which had been destroyed by fire. The compressor building and hoist-room are built of hollow tile; the other buildings are frame.

OFFICE STATISTICS—GREENWOOD MINING DIVISION.

Locations, quartz	90
Locations, placer	2
Rerecords, placer	7

Certificates of work	146
Free miners' certificates	206
Free miners' certificates (special)	1
Bills of sale	20
Powers of attorney	2
Agreements	2
Certificates of improvement	2
Abandonments	1
Miscellaneous	1
Filings	9

GRAND FORKS MINING DIVISION.

REPORT OF S. R. ALMOND, GOLD COMMISSIONER.

I have the honour to submit the annual report on mining in the Grand Forks Mining Division for the year 1916.

Owing to a very quiet year in this industry, there is little else to report than what the statistics at the foot show.

Outside of the Granby Company's mines, the only other mines working in the Grand Forks district are the *Emma*, in Summit camp, and the *Union*, in Gloucester camp.

The *Emma* mine has now been worked for six months by the Consolidated Mining and Smelting Company, and the ore has been shipped to its smelter at Trail.

The *Union* mine has been working steadily during the year and has shipped its ore to the Granby smelter at Grand Forks. A good report on the camp in which this mine lies and of the mine itself is given by A. G. Larson, M.E., in the Annual Report of the Minister of Mines for 1914.

As the Granby Company's smelter and its mines form the chief industry in this district, I append some excerpts of valuable information, taken from the annual report of the Granby Consolidated Mining, Smelting, and Power Company for the year ending June 30th, 1916.

Speaking of the Phoenix ores, the report says:—

"At Phoenix-Grand Forks the operations have proceeded in the usual manner; the efficiency of production of the last two years has been maintained, though the cost per pound of copper has been higher, due to higher wages and higher costs of all supplies and to working 330,000 tons of low-grade ore that could not have been handled except for the prevailing high price of copper."

In his report on the company's smelters, W. A. Williams, superintendent of smelters, gives the following on the Grand Forks smelter:—

"Operations at this plant for the fiscal year ending June 30th, 1916, were characterized chiefly by the handling of nearly 500,000 tons of material which was very low in copper content and highly siliceous. Up to the present time this material has not been taken into the ore reserves, but on account of the very high price of copper which has prevailed during the past year it became profitable to handle. This partially accounts for the high costs of that period. However, for the first six months of the year the costs were the lowest in the history of the plant, being $1,233 for smelting and converting. Owing to the high price of copper, the increase of wages added 1.7 cents to costs. Coke was 13 cents higher per ton of ore, due to the siliceous nature of the ore. Anyox matte added 0.7 cent. The slow-running of the furnaces, due to high silica slags, offsets the increase of this year's costs over last year. With eight furnaces in blast, there were from 195 to 200 men on the pay-roll. There was no new construction during the year, but repairs have been kept up and the plant is in first-class operating condition."

In his report on the blast-furnace department at Grand Forks, W. B. Bishop, the superintendent, gives the following:—

"There were operated in the blast-furnace department the equivalent of 7.27 furnaces for the year, smelting 1,166,015 tons of ore, matte, converter-slag, and flue-dust. The average per cent. of coke used per ton of ore was 13.42. The smelting cost of this department was $1,237, as against $1,187 for 1915 and $1,217 for 1914. This department produced 15,985,730 lb. of

copper from Phoenix and foreign ores, as well as 4,801,355 lb. from Anyox matte, being a total of 20,787,085 lb. The above copper was obtained from 31,800 tons of 32.70 per cent. matte. Total smelting and converting costs for the year were $1,298 and loss of copper in slags 4.2 lb. There has been no new construction during the year. Repairs have been fully taken care of and the plant is in first-class operating condition."

The report of C. M. Campbell, superintendent of the Granby Company's mines at Phoenix, follows:—

"*Knob Hill-Ironside Mine.*

"*Victoria Shaft.*—The output, 760,693 tons, from this outlet amounted to 69 per cent. of the total shipments. This included 103,699 tons from No. 3 tunnel. This ore, formerly handled by a separate crusher, was so situated and so limited in amount that it was rehandled through the shaft at a cheaper cost per ton than if sent to a separate crusher. With this ore and with ore from the lower levels the shaft plant was worked continuously, shipping uniformly at the rate of about 63,000 tons per month. The Victoria ore for the year averaged slightly better than $^{9}/_{10}$ of 1 per cent. in copper. The mining, crushing, and handling cost was 70 cents per ton and the development costs 13 cents, making a total cost on cars of 83 cents. The Victoria was the only part of the property where mining conditions approximated those of former years, and notwithstanding the handicap in the shape of extra cost of labour and supplies, this cost compares very favourably with that of former years.

"*No. 2 Tunnel.*—Ore from this level, amounting to 193,206 tons, was made up chiefly of ore handled by the electric shovel. A small tonnage was also brought from underground. It was all shipped through No. 1 crusher terminal and amounted to 18 per cent. of the total shipments. This ore contained about 1 per cent. copper. The cost on cars was $1.10 per ton. This cost includes a 15-cent development charge and a heavy charge for handling waste. The development was mainly directed towards opening up the *Grey Eagle* body of iron flux. This ore-deposit has been opened up by a drift and raised to the surface, so that fluxing-ore may now be shipped at any time. The large amount of waste handled, amounting to 137,400 tons, and the fact that for a considerable period it had to be handled exclusively, caused the monthly cost to fluctuate considerably during the year. In February the ore tonnage was 7,184, the waste tonnage was 18,190, and the cost of the ore, exclusive of development, was $1.75 per ton; while in June the corresponding figures were 27,061 tons of ore, 1,270 tons of waste, and an ore cost of 78 cents. The bulk of the waste handled was used as stope-filling. The electric shovel was operated continuously and satisfactorily during the year.

"The ore-bodies making up the *Knob Hill-Ironsides* mines showed 4,171,005 tons remaining at the beginning of the year. New ore of regular grade developed during the year amounted to 46,000 tons. Shipments amounted to 953,899 tons, of which 267,890 tons was low grade. The amount of regular grade remaining is therefore 3,530,996 tons.

"*Gold Drop Mine.*

"Ore from the *Gold Drop* totalled 142,400 tons, or 13 per cent. of the total. It was anticipated that this property, which showed only 61,400 tons remaining on July 1st last, would be worked out before the end of the year. The high price of copper, however, enabled low-grade ore to the extent of 61,000 tons to be shipped, and in the meantime further diamond-drilling developed additional ore-bodies amounting to 100,000 tons, which, though of average grade, do not lend themselves to economical mining. This new ore can, however, be handled at a cost not exceeding $1.40 per ton, and shipments have been made from these sources for the past four months. The mine, therefore, shows 80,000 tons remaining in addition to some low-grade ore. *Gold Drop* ore for the past year cost $1.32, of which 28 cents was for development. The copper contents was about 0.95 per cent.

"*Shipments.*

"Total shipments from all sources amounted to 1,096,299 tons.

"*Development-work.*

"This amounted to 14,608 feet and is the largest yearly total on record. Development-work amounted to 15.1 cents per ton. Diamond-drilling for the year amounted to 11,392 feet, and the total to date is now 112,620 feet.

"*Cost.*

"The average cost per ton of the total output, crushed, on cars, including all development, was 94.1 cents. This also includes the cost of disposal of 204,623 tons of waste. The wage bonus amounted to $81,211.70, or 7.4 cents per ton. Increase in cost of supplies over pre-war prices meant an additional $67,125.60, or 6.1 cents per ton.

"*Ore remaining and Grade.*

"As in the preceding year, due to the high price of copper, we were enabled to increase our shipments by mining a considerable tonnage of low-grade ore not hitherto considered an asset. This low-grade ore amounted to 328,890 tons and caused a reduction in the recovery from 17 lb. of copper to 14½ lb. To offset this reduction in grade the ore remaining in the mine has been increased by this tonnage. Development-work further increased this tonnage by 146,000 tons, making a total increase of 474,890 tons. The present condition of the ore reserves is therefore as follows:—

	Gold Drop.	Ironsides.	Total.
Ore developed	1,592,000	14,167,130	15,759,130
Mines have produced and shipped	1,512,000	10,636,134	12,148,134
Totals	80,000	3,530,996	3,610,996

"From this we estimate that a recovery of 17 lb. of copper and 75 cents in gold and silver can be maintained. There is still a considerable amount of low-grade ore of which a reliable estimate is impossible, but which will approximate 400,000 tons. This will give a recovery of about 9 lb. of copper. It is noticeable that the inclusion of the low-grade ore during the past year did not reduce the recovery of gold and silver below the average of the previous five years. An estimate, therefore, of 60 cents per ton for these metals for this grade of ore will be approximately correct. The *Grey Eagle* body of iron flux, already referred to, amounts to 50,000 tons. It runs 0.2 per cent. copper, trace silver, 0.02 oz. gold, 18 per cent. silica, 36 per cent. iron, 10 per cent. lime, and 5 per cent. sulphur."

OFFICE STATISTICS—GRAND FORKS MINING DIVISION.

Free miners' certificates	127
Locations	63
Certificates of work	140
Filings	20
Certificates of improvements	3
Crown grants	2
Transfers	10
Leases of reverted Crown-granted mineral claims	6

OSOYOOS MINING DIVISION.

REPORT OF R. D. TWEEDIE, MINING RECORDER, FAIRVIEW, B.C.

I have the honour to submit herewith the annual report of the mining operations in the Osoyoos Mining Division for the year 1916.

With exception of the regular assessment-work, very little development has occurred in this Mining Division during 1916.

At Hedley the Hedley Gold Mining Company, operating the *Nickel Plate* mine, has carried on extensive operations continuously. Their statistics have been published in various papers, and I will therefore not give them here.

At Similkameen, in the lower Similkameen valley, the Condit Bros., under the management of E. W. Condit, are developing and also mining the *Horn Silver* claim with good results. Lately

they have purchased an auto-truck for haulage of the ore from the dump to the railroad-siding, and, from all appearances, a steady shipping-mine is being brought into existence.

At Olalla L. S. Brown, of Ashland, Ore., with his partner, C. W. Jordan, of Keremeos, shipped a car of ore from the *Dolphin* and *Spar Fraction* mineral claims, getting net returns of $837.56. During the fall they quit work, but are now mining more ore for shipment. This is a copper and gold proposition.

In the Fairview camp a party of Vancouver men came in and inspected the old *Oro Fino* claims during early part of December, but no advice has been given so far as to their doing any work.

During the first three months of 1916 the Stewart-Calvert Company, of Seattle, Wash., shipped 250 tons of magnesium sulphate from *Spotted Lake*. This is a lake on Kruger mountain, between the lower Okanagan and Similkameen valleys, where the deposits form daily. No accurate survey of the deposits available has been made so far. The company gave up operations owing to the excessive amount of water, and also owing to the difficulty of transportation to the railroad. It has also claims on the American side that are easier of access. If a market could be found on this side of the line for the product, it would pay interested parties to investigate, as the claims could be purchased at a fairly reasonable price, I am told.

OFFICE STATISTICS—OSOYOOS MINING DIVISION.

Free miners' certificates issued	125
Claims recorded	92
Certificates of work issued	79
Certificates of improvements issued	3
Bills of sale, etc., recorded	14
Total mining receipts for the year	$1,389.15

YALE DISTRICT.

SIMILKAMEEN MINING DIVISION.

REPORT OF HUGH HUNTER, GOLD COMMISSIONER.

I have the honour to forward the annual mining report on the Similkameen Mining Division for the year 1916.

On Granite creek little or no placer-mining was done this year, the extreme high water having washed out the workings prepared for this mining season.

On the Tulameen river a small back-channel was worked during the past season. Mr. Schubert, of Tulameen, purchased the property and had three men employed. He washed 2,000 yards of pay-dirt, averaging 50 cents per yard, besides a lot of outside work, which will enable him to work the property to advantage next season. The result of the season's work was $600 in platinum and $400 in gold.

The Efangay Syndicate, representing Spokane capital, has acquired two leases on the river, one below and one above Bear creek. On the lease below Bear creek it has constructed a wing-dam 750 feet long, with head-dam, and has turned the river and installed a gasolene-engine and pump to keep the workings dry. It is expected that mining will begin within two weeks.

A number of people are working on the river in a desultory manner, using rockers and sluice-boxes, and have done exceedingly well, the high price now paid for platinum being the incentive.

A car of copper ore was shipped from the *St. George* mineral claim, on Bear creek, owned by Charles F. Law *et al.* After paying all charges the owners realized over $600.

On this creek there are other promising properties—*St. Helen* and *St. Lawrence*, owned by Charles F. Law *et al.*, and *Liverpool* and *London*, owned by Louis Marcotte *et al.*

A car of ore was shipped from the *Bornite* mineral claim, on Kenendy mountain, and from the *Totem Pole*, on Thynne mountain. Returns from both these shipments were unsatisfactory.

In Summit camp, at the headwaters of Tulameen there are some high-grade silver-lead properties, but these are not worked for lack of proper transportation facilities for getting the ore out.

F. S. Norcross, Jr., superintendent for the British Columbia Copper Company on Copper and Kennedy mountains, has kindly furnished me with the following information:—

"COPPER MOUNTAIN.

"From January 1st to July 30th, 7,487 feet of diamond-drilling was done and 1,650 feet of trenching.

"On April 25th work was begun on the temporary power plant to be used in driving tunnels and raises to prove up the size and to check the grade of the ore as outlined by the company's engineers. This plant included one 1,100-foot and one 500-foot compressor; one Connersville blower, capacity 3,000 feet a minute, for ventilation; also machine, blacksmith, and carpenter shops, with miscellaneous buildings.

"Two 32- x 100-foot buildings were erected for store, office, and bunk-house accommodations; also eight six-room and four two-room houses were put up. Boarded tents were also erected for accommodation.

"A power-line fourteen miles long was run to Princeton to carry power from the 500-horse-power steam-electric plant used for generating power. This line was No. 4 galvanized-iron wire and carried 15,000 volts. Later this was raised to 22,000 volts, and ultimately will carry 38,000 when the pump is installed.

"Power was turned on June 20th and actual underground work begun, and to date there has been 5,400 feet driven.

"The present tunnel underlies the upper or glory-hole ore. The lower or deep ore will be mined from a tunnel 800 feet lower down.

"A pumping plant for water-supply has been installed, which will lift water 1,700 feet from the Similkameen river.

"KENNEDY MOUNTAIN.

"Exploration-work was started on Kennedy mountain in January. To date 709 feet of diamond-drilling has been done and 823 feet of tunnelling."

H. Barnes, secretary of the Claremont Syndicate on Claremont creek, a tributary of the Jameson creek, states:—

"Tunnel drifts Nos. 1 and 2 have been driven 148 feet and 60 feet respectively on the strike of the vein. Crosscuts were run from each drift towards the foot-wall.

"The outcrop was traced down the hill by a series of open-cuts, and a crosscut is now being driven at a point about 100 feet lower than tunnel No. 1, with the expectation of intersecting the vein on its dip. The total amount of work done totals about 300 feet, including the surface cuts.

"The vein itself appears to be a true fissure, with a strong, well-defined, andesite hanging-wall and a quartz-porphyry foot-wall. The dip is about 50 degrees to the south-east.

"The vein-filling is mainly quartz, carrying galena, pyrite, and small amounts of ruby-silver. The best values seem to be associated with the galena."

OFFICE STATISTICS—SIMILKAMEEN MINING DIVISION.

Free miners' certificates	221
Free miners' certificates (special)	3
Location records	192
Certificates of work	267
Conveyances (mineral claims)	73
Records (placer)	11
Leases (placer)	3
Permits (placer)	5
Powers of attorney	4
Conveyances (placer)	7
Certificates of improvement (mineral claims)	13

Actual yield of gold for 1916, $1,079; average price, $17.50 an ounce. Actual yield of platinum for 1916, $1,764; average price $48 an ounce.

NICOLA MINING DIVISION.

REPORT OF W. N. ROLFE, MINING RECORDER.

I have the honour to submit herewith the annual report and office statistics of the Nicola Mining Division for the year ending December 31st, 1916.

The dominant feature of interest in this Division is the taking-over and active development of the two groups of mineral claims touched upon in my last year's report, the properties in both instances having been lying idle and neglected for a number of years.

Aberdeen Group.

One of these is the *Aberdeen* group, situated on Ten-mile creek, on which the purchasing syndicate has during the year accomplished the following work: One shaft sunk to a depth of 160 feet, as also a manway shaft 100 feet, while drifts have been run on three levels to the extent of 400 feet. Approximately 1,400 tons of ore has been shipped, averaging 7 per cent. copper, coupled with small silver values, while there are some 3,500 tons of second-grade ore on the dump.

With regard to outside developments, a road of about seven miles has been made between the mine and Coyle Station at a cost of $8,000, as also a loading-platform adjoining the railway-track. In addition, a number of mine buildings have been built, and boilers, air-compressor, hoists, pumps, a cage, and mine-cars have been installed and are now being operated.

Donahue Mines.

The other property mentioned as having been revived after a long period of inactivity, and an expenditure incurred estimated in excess of $100,000, has been acquired by the Donahue Mines Corporation, the group consisting of eight Crown-granted claims. Upon assuming actual possession of the property in March last, work

was immediately commenced, and has been diligently prosecuted since then. Several buildings have been erected, together with the installation of a fully equipped sawmill of a capacity sufficient to meet all building and mining requirements.

Steady efforts have been concentrated in reclaiming the ore-bodies developed by the original owners on the two claims known as the *Joshua* and the *Tubal Cain*, the shaft on the former having been widened to a depth of 200 feet, and ore is now being mined from the south drifts of the 100- and 200-foot levels.

The work done on the *Tubal Cain* consists of reopening two tunnels, 500 and 600 feet long respectively, necessitating the removal of large quantities of earth which had been deposited at the entrances by repeated landslides during the thirty years of inactivity on the part of the former proprietors. A very considerable amount of debris had accumulated in the tunnels during that period of time, but they are now in excellent condition.

It is worthy of note that the reopening and working of the above-mentioned groups has proved quite a stimulus to the seeking and staking of numerous prospects throughout the district, the number of locations made and recorded during the year being nearly double that of the one preceding.

OFFICE STATISTICS—NICOLA MINING DIVISION.

Locations recorded	150
Free miners' certificates	166
Certificates of work	95
Bills of sale	20

VERNON MINING DIVISION.

REPORT BY L. NORRIS, GOLD COMMISSIONER.

I have the honour to submit my annual report on mining operations in the Vernon Mining Division for the year ending December 31st, 1916.

There is not very much in the way of development-work accomplished to report during the past year. The work undertaken in 1914 and carried on for some time in 1915 on the *Monashee* by the Fire Valley Gold Mining Company under the management of Dr. Elftman, which promised so well, was discontinued, probably owing to war conditions.

The owners of the *Minerva* group, Woods, McDaniels & Paul, ran a tunnel in on the *Tough Nut* claim for 350 feet, when work was stopped owing to the death of Mr. Paul. This group embraces the *Tough Nut*, *Zilpah*, *Minerva*, and *Black Bess* claims near the *Monashee*, and there is reason to believe it is a valuable property.

On Siwash creek west from Vernon about twenty miles by road, the Union Hydraulic Mining Company after a run of some sixty days closed down, and I understand is now confronted with the problem of constructing a flume to carry the tailings across the Indian reserve into Okanagan lake. The estimated cost of the flume is $8,000. The clean-up, I am informed, amounted to $7,000, but there is no assurance that work will be resumed next year.

OFFICE STATISTICS—VERNON MINING DIVISION.

Free miners' certificates recorded	102
Mineral claims recorded	27
Certificates of work recorded	16
Placer claims recorded	2
Transfers recorded	2

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.

Very little placer-mining has been carried on; Cherry & Brady continued developing their placer leasehold on the Coquihalla river, and some work was done by W. E. Adams and associates on their leaseholds on Siwash creek. Owing to the high rate of wages prevailing elsewhere, the Chinamen practically abandoned the bars on the Fraser. From general inquiries I find that some $2,400 of placer gold was purchased by storekeepers in the Division during the year.

QUARTZ-MINING.

In regard to quartz-mining, the situation is considerably brighter, development having been carried on to a greater extent than ever before in the Division.

C. H. Lighthall, who has bonded the *Emancipation* group of fifteen claims situated on Ladner creek, Coquihalla valley, informs me that he built a mile of trail from the Kettle Valley Railway to the workings on the *Emancipation* claim, drove 185 feet of drifts and crosscuts, and also made a considerable number of open-cuts. The only ore mined was that encountered in development-work, and from this was sorted about 12 tons of shipping grade. Next season it is the intention to continue development and exploratory work, and as soon as means of transportation can be installed ore will be shipped. Work was started on July 8th and continued until November with an average of six men, and two miners will be employed all winter on explorative work.

About 3 tons of ore was shipped to San Francisco by the owners of the group before it was bonded to Mr. Lighthall, and returned over $1,500.

Throughout the Coquihalla valley generally, assessment-work was performed on all properties, and, though no other deals of any magnitude were concluded, sales of fractional interests have resulted in greatly increasing the number of people concerned in its future development.

In the 23-Mile district development-work was continued as long as weather permitted, on the *Diamond* group, owned by Frank Fritz and associates, and on the *Defiance* group, owned by Pennie, Robinson & Bears. On other claims assessment-work was done. Early in the summer Vancouver people took a working bond on the *Silver Daisy* group, owned by Pennie & Robinson, and during the season some 7 tons of high-grade ore was brought to Hope by pack-train. This ore was recently shipped to Trail, but returns are not yet to hand.

In September Sperry & White, of Vancouver, acquired the *Lucky Four* group of six claims, situated near Jones lake, for $100,000, paying $12,000 down. Detailed examination in their interests have satisfied the new owners that they have a very extensive body of high-grade copper ore, the value of which is enhanced by its comparative nearness to the lines of the Canadian Northern and Great Northern Railways. The *Lucky Jack* group of four claims, adjoining the *Lucky Four* group on the north-west, was also acquired by Sperry & White. In addition, in surveying the two groups, six large fractions and a full claim were found, making a compact group of seventeen claims on which it is anticipated a great amount of work will be performed next season.

On the *Emigrant* group, on Siwash creek, owned by Fagan and Bosence, from two to four men have been continuously employed all season and some 300 feet of tunnelling has been done. The owners are well satisfied with their showings and are continuing work during the winter.

W. S. Clark, of Keefers, informs me that owing to the excessive snowfall last winter it was impossible to get to the antimony claims owned by himself and associates, and which are situated up Quoieek creek at an altitude of 8,000 feet, until July. The group had been bonded to the Consolidated Mining and Smelting Company, of Trail, but, owing to inability to examine the property owing to the snow before the first payment was due, and also the drop in the price of the metal, the option was allowed to lapse. The property was visited in September by Dr. W. F. Ferrier, of the Imperial Munitions Board, who, however, was not able to make a full examination, as he was driven out by snow-storms. Next summer the owners intend to construct a new trail over another route which will shorten the distance to the claims some five miles.

A pleasing feature is that the claims in the Division are largely held by men who have done and intend to continue doing considerable work to prove their holdings, the acquiring by Mr. Lighthall and Sperry & White of the groups they have secured, after detailed examinations, having given the prospectors a greater amount of confidence than they have had since the Steamboat Mountain fiasco. Moreover, with the completion of the Canadian Northern and Kettle Valley Railways, the question of transportation has been greatly simplified, the only district not having a railway outlet being the 23-Mile, and to this the Hope-Princeton trail, one of the best in the Province, gives access.

The statistics show that, while there was a slight falling-off in revenue from last year, due principally to the non-payment of placer and dredging lease rentals and a drop in revenue from other sources than mining receipts, there was a 135-per-cent. increase in the number of certificates of work issued, and a 42-per-cent. increase in the number of new locations recorded.

OFFICE STATISTICS—YALE MINING DIVISION.

Free miners' certificates issued	179
Locations recorded	230
Certificates of work issued	120
Bills of sale, powers of attorney, options, etc., recorded	58
Filings	17

Revenue.

Free miners' certificates	$ 892 75
Mining receipts	1,751 45
Other sources	611 50
	$3,255 70

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 1916.

There has been quite a little activity shown in development-work on the various properties in the Highland Valley. Eight car-loads of ore have been shipped, of which four car-loads came from the *Snowstorm* group, making a return from 27 to 31 per cent. copper; the other four car-loads were mined from the *O.K.* group and contained 9 to 13 per cent. copper.

The *O.K.* group, owned by Ward & McAbee, has been bonded to the Highland Valley Mining and Development Company, of Spokane, who have erected a concentrator on the *O.K.* claim, which is now in operation and crushing daily from 50 to 60 tons of ore. This company expects to ship from two to three car-loads of concentrates weekly after the first of the year.

I might also mention the *Tamarac* group, owned by Ward & Sanson, has been bonded to the same company with the intention of sending ore to the concentrator.

The *Glossie* group, owned by Burr, Woods & Campbell, has done a considerable amount of development-work which has proved highly satisfactory. Taken altogether, the prospects for the district from a mining standpoint look more promising than they have done for many years.

PLACER-MINING.

During the past year there has been considerable activity in placer-mining on Criss creek. The Thompson River Placer Gold Mining Company, Limited, has acquired some thirteen leases on the creek and has spent a very considerable amount in prospecting and development work, but I have not received any report as to the results of their work.

Another syndicate has also taken up some leases at the mouth of the creek, and has also acquired the Williams ranch in connection with the operations. The results of the prospecting done so far has proved so satisfactory that it is intended to do a large amount of development-work during the coming season.

OFFICE STATISTICS—ASHCROFT MINING DIVISION.

Free miners' certificates issued	140
Certificates of work recorded	92
Conveyances recorded	5
Locations recorded	98

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, 1916.

No placer-mining has been carried on in this Division during the past year. There has been a big revival in the quartz-mining, particularly in prospecting and the recording of new locations, as is evidenced by an increase of 182 in the number of claims recorded during 1916 over 1915. The majority of new locations are in the locality of Whistler mountain, about eighty miles north of Kamloops. The ore in this vicinity is a galena, the values in silver and lead running very high. The country at present, owing to lack of trails and wagon-roads, is not easy of access, but in spite of these difficulties many of the new locators have packed in sufficient supplies and equipment to enable them to continue development-work during the winter.

The reason for the activity in this locality is accounted for by the returns secured by George Fennell and his partner from a shipment of ore made last winter from the *Fog Horn* group. Two car-loads were rawhided down to the Canadian Northern Pacific Railway, and in spite of the high cost of $17 a ton for mining, freight, and treatment, the two cars brought a net return of about $3,500.

With the advent of spring and improvement in transportation facilities in the way of a wagon-road for the hauling-in of supplies, it is fully expected there will be increased activity, as there is plenty of ground available yet for prospecting.

Another new discovery of gold-bearing quartz has been made during the past year on Dunn creek, a tributary of the North Thompson river, about fifty-five miles north of Kamloops. A sample car recently shipped from the *Wind Pass No. 1*, which is one of a group of six claims owned by Oscar Hagen and associates, yielded a net return of $1,400, and I am informed by George Fennell, who is also interested in some claims in this vicinity, that on the above return it is estimated there is $50,000 of ore in sight, and the building of about three miles of wagon-road would enable them to ship steadily.

Some thirty new claims have recently been staked in the vicinity of Mamete lake, where some excellent showings of copper have been found. Some good claims were located in this vicinity many years ago, but the owners were never able to do anything with them; but with these new discoveries it is hoped that renewed interest will be taken in this promising locality.

The *Iron Mask* mine has been shipping steadily throughout the year in addition to continuing the systematic development-work, of which a large amount has been done. Some 6,601 tons of ore and 1,302 tons of concentrates was shipped during the first three quarters of the year; returns for the last quarter are not yet available, but they are no doubt up to the average of the previous quarters. At the present time the company is using a diamond-drill for the purpose of determining the extent of the ore-bodies, with, I understand, very satisfactory results.

During the past season the Granby Company secured options on the *Python*, *Evening Star*, and *Wheal Tamar* group, and a considerable amount of prospecting was done on these groups by diamond-drilling, the results of which I have not been able to obtain, but I understand the work is to be continued during the coming season.

Another company incorporated under the name of the United Six Mining Company, Limited, backed by American capital, has taken over some properties, comprising fifteen claims, situated in the immediate vicinity of Kamloops. A mill test of 30 tons of ore was made at the Bachelor mill during the past summer, and the results of the run were taken to Seattle and tests made to determine the best method for treating the ore. The results were so satisfactory that the company has decided to erect a plant on the old *Noon Day* claim, which is about six miles south-east of Kamloops, and hopes to have it in operation by April 1st.

A car-load of silver-lead and zinc ore is being shipped from the *Iron Clad* and *Lone Prospector* Crown-granted claims, situated in the vicinity of Black pool, which have been lying idle for many years, but have recently been bonded by B. T. Foote and J. L. Cardon.

Generally speaking, the mining situation in this Division never looked brighter, and it is fully expected that the coming season will see it firmly established, and it only needs the erection of a smelter at this point, where it would serve a large territory, to make this Division a steady producer.

OFFICE STATISTICS—KAMLOOPS MINING DIVISION.

Free miners' certificates issued	251
Mineral claims recorded	251
Certificates of work issued	77
Bills of sale recorded	18
Mining receipts	$2,265 65
Mineral-tax	2,380 70

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 1916.

MINERAL CLAIMS.

Pioneer. On Cadwallader creek, Bridge river. The syndicate owning this property installed a Bryan mill during the winter of 1915-16 and commenced milling ore in the month of June. The mill is run by a Pelton wheel, capable of developing 75 horse-power. The tonnage so treated varied from 10 to 24 tons in twenty-four hours' milling, and I am informed the returns were most satisfactory. Development-work carried on in other past seasons proves there is plenty of free-milling quartz in sight. In the earlier stages ore was taken from the shaft; later this shaft was sunk 100 feet, and ore taken from stopes worked east and west.

Details of mining operations for the season are lacking, and the amount of ore milled and treated at this camp has not been, so far, accounted for to me.

Coronation Mines, Ltd. Operations were resumed in May and continued until October with an average working force of five men. Small quantities of ore were milled from time to time at different periods during the season with good results, the quartz so milled being taken from the old workings. The tunnel of the *Countless* claim was driven ahead, and late in the fall ore of a good milling quality was struck.

Blackbird Syndicate.—No work was done on the *Blackbird* location this year.

Ida May Mine.—The same remark applies to this property.

Lorne Mine.—This property, after being idle the previous year, commenced operations in June under new management with a working crew of eight men. During the season considerable development-work was done, viz.: Tunnels, 155 feet; stoping, 200 x 100 feet; open-cuts, 130 feet long, 6 feet deep, 4 feet wide; repairing and remodelling 650 feet of old tunnels; renewing 1,100 feet of pipe-line and repairing two miles of water-ditch, as well as overhauling the 5-stamp mill. A new building was erected and the bunk-house and dining-room renovated. Trails to the different mine-workings, besides about 10 acres of ground surrounding the mill and buildings, were cleared as a protection against fire.

It is noteworthy also that the *Lorne* mine has been an incentive to the prospector in this section, as, with no capital to start, the original owners, with good management, proved the then prospect, built arrastras, and from the proceeds thus recovered distributed dividends among the owners.

The vein known as the *Wedge Ledge* leading to *Golden King* claim has been lately tapped at a depth of 400 feet, and I am informed that the quartz shows good milling values on a vein averaging 2 feet wide. A force of three men is now at work putting in an upraise from this 400-foot level to connect with the 300-foot level. When this is completed it will reduce the cost of transportation of ore to the mill to about one-half, as well as blocking out 100 feet additional of ore. The milling returns for the season gives 1,000 tons treated, the gross value of which is $11,324.32, less transportation and milling charges, $2,500, leaving a net value of $8,824.32, on which amount tax has been rendered.

Forty Thieves. This Crown-granted property has been idle for some seasons past, also the *Why Not*, an adjoining claim, was neglected during the year. Near by is the *Jewess* group, on which a small force of men was engaged during the season. The work done consists of a tunnel driven 400 feet. This property is within the diorite belt and a fine showing of free-milling quartz is disclosed. It is the intention of the owners in the coming season to further develop this promising location.

Wayside.

The small milling plant erected last year was not run. This season's operations were confined to driving No. 4 tunnel ahead for a distance of 200 feet. Good ore was struck in this tunnel at 150 feet. In the face the ledge is over 5 feet wide and is estimated to mill between $15 and $20 to the ton in free gold. An average of three men was employed during the year.

On Gun creek the antimony locations had but very little attention. While some shipments were made, the cost of transportation from mines to the railway shipping-point on Seton lake is almost prohibitive. According to Dr. Drysdale, of Ottawa, this antimony ore, to be successfully or profitably worked at distant points, is by installation of a small plant on the ground at the mine to produce crude antimony. The distance to the Pacific Great Eastern Railway from many of the baser ore-bodies in the Bridge River country is too great for profitable mining of other minerals than free gold.

Broken Hill Mining and Milling Co.—This company did very little work during the season.

The new discoveries reported, relative to diamondiferous chromite and magnesite in Bridge river, I am not in a position to comment on in the absence of information.

Anderson Lake Mining and Milling Co., Ltd.—This property is most favourably situated. For cheap milling and mining the location is an ideal one. Beyond the necessary assessment-work done during the season, this mine remained inactive. The vein is a true fissure and some fine milling-quartz was recently disclosed.

Talc.—Some locations were recorded on Anderson lake, and a few shipments made to Victoria of this mineral gave fairly good returns. These claims being within easy reach of the Pacific Great Eastern Railway, the product can be handled at a minimum of expense and shipped. As there is a demand by the makers of roofing material and also the paper industry for this mineral, it may be commercially valuable.

Seton Lake.—On the north side of Seton lake, near the Mission, and situated about 1,800 feet from the Pacific Great Eastern Railway on a contact-zone between a coarse-grained granite above and an eruptive rock below, is found a fine-grained massive sulphide ore carrying values in gold and a small proportion of silver. Development consists of a tunnel about 400 feet, also a shaft. Considerable work will yet be required to put this property on a shipping basis.

Passing mention may be made in respect to Cayoosh creek, the quarter that first attracted the quartz-miner in this section. For some years the Crown-granted mineral claims remained dormant, yet the owners have faith in the future.

On Texas creek, a tributary of the Fraser, about sixteen miles from the town of Lillooet, some molybdenite locations were recorded.* The country is somewhat rugged and inaccessible. Trails were made by the owners to bring in mining supplies, after they had satisfied themselves of the character of the quality and quantity of ore outcropping and its importance. Considerable work was done, and, the ore values proving of a high character, arrangements were made to ship the mineral. A shipment was made of some 9 tons, containing 16 per cent. molybdenite.

Pemberton Meadows.—On Lillooet river, within twenty-five miles of the railway at Agerton depot, recent discoveries of copper-deposits were made and several locations recorded. These claims are situate at the source of a branch of the Birkenhead river.

Mr. Croteau reports in respect to the new camp: "The formation of the *Copper Plate* group is slate, granite, and schist; also a very large dyke of porphyry, extending over half a mile wide, in which there are a great number of quartz ledges, and also several large dykes of copper ore found in a contact between slate and schist, and likewise between granite, schist, and slate. The ore is mostly all copper, with a little value in gold. Some of the samples taken from the surface give assay returns of 4 to 12 per cent. in copper, with $2 to $3 in gold and silver. Zinc ore is also found in the same vicinity. The claims were located in the middle of summer. Preliminary work, such as cutting about ten miles of trail and the erection of bunk-house, sinking a shaft 10 feet, and making a few open-cuts. It was then very late in the season and but little time left to do any real prospecting-work, the ground then being covered by snow."

A. McLeod, an experienced prospector, submitted me some remarkably fine samples of native-silver ore taken from this neighbourhood. His locations are situate nearer to Agerton. This ore should pay the mining and transportation expenses.

Several locations of copper ore were also recorded on Owl creek.

* *See also* notes by Provincial Mineralogist, page 270.

PLACER-MINING.

Golden Dream Mining Co.—This company confined the season's work to prospecting the bed of the South fork of Bridge river. A small plant was installed, 2,000 feet below the dam, on the dried bed of the creek, the plant consisting of an overshot-wheel pump and drag-line scrapers. Bed-rock was found at a depth of 21 feet. About 600 yards of gravel was handled, yielding an average of 40 cents a yard in gold. Considerable heavy wash was encountered that hampered the little plant. With this data available from the season's work, plans are now being formed to operate on a larger scale next spring. An average of seven men secured employment from May until November.

Lillooet B.C. Mining Co., Ltd.—The majority of the shareholders being with the Army since the war began, but little work has been done on the *Horse Shoe Bend* mining leases.

Operations of the individual miner were confined to Bridge river, Cayoosh creek, and McGillivray creek. Owing to the adverse natural conditions in the spring of the year, the recovery of gold by placer-mining suffered; about $2,900 is all that has been reported.

OFFICE STATISTICS—LILLOOET MINING DIVISION.

Free miners' certificates issued	154
Mineral claims recorded	156
Certificates of work recorded	131
Placer claims recorded and rerecorded	11
Placer and dredging leases in force	34
Conveyances, etc., recorded	58

Revenue.

Free miners' certificates	$1,197 00
Mining receipts, general	2,429 50
Tax, Crown-granted mineral claims	452 25
	$4,078 75

LILLOOET MINING DIVISION.

NOTES BY PROVINCIAL MINERALOGIST.

In September the Provincial Mineralogist visited the Lillooet Mining Division, and submits the following notes on properties examined:—

Copper Queen.

Virginia group and *Copper Queen* group mineral claims, comprising over twelve claims; owners, Hugh Ross, Kenneth Ross, and George Moore. This property has since been acquired by the Copper Queen Mining and Smelting Company, of Vancouver. These claims are situated on the east side of Owl creek, about two miles up from its junction with the Birkenhead river at the Dominion Fish Hatchery at Pemberton Portage. The workings on the property are from the creek-bed and at an elevation above the valley and Pacific Great Eastern tracks of about 800 feet.

From the Hatchery Station of the Pacific Great Eastern Railway a road about 200 yards long connects with the main wagon-road over the Portage, which has existed as a main road since the "sixties" and is in good repair. From this main road, at a point about half a mile east of Hatchery Siding, a trail strikes to the north over a gravelly flat timbered with small jack-pine for a distance of about half a mile to the mouth of the canyon of Owl creek; the rise to this point from the main wagon-road is estimated at about 40 feet. This first half a mile could be made into a good wagon-road for about $200.

The claims are about one mile and a quarter up the bed of the creek from where the canyon starts, the creek being in canyon all the way. From this point the present trail zigzags up the east bank of the creek, gaining an elevation of 300 or 400 feet, bringing it above a rocky bluff which forms the immediate bank of the creek. From here on, the trail follows a side-hill of loose rock, gravel, and earth on a fairly uniform grade to the properties.

This trail is as good a foot or horse trail as could be desired and should not have cost more than $200 or $300 to build, but, being on a steep side-hill, it cannot be widened into even a skid-road without considerable expense, as the cut would in many places strike into rock.

Mr. Ross told me he had made two round trips in a day with a loaded pack-train. This could easily be done and perhaps four trips made if loading and unloading had proper facilities provided for.

The men at the property go down to the Hatchery for supplies, packing them home on their backs, the round trip being made in two hours.

Mineral Showings.—On the east side of the creek, the creek forming its western boundary, is what appears to be an igneous dyke of undetermined width, striking in a north-westerly and south-easterly direction, parallel with the general direction of the creek. Into this dyke from creek-level a tunnel has been driven in a general S. 30° W. direction for a distance estimated at about 230 feet, crosscutting the strike of the dyke. At numerous places in the length of this tunnel fissures were noted running parallel with the course of the dyke and at right angles with the tunnel.

In several instances this fissuring was accompanied by a crushing, extending to a width up to, say, 8 feet, which crushed zones appeared to be much more heavily mineralized than the intervening and more solid formation, which also is mineralized, but much more sparsely.

While the whole tunnel may be said to be mineralized with iron and copper pyrites, the mineralization is not uniform, as already pointed out, and it is doubtful if, taken as a whole, the mineralization reaches the commercial limit; for this reason, in the opinion of the writer, it would be unfair to the property to sample the tunnel as a whole, although it is currently reported that this was done by one engineer examining the property recently, and that his resulting assays on the tunnel as a whole are not up to the commercial requirements.

The writer therefore sampled in the tunnel two of the fissured zones already mentioned, with the following results:—

Sample A.—At about 150 feet in from the portal a drift has been started to the left, and had then been driven in for some 8 feet following one of these fissured zones. This zone as it appeared in the face of the drift was sampled across a face of 5 feet by taking two cuts across at different heights; these were mixed, broken down, and quartered as one sample, which upon assay was found to contain, by wet assay, 5.1 per cent. copper, with only traces of gold and silver.

Sample B.—At about 190 feet in from the portal another fissured zone across the tunnel occurs, and this was similarly sampled across a face of 5 feet on the left hand side of the tunnel, and was found to contain 5.4 per cent. copper, with only traces of precious metals.

At these points the "backs" or height to the surface would be between 100 and 150 feet above the tunnel-mouth. There are several of these fissured zones cut by the tunnel, and there is little doubt but that others are similarly mineralized, but these were the only two sampled, as they appeared to the writer the most promising.

It is, however, recommended that all the fissures be carefully sampled and assayed, and also the intervening more solid formations, which, although evidently too low grade for direct shipping, might prove amenable for some process of concentration. The face of the tunnel at present appears to be in a more solid phase of the same rock, and whether it has crosscut all the fissured zones cannot be guessed at.

It is further recommended that some drifting be done from the tunnel both ways, thus blocking out ore that could be measured up as such, which the present development scarcely permits of.

The rock in these zones is so broken that there is no need of any machinery or power for doing the work.

The location of the tunnel is such that it would not be advisable to consider it anything more than a prospecting-tunnel, as, if further development continues as favourable as the present showing gives expectation of, then a working-tunnel would be started much lower down the creek.

What is known as the "second outcrop" occurs a short distance down the creek and up the bank about 100 feet higher than the creek-bed; here only a little surface work has been done, from which exposed surface a rough sample was taken, marked "Sample C," which assayed 4.7 per cent. copper, with negligible gold and silver values.

The properties, as can be seen from the foregoing, have considerable promise and are well worthy of much more extended and systematic development, while their situation so close to rail transportation adds much to their value.

There is ample water-power at hand which could be developed at a small cost, while timber is plentiful and convenient.

As has been pointed out, there is a particularly good trail to the property, which in the opinion of the writer is all that is required for the proper preliminary development of the mineral showing, inasmuch as it will be some time before machinery is advisable.

A road to reach the property would have to rise some 600 or 700 feet in, say, one mile and a half, which would call for an average grade of 8 to 10 per cent., which is scarcely workable and would be expensive to build.

A small aerial tramway would appear to be an easier solution and the only one to enable the ore to be got out at a cost not prohibitively high. Further, the location of a working-tunnel cannot even be guessed at now, and the property is too good to be spoiled by temporary makeshifts.

Index M.C. Owned by A. F. Hautier and others, of Lytton. I inspected this property on September 7th and 8th, 1916. The property straddles the summit between the North fork of Texas creek and Cottonwood creek, the latter a tributary of Cayoosh creek, and is at an elevation of approximately 8,000 feet, or from 1,500 to 2,000 feet above timber-line. It is reached via Texas creek, which flows into the Fraser river on the west side, some thirteen miles below Lillooet. There is a good wagon-road from Texas creek to Lillooet and the Pacific Great Eastern Railway.

Texas creek is in canyon on its lower half, the first mile or so of which is impassable, even for man or horse, except at low water. The hills on either side rise precipitously to about 4,000 feet, and over these a high-water trail has been built.

A trail has existed up Texas creek for years, but this has been improved by Mr. Hautier, who had six Indians at work on it at the time of my visit, so that now—low water—it is as passable as the nature of the country (boulders and slide-rock) will admit of. The trail crosses and recrosses the creek in six temporary pole-and-log bridges, while there are two fords dangerous to horses, and all these are necessitated by the nature of the canyon.

The length of the trail from the wagon-road to the company's camp has been variously estimated at between twelve and fifteen miles, and occupies, travelling light with a good saddle-horse, seven hours to go up and six hours to come down. The camp is on the very edge of timber-line and at an elevation of about 6,500 feet.

The outcrop of the ore is on a saddle-back some 1,500 feet above the camp, and from a mile to a mile and a half beyond timber-line, on a bald, exposed summit facing Cottonwood creek.

On the morning of September 8th about 2 inches of new snow fell, rendering any general inspection of the local geology very difficult, although the workings were quite visible.

It would appear as if the summit of the range at this point was occupied by a great dyke or spur of granite or pegmatite, in which, at the principal shpwing, there is a fracture running more or less with the course of the dyke, on which, as the face of the open-cut then appeared, there is a heavy impregnation of the granite on either side of the fissure, for a width of about 2 feet, of molybdenite, which is estimated to run from 10 to 12 per cent. of that mineral.

Extending beyond this heavier mineralization there is a zone of from 4 to 6 feet, in which molybdenite occurs sparsely scattered through the granite to the extent of from 1 to 2 per cent.

It seems well established that this general mineralization extends laterally for a distance of at least 2,000 feet and possibly considerably more, the snow on the ground preventing accurate investigation.

It would seem as though there were several fracture-planes along and from which mineralization took place, and that there are various spots at which concentration occurs. The development-work on the property is very slight and superficial and is chiefly confined to the "big showing," where a face of about 8 feet high has been dressed up. How far this concentration extends laterally is not shown by the work done, and the surface is so covered by broken rock that it cannot be seen without extended work being done.

From the open-cut the owners have broken a quantity of ore which has been hand-cobbed, and some 3 tons of this cobbed ore lay on the dump already sacked, while a further pile of

cobbed ore, estimated at about 3 tons, lay on the dump ready for being sacked. A rough sample of this cobbed ore was taken from this pile, which assayed 7.3 per cent. molybdenum, equivalent to 12.10 per cent. of the mineral molybdenite.

There is thus some 6 tons of this class of ore ready for shipment now and the owners expect to have 4 tons more ready this fall. One man was at work on the property. As far as present development shows, there might be said to be some 20 tons more reasonably certain, with unknown possibilities.

Of the low-grade ore there is undoubtedly a large tonnage, which would, however, require to be concentrated on the spot.

The showing being absolutely on the summit, there is naturally no water or water-power nearer than the valleys about two miles distant, where there is ample.

A wagon-road into the district would be very expensive, even should future development prove successful. The present trail is capable of some improvement, but it would be very expensive to make it really good.

It is considered that, with the improvement to the trail already made by Hautier, a pack-train could make two round trips from the wagon-road to the mine in a week, and that each horse loaded could average 200 lb. ore; this is considered the limit, and, as the trail is very rocky, all the horses would have to be shod. From this data an estimate could be made of cost of transportation to the wagon-road.

From Texas creek to Lillooet—thirteen miles—is over a fair wagon-road, good in dry weather, but very clayey in wet weather. From Lillooet ore could be shipped via the Pacific Great Eastern to Vancouver and thence east.

There are several other prospects and prospectors in the vicinity, and it seems to the writer only fair that Mr. Hautier and associates be allowed some financial assistance for the improvements to the trail.

During 1916 a shipment of molybdenite ore was made from the *Texas* mineral claim on Texas creek. The shipment contained 9 tons of molybdenite ore which carried 16 per cent. molybdenite. The operators of this property are greatly handicapped because of remoteness from transportation and rough trail from the claims to the Lillooet wagon-road.

Talc.—Two cars of talc were shipped during 1916 from near the shore of Anderson lake, near the mouth of McGillivray creek.

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, 1916.

As will be shown by the enclosed office statistics, the mining industry has not shown much activity during the past year; in fact, in almost every case the statistics show a decrease of business done.

A certain amount of interest is still shown in the soda-deposits to the north of Clinton, and from information received it would appear probable that, when the Pacific Great Eastern Railway is in operation a few miles farther north than at present, certain development-work will be undertaken. I much regret having to show such an unsatisfactory report, but it is doubtless largely due to the fact that capital for the purposes of prospecting and development has been extremely hard to obtain, and men in the district have been keenly sought after for ordinary civil work as well as for His Majesty's Forces.

OFFICE STATISTICS—CLINTON MINING DIVISION.

Free miners' certificates (individual)	52
Mineral claims recorded	20
Placer claims recorded	5
Certificates of work issued	17
Conveyances, etc., recorded	8

VANCOUVER ISLAND AND COAST.

REPORT ON THE OCCURRENCES OF IRON-ORE DEPOSITS ON VANCOUVER AND TEXADA ISLANDS, B.C.

By Wm. M. Brewer, M.E.

OUTLINE OF REPORT.

The following report is made after an examination by the writer of the various occurrences of iron ore on Vancouver and Texada islands during the summer of 1916, in compliance with instructions from the Provincial Mineralogist. The most important deposits of iron ore occur at several points along the west coast of Vancouver island, also at points near the east coast; and on the west coast of Texada island, in the strait of Georgia.

The most notable points along the west coast of Vancouver island where such deposits occur are the Gordon river, Bugaboo creek, Barkley sound, Alberni canal, Henderson lake, Kennedy lake, and Nootka and Quatsino sounds. Near the east coast of Vancouver island deposits are found on the Upper Quinsam lake and on Klaanich river. On the west coast of Texada island the deposits occur between three and four miles north of Gillies bay.

Magnetite is the most usual iron ore occurring at the several points referred to. This ore is usually found at or near the contact between crystalline limestone and eruptive rocks belonging to the Vancouver series, as classified by the late Dr. Dawson. The percentage of iron carried by the ore is usually between 55 and 70 per cent., with the percentage of phosphorus quite low and generally considerably below the "Bessemer" limit.

In some of the deposits the content of sulphur is more than 1 per cent., but usually it is less than that. The higher sulphur content is accounted for by the fact that there is sometimes a variable quantity of pyrrhotite and iron pyrites more or less closely associated with the magnetite, and generally when this is the case some of the ore also carries a low percentage of copper.

In many cases the magnetite-deposits have been found to carry a percentage of copper sufficiently high to cause such deposit to possess a greater commercial value for the copper content, and therefore no value for iron-making. Many of the occurrences of copper ore on the islands referred to are closely associated with magnetite, and such ore is sometimes attractive to smelters on account of the fluxing qualities. None of such occurrences of copper ore are described in this report, which is confined to a description of such deposits only as apparently possess commercial value as iron-ore mines for the production of pig-iron.

The percentage of insoluble matter, chiefly silica, contained in a number of samples varies appreciably, ranging from less than 3 to 26 per cent.

Limonite, or bog-iron ore, occurs on the west coast of Vancouver island, near its north end, on the West arm of Quatsino sound.

Hæmatite has been reported to occur on the islands referred to in this report, but the writer failed to find any deposits of this variety of iron ore during his examinations.

Tonnage.—From the writer's observations and examinations of the surface showings and the development-work on the various mineral claims examined by him for iron ore during 1916, he concludes that, so far as quantity of ore available for mining is concerned, it is only possible to make a very rough estimate. Under the present conditions even that estimate can only be made on theory, and much more development must be done to prove the figures, which may be considerably increased, given in the following report. The development-work is not sufficient in any instance to determine the conditions beyond a shallow depth, as regards the continuity of the magnetite-deposits to deep levels. The same statement applies to the question of the superficial extent, because except in a few cases the boundaries of the deposits are not exposed. It is evident that in several instances the workings underground show that the ore-body is still strong at the lowest level reached, but that is only a shallow depth.

The writer has attempted to make an estimate of tonnage of ore available by dividing it into three classes, as follows:—

(1.) *Actual ore*, meaning thereby such quantity as development has exposed sufficiently to be considered as measurable and immediately available.

(2.) *Probable ore*, meaning such ore as is only partially developed, not sufficiently so to admit of definite measurement, but of the occurrence of which the indications are sufficiently strong to warrant an assumption that such ore probably occurs.

(3.) *Possible ore*, meaning such ore as is undeveloped, but which may possibly and is hoped to be found by further prospecting and development, the only indications of which are surface outcrops, and which may be postulated as possible from a knowledge of the geological conditions.

Name of Property.	Actual Ore.	Probable Ore.	Possible Ore.	Total.
	Tons.	Tons.	Tons.	Tons.
Ralph*	....	....	....	....
Rose*	....	....	....	....
Baden Powell and Little Bobs	....	500,000	250,000	750,000
Sirdar	94,000	....	47,000	141,000
Conqueror	16,000	230,000	120,000	366,000
Sarita (Provincial Mineralogist's estimate)	....	30,000	25,000	55,000
Henderson Lake	20,000	....	280,000	300,000
Black Prince	15,000	....	15,000	30,000
Crown Prince	75,000	....	200,000	275,000
Glengarry and Stormont (Nootka sound)	250,000	250,000	750,000	1,250,000
Fido (Nootka sound)	....	50,000	200,000	250,000
Quinsam Lake Iron Syndicate	....	....	5,000,000	5,000,000
Prescott (McConnell's estimate)	....	1,366,400	993,600	2,360,000
Paxton (McConnell's estimate)	....	1,607,200	....	1,607,200
Lake (McConnell's estimate)	....	504,000	....	504,000
Klaanch River*	....	....	....	....
Totals	470,000	4,537,600	7,880,600	12,888,200

* Properties marked * are in such condition that no estimate can possibly be made of the tonnage available.

Prospecting with diamond-drills should be carried on quite extensively preparatory to the installation of any manufacturing plants.

INTRODUCTION.

The examinations made by the writer during the past season were undertaken principally for the purpose of bringing the information regarding the iron ores already in the possession of the Bureau of Mines up to date. During the past summer the writer was heavily handicapped, owing to the fact that because there has been no movement to create a demand for either iron-ore mines or the ore, the prospectors and other owners of deposits that had been staked several years ago had suspended development-work after having acquired Crown grants for their claims. Owing to this fact the trails to the workings and outcroppings have been neglected; the under-brush, devil's-club, huckleberry, salmon-berry, and salal bushes have reached such great growth that the old trails were mostly found to be impassable, dumps of ore, as well as outcroppings, were covered up, and the entrances to tunnels were only found with great difficulty; consequently, considerably more time was occupied in making the examinations than otherwise would have been the case. In addition to such difficulties, the absence of the owners from most of the properties examined often presented such an obstacle as to seriously impede the work of examination.

BIBLIOGRAPHY.

The following mentioned reports have been published relative to the occurrences of iron ore on Vancouver and Texada islands:—

Report on the Iron Ores of the Coast of British Columbia, by Herbert Carmichael, published in the Minister of Mines' Report for 1902.

Bulletin on the Iron Ores of the Coast of British Columbia, by the Provincial Mineralogist, published in 1903.

Bulletin No. 47 on the Iron-ore Deposits of Vancouver and Texada Islands, British Columbia, by Einar Lindeman, M.E., published by the Mines Branch, Canadian Department of Mines, in 1910, from examinations made in 1907.

Memoir No. 13, Southern Vancouver Island, by Chas. H. Clapp, published by the Canadian Geological Survey Branch, Department of Mines, in 1912, from examinations made in 1908, 1909, and 1910.

Memoir No. 58, Canada Department of Mines, Geological Survey, Texada Island, B.C., by R. G. McConnell.

In addition to the literature referred to, there have been several reports from examinations made by mining engineers for private clients previous to 1910 which have not been published.

HISTORY.

The history of the interest taken by the public in the iron-ore deposits on Vancouver and Texada islands dates back to 1874, when Messrs. Goodall, Perkins, and Prescott, of San Francisco, engaged W. H. Lee, a furnaceman from Alabama, to examine the deposits of magnetite on the west coast of Texada island, which that firm purchased the following year. The Puget Sound Iron Company was organized, which later erected a blast furnace at Irondale, near Port Townsend, in the State of Washington, U.S.A., where the manufacture of charcoal pig-iron was started. The magnetite ore from Texada island was mixed with bog-ore from Hamilton, Skagit County, Washington.

At that time the San Francisco firm owned, in addition to the mines and blast-furnace, a fleet of steamers that plied between Puget Sound ports and San Francisco, also the manufacturing plant in San Francisco now owned by the Union Iron Works Company. Some years later all of these interests except the iron-ore mines were sold, but the last-named property was, and still is, retained by the original purchasers.

Until about 1907 considerable prospecting and some development-work was done in various portions of Vancouver island and at a few points on the mainland of British Columbia by various prospectors and companies in searching for other deposits of iron ore, but since then the interest has waned until the present time.

The most serious efforts to develop the iron industry on this portion of the Coast and utilize British Columbia ore were made by the late Homer Swaney, who was unfortunately drowned about 1904 in the wreck of the steamship "Clallam," when he had practically carried his negotiations to the point where he was promised the necessary financial assistance to attempt to place the industry of iron and steel making on a commercial basis.

After the death of Mr. Swaney other attempts were made to establish the industry by using iron ore from Vancouver island and smelting it in the State of Washington; the most notable by the Irondale Iron and Steel Company, which resulted in failure principally owing to commercial reasons.

No blast-furnace has yet been built in British Columbia, although the advisability of doing so has been very freely discussed.

GEOGRAPHY.

Considered geographically, the occurrence of deposits of iron ore are found to occupy positions, so far as the west coast of Vancouver island is concerned, either immediately along the coast-line or a short distance back, usually not exceeding about ten miles. The deposits already known are found along an almost straight line in a north-west direction, conforming very closely with the general line of contact of the sedimentary deposits on the west with the general igneous batholith of the interior of the island. The most southerly deposit is situated almost directly on the coast-line south of the entrance to Sooke harbour, about thirty miles by auto-road west from the city of Victoria.

Travelling towards the north-west, the next known deposits of iron ore are near Port San Juan, on the Gordon river, also on Bugaboo creek, a tributary of that river. This location is about eighty miles by steamship route from Victoria.

Travelling still in a north-west direction, the next deposits of iron ore are adjacent to the Eastern channel of Barkley sound at the following locations, viz.: On the Sarita river, that empties into the sound in Numukamus bay; on Copper island, about four miles north-west of the mouth of Sarita river; on the east side of Uchucklesit harbour, about a mile from the

entrance; near the head of Henderson lake, about fourteen miles in a direction slightly west of north from the entrance to Uchucklesit harbour; at the head of Handy creek, that flows into Alberni canal, about two miles northward from the entrance to Uchucklesit harbour; also at Smith's Landing, about three miles farther up the canal on the east side.

There are two routes by which all of these deposits on Barkley sound can be reached; one is by railway over the Esquimalt & Nanaimo Railway to Port Alberni, the western terminus, thence by launch to the nearest landing to the deposit desired to be reached; the other route is by Canadian Pacific Railway steamer from Victoria direct, and as all of the occurrences of iron ore are within easy walking distance from the shore this route is very advantageous.

Continuing to travel in a north-westerly direction across Barkley sound from the Eastern channel to the Middle channel, several deposits of iron ore are found within a short distance from the shore at Sechart, which can be reached by either of the routes already mentioned.

The next occurrence of iron ore is near the head of Kennedy lake, and only about twelve miles in an air-line north-west from the head of Henderson lake. To reach Kennedy lake it is necessary, with the present facilities, to travel by steamer to Clayoquot sound, about twenty-five miles north-west from Barkley sound; thence by launch up Tofino inlet, an arm of the sound, to the mouth of Kennedy river, and up that river into the lake, which is about twelve miles in length, to a point near the head, from which a trail has been built about three miles in length to the iron-ore deposits in the vicinity of Mount Maitland.

The next deposits of magnetite occur near the eastern and western shores of Hesquiat lake, at the head of Hesquiat harbour, situated about forty-eight miles in an air-line and north-westerly direction from Kennedy lake. Hesquiat harbour is reached by mail-steamer from Victoria twice each month under the present schedule.

From the last-mentioned location to the next known deposits of iron ore is a distance in a north-west direction, in an air-line, of about twenty-four miles, as they are located at the head of Head bay, on the Tlupana arm of Nootka sound. To reach that point it is necessary to travel by steamer to the Indian village of Nootka, on Friendly cove, and take launch from there to the head of Head bay, a distance of about twenty miles, from which point there is a trail to the deposits, about one mile and a half in length.

The last mentioned is the most northerly deposit of magnetite on Vancouver island so far as at present known. There are deposits of bog-ore near the shore on the West arm of Quatsino sound.

There are two routes to Quatsino sound; one being by steamer from Victoria to Quatsino Landing, and by launch to the West arm, a distance of about ten miles; the other route being by steamer from Vancouver up the east coast of Vancouver island to Hardy bay, thence by trail across the island, a distance of about ten miles, to Coal harbour, on the West arm of the sound, distant about two miles from the iron-ore deposits. On the east side of Vancouver island deposits of iron ore, so far, have only been found in two localities; one on the Upper Quinsam lake, the other on the Klaanch river.

Upper Quinsam lake is situated about eighteen miles, in an air-line, from the village known as Campbell River, in a south-westerly direction, but by trail the distance is about twenty-five miles. The lake is the source of the Quinsam river, which is a tributary of the Campbell river, that flows into the strait of Georgia nearly opposite to Cape Mudge, the south end of Quadra island, distant about 120 miles in a north-westerly direction from the city of Vancouver. The occurrences of iron ore are reached by steamer from Vancouver to Campbell River Landing; thence by auto or wagon along the Strathcona Park highway seventeen miles to Gooseneck lake, where the main highway is left and a pack-trail followed for a distance of about five miles in a south-westerly direction to the north end of the Upper Quinsam lake; here a canoe is used to the south end of the lake, from which point a trail has been built for a distance of about half a mile to the mining camp.

The Klaanch River iron-ore deposits are situated about seven miles above the mouth of that river, which empties into the south-east end of Nimpkish lake, that drains through the Nimpkish river into Broughton strait at a point directly opposite to Alert bay. These deposits of iron ore are reached by steamer from Vancouver to Alert Bay Landing; thence by launch or canoe across Broughton strait to the property, a total distance from Alert bay of about twenty-seven miles, and from Vancouver of about 207 miles.

The Texada Island iron-ore deposits are situated on the west side of that island about six miles from the north end, and about the same distance westerly from the village of Vananda, on the east coast, which is the port of call for all steamers plying between Vancouver and the island. Texada island is one of the largest islands situated between the mainland of British Columbia and Vancouver island in the strait of Georgia. Vananda is about seventy miles distant from Vancouver in a north-westerly direction. There is a good wagon-road connecting the village with the iron-ore deposits.

TOPOGRAPHY.

The following description of the topography of Vancouver island is copied from the report of Chas. H. Clapp, in Memoir No. 13, page 16, Geological Survey, Canada:—

"Vancouver island is a mountain range characterized by both flat-topped and ridge-like summits, and is the result of the mature dissection of an uplifted, subdued surface formed during a Tertiary erosion cycle acting on a heterogeneous group of deformed rocks. It lies to the west of the great marginal depression of North America, known as the Pacific Coast down-fold, and is one of the border ranges which characterize the western shore of the American continents. The Pacific Coast down-fold extends from the gulf of California to north of the Queen Charlotte islands. This down-fold is in part above sea-level in California, Oregon, and Washington, but both the southern and northern ends are submerged. The submerged northern end forms the sound region separating Vancouver island and the Queen Charlotte islands from the mainland. The down-fold is flanked on either side by great mountain ranges. Those on the east side are the Sierra Nevada of California, the Cascade range of Oregon and Washington, and the Coast range of British Columbia; those on the west are the Coast range of California, the Klamath mountains of Oregon, the Olympic mountains of Washington, the Vancouver range, and the low range of Queen Charlotte islands. The last two ranges have been grouped by Dawson and designated the Vancouver system. The Vancouver range constitutes virtually the entire island, which is 290 miles long and fifty to eighty miles wide, the total area being about 20,000 square miles.

"The Tertiary erosion surface, the general outlines of which are now preserved on the upland of Vancouver island, had reached before uplift a stage varying from late maturity to old age. It was peneplaned in the southern part where a few rounded, monadnock-like hills remained a few hundred feet above the general level. In the central region larger and higher monadnocks and small ranges of mountains—divide residuals—survived, which apparently had elevations of from 1,000 to 3,000 feet above the general Tertiary erosion level, and which are now from 5,000 to 7,000 feet above sea-level, a few peaks being higher. The elevation of the Tertiary peneplane is at present less than 1,500 feet near the southern coast, but increases rapidly to 2,000 feet, and then increases more slowly until the peneplane merges into the more rolling and mountainous country which, as mentioned above, is characteristic of the central part of the island."

The topography of the northern portion of Vancouver island is a continuation of the rolling and mountainous country described by Clapp as characteristic of the central portion, but towards the extreme north end the elevations of the mountain ranges decrease, the valleys become more extensive, and the peneplaned surface gradually loses elevation, until it is submerged into the sound region mentioned by Clapp as separating Vancouver island from the Queen Charlotte islands.

The deposits of iron ore usually occupy positions in the mountain ranges at elevations varying from sea-level, as is the case in the south end of the island, to nearly 3,000 feet above sea-level in the central and northern portions, except at Quatsino sound, where the bog-ore deposits occur near sea-level.

The topography of the north-western portion of Texada island, where the iron-ore deposits occur, is characterized by round-topped, often cliff-bordered hills and ridges, not exceeding 1,000 feet in elevation, and separated by low-lying areas. The slopes of the hills are quite steep and the shore-line bold and rocky, so that some difficulty is found in locating a desirable wharf-site; Gillies bay is the only shelter on the west coast of the island, and as that is located about three miles south from the iron-mines, it has never been considered a convenient or desirable location for a shipping-point.

GEOLOGY.

The geological conditions that surround the occurrences of iron ore on Vancouver and Texada islands are very similar. In both districts the magnetite-deposits occur at or near the contacts between igneous rocks and crystalline limestone. These rocks are referred to by the late Dr. G. M. Dawson as the Vancouver Series of Triassic age, and include not only the entire mass of volcanic materials which unconformably underlie the Cretaceous, but also the interbedded limestones and flaggy argillites and quartzites.

By Chas. H. Clapp the same rocks are referred to as the Vancouver group, which he has mapped out and subdivided as follows:—

Jurassic (?)—Metchosin volcanics (basalt, tuff, etc.).	Vancouver group.
Jurassic or Triassic—Sicker series (andesite flows, tuff, etc.).	
Lower Jurassic—Sutton formation (crystalline limestone).	
Lower Mesozoic, possibly, in part, Palæozoic—Vancouver volcanics (andesite, amygdaloid porphyries, tuff, etc.).	
Jurassic or Triassic (?)—Nitinat formation (crystalline limestone).	

R. G. McConnell, in Memoir No. 58, Canadian Department of Mines, Geological Survey, refers to the deposits of magnetite on Texada island as occurring at and near the contact of quartz diorities and crystalline limestone classified as the Marble Bay formation, also at the contact between quartz diorite and porphyrites assigned to the Texada group by O. E. LeRoy, of the Canadian Geological Survey. McConnell considers that the quartz diorite should be tentatively assigned to the Upper Jurassic age, the porphyrites to the Lower Jurassic, and the Marble Bay limestone to either the Triassic or Jurassic periods, but states that the ages assigned are tentative only, as definite fossil evidence is wanting.

ORE-DEPOSITS.

The general characteristics of the bodies of magnetite on the coasts of both Vancouver and Texada islands show marked similarity as regards the genesis of the ore-structure of the bodies and associated minerals. All the authorities agree that the genesis of the magnetite ore is due to contact replacement of the limestone, and sometimes also of the contact basic igneous rocks, and that the most important deposits belong to the contact-metamorphic type, although in Clapp's report he refers also to deposits occurring as impregnated schists in the Sicker series, as well as replacement or segregation deposits in the Sooke gabbro. The writer's observations show that the contact-metamorphic and replacement or segregation deposits are the only types that at present, at least, have commercial value; in fact, such is also the opinion of Mr. Clapp, as expressed in his report quoted.

The structure of each of the contact-metamorphic deposits examined by the writer is that of a mass or lens usually forming the end or flank of a ridge or occurring as a steep cliff standing out as a prominent landmark, which on account of its hardness has escaped destruction from the forces of erosion and denudation. These masses or lenses often reach dimensions of great extent in superficial area, sometimes several hundred feet in length and more than 100 feet in width, but have irregular outlines.

GENESIS.

Chas. H. Clapp, in the Memoir No. 13, Southern Vancouver Island, of the Geological Survey, 1912, pages 192, 193, gives the following theory of the origin of the contact deposits of magnetite, which is quoted below because the majority of the deposits examined by the writer belong to that type:—

"As the occurrence of the magnetite bodies is restricted to the contacts of the marble and the intrusive plutonic rocks, there can be little question that they owe their origin to the contact action of the plutonic rocks on the marble. This conclusion or theory has been substantiated by observations in many parts of the world. The original limestones, to judge from the residual lenses now remaining, and from the absence of other sedimentary rocks in the Nitinat formation, were comparatively pure carbonates of lime and magnesia. Although the Nitinat marbles have been invaded by the granitic rocks to such an extent that the present masses are virtually large 'roof pendants' in the batholiths, in no case do pure marbles occur in actual contact with the plutonic rocks. They must, therefore, have been subject to profound alteration. The magnetite

bodies are usually developed in the altered or metamorphosed marble, but are occasionally in contact with the basic and schistose diorite, and more rarely with the unaltered marble.

"An exceptionally good contact of the magnetite with pure marble occurs on the *Conqueror* claim, on Bugaboo creek. There the magnetite body, which forms a cliff 30 to 40 feet high over which the creek falls, is in contact with a mass of white crystalline marble, at least 100 yards in width, which occurs down-stream, that is to the north. Irregular magnetite veins extend from the magnetite body into the pure marble, brecciating it and including blocks of marble much as apophyses of an igneous rock would brecciate and include fragments of an invaded formation. From the above evidence it is seen that the magnetite-deposits of the Nitinat formation not only owe their origin to the intrusion of the plutonic rocks, but since it seems as if the original limestones were pure, the minerals of the deposit have apparently been derived from the intruding batholith. After the limestones had been more or less contact-metamorphosed, as inclusions of silicates occur in the magnetite, solutions of magnetite, with small amounts of sulphides, penetrated the contact zone and replaced it in part.

"The solutions were apparently very concentrated, virtually magnetite magma, since they intruded and brecciated the sheared diorite, and unaltered marbles in much the same manner as rock magma intrudes and brecciates. Very large deposits of magnetite supposed to have been formed in a similar manner—that is, by the intrusion of concentrated magnetite solutions or magnetite magma—occur in Norway, the famous deposits of Kiirunavaara. Similar contact deposits have been recognized by several observers, and in recent classifications of ore-bodies have been made a separate type of contact deposits, the magnetite type."

The associated minerals found with the magnetite are the usual contact-metamorphic minerals, principally epidote, andradite (lime-iron garnet), augite, and varieties of amphibole.

The distribution of the lenses of magnetite are noticeably very erratic, as they are found along the contact of lime diorite, lime porphyrite, porphyrite diorite, and also in some cases are found enclosed in all three formations at considerable distances from their boundaries. In two cases, at least, on Texada island, as well as in some instances on Vancouver island, lenses of magnetite have formed at the ends of quartz-diorite dykes.

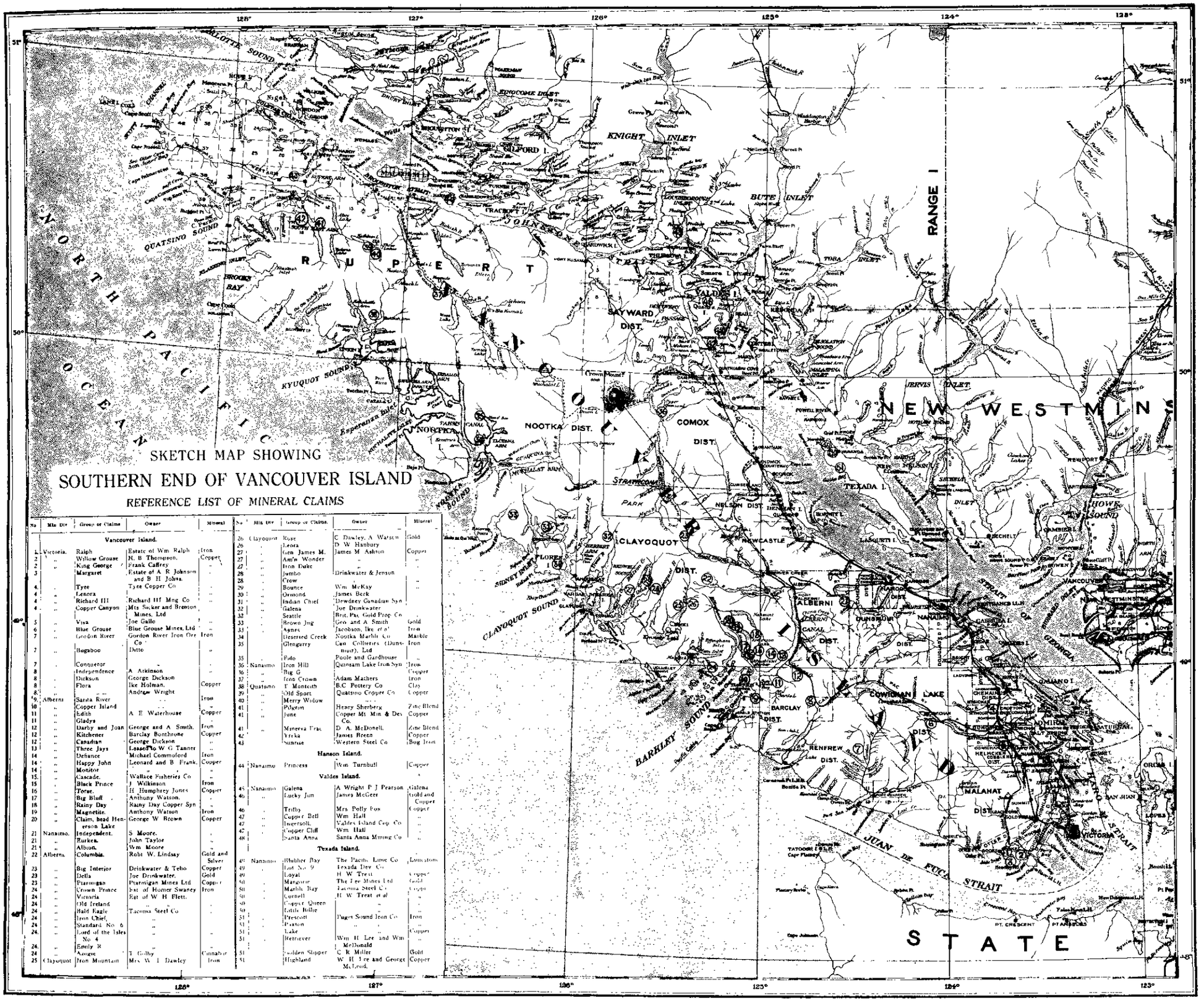
Up to the present time there has been practically no exploration on any of the deposits of magnetite to determine the question of continuity of the ore to a depth below 430 feet from the apex of the outcrop, and that has only been done at one point on Texada island; consequently the question as to the conditions in respect to the depth to which the various ore-deposits may maintain persistency is yet to be determined. The conditions surrounding some of the magnetite-deposits on Vancouver island suggests shallowness, but until prospecting with diamond-drill has been done the question must remain open, so far as actual proof is concerned.

THE MINES, SOOKE DISTRICT.

The deposits of iron ore in this portion of Vancouver island belong to the type classified by Clapp as "replacement or segregation deposits in the Sooke gabbro."

As no work has been done since 1900 on any of the magnetite-deposits in this district, the writer did not examine them during the past summer, as the conditions are the same as when an examination was made by Herbert Carmichael in 1902 and reported on in the Minister of Mines' Report for that year, as follows: "Magnetic iron has been known for many years to exist at Sooke, on the peninsula to the east of Sooke harbour, where there are very extensive surface exposures. These deposits were mentioned by Dr. Dawson in 1887, who said: 'The deposit is rather of the nature of a stockwork than a true vein, but can be traced for some distance in a north-easterly and south-westerly direction, and in places shows from 10 to 20 feet of nearly pure ore. The country-rock is a crystalline diorite, containing much hornblende.' Assays on specimens of the ore gave from 49 to 72 per cent. metallic iron, the samples being all taken from very near the surface.

"A sample of the country-rock from this locality was recently sent to Dr. Barlow, Petrographer to the Geological Survey of Canada, who reports as follows: 'The hand specimen shows a porphyritic rock made up chiefly of pale yellowish-green phenocrysts of plagioclase, with very little ground-mass. Under the microscope it seems to be an olivine diabase made up chiefly of plagioclase, probably labradorite, olivine, pyroxine, and hornblende. Much of the olivine has been converted into serpentine with the separation of iron ore.'"



No	Min Div	Group or Claims	Owner	Mineral
		Vancouver Island.		
1	Victoria.	Ralph	Estate of Wm Ralph	Iron
2	"	Willow Grouse	H. B Thompson.	Copper
2	"	King George	Frank Caffrey	"
3		Margaret	Estate of A R Johnson and B H Johns.	"
4	"	Tyee	Tyee Copper Co	"
4	"	Lenora	"	"
4	"	Richard III	Richard III Mng Co	"
4	"	Copper Canyon	Mts Sicker and Brenton Mines, Ltd	"
5	"	Viva	Joe Gallo	"
6	"	Blue Grouse	Blue Grouse Mines, Ltd	"
7	"	Gordon River	Gordon River Iron Ore Co	Iron
7	"	Bugaboo	Ditto	"
7	"	Conqueror	"	"
8		Independence	A Atkinson	"
8		Dickson	George Dickson	"
8		Flora	Ike Holman.	Copper
8	"	"	Andrew Wright	"
9	Alberni	Santa Rivet	"	Iron
10	"	Copper Island	"	"
11	"	Edith	A E Waterhouse	Copper
11	"	Gladys	"	"
12	"	Darby and Joan	George and A Smith.	Iron
12	"	Kitchener	Barclay Bonthrone	Copper
12	"	Canadian	George Dickson	"
13	"	Three Jays	Leased to W G Tanner	"
14	"	Defiance	Michael Commoford	Iron
14	"	Happy John	Leonard and B Frank.	Copper
14	"	Monitor	"	"
15	"	Cascade.	Wallace Fisheries Co	"
15	"	Black Prince	J Wilkinson	Iron
16	"	Torse.	H Humphrey Jones	Copper
17	"	Big Bluff	Anthony Watson.	"
18	"	Rainy Day	Rainy Day Copper Syn	"
19	"	Magnetite.	Anthony Watson	Iron
20	"	Claim, head Henderson Lake	George W Brown	Copper
21	Nanaimo.	Independent.	S Moore.	"
21	"	Rurkea.	John Taylor	"
21	"	Albion.	Wm Moore	"
22	Alberni.	Columbia.	Robt W. Lindsay	Gold and Silver
23	"	Big Interior	Drinkwater & Teho	Copper
23	"	Della	Joe Drinkwater.	Gold
23	"	Ptarmigan	Ptarmigan Mines Ltd	Copper
24	"	Crown Prince	Est of Homer Swaney	Iron
24	"	Victoria	Est of W H Flett.	"
24	"	Old Ireland	" "	"
24	"	Bald Eagle	Tacoma Steel Co	"
24	"	Iron Chief.	"	"
24	"	Standard No. 6	"	"
24.	"	Lord of the Isles No. 4	"	"
24.	"	Emily B	"	"
24	"	Aengus	T Golby	Cinnabar
25	Clayoquot	Iron Mountain	Mrs W. I Dawley	Iron
26	Clayoquot	Rose	C Dawley, A Watson	Gold
26	"	Leora	D W Hanbury	"
27	"	Gen James M.	James M Ashton	Copper
27	"	Am'n Wonder	"	"
27	"	Iron Duke	"	"
28	"	Jumbo	Drinkwater & Jenson	"
28	"	Crow	"	"
29	"	Bounce	Wm McKay	"
30	"	Ormond	James Beck	"
31	"	Indian Chief	Dewdney Canadian Syn	"
32	"	Galena	Joe Drinkwater	"
32	"	Seattle	Brit. Pac. Gold Prop. Co	"
33	"	Brown Jug	Geo and A Smith	Gold
33	"	Agnes	Jacobson, Ike et al	Iron
34		Deserted Creek	Nootka Marble Co	Marble
35		Glengarry	Can Collieries (Dunsmuir), Ltd	Iron
35		Fido	Poole and Gardhouse	"
36	Nanaimo	Iron Hill	Quinsam Lake Iron Syn	Iron
36	"	Big G	"	Copper
37	"	Iron Crown	Adam Mathers	Iron
38	Quatsino	T Montesth	B.C Pottery Co	Clay
39	"	Old Sport	Quatsino Copper Co	Copper
40	"	Merry Widow	"	"
41	"	Pilgrim	Henry Sherberg	Zinc Blend
41	"	June	Copper Mt Min & Dev Co.	Copper
41	"	Minerva Frac	D A. McDonell.	Zinc Blend
42		Yreka	James Breen	Copper
43		Sunrise	Western Steel Co	Bog Iron
		Hanson Island.		
44	Nanaimo	Princess	Wm Turnbull	Copper
		Valdes Island.		
45	Nanaimo	Galena	A Wright P J Pearson	Galena
46	"	Lucky Jim	James McGeer	Gold and Copper
46	"	Trilby	Mrs Polly Fox	Copper
47	"	Copper Bell	Wm Hall	"
47	"	Ingersoll.	Valdes Island Cop Co	"
47	"	Copper Cliff	Wm Hall	"
48		Santa Anna	Santa Anna Mining Co	"
		Texada Island.		
49	Nanaimo	Rubber Bay	The Pacific Lime Co	Limestone
49	"	Lot No. 9	Texada Dev Co	"
49	"	Loyal	H W Treat	Copper
50	"	Margorie	The Tee Mines Ltd	Gold
50	"	Marble Bay	Tacoma Steel Co	Copper
50	"	Cornell	H W Treat et al	"
50	"	Copper Queen	" "	"
50	"	Little Billie	" "	"
51	"	Prescott	Puget Sound Iron Co	Iron
51	"	Paxton	" "	"
51	"	Lake	" "	Copper
51	"	Retriever	Wm H Lee and Wm McDonald	"
51		Golden Slipper	C R Miller	Gold
51		Highland	W H Lee and George McLeod.	Copper

Ralph. Carmichael's report next describes the *Ralph* mineral claim, situated on the headland of East Sooke, near the entrance to the harbour (near Lot 111), which he describes as: "A deposit of magnetite carrying more or less copper values, but not of sufficient grade to pay for extraction unless the mixed ore could be used as a flux in a copper-smelter." The only work mentioned in the report is a shaft and a short tunnel, the former being described as full of water, and the latter as not having been driven sufficiently far to reach the magnetite exposed in the shaft.

Other exposures of magnetite mixed with pyrrhotite, iron pyrites, and chalcopyrite are mentioned as occurring on Lots 79 and 83 near the *Ralph* mineral claim in the same district. Some stripping and open-cut work is mentioned as having been done, but not enough to demonstrate any commercial value.

Apparently the bulk of the magnetite in the Sooke district is so much mixed with chalcopyrite as to be unsuitable for the manufacture of pig-iron because of the contamination of copper, while at the same time it is not sufficiently high in copper to give it commercial value as a copper ore, except possibly as a flux.

PORT SAN JUAN OR RENFREW DISTRICT.

This district is known by both names; the former, being the older, is still retained on the maps, while the latter name is used locally and by the postal authorities.

The deposits of magnetite in this district occur on the Gordon river and on some of its tributaries, notably on Bugaboo creek. The Gordon river flows into the head of San Juan bay from the north, and is about twenty miles long, heading in the mountains on the west side of Cowichan lake.

HISTORY.

Prospecting for iron ore on the Gordon river and its tributaries was very actively prosecuted during 1898 and for a few years later, during which time a large number of mineral claims were located, on some of which considerable development-work was done, notably on the *Gordon River* group, owned by the Gordon River Iron Ore Company; also the *Bugaboo* group, the property of the same owners; and on the *Conqueror* group, owned by a Victoria syndicate.

This work was being carried on during 1902, when Herbert Carmichael, then Provincial Assayer, made the examinations which are the basis of his report in the Minister of Mines' Report for that year. Later all work was suspended, and in 1907, when Einar Lindeman was making an examination for the Mines Branch, Canadian Department of Mines, no work was being done on any of the properties, nor has any been done since.

Owing to these facts, and because the writer had made an examination for private interests several years ago, it was not considered necessary for him to visit the district during the past summer, especially as none of the owners had representatives on the ground; therefore the following description of the deposits in this district is a compilation from the reports referred to above.

Gordon River. This group of mineral claims contains the following named eleven claims, viz.: *Rose*, *Sophia*, *Rambler*, *Jen*, *Puffing Billy*, *Pig Iron*, *Cold Steel*, *Max*, *Max Frac.*, *Fizz*, and *Fizz Frac.*; and is owned by the Gordon River Iron Ore Company. The total area contained in the group is 352.22 acres. The property is situated on the north bank of the Gordon river about five miles from salt water, and is connected with San Juan bay by a good trail.

The development-work on the group has been principally done on the *Rose* claim, on which a shaft has been sunk to a depth of about 300 feet on an outcrop of magnetite, and drifts driven at the 100-, 200-, and 300-foot levels. Carmichael's description of this shaft is as follows: "Close to the camp a shaft had been sunk about 300 feet on a magnetite outcrop, which appeared to dip into the hill. At about 100 feet down this shaft a crosscut drift had been run to the north. This drift was not examined. It was reported by the foreman to be boarded up, and all work had been suspended for the time at this point, but it was stated by the management that the drift had been run for about 40 feet, and had cut diagonally through about 18 feet of ore mixed with country-rock. Similar drifts had been set off at the 200- and 300-foot levels simultaneously, that at the 200-foot level being now in about 18 feet, and that at the 300-foot not so far. In neither of these drifts nor in the shaft was any ore visible, the rock passed through

being chiefly diorite, though, of course, these drifts had not been driven far enough to strike the ore-body, should it continue at the surface dip to this depth."

From the foregoing description, the only occurrence of magnetite exposed underground is on the 100-foot level, where, the management stated, "the drift cut diagonally through 18 feet of ore mixed with country-rock." There is consequently no data on which any tonnage of *actual* ore, or even *possible* ore, can be estimated.

Other outcroppings of magnetite occur along the Gordon river on both banks for about a mile, following the contact between the Nitinat marble and plutonic rocks. The work, consisting of trenching at various intervals, shows that the outcroppings are apparently disconnected lenses. Further systematic prospecting is necessary in order to demonstrate the extent of the ore-bodies and determine their commercial value.

Bugaboo Creek Group.

There are ten mineral claims in the *Bugaboo Creek* group, named as follows: *Wax*, *Ax*, *Ax Frac.*, *Tax*, *Gen. Warren*, *Gen. French*, *Little Bobs*, *Baden Powell*, *Gen. White*, and *Sirdar*. The total area is 381.67 acres. This property is now also held by the Gordon River Iron Ore Company. The most important of the claims are the *Baden Powell*, *Little Bobs*, and *Sirdar*, which are in the Gordon valley, about seven miles from San Juan harbour.

The following description of these mineral claims is copied from Einar Lindeman's "Iron Ore Deposits of Vancouver and Texada Islands, British Columbia," published by the Canada Department of Mines in the Mines Branch Bull. No. 47, 1910, page 10. "An outcrop of magnetite is found on the flank of a ridge, along which it can be traced for 350 feet. In several places on the ridge a sharp contact between the ore and an igneous rock was observed. About 90 feet below this contact a tunnel 114 feet long had been run directly into the hill, showing magnetite in its full length, with the exception of a diorite dyke 8 feet wide about 30 feet from the mouth. mouth.

"An average sample of the ore taken along the tunnel gave the following analysis:—

	Per Cent.
Insoluble matter	8.88
Iron	58.30
Sulphur	2.75
Phosphorus	0.013

"About 35 or 40 feet below this tunnel another tunnel had been run in the same direction for 114 feet into the hill, going through limestone and diorite. The last few feet, however, show magnetite dipping in towards the hill."

From the foregoing description of the underground workings, associated with that of the surface showings, the writer can only roughly estimate tonnage of *probable* and *possible* ore, as the data is insufficient to warrant any estimate of *actual* ore. Of *probable* ore he estimates 500,000 tons, and allows 250,000 tons, or 50 per cent., additional for *possible* ore, being a total of 750,000 tons that may be available after further development-work has been done.

"East of this main outcrop, and close to the trail leading down to the main trail up the Gordon valley, several strippings had exposed magnetite, but did not give sufficient information in regard to the extent of the ore-bodies.

"The *Sirdar* mineral claim is situated two miles farther up the valley, and is very similar to the *Baden Powell* and *Little Bobs*. The magnetite outcrops here along the face and brow of a ridge for about 160 feet.

"About 50 feet below the top of the ridge a tunnel has been run 103 feet into the hill, showing the width of the ore to be about 82 feet. An average sample taken along the tunnel gave the following analysis:—

	Per Cent.
Insoluble matter	8.52
Iron	56.57
Sulphur	2.75
Phosphorus	0.121"

The writer roughly estimates the tonnage of *actual* ore exposed in the underground workings at 94,000 tons, and allows 47,000 tons, or 50 per cent., additional as *possible* ore that may be found to be available after further development-work is done.

Since the examinations made by Mr. Lindeman in 1907, on which the above report is based, the writer is reliably informed that practically no further work has been done.

Conqueror Group.

There are fifteen mineral claims in the *Conqueror* group, named as follows: *Cyrus, Daniel, Conqueror, Elijah, Benjamin, Grip of Iron, Iron Master, Iron Master's Son, Iron King, Iron Prince, Jennie Fractional, Joseph, Iron Prince Fractional, Jacob*, and *David*. The writer examined this property some years ago. Since then it has been examined and reported on by Herbert Carmichael, in the Minister of Mines' Report, 1902; also by Einar Lindeman, in the Canada Department of Mines, Mines Branch Bull. No. 47; and by other engineers for private interests.

The group is on Bugaboo creek, a tributary of the Gordon river, and the main showing of magnetite occurs on the *Conqueror* mineral claim, about eight miles from San Juan bay, at an elevation of about 1,600 feet above sea-level, where the creek crosscuts a solid body of magnetite about 40 feet high, over which the creek forms a waterfall. This deposit belongs to the contact-metamorphic type, and the ore-body lies between crystalline limestone and diorite.

The maximum width of the ore-body exposed in the bed of the creek is about 100 feet. Surface stripping east of the creek has exposed outcroppings of magnetite for some distance, indicating that the deposit may extend for at least 200 feet in length. About 40 feet below the top of the outcrop a drift has been driven 14 feet long in solid magnetite.

From the foregoing data the writer estimates 16,000 tons of *actual* ore exposed on three sides, 14 feet long, 100 feet wide, 80 feet deep, but from the exposures he roughly estimates 230,000 tons of *probable* ore and 120,000 tons of *possible* ore that further development may make available.

Average samples taken in 1900 by the writer assayed:—

	Per Cent.	Per Cent.
Iron	59.7	62.98
Silica	6.16	4.28
Sulphur	3.08	Trace.
Phosphorus	*Nil.*	*Nil.*

A sample taken along the drift by Lindeman assayed:—

	Per Cent.
Iron	67.09
Insoluble matter	4.51
Sulphur	1.60
Phosphorus	0.009

A sample taken by Carmichael assayed:—

Iron	69.2
Silica	2.7
Sulphur	0.5

Outcroppings of magnetite occur on some of the other claims in the group, notably on the *David*, east of the *Conqueror*. Open-cuts have been made in several places, exposing magnetite of approximately the same grade as the above samples, but the work is not sufficient to warrant an estimate of the tonnage of available ore.

The water-supply in the Gordon river, as well as in Bugaboo creek, is sufficient for ordinary power purposes, as well as for mining and domestic use. The timber is ample for all purposes, including the manufacture of lumber.

Transportation facilities to salt water from any of the mineral claims included in the groups described herein, in the Port Renfrew district, can be installed at reasonable cost. The harbour near the mouth of the Gordon river affords some good sites for bunkers and wharves.

BARKLEY SOUND DISTRICT.

SARITA RIVER DEPOSITS.

Deposits of magnetite belonging to the contact-metamorphic type, with the ore lying between crystalline limestone and diorite, occur about one mile up the Sarita river and about a quarter of a mile back from the south bank. The Sarita river rises in Sarita lake, flows westward into Numukamis bay, in the Eastern channel of Barkley sound, about fifteen miles from Cape Beale, on the west coast of Vancouver Island.

The mail-steamer that leaves Victoria each week during the summer and every ten days during the winter passes within a short distance of the mouth of the river, which has numerous channels that form a wide delta. An alternative route to these deposits is via the Esquimalt and Nanaimo Railway to Port Alberni; thence by launch down the Alberni canal about twenty-five miles to the mouth of the river. A canoe can be rowed to within a short distance of the mining camp, or an old trail can be travelled from the shore of the bay, a short distance south of the delta.

A bluff of iron ore about 50 feet wide, of low grade and very siliceous, occurs on the south bank of the river, about one mile and a half from the mouth. This apparently is the east end of the main ridge in which magnetite-deposits occur farther west, and from the work done was the scene of the earliest attempt to develop the mineral. Several adits were driven into this bluff from the same level, one being 172 feet long, with two drifts driven in opposite directions from the adit, a total length of 107 feet. A winze of unknown depth, as it was full of water, was sunk from the adit at a point 50 feet from the portal. Mineral is exposed for about 70 feet from the portal; the remainder of the work is in country rock. The mineralization is a mixture of iron pyrites, magnetite, pyrrhotite, and marcasite.

Average samples assayed:—

	Per Cent.	Per Cent.
Iron	23.8	13.4
Sulphur	14.4	6.9
Phosphorus	Trace.	Trace.
Silica	48.0	69.3

Evidently work was abandoned after the grade of the ore was ascertained, and further prospecting was done along the ridge to the west, because about a quarter of a mile in that direction there is an occurrence of magnetite on the east bank of a swampy creek that crosscuts the same ridge, as already mentioned. An open-cut 10 feet deep by 120 feet long has been made across a part of the ridge, exposing diorite on the south side, next magnetite 62 feet wide, then crystalline limestone 12 feet wide, then magnetite 45 feet wide, to limestone wall. In this deposit the magnetite is good grade, and the impurities found associated with the ore in the bluff overlooking the river are lacking. The gangue material is garnetite.

The writer attempted to trace the deposit on the surface farther to the west, but found it impossible to do so because of fallen timber and heavy growth of bushes, or to connect it with the open-cuts seen by the writer when he made a previous examination, and described in Carmichael's report; consequently a detour was made along the north base of the ridge for about a quarter of a mile to the bluff at the base of which is the portal of the adit described and sketched in that report. To-day this might easily be passed by without notice, so dense is the growth of alder and other bushes, that even the dump containing several hundred tons of ore is hidden, and the face of the bluff of magnetite about 60 feet high, that formed such a prominent landmark after it was stripped years ago, is also hidden.

The adit is 260 feet long, including all of the crooks; it is driven in solid magnetite, along a limestone wall for 111 feet, when diorite is exposed; the adit was continued 18 feet in diorite but where the magnetite disappeared a turn is made to the left and the adit continued through magnetite 76 feet, with diorite on the south-east side. About 40 feet from the turn diorite shows in the roof, with magnetite underlying it. Gradually the magnetite wedges out, and at 76 feet from the turn practically disappears, except in the floor. At this point the course of the adit is again changed, to the south-east, and driven 60 feet through diorite to the face.

A winze full of water, said to be 7 feet deep, and sunk in magnetite is located 28 feet from the portal of the adit. The body of magnetite in the bluff is 92 feet wide by 60 feet high above the adit level. Climbing the bluff, the elevation of the ridge increases to the east to about 150 feet above sea-level. Test-pits and trenches that were examined show magnetite in several places for about 1,000 feet eastward. The most important of these occurrences is the one on the bank of the swampy creek, already described. This is apparently the farthest east that a good grade of magnetite extends. There is a possibility that the deposits to the east from the long adit are connected and form a continuous ore-body.

A sample from the dump at the portal of the adit assayed:—

	Per Cent.
Iron	63.8
Sulphur	0.55
Phosphorus	Trace.
Silica	4.2

A sample reported by Carmichael from the same dump assayed:—

Iron	63.7
Sulphur	0.3
Phosphorus	Trace.
Silica	3.85

A sample reported by Lindeman from the same dump assayed:—

Iron	60.89
Sulphur	0.76
Phosphorus	0.004
Insoluble matter	3.81

The quantity of available magnetite in the Sarita River deposits, so far as exposed by the workings, is estimated by the Provincial Mineralogist, in the bulletin published in 1903, at 55,000 tons of "probable or possible ore." Since that time no further work has been done. In this estimate no allowance has been made for possible continuity to a depth below the adit level, which the writer considers is possible, but must remain an open question until proven. Prospecting with a diamond-drill would determine the conditions at depth, and this undoubtedly should be done before any equipment is installed to mine on an extensive scale.

Water-power can be developed on the Sarita river by using the lake at the head for a reservoir. Timber for building, mining, and fuel is very plentiful and easy of access.

COPPER ISLAND DEPOSITS.

This island, also called Tzartoos, is the largest of a chain of island in Barkley sound, between the Eastern and Middle channels. It rises quite abruptly from the sea on the east side, and reaches an elevation of about 1,000 feet within about half a mile from the shore.

The *Mountain*, *Barkley*, *Clifton*, *Charmer*, *Pilot Fraction*, *Rainbow*, and *Sunbeam* mineral claims form the group on Copper island on which magnetite occurs, near the summit, about two miles from the north end. The workings consist of an adit and several open-cuts over a large area which expose extensive bodies of magnetite; sometimes apparently resting on an igneous rock of greenish colour, and in places filling fissures in the country-rock.

The exposures are too irregular and the distribution too erratic to base any calculations as to tonnage of available ore, but there is no doubt but that a very considerable quantity can be obtained from the exposures already made.

Although a belt of limestone occurs a short distance north of the magnetite-deposits, there is none in the immediate vicinity, so that these occurrences of magnetite appear to belong to the type described by Clapp as "replacement or segregation deposits," or such as are described in "Kemp's Ore Deposits," page 63: "The concentration of the magnetite seems to the writer best explained by its settling in the still molten mass until it formed considerable aggregates. When once there rich aggregates have formed they may, in the process of eruption or intrusion, take almost any place in the resulting rock."

The most important development-work has been done on the *Mountain* claim, where there is an adit 94 feet long, with open-cut approach 41 feet long, also an open-cut 100 feet long by about 50 feet deep at the face, and a shallow shaft sunk from the open-cut 50 feet from the entrance. There is also an open-cut between the two mentioned, which is 24 feet long in solid magnetite, but towards the face igneous rock underlies the magnetite, which appears as a blanket, covering the rock up the bluff nearly to the summit.

The open-cut approach to the adit exposes a body of magnetite about 20 feet wide, but in the adit the only magnetite exposed is a body about 6 feet wide in a drift on the right-hand side, at the junction, and about 27 feet from the portal of the adit. These bodies are not connected, and beyond the last mentioned the adit is continued for about 75 feet in country-rock, evidently in the expectation of intersecting the body of magnetite exposed in the open-cut about 60 feet northward, but whether this has been continued sufficiently far requires a survey to determine.

The open-cut northward from the adit is on the same level, and made into a bluff about 50 feet high, above the floor of the open-cut; on the right of the cut about 50 feet from the entrance there is a shaft said to be 12 feet deep, but full of water. This is sunk in solid magnetite, but whether the bottom shows ore or country-rock the writer could not ascertain, having no means of unwatering the shaft.

There are about 2,000 tons of magnetite of commercial grade on the dumps.

A solid body of magnetite is exposed by the open-cut for about 25 feet, and about 10 feet high; then a narrow granite dyke is cut through, beyond which the cut exposes magnetite mixed with igneous rock for about 45 feet, then igneous rock to the face. On the summit of the bluff there are lenses of magnetite, mixed with considerable garnetite and epidote, covering a width of 52 feet and a length of 330 feet.

Quite extensive outcroppings of magnetite occur towards the west side of Copper island, from the summit of the bluff, in which the long open-cut is made and about 200 feet higher elevation. These are distributed over an area of about 1,000 feet in length and 100 feet in width. The magnetite is more or less mixed with garnetite, epidote, and country-rock in these outcroppings, which occur in low bluffs and knolls.

Masses of float indicate that magnetite occurs in at least one other zone to the south-east from the workings described, as such are seen along a trail to the beach some distance south of the one usually travelled, but no work has been done to prospect that portion of the group of mineral claims. Concentration is necessary in order to produce a marketable grade of magnetite from most of the outcroppings.

It is absolutely impossible for any engineer to make an estimate of tonnage in these deposits; there may be 20,000 tons or even 100,000 of *possible* ore.

A sample of solid magnetite taken by the writer from the mine workings assayed:—

	Per Cent.
Iron	56.2
Sulphur	1.3
Phosphorus	*Nil.*
Silica	17.0

A sample reported by Carmichael from the same workings assayed:—

Iron	50.4
Sulphur	0.3
Phosphorus	0.053
Silica	18.6

A sample reported by Lindeman from the same workings assayed:—

Iron	52.09
Sulphur	0.230
Phosphorus	0.025
Insoluble matter	16.52

Timber is scarce in the vicinity of the deposits of magnetite at the higher elevations, but plentiful lower down the mountain. Water is not plentiful on the mountain, but there is ample for domestic use near the beach.

Transportation facilities can be installed at a minimum cost from the mine-workings to a bay at Clifton point, distant about half a mile in an air-line.

HENDERSON LAKE DEPOSITS.

Near the head of Henderson lake, which empties into Uchucklesit harbour, at the entrance to Alberni canal, and about ten miles from the harbour, a magnetite-deposit occurs on a small creek on the west side of the lake.

Magnetite.

This mineral claim was originally the *Iron Mountain*, and was first staked about 1901, but allowed to lapse. Since then it has been staked and abandoned several times until the summer of 1916, when it was restaked by Anthony Watson, of Port Alberni, who has since done considerable open-cut work. About 250 feet from the lake-shore, and about 100 feet higher elevation, on the south side of a small creek, a continuous deposit of magnetite is exposed by open-cuts for a distance of 130 feet along the precipitous banks of the creek. Apparently this exposure is across the ore-body which strikes

north-west or nearly parallel with the lake-shore, and dips 63 degrees to the north-east. The outcroppings of magnetite can be traced about 30 feet down the creek-bank nearly to water-level, but no continuation of outcroppings are seen across the creek on the north side.

Only a very rough estimate of tonnage of available ore can be made. The writer estimates the *actual* ore at 20,000 tons and the *possible* ore at 280,000 tons.

The mountain rises very abruptly on the south side of the creek, and outcroppings of magnetite occur about 250 feet higher elevation than the open-cuts, but no work has been done. An average sample assayed: Iron, 50 per cent.; sulphur, 0.24 per cent.; phosphorus, *nil;* silica, 22 per cent.

Timber adapted for all purposes is very plentiful on the claim. The water in the small creek is sufficient for all purposes, including limited power, provided a storage-reservoir is constructed to conserve the supply.

Transportation facilities can be easily installed to the lake, where ore can be loaded on to scows and transported to deep water on Uchucklesit harbour, provided some more dredging is done in the stream that connects the two bodies of water.

UCHUCKLESIT HARBOUR DEPOSITS.

Black Prince No. 2.

Cascade creek flows into Uchucklesit harbour about one mile and a half from the entrance, and is capable of being developed into one of the greatest water-powers on Vancouver island; it falls 2,100 feet in about one mile and a quarter through precipitous canyons. Water for power purposes is already taken from Cascade creek by the Wallace Fisheries Company, and is used to run the machinery in the cold storage and cannery on Uchucklesit harbour at the foot of Cascade mountain, but in addition to this there is an ample supply for domestic and mining purposes near the head of the creek.

On the *Black Prince No. 2* claim, at the head of this creek, deposits of magnetite and pyrrhotite occur that form bluffs, below the summit, and are distributed over the surface on the summit of Cascade mountain, a superficial area between 2 and 3 acres in extent.

These deposits are apparently not of the contact-metamorphic type, although, lower down the mountain, immense masses of crystalline limestone occur in contact with the same greenish-coloured igneous rock as enclose the magnetite-deposits on the summit. The exposures are all lenses, apparently disconnected. The line of strike is north-westerly, the dip about 75 degrees to the east. The development-work consists of large open-cuts; the most important of these is across the face of a bluff of pyrrhotite 25 feet long by 20 feet deep at the face and about 15 feet wide.

The occurrence of the bluff of mineral in such close proximity to magnetite-deposits is noticeable, and a sample was taken merely to determine the contents, and not because it was considered to represent iron ore. The sample is an average from the open-cut, and assayed:—

	Per Cent.
Iron	8.8
Sulphur	5.0
Phosphorus	0.3
Silica	75.5

Another open-cut 24 feet wide by 40 feet long by 7 feet deep is made on a disconnected lens of magnetite about 40 feet higher up the mountain, close to the summit. An average sample from this open-cut assayed:—

	Per Cent.
Iron	70.2
Sulphur	Trace.
Phosphorus	Trace.
Silica	1.4

On the summit of Cascade mountain there are several open-cuts farther to the north-west that expose lenses of magnetite distributed over an area between 2 or 3 acres. The ore exposed in these is apparently about the same grade as the last-mentioned sample.

A rough estimate of the tonnage of magnetite that is classed as *actual* ore exposed on this property is made by the writer at 15,000 tons, with an additional 15,000 tons of *possible* ore that may be made available by further development-work.

Timber for mining and fuel is plentiful in the vicinity of the outcroppings of magnetite. The opportunity for installing transportation facilities is exceptionally good, as an aerial tramway about 6,500 feet long would connect the mine with a wharf at deep water, where ocean-going vessels could load.

Sunshine Group.

This property is on Cascade creek at 900 feet elevation, where deposits of magnetite occur of the contact-metamorphic type, lying between crystalline limestone and igneous rock, but those examined appear to carry too much copper to be of value for iron-making. The claims have been prospected to some extent to determine their value as producers of copper ore, and during 1916 a small shipment of ore was made to a copper-smelter by the Woodworth Bros., who held a bond on the group, but the returns were not made public, and as work was not continued it appeared as though conditions were not satisfactory.

The writer examined two adits on the *Fern* mineral claim, one of the *Sunshine* group. These adits are driven into the steep creek-bank near Cascade falls; each is about 60 feet long, driven across lenses of magnetite, one about 12 feet wide; the other could not be closely examined because of its caved condition, but the dump contains magnetite with the small content in copper.

The workings from which the small shipment of copper-bearing ore was made were not examined. They are some distance from the creek, and the time at the writer's disposal was not sufficient to permit an examination.

ALBERNI CANAL.

Defiance Group.

This group contains the *Defiance* and the *Defiance No. 1* Crown-granted mineral claims, situated at the headwaters of a tributary of Handy creek, which flows into the Alberni canal on the west side about seventeen miles below Port Alberni, and is owned by Michael Commoford, of Alberni. The distance from the shore to the claims is about two miles by trail, but only about 4,000 feet in an air-line. The elevation is about 1,000 feet above sea-level.

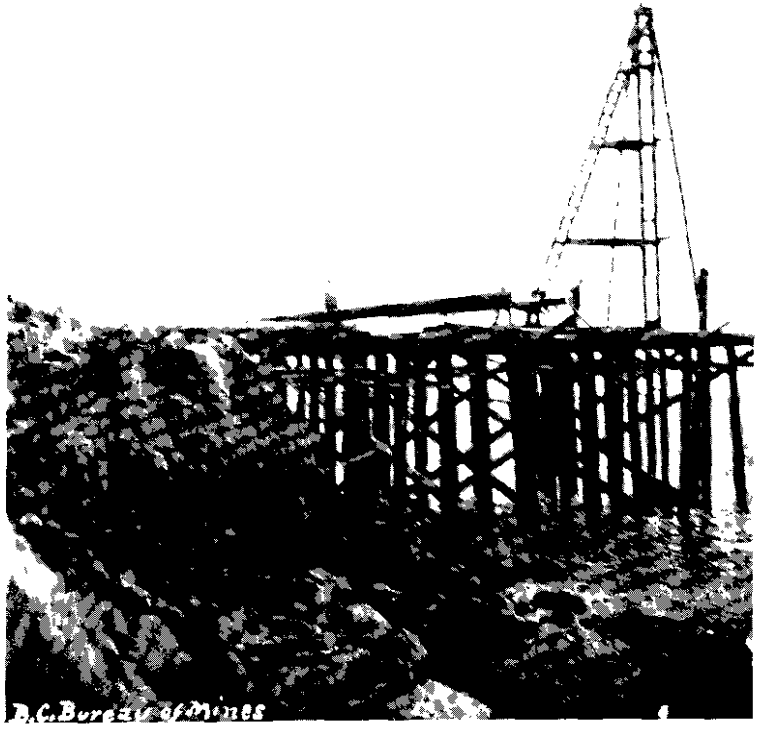
Magnetite-deposits with lenticular structure occur on a comparatively flat bench; two of these occurrences are cut by a small creek, while the third covers a flat about 50 feet square. The deposits belong to the contact-metamorphic type, the ore lying between crystalline limestone and an igneous rock of the Vancouver series.

The last-mentioned occurrence has been exposed by stripping, but no attempt has been made to determine the conditions at depth by sinking in the ore, but an adit has been driven from a bench about 20 feet lower elevation, evidently with the expectation of intersecting the magnetite on that level, which the dump would indicate had been done at or near the face, as there is a small quantity of magnetite mixed with chalcopyrite on the dump that apparently was the last material taken from the adit. A sample of this ore assayed:—

Gold	Trace.
Silver	1.2 oz.
Copper	3.3 per cent.
Iron	52.6 „
Sulphur	4.2 „
Phosphorus	*Nil.*
Silica	12.1 per cent.

The adit could not be examined because of its caved condition near the portal and the depth of water, caused by a dam of debris.

One of the other occurrences of magnetite is exposed in an open-cut approach about 15 feet long and an adit driven in magnetite 20 feet long, with igneous rock as one wall. A crosscut about 8 feet long at the face of the adit is driven to limestone. This work shows a width of about 12 feet of solid magnetite. The deposit is about 60 feet long, striking north-west and dipping vertically. At the face of the adit there are about 35 feet of backs above the level of the floor, but no attempt has been made to determine the occurrence of magnetite below that level. The magnetite shows very little impurities; the only gangue material is garnetite in small quantities.



Dock at Iron-mines, Texada Island.

Marjorie Mine, Texada Island, Open-cut.

An average sample from a large dump at the portal of the adit assayed:—

	Per Cent.
Iron	66.0
Sulphur	Trace.
Phosphorus	*Nil.*
Silica	3.3

Another occurrence of magnetite mixed with small particles of chalcopyrite outcrops in the contact between crystalline limestone and igneous rock, about 150 feet to the north-west from that last described. The ore-body is about 4 feet wide and has been prospected by an open-cut.

No attempt is made by the writer to estimate tonnage of ore occurring on this property, as it is impossible to make even a shrewd guess.

An average sample taken from across the outcropping assayed:—

	Per Cent.
Gold	Trace.
Silver	Trace.
Copper	0.2
Iron	65.8
Sulphur	2.2
Phosphorus	Trace.
Silica	4.8

Water and timber are plentiful for mining and domestic purposes.

Transportation for ore and supplies on any large scale would necessitate the construction of an aerial tramway across the Monitor group of mineral claims to the shore of Alberni canal, near the mouth of Handy creek.

Darby and Joan.

These mineral claims are at Smith's Landing and on the east shore of Alberni canal, twelve miles below Port Alberni. Occurrences of magnetite outcrop along the ridge and base of a low hill, about half a mile from the canal, that can be traced for about 120 feet to the north from the point where the outcroppings are first seen, but whether unbroken continuity is maintained has not been determined. This deposit of magnetite appears to fill a fissure in diorite, which is from dark to light green in colour, and although there is a wide belt of crystalline limestone about half a mile south of the magnetite, there is no contact between the diorite and limestone showing near it.

The only development-work done is a series of open-cuts and two short adits. One of these open-cuts at the south end of the ore-body is 23 feet long, and crosscuts magnetite mixed with iron pyrites and pyrrhotite for 20 feet. The next open-cut is about 100 feet farther north; in this the ore-body is narrower, but the magnetite is much purer.

Another open-cut is 36 feet farther north; this is an approach 24 feet long to an adit 9 feet long driven through diorite, except through about 1 foot of magnetite at the portal. Another open-cut approach to an adit is 80 feet farther north, but because of caving this could not be examined. Stripping on the hill about 65 feet above the level of the work showed magnetite, but the dump at the entrance to the open-cut and adit was all country-rock.

Lindeman used a dip-needle in his examinations, and in his report states: "No magnetic attraction could be noticed north of the ore-outcrop, but the attraction was strong south of it for a distance of about 70 feet."

An average sample of the ore-dump gave the following analysis:—

	Per Cent.
Insoluble matter	25.95
Iron	50.96
Phosphorus	0.004
Sulphur	0.083

Carmichael's report states: "A rough but approximate average sample of the ore on the dump gave the following analysis:—

	Per Cent.
Iron	55.9
Silica	16.0
Sulphur	1.0
Copper	None."

The opportunity for cheap transportation is particularly good; a surface tramway about half a mile long, with no excessive grades to overcome, would connect the deposits with a sheltered harbour on the canal, where ocean vessels could safely lie.

Timber and water are plentiful on the property, but whether the water-supply has a sufficient fall for power needs investigation.

KENNEDY LAKE DISTRICT.

Iron Mountain and Chieftain.

These mineral claims are owned by Mrs. W. T. Dawley, of Clayoquot, and were originally staked because of the discovery of a vein of gold-bearing quartz. Magnetite-deposits of the contact-metamorphic type occur about three miles northward from the head of Kennedy lake, and twelve miles north-westward, in an air-line, from the deposit near the head of Henderson lake. This section is very mountainous, cut by deep precipitous gorges which are the beds of creeks. One of these creeks heads at an elevation of about 2,700 feet above sea-level and flows through deep canyons. The lowest occurrence of magnetite seen by the writer is an outcropping in the steep bank of the creek, at an elevation of about 1,800 feet, on the *Chieftain* claim. The exposure of magnetite is about 20 feet long, but whether this is along the strike or across the body cannot be determined until some work is done.

An average sample of the outcrop assayed:—

	Per Cent.
Iron	30.10
Sulphur	0.31
Phosphorus	Trace.
Silica	51.5

This outcropping occurs under a limestone bluff, and overlies an igneous rock. Some development-work is said to have been done farther up the creek on the opposite side, but the guide with the writer was unable to locate it because of the great growth of bushes and lack of a trail.

Outcroppings of magnetite occur at several points on the sides of steep ravines farther up the same creek, but no work has been done, and as the slopes are almost perpendicular, too steep to climb, no examination could be made.

The mineral claims were staked originally because of the occurrence of gold-bearing quartz at an elevation of 2,400 feet above sea-level, which has been prospected by an adit.

The *Iron Mountain* mineral claim adjoins the *Chieftain* on the north and occupies a part of the summit of the mountain about 1,000 feet higher elevation, where outcroppings of magnetite occur that need development-work before any estimate can be made as to extent.

Lindeman reports an analysis of a sample of magnetite from this group as follows:—

	Per Cent.
Insoluble matter	7.64
Iron	63.07
Phosphorus	0.016
Sulphur	0.043

HESQUIAT LAKE DISTRICT.

Owing to the absence of all the owners, the writer, accompanied by two Indian guides, spent a day trying to locate the deposits of magnetite, described by Carmichael in the Minister of Mines' Report for 1902 as occurring in the vicinity of Hesquiat lake, but was unable to find any trace of trails or blazes leading to outcroppings, nor could any one be found who had any knowledge of any work having been done in recent years; consequently the description from that report is copied, as follows:—

"*Agnes No. 1 and No. 2.*—These claims are situated on the east shore of Hesquiat lake, at an elevation of 175 feet above and some 4,000 feet back from the water, and are reached at present by a blazed trail only. The properties are owned by Messrs. Jacobsen, Ike, and Roseberry, of Clayoquot, and were located in June, 1902. A small creek runs through the locations, and in the banks of this stream there have been exposed some outcrops of magnetic iron, a few yards in extent only, which form the basis of these locations. Assays of average

samples gave about 50 per cent. iron, 13.1 per cent. silica, no copper. These outcrops are apparently on the contact (limestone with an eruptive rock, probably diabase) mentioned and extend for some distance. Other than these exposures made by the creek, there is only a little surface stripping, the surface elsewhere being covered with soil. The work done simply proves the existence here of magnetite, and it is quite possible and even probable that further development will prove up a more extensive body of ore.

"*Violet Mineral Claim.*—This claim, owned by F. Jacobsen, of Clayoquot, is situated on the west side of the lake, opposite the *Agnes*, probably on an extension of the same contact already mentioned. The principal outcrop is at an elevation of about 300 feet above the lake and less than a quarter of a mile back from the water, and is reached by a steep trail from the shore. Here there is an exposure of magnetite some 15 feet wide, developed by an open-cut into the hillside, 12 feet long and about 4 to 5 feet deep at the face, showing up very clean and solid ore, a sample of which taken for assay gave 59.8 per cent. iron, 11 per cent. silica, 0.55 per cent. sulphur, and no copper. Some 400 feet higher up the hill there is another small exposure of similar ore. Where the rocks were exposed the ore appeared to lie on the lime-diabase contact, which is more clearly defined on this the west side of the lake."

SECHART.

Sechart peninsula is bounded on the east by Effingham inlet, an arm of Barkley sound; on the south by Sechart channel, that connects the Middle and Western channels of Barkley sound; on the west by the Western channel of Barkley sound; and on the north by Pipestem inlet, except a narrow neck of mountain range between the heads of the two inlets.

The Broughton mountain range forms the peninsula; it rises to an elevation of about 3,000 feet by a series of benches and gradual grades from the shore, and magnetite-deposits occur on its southern slope above an elevation about 700 feet.

During the early nineties Captain Anderson located several mineral claims because of the occurrences of magnetite, some of which he sold during 1901 to the Pacific Steel Company, of the State of Washington, and others to the Tacoma Steel Company, of the same State. The claims were later Crown-granted as lots numbered 456, 457, 458, 459, 374, 392, 695, and 696, and at present are assessed to the following owners:—

Lot No. 456, *Crown Prince* claim, to the estate of the late Homer Swaney.
Lot No. 457, *Victoria* claim, to the estate of the late W. H. Flett.
Lot No. 458, *Old Ireland* claim, to the estate of the late W. H. Flett.
Lot No. 459, *Bald Eagle* claim, to the Tacoma Steel Company.
Lot No. 374, *Iron Chief* claim, to the Tacoma Steel Company.
Lot No. 392, *Standard No. 6* claim, to the Tacoma Steel Company.
Lot No. 695, *Lord of the Isles No. 4* claim, to the Tacoma Steel Company.
Lot No. 696, *Emily R.* claim, to the Tacoma Steel Company.

The most important deposits of magnetite occur on the *Crown Prince*, *Lord of the Isles*, and *Bald Eagle* mineral claims, where the most development-work has been done. These occurrences belong to the contact-metamorphic type, in which the ore lies between crystalline limestone and hornblendic igneous rock coloured in varying tints of green.

Crown Prince. This mineral claim is on the east slope of the Broughton range of mountains, overlooking Effingham inlet, at an elevation of about 1,600 feet and about two miles and a half by trail from the beach of Sechart channel at Anderson's camp, but from deep water in Canoe pass the distance is considerably less. The most extensive outcroppings of magnetite occur in a prominent ridge where wide bands of magnetite are exposed alternating with bodies of green igneous rock, much sheared, altered, and quite schistose near the magnetite. The strike of the bands of magnetite is south-eastward, the dip being 45 degrees southward.

The face of the ridge is stripped about 200 feet long by 70 feet high up the slope about 45 degrees, exposing magnetite mixed with country-rock in the banded structure for 70 feet along the ridge, then country-rock for 100 feet, then magnetite for 33 feet.

Near the base of the ridge an open-cut approach to an adit has been made through one outcrop of magnetite for about 33 feet, but the portal of the adit is in the green altered igneous rock; this was driven through about 50 feet, where a narrow seam of calcite occurs followed by a body about 10 feet wide of arsenical pyrite mixed with iron pyrite and magnetite, which

changes to a mixture of magnetite and green country-rock, then to solid magnetite, through which the adit is driven nearly 20 feet to the face, and was still in ore.

An average sample across the face assayed:—

	Per Cent.
Iron	56.6
Sulphur	0.72
Phosphorus	*Nil.*
Silica	19.0

A branch from the adit starting about 50 feet from the portal, was driven to the left for 72 feet; this exposes magnetite for 28 feet adjoining the calcite 5 feet from the junction, then continues through dark-green hornblendic country-rock to the face. The last 34 feet of the branch adit is apparently under the magnetite exposed in the main adit, as the dip of that body is 45 degrees to the southward, or to the right of the opening.

From the condition of the workings, as seen by the writer, only a very rough guess can be made as to the tonnage of ore available. Of *actual* ore the tonnage may be estimated at 75,000 tons, while the tonnage of *possible* ore may be placed at an additional 200,000 tons.

Average samples taken along 28 feet on the left side of the branch adit assayed:—

	Per Cent.	Per Cent.
Iron	54.4	55.6
Sulphur	1.4	0.4
Phosphorus	*Nil.*	Trace.
Silica	21.2	17.6

Carmichael reports an assay from the same workings as:—

"Iron	48.4
Sulphur	0.7
Phosphorus	Trace.
Titanium	Trace.
Copper	*Nil.*"

Lindeman reports an assay from the same workings as:—

"Iron	48.06
Sulphur	0.623
Phosphorus	0.006
Insoluble matter	23.22"

Lord of the Isles. This mineral claim is about 2,000 feet west from the *Crown Prince*. It adjoins the *Victoria*, which lies between the two first-named claims, and is reached by a trail about two miles and a half long from the beach at Anderson's camp. A deposit of magnetite outcrops on the face of a precipitous bluff at about 850 feet elevation.

The face of the bluff is heavily stained with iron from the decomposition of iron pyrites, and the magnetite is mixed with pyrites, garnetite, and limestone. An adit is driven towards the north in magnetite, along a wall of green hornblendic igneous rock, for about 20 feet, then a belt of crystalline limestone is exposed and the course of the adit changed eastward. This course is continued for about 37 feet, driven in magnetite along a limestone wall on the north. At the face there is a winze, apparently sunk in magnetite; this winze is of unknown depth, and being full of water could not be examined.

The dimensions are 13 x 10 feet across the top, with the east wall in igneous country-rock that appears to cut off the ore. The adit is continued 40 feet northward in limestone beyond the turn to the east. It is impossible to estimate quantity of magnetite from the work done, which shows that the occurrence is very irregular in outline, lenticular in structure, and apparently not very extensive, unless drilling should prove that it maintains continuity with depth. The dip of the limestone wall in the east drift is nearly vertical, and it is possible that the magnetite may continue down along this wall.

A grab sample from the dump assayed:—

	Per Cent.
Iron	50.4
Sulphur	2.5
Phosphorus	Trace.
Insoluble matter	10.6

Bald Eagle. This claim is west and adjoining the *Lord of the Isles;* it is reached by an old trail that branches off from that leading to the last-mentioned claim, and is about three miles from the beach at Anderson's camp. Outcroppings of magnetite occur on the face of a steep bluff at about 1,000 feet elevation above sea-level. This outcrop measures about 75 feet long by about 50 feet up the slope of the bluff at the widest point. The occurrence of magnetite has the appearance of a blanket covering the light-coloured igneous rock that forms the bluff. An adit is driven 72 feet into the bluff under the outcropping, about 40 feet vertical measurement below the top, and at the face a drift is driven 45 feet to the right. No magnetite is exposed by this work, which confirms the blanket-structure theory, but farther up the mountain there is a contact between crystalline limestone and igneous rock, similar to that underlying the magnetite on the face of the bluff, and at the contact an outcropping of magnetite occurs, but apparently not of sufficient extent to be of importance.

A sample from the bluff assayed:—

	Per Cent.
Iron	60.7
Sulphur	Trace.
Phosphorus	Trace.
Silica	13.6

HEAD BAY, NOOTKA SOUND DISTRICT.

Glengarry and Stormont. These mineral claims are situated about one mile from the head of Head bay, at the upper end of Tlupana arm, Nootka sound. The original locators sold a two-thirds interest in the property a few years ago to the Wellington Colliery Company, through the late William Sutton, which interest passed to the successors of that company, the Canadian Collieries (Dunsmuir), Limited, the remaining one-third being owned by Clarence Dawley, of Clayoquot.

The claims are staked from south to north, with the No. 1 stakes adjoining, and within the boundaries there is a ridge that reaches an elevation of about 800 feet and extends across both claims from south-eastward. Magnetite-deposits occur along the ridge, of the contact-metamorphic type, lying between crystalline limestone and diorite. Garnetite is the only gangue material associated with the magnetite in any appreciable quantity.

Open-cuts and stripping along the north slope of the ridge have exposed solid masses of magnetite which can be traced in a nearly continuous line for several hundred feet, and varying in width from about 7 to 55 feet. Some of the open-cuts are about 20 feet high at the face, and stripping, in some places, exposes magnetite outcroppings extending downwards from the summit to near the base of the ridge for a continuous length on the incline of about 200 feet, and a maximum width of 40 to 55 feet.

A general sample representing about an average of the deposits assayed:—

	Per Cent.
Iron	56.8
Sulphur	0.1
Phosphorus	Trace.
Silica	1.6

Lindeman reports a sample from this property that assayed:—

"Iron	66.17
Sulphur	0.017
Phosphorus	0.016
Silica	6.10"

Apparently the quantity of magnetite on these claims is exceptionally large. Considering the exposures seen by the writer, and estimating from approximate measurements, he figures that he is safe in placing the tonnage of *actual* ore available for quarrying at 250,000 tons, with an additional 250,000 tons of *probable* ore and 750,000 tons of *possible* ore that may be exposed by further development-work. The deposits are very favourably situated to ensure mining and transportation at a minimum cost.

Apparently the magnetite can be quarried from the north slope of the ridge to a very considerable depth, for a length of several hundred feet and an average width of about 40 or 50 feet, as seen by the writer. This would ensure cheap mining for a very large tonnage. A

surface tramway can be constructed to the base of the ridge from deep water in a sheltered harbour with a reasonable grade, where if necessary a connection can be made with a short gravity or an aerial tramway.

There is a plentiful supply of water except for power purposes. Timber is quite plentiful for all purposes, including saw-logs for lumber.

Fido. To the southward from the *Glengarry* and *Stormont* claims a mountain-slope rises to an elevation of about 1,500 feet above sea-level, almost within the length of one mineral claim. The *Fido* mineral claim is located on the north slope of this mountain and adjoins the south line of the *Glengarry* and *Stormont*, the No. 1 post of the *Fido* being on the south line of those claims, 200 feet west from their No. 2 posts.

Wm. Poole and J. H. Gardhouse, of Nootka, own the *Fido* claim, and have prospected it to some extent by stripping and open-cuts, which have exposed large bodies of magnetite on the north slope of the mountain southward from those exposed on the *Glengarry* and *Stormont* claims. The grade of this magnetite is so near that in the samples taken from those claims there was no necessity for sampling.

It is to be regretted that no diamond-drill boring or other development-work has been done on any of these deposits of magnetite, because the surface indications promise so favourably with regard to extent.

The writer can only estimate roughly a tonnage of *probable* and *possible* ore, as there is no work done by which actual ore can be measured. This estimate is placed at 50,000 tons of *probable* ore and 200,000 tons of *possible* ore.

WEST ARM, QUATSINO SOUND.

Some years ago a large number of claims were located in the vicinity of Coal harbour, near the east end of the West arm of Quatsino sound, for bog-iron ore, a form of limonite, some of which were sold to the Moore Investment Company, of Seattle, which operated the blast-furnace at Irondale, in the State of Washington, for a few months, and some shipments of this bog-ore were made, but since that enterprise failed the mineral claims have reverted to the Metropolitan Trust Company, of New York, which acquired the assets of the original purchasers.

The most important of the deposits occur about one mile west from Coal harbour, in and on the border of swampy basins, and on the ranges of adjoining hills.

The origin of bog-ore is described in Kemp's "Ore Deposits of the United States and Canada," page 87, as follows: "Bog-ore, beds of limonite, superficially formed in marshes, swamps, and pools of standing water. The general circulation of water through the rocks enables it very frequently to take up iron in solution. Ferruginous minerals are amongst the first and easiest that fall a prey to alteration. Carbonic acid in the water aids in dissolving the iron, which thus, in waters containing an excess of CO_2, passes into solution as the proto-carbonate ($FeCO_3$). Organic acids may also play a part. The alteration of pyrite affords sulphuric acid and ferrous sulphate, and the latter enters readily into solution. On meeting calcium carbonate, both ferric and ferrous sulphate are decomposed, yielding in the first place calcium sulphate, ferric hydrate, and carbonic acid; in the second place, if air is absent, ferrous carbonate and calcium sulphate, but on the admission of air, ferric hydrate soon forms."

The fact that the prevailing country-rock in the vicinity of the occurrences of bog-ore on Quatsino sound are granites and felsitic rocks, often heavily charged with iron pyrites, accounts for the rusty water, impregnated with decomposed pyrite, flowing down the hillsides and leaving a thick scum on the rocks. This was considered an outcropping of iron ore and was responsible for many claims being staked, especially on the divide between Iron creek and Nahwitte river.

The occurrences that appear to possess commercial value are those exposed in many open-cuts on the group of mineral claims about a mile west from Coal harbour, where the ore is generally quite clean and free from impurities, as is shown by the following analyses of average samples reported by Lindeman:—

	Per Cent.	Per Cent.
"Insoluble matter	2.32	1.40
Iron	54.46	56.97
Sulphur	0.15	0.447
Phosphorus	0.038	0.038."

All of the deposits of bog-ore are very irregular in outline, and vary in thickness with the variations of the surface of the ground, the greatest depth of ore being found in basins or depressions but as very little serious attempt to determine extent has been made, consequently, in the absence of proof of depth by drilling or sinking shafts, it is not possible to estimate tonnage available.

Owing to the fact that no work has been done on any of the claims since 1906 and 1907, and the conditions surrounding the old workings are such that no satisfactory information can be gained from an examination, the writer has incorporated in this report the one made by the Provincial Mineralogist, in the Minister of Mines' Report for 1907. His examination was made soon after shipments of the ore had been sent to the Irondale blast-furnace, and when the workings were fresh and in good condition for a thorough examination. The report is as follows:—

"*Quatsino Iron Ore.*—On arriving at the claims it was found that this company had acquired certain claims on the north side of the West arm, in Section 26 of the Quatsino Land District, as nearly as could be determined. The claims extend to the edge of the arm, and at a point about a quarter of a mile from the water a deposit of bog-iron ore of excellent quality had been discovered, covering the surface over a considerable area. To extract this ore, the Moore Investment Company had, earlier in the year, sent up a large force of men on an ore-barge, and had built a temporary wharf, from which a tramway was built to the iron-ore deposit. In August the property was found to have been abandoned, the track torn up, and the rails shipped away. From the workings visible it would appear that the iron-deposit over an area 300 feet long and 200 wide had been removed from the surface down to solid bed-rock, and this area had yielded 1,500 tons of ore, which had been shipped. The work done showed the deposit of bog-ore to be on a side-hill, which sloped at an angle of about 20 degrees towards the sea, lying on a smooth, water-worn bed-rock to a depth of, in some places, 4 feet, and in others, of as many inches; the average thickness of the deposit was not over 24 inches. Large trees and brush had been growing on top of the deposit, the roots being all through the ore, greatly increasing the cost of extraction, which, under the circumstances, must have been excessive. The superficial area over which the deposit shows is considerable, but no prospecting that has been done proves it to be of a greater average depth than at the point where its extraction was attempted.

"*Prince's Iron Claims.*—A few miles to the west, along the shore of the arm, a trail leads inland to the north for a couple of miles, to what is known as *Prince's Upper Claims*, a group of claims the number or names of which could not be ascertained. About two miles in on the trail two large cabins were found, and evidences that considerable work had been done, but no one was on the property when visited. The work had consisted of pits and open-cuts along the course of the valley of a small stream flowing into the arm. For the most part the pits were full of water and the materials taken out from them so mixed upon the dump as to be meaningless. The open-cuts were seen, however, and of these the one in which the most promising showing occurred started from the creek-bed and ran up the face of its gently sloping bank, showing in nearly horizontal layers, first, 4 feet of bog-iron ore; next, 1 foot of gravel with a layer of fine kaolin clay on top; next, 9 inches of iron ore, then 2 feet of ochre and clay, above which was the black surface mould. A similar showing was seen in another cut about 150 feet farther up the creek, and these may be taken as typical of the more successful strippings made. There is, undoubtedly, a very considerable area covered with iron ore, but, so far as could be seen, its depth had not been demonstrated further than described. Samples were taken from the lower 4-foot deposit of ore, and upon assay gave 48.12 per cent.—48.31 per cent, and 50.19 per cent. of iron—with much organic matter. The ochre and clay stratum assayed 36.6 per cent. of iron.

"About three miles to the north-west from Prince's camp, claims to the number of about 100 had been staked during the summer by other parties. This wholesale staking had been done to blanket the district until the claims could be roughly prospected, when those not wanted could be dropped—the land being held for one year at an outlay in fees of 5 cents an acre. This procedure, although contrary to the spirit of the 'Mineral Act,' was brought about by a tendency of certain local prospectors to stake 'extensions' to any claims that might be found by outside prospectors. No work other than staking had been done on any of these claims,

and as they were from six to seven miles back from the lake, through wet brush, they were not visited."

The opportunity for cheap transportation is so favourable as to make these occurrences of bog-ore attractive, and should encourage more thorough prospecting, especially in the event of the development of the iron and steel industries on the Coast, because this ore is valuable to mix with magnetite in the blast furnace.

UPPER QUINSAM LAKE.

Quinsam Lake Iron Syndicate.

Numerous large outcroppings of magnetite occur on the north slope of a mountain about half a mile south from the south end of Upper Quinsam lake at elevations from 220 to 560 feet above the lake. These outcrops occupy a zone striking almost due east, and expose deposits that are representatives of the contact-metamorphic type, with magnetite lying between limestone and diorite, dipping 80 degrees north. The occurrences are found distributed within an area measuring about 1,000 feet wide north to south by 1,200 feet east to west, and while unbroken continuity is not shown between the various outcroppings on the surface, yet there are so many that it is almost excusable to consider them as belonging to one deposit until the contrary is proven.

At 240 feet elevation above the lake there is an adit 135 feet long, driven into the mountain-side southward in magnetite the entire distance, and with magnetite in the face, but somewhat mixed with country-rock and garnetite. The side-hill rises at an average angle of 44 degrees, but over the face of the adit the slope is steeper, so that there are about 195 feet backs.

An average sample from the dump assayed: Iron, 58.6 per cent.; sulphur, trace; phosphorus, trace; silica, 9.3 per cent.

The adit is projected to crosscut the mineralized zone at the point, where it is about 800 feet north to south. According to a topographic survey this adit is driven under several outcroppings of magnetite, and the projected face is 320 feet vertically under the farthest outcrop south of the portal.

Other work on the property consists of open-cuts and surface stripping to the east and south from the adit, and at various levels above the 240 or adit level, which openings expose a large number of outcroppings of clean magnetite. The most extensive occurs about 1,000 feet south-eastward from the adit on the 400-foot level; this measures about 100 feet across and is almost square.

It is impossible to form any reliable estimate of the tonnage of ore available from measurements made where work has been done because of insufficient data. There is no question but that a very large quantity of magnetite can be quarried for immediate shipment. The contour of the mountain-side is such that the ore can be mined with steam-shovels, in a manner similar to that in use in the low-grade copper-ore mines in Utah, and the large quantity of ore exposed in surface outcroppings alone is evidently sufficient to suggest this method for mining operations.

In the floor of the adit on the 240-foot level the ore-body is quite as strong as on the surface, and there is every indication that it maintains its continuity to an undetermined depth below this level.

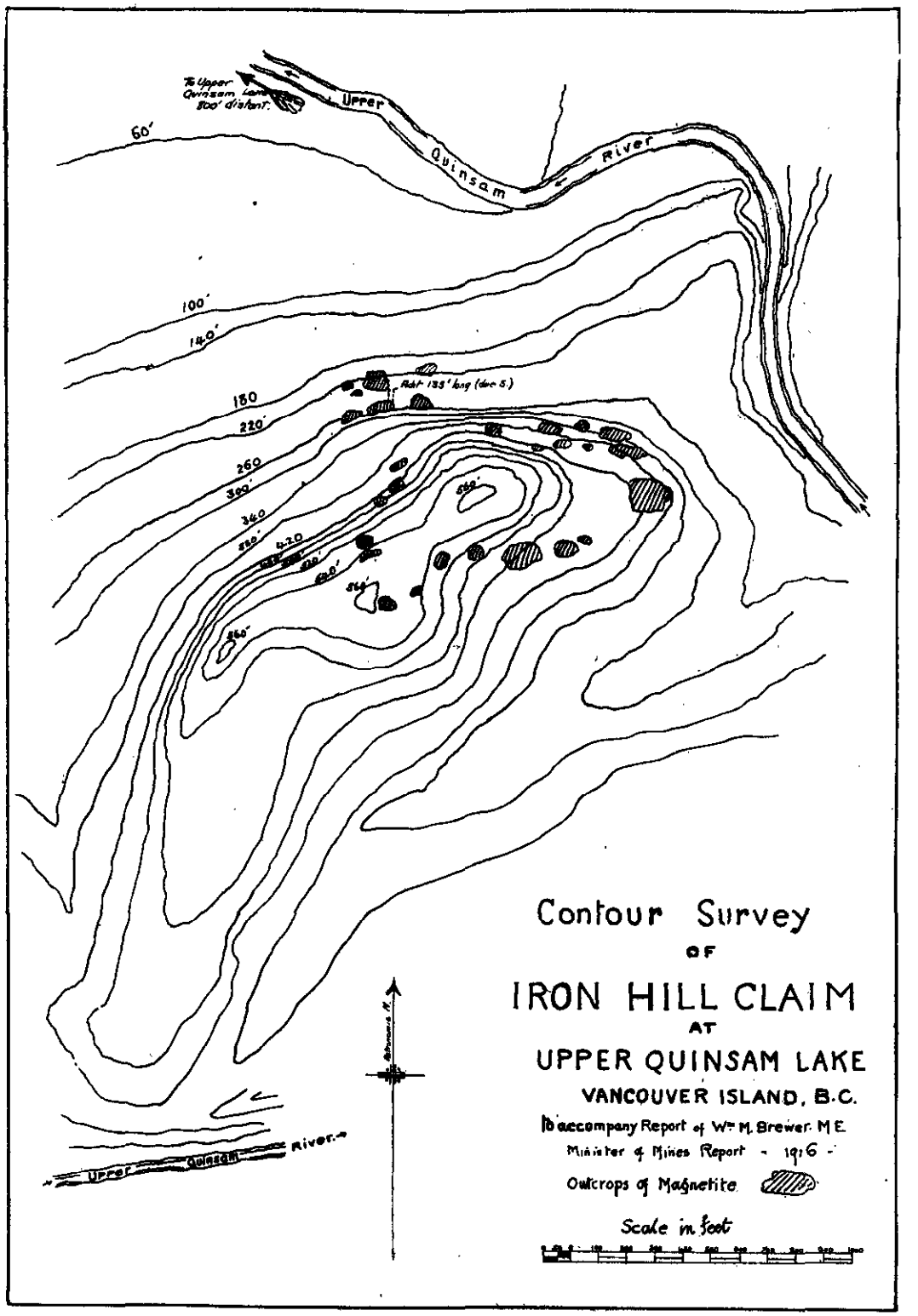
TEXADA ISLAND.

Puget Sound Iron Co.

The property owned by the Puget Sound Iron Company is on the west coast of Texada island; it extends from Gillies bay north-westward along the coast three miles and a half, and contains 3,094 acres of Crown-granted land. The original locations that make up the portion known as the "Iron Mines" comprise about 1,000 acres at the north-west end of the property, included in which are the three quarter-sections for which Crown grants were issued in 1874 by Lieutenant-Governor Joseph William Trutch to Henry William Hughes, Harry Trim, and Josias Charles Hughes. The Puget Sound Company, after acquiring these Crown-granted quarter-sections, had mineral locations staked over them in order to secure the precious metals as well as the base, and these locations have since been also Crown-granted. The most important occurrences of magnetite occur on the quarter-sections mentioned; they are named the *Prescott*, *Paxton*, and *Lake* mines, and belong to the contact-metamorphic type of deposits.

Prescott Mine, Texada, No. 2 Level.

Prescott Mine, Texada, No. 1 Level.


To Upper Quinsam Lake 800' distant.
Upper Quinsam River
60'
100'
140'
150
220'
260
300'
340
380'
420
460'
560'
Adit 135' long (dec S.)
Upper Quinsam River
Contour Survey
OF
IRON HILL CLAIM
AT
UPPER QUINSAM LAKE
VANCOUVER ISLAND, B.C.
To accompany Report of Wm M. Brewer M.E.
Minister of Mines Report - 1916 -
Outcrops of Magnetite
Scale in feet

Prescott.

This mine is near the extreme south-western corner of the range of limestone hills that extend across Texada island from Sturt bay, on the north coast, to the iron-mines within about half a mile from the south coast, where the limestone contacts with igneous rocks, with porphyrite on the east, quartz diorite on the south, and porphyrite on the west. Lenticular masses of magnetite from 200 to 300 feet long occur at the contacts. The apparent continuity of the magnetite has been shown to a vertical depth of 670 feet below the highest outcrop to the northward at 820 feet elevation, with the ore showing 80 feet wide in the floor of the adit, 150 feet above sea-level, and the face in solid magnetite. The magnetite outcroppings occur on the steep side-hill at elevations from 290 to 820 feet above sea-level, with those above the third level at 520 feet occurring almost directly north from the mine-workings on the *Prescott* ore-body and within a distance of 1,000 feet. The area in which the outcrops are enclosed measures about 1,500 feet north to south by about 1,000 feet east to west. The mine-workings are on four levels above the adit, at 150 feet elevation. These are called: Shaft level at 290 feet elevation; first level at 365 feet; second level at 405 feet; third level at 520 feet. The adit, which is 700 feet long, intersects the bottom of the shaft 475 feet from the portal. It is then driven northward through quartz diorite 380 feet, where a mineralized vein 4 feet wide is crosscut; the minerals in this vein are marcasite, iron pyrites, and some chalcopyrite. It strikes north-west and dips 54 degrees southward. After crossing this vein the adit is continued through quartz diorite to 600 feet from the portal, where the quartz diorite contacts with garnetite mixed with magnetite; this is crosscut for about 20 feet, then solid magnetite is exposed and crosscut 80 feet to the face, which is still in magnetite. An average sample across the face of this adit assayed: Iron, 66 per cent.; sulphur, *nil;* phosphorus, trace; silica, 3.3 per cent.

The shaft is 140 feet deep, sunk from 290 feet elevation, but as this was sunk in 1899 for prospecting and has never been used as a working opening, the ladders were in an unsafe condition and no examination could be made. The record of the work kept by W. H. Lee, the superintendent, shows that the shaft from the collar to about 70 feet deep passed through magnetite mixed with iron pyrites and some chalcopyrite in a garnetite, epidote gangue; then through quartz diorite to the bottom. A sample from the outcrop in which the shaft is sunk assayed: Gold, trace; silver, 0.3 oz.; copper, 1 per cent. This sample was not assayed for iron. Another sample from the dump at the collar of the shaft taken for the purpose of showing the copper content assayed: Gold, trace; silver, 1.6 oz.; copper, 6.2 per cent.; iron, 26.2 per cent.

On the first level there is an open-cut, the dimensions of which are 60 feet long on the strike by about 30 feet wide by 35 feet high at the face. This cut exposes a solid body of magnetite associated with some little chalcopyrite and iron pyrites in a garnetite gangue. A considerable proportion of this ore will carry about 1.5 per cent. copper content, and in places could be sorted up to about 3 per cent. copper.

The second level is opened 40 feet above the first and a short distance west of a straight line up the hill, where there is an occurrence of magnetite about 300 feet long by 80 feet wide. The workings are an open-cut 60 feet north to south and 30 feet east to west, with its face nearly 100 feet wide, and an adit driven northward from the open-cut 22 feet long in magnetite. This level is connected with tide-water by a gravity-tramway that was used some years ago when active mining was being done. Several thousand tons of magnetite was shipped to the Irondale blast-furnace for making pig-iron, and the portion of the ore with copper content was sorted out and shipped to some of the copper-smelters on the Coast for fluxing material.

Average samples of magnetite from the second level assay:—

	Lindeman's Sample.	McConnell's Sample.
"Iron	64.30 per cent.	62.57 per cent.
Sulphur	0.303 „	0.403 „
Phosphorus	Not determined.	0.024 „
Insoluble matter	Not determined.	6.46 „
Copper	0.14 per cent.	Not determined."

A shipment of 600 tons of magnetite made about 1885 to the Irondale blast-furnace assayed: Iron, 65.7 per cent.; phosphorus, 0.083 per cent.

The third level is opened at 520 feet elevation by a large open-cut made in magnetite, which shows much less copper and iron sulphides mixed with the magnetite than on either the first or

second levels, and is of superior quality for iron-making. This open-cut is made along the strike of the ore; it is 50 feet wide by 100 feet long by 50 feet high at the face. This lens of magnetite on the surface is apparently about 300 feet long, or about the same length as on the second level.

Garnet, hornblende, epidote, and calcite are the non-metallic impurities that occur with the ore on all the levels in varying quantities, these minerals are usually found at and near the boundaries of the occurrences of magnetite, and less frequently in the interior of the mass or lens.

Higher up the mountain, northward from the third level, other large outcroppings of magnetite occur. Two of these are at 640 feet elevation and are in the same contact as the main mass lower down the slope. The third occurrence is at 820 feet elevation and has formed entirely in limestone; it appears to be separated from the main ore-body by a mass of coarse crystalline limestone, in which a number of apparently small irregular lenses of magnetite occur.

There are also outcroppings of magnetite west from the main workings on the *Prescott* mine, along the limestone-diorite and limestone-porphyrite contacts, on which no work has been done.

Paxton. This mine is about 3,300 feet eastward from the *Prescott*, and the line of the limestone-diorite contact is traceable between the two mines, but very irregular. The diorite gives place to porphyrite near the west boundary of the *Paxton* ore-body, which, though, occurs in the quartz diorite near its contact with porphyrite, and very near the limestone, but not in the immediate contact.

The *Paxton* mine has been developed by open-cuts and short adits on about the same level as the collar of the shaft on the *Prescott* at 290 feet elevation. The open-cuts show the dimensions of the occurrence of magnetite to be about 300 feet long by about 150 feet wide by about 100 feet high above the floor.

The ore-body outcrops on a steep slope about 100 feet high, the lower part of which is diorite and the upper part magnetite. The face of the slope has been stripped 220 feet from east to west, and open-cuts and adits have been driven northward from near both ends of the stripping. The easterly open-cut is about 100 feet from the east end, and is 36 feet long, serving as an approach to an adit 40 feet long. The open-cut is made through quartz diorite for 18 feet, where the contact with magnetite is exposed and the remainder of the open-cut, as well as the adit, is in solid magnetite. The westerly open-cut is 37 feet from the west end of the stripping and 83 feet from the other open-cut. This cut is driven 32 feet as an approach to a short adit. Of the 32 feet, 20 feet are through quartz diorite to the contact with magnetite, and the remainder, as well as the short adit, through magnetite. The faces of both adits are in solid magnetite, so that the width of ore is undetermined. The dip of the diorite-magnetite contact is nearly vertical, and the strike of the magnetite lens is eastward.

The quantity of sulphides, mostly iron pyrites, is greater in the *Paxton* ore than in the other bodies. A sample taken along the adit by McConnell, assayed: "Iron, 59.40 per cent.; copper, 0.30 per cent.; sulphur, 1.07 per cent."

A sample taken by Lindeman from the same adit assayed: "Iron, 64.48 per cent.; sulphur, 1.866 per cent.; phosphorus, 0.005 per cent.; silica, 4.47 per cent.; copper, 0.22 per cent.; magnesia, 1.13 per cent.; lime, 1.32 per cent.; alumina, 0.66 per cent."

Lake. The third important occurrence of magnetite on the property of the Puget Sound Iron Company is known as the *Lake* mine, and is 1,300 feet east from the *Paxton*. The occurrence of magnetite lies in a bluff about 80 feet high at the contact between limestone and porphyrite, with porphyrite on three sides and with a body of garnetite and epidote on the north side separating the magnetite and limestone. The strike is east and dip nearly vertical. The mass of magnetite measures about 300 feet in length, with an average width of about 130 feet. It has been developed by an open-cut 100 feet long from east to west by 60 feet wide, and about 80 feet high at the face. The magnetite in the *Lake* deposit is finer grained than in the other large masses, and freer from iron and copper sulphides. A grab sample taken from the dump assayed: Iron, 58.0 per cent.; sulphur, 1.6 per cent.; phosphorus, trace; silica, 0.5 per cent.

McConnell reports that a rough general sample taken from the faced magnetite cliff, and assayed in the laboratory of the Canadian Mines Branch, yielded: "Iron, 57.50 per cent.; copper, trace; sulphur, 0.046 per cent."

Lindeman reports an average sample from the *Lake* mines assaying: "Iron, 59.57 per cent.; sulphur, 0.137 per cent.; phosphorus, 0.057 per cent.; silica, 8.33 per cent.; copper, 0.08 per cent.; alumina, 1.71 per cent.; lime, 3.82 per cent.; magnesia, 1.05 per cent."

There are several lenses of magnetite on the property of the Puget Sound Iron Company in addition to those on which development-work has been done, but while some of the occurrences are of considerable extent as shown by the surface outcroppings, no attempt has been made to prospect them. South from the *Lake* mine there is a line of narrow magnetite lenses within about 1,000 feet, all of which occur in porphyrite at considerable distances from limestone and diorite contacts. The longest of these is 220 feet, with a width varying from 10 to 20 feet. Two other lenses measure respectively 84 and 50 feet in length, with widths from 10 to 20 feet. The other lenses along this line are smaller.

The magnetite in all of these occurrences is very pure, and an assay of a sample from the longest lens is reported by McConnell as yielding: "Iron, 69.40 per cent.; copper, none; sulphur, 0.01 per cent."

It is impossible to estimate with any degree of accuracy the tonnage of magnetite in the several masses that occur on the property, because the development-work has been done with a view of mining and shipping ore rather than for measuring the available tonnage, and no underground work has been done except on the *Prescott* mine.

Regarding tonnage, McConnell, in his report on Texada island in Memoir 58, Department of Mines, Canada, page 88, says as follows: "For the purpose of making a rough estimate, it is assumed that the lenses extend downwards for a distance equal to their exposed surface length. The *Prescott* ore-body with a surface length of 300 feet has been proven to extend downwards for a distance of 430 feet, and at the lower level is still strong and must descend considerably farther. The tonnage in the main *Prescott* ore-body above the lower tunnel is estimated at 1,366,400 tons. The three large lenses in the limestones north-eastward from the *Prescott* assuming that they persist to a depth equal to their surface length, would yield 993,600 tons. The *Paxton* ore-body yields 1,607,200 tons and the *Lake* ore-body 504,000 tons. The total tonnage in the six ore-bodies, estimated on the basis adopted, amounts to 4,521,200 tons.

"No account is taken in this estimate of the numerous small lenses from 20 to 100 feet or more in length occurring along the range. Some of these are surrounded by large areas of intense alteration and mineralization, and the concealed portions may be much larger than the small outcrops appear to indicate.

"It is also unlikely that the lenses cut by the present surface represent the lowest tier formed. It is more probable that they are followed in depth along the contacts by other lenses, and the tonnage given above may be multiplied several times before the iron resources of the district are exhausted."

KLAANCH RIVER.

Iron Crown.

The Klaanch river flows from the south-east into Nimpkish lake at the south end; the lake empties into Broughton strait opposite Alert bay through the Nimpkish river, about 180 miles north-westward from the city of Vancouver. The *Iron Crown* mineral claim is the most important of a group of claims owned by Adam Mathers, of Alert Bay, and is situated about seven miles up the Klaanch on the south side of the river.

Practically but little development has been done since an examination was made by Einar Lindeman in 1907, when he made a magnetic survey and map, which accompanies his report in Bulletin 47, Mines Branch, Department of Mines, Canada, page 19. For this reason the writer did not visit this property, as the time at his disposal was limited. Lindeman's report is as follows:—

"The claim of most interest is, however, the *Iron Crown* mineral claim. An exposure of magnetite extends along the face of the river-bank for some 180 feet. The height of the bank is about 80 or 100 feet, forming at some points cliffs of magnetite 25 to 30 feet high. A sample of the ore gave the following analysis: Insoluble matter, 4.12 per cent.; iron, 64.23 per cent.; sulphur, 0.233 per cent.; phosphorus, 0.010 per cent.

"Farther up the hill, about 650 feet from the river, several outcrops of magnetite occur along the ridge. An average sample from these gave the following analysis: Silica, 5.30 per cent.; iron, 63.89 per cent.; alumina, 1.74 per cent.; lime, 0.80 per cent.; magnesia, 1.86 per

cent.; copper, trace; sulphur, 0.017 per cent.; prosphorus, 0.037 per cent. The solid formation being effectively covered by a sandy loam and a heavy vegetation, the outcrops mentioned were all that could be seen, but as the dip-needle showed a very strong magnetic attraction in several places, it was found advisable to make a magnetic survey and get some information in regard to the extent of the ore-bodies. The topography of the ground, the heavy vegetation, and the great number of windfalls delayed this investigation very much. In the magnetometer the vertical force of the normal terrestrial field is counterbalanced beforehand by a small weight on the arm of the needle. Through the swinging of the needle in a plane, as above mentioned, the horizontal intensity of the earth's normal magnetic field and the horizontal component of the magnetic force of the ore-body become annulled, and the vertical component of the magnetic force of the ore-body is, therefore, the only magnetic force which affects the needle, and, according to its strength in the different places, causes the different readings marked on the map. The places which have positive magnetic intensity—i.e., when the north pole of the magnetic needle points below the horizontal plane—are marked blue, and, on the other hand, the places where negative magnetic intensity—i.e., where the south pole of the needle points below the horizontal plane—are marked yellow on the map.

"To avoid misunderstanding by any person who is not familiar with magnetic maps of this kind, I desire to point out that all the area coloured blue cannot be considered to be underlaid by magnetite, but only a certain part of it. Further development-work will find the magnetite underneath the places with the highest positive readings, and north of them for a short distance down the hill, and here outcrops of magnetite were and will be found where strong negative readings were observed. This fact is due to the topography of the ground, the instrument being set up below the upper pole of the ore-body. This attracts the north pole of the magnetic needle and causes the negative reading. The map shows three separate deposits or groups of deposits, which for reference have been numbered I., II., and III.

No. I. outcrops on the river-bank, as before stated. The top of the bank is covered with soil, and no work has been done to ascertain the width of the deposit; but, to judge from the magnetic curves and outcrops available, the width at the west end may be estimated at not less than 100 feet. The length of the ore-body may be assumed to be about 190 feet.

"Group II. is the most important and may be assumed to consist of two, possibly three, ore-lenses, not counting the small pockets in the southern part of the group. The largest of these ore-lenses has a length of at least 380 feet; a width of 60 feet is very probable, and in some places it is even greater.

"Group III. is altogether covered by soil. The magnetic curves show, however, the ore strikes to be about parallel with the former group, with a length of about 480 feet, and a width which, in places, may be assumed to be very little less than that of the former. In regard to the depth of the different ore-lenses, no conclusion can be drawn from the magnetic map; but as far as surface indications go the claim may be said to be one of the best iron prospects on Vancouver island, and well worth further development."

HÆMATITE.

A report by J. D. Galloway, Assistant Mineralogist, on the occurrence of hæmatite-iron ore on a branch of the Klinaklini river, in the Nanaimo Mining Division, will be found on page 166 of this Report.

LIMONITE.

In connection with the foregoing description of the occurrences of magnetite on Vancouver and Texada islands, it is considered advisable to publish the report by J. D. MacKenzie, in the Summary Report for 1915 of the Geological Survey Branch, Department of Mines, on the occurrence of bog-iron ore on a branch of the Zymoetz river, in the Skeena Mining Division.

LIMONITE (BOG) ORE DEPOSITS IN THE SKEENA MINING DIVISION.

The following is the report of J. D. MacKenzie:—

"The bog-iron ore property owned by the North Pacific Iron Mines, Limited, of Prince Rupert, is situated on Limonite (Summit) creek, a tributary of the Zymoetz (Copper) river, thirty-eight miles east of Copper City, on the Skeena. It is six miles west of the summit of the Zymoetz River-Telkwa River trail and about forty miles from Telkwa. The property consists of nine claims on the north side of the creek, covering approximately 375 acres.

"The largest of the deposits on the property, shown in the accompanying sketch-map, was examined by the writer and is described below. He was later informed on good authority, however, that other, smaller, similar deposits occur at higher elevations on the mountain-side, farther back from the creek, but these were not visited by him.

"The deposit examined, which consists of a sheet of bog-iron ore of unknown thickness, extending from the 'moss-roots' to bed-rock, lies on the steep north side of Limonite Creek valley. It extends from the stream itself for a distance of 1,800 feet in a straight line up the mountain-side, which rises steeply from an elevation of 2,600 feet at the stream to 3,500 feet at the upper edge of the bog-iron ore. The irregular area underlain by the limonite measures about 2,250,000 square feet (50 acres), and its greatest width is about 1,800 feet.

"Everywhere in this area, yellow or brown earthy limonite may be uncovered merely by removing the moss from the surface; there is no overburden except the trees and moss growing on the limonite beneath, and this vegetation has been removed by burning in two places, leaving large areas of the ore exposed.

"The deposit consists of bedded bog-iron ore, occurring in platy layers from 1 to 3 inches thick, lying parallel to the hillside, which here has an average slope of nearly 30 degrees. In addition to the stripping of the ore by burning, prospecting has been done by trenching and sinking numerous pits. The greatest thickness of limonite anywhere exposed is 15 feet; in two or three places 10 feet is exposed, and several cuts show 3 to 4 feet. In no place has the bottom of the sheet of ore been reached, and as no systematic attempt has been made to determine the quantity of ore present it is difficult to form any estimate of the amount available.

"The ore consists of yellow and brown earthy limonite, free from sandstone or other impurities, rather soft and of a loose consistency, so that it may readily be dug with a pick or cut with an axe. The ore extracted from the large open-cuts has disintegrated on weathering to a crumbly, in part pulverulent mass, ranging in size of from a grain of powder to fragments an inch or two across. It is thoroughly saturated with water as it lies in the bed, but when dried might run about 20 cubic feet to the ton, at a guess.

"If the surface area be taken at 2,250,000 square feet, this figure would give 112,500 tons per foot of depth. An average depth of 5 feet for the deposit is almost certain; 10 feet is probable and perhaps the depth is greater. In other terms, 562,500 tons may be considered as almost certainly proven; twice that as probable, and perhaps the amount is considerably larger. Analyses of the ore are given below:—

"ANALYSES OF ORE FROM NORTH PACIFIC IRON MINES, LTD.

	1.	2.	3.	4.	5.	6.	7.	8.	9.
Iron (metallic).....	54.20	56.01	54.32	52.19	51.0	50.6	53.2	53.2	54.0
Silica (SiO_2).....	1.02	0.83	1.99	1.56	2.0	1.7	1.31	1.62	1.04
Manganese (Mn)....	0.85	0.51	0.39	0.70	..	..	..	..	..
Phosphorus (P).....	0.407	0.016	0.065	0.616	None.	None.	0.0016	0.014	0.002
Sulphur (S).....	1.16	1.52	1.14	1.47	1.7	0.8	2.65	1.89	1.15
Water, combined...	18.54	16.02	20.47	19.61	..	..	..	..	..

Analyses 1 to 4 were made by H. A. Leverin, Mines Branch, from samples collected by J. D. MacKenzie.

1. Sample of a trench wall, from 2 feet to 10 feet below the surface. Taken by cutting a groove 1 foot wide, 6 inches deep, 8 feet long, and quartering to 8 lb.

2. A picked specimen representing a 12-inch, harder, more compact band about 2 feet below the surface at the locality of No. 1, and also found in several other places in the deposit.

3. Sample of dump thrown out of a cut made in the deposit on a steep hillside; the cut is 2 to 3 feet wide, with a level bottom 40 feet long and a 20-foot face, exposing 15 feet of platy bedded ore lying on the hillside.

4. Sample of the dump from a trench 2 feet wide, 3 feet deep, and 50 feet long.

(These four analyses were made on material finely ground and dried at 104° C. until all hygroscopic moisture had been expelled.)

5. Sample taken at a depth of 15 feet from the surface (doubtless from the cut represented by analysis 3). Collector, W. M. Brewer.

6. Sample sent to British Columbia Bureau of Mines by the owner. (Analyses 5 and 6 by the Analyst of the British Columbia Bureau of Mines.)

7, 8, and 9. Analyses by Falkenburg and Laucks, of Seattle.

"These analyses, on samples taken in different ways and by different men, and made by at least three different analysts, agree very well, and emphasize the homogeneity and purity of the bog-iron ore.

"The country-rock on which the ore lies is an altered, greenish porphyry, containing in many places impregnations of pyrite. Across the valley of Limonite creek to the south this porphyry is in contact with quartz diorites of the Coast Range rocks, which are probably intrusive into it. The writer is informed that on the mountain-side above and to the north of the iron-deposit are many quartz veins carrying pyrite.

"The deposit lies on the western slope of the high eastern ridges of the Coast range, and the rainfall in this district, to judge by the vegetation, is very much in excess of that only a few miles to the east. At any rate, moisture is abundant throughout most of the year, and water is constantly flowing down the hillside under the moss. The water flowing over the iron-deposit has a strong taste of iron salts, and plainly has been derived from the decomposition of iron sulphides farther up the mountain-side. This strong solution of iron sulphates trickling down under the moss has built up the deposit as it now stands by the progressive transformation to limonite of successive layers of moss and other vegetation from beneath. That the efficacy of this process is undoubted is borne witness to by the limonitized twigs, roots, chips, fir-needles, and cones that have been transformed partly or wholly to limonite in the few years since the burned areas were cleared. In several places beautiful stalactitic terraced accumulations of limonite have been built up, which are even now in rapid process of growth.

"The iron ore is excellently situated for mining, provided transportation could be obtained. There is ample hemlock and balsam fir timber in the vicinity, and Limonite creek, with its fall of 400 feet in the first mile of its course from the lakes at its head, would furnish sufficient power for a considerable plant, at all seasons, as the water could be readily impounded in storage reservoirs."

During the summer of 1914 the writer (Wm. M. Brewer) examined the group of mineral claims owned by the North Pacific Iron Mines, Limited, described in MacKenzie's report herein quoted. His report was published in the Minister of Mines' Report for 1914. It is not necessary to reproduce it in this bulletin, because MacKenzie's report shows that he was enabled to devote more time to the examination and cover the ground more thoroughly than the writer (Wm. M. Brewer), who had no guide conversant with the property to assist him in his examination.

The following remarks relative to transportation facilities and other iron-ore prospects are copied from the writer's (Wm. M. Brewer) old report, as they are equally applicable to the conditions prevailing in 1917:—

"At the present time this property is handicapped by the lack of transportation, but the Grand Trunk Pacific Railway Company has had a preliminary survey made, and from that data the length of this railroad from the property to Copper City, on the main line of the Grand Trunk Pacific Railway, would be about sixty miles. The writer was informed by C. C. van Arsdol, chief engineer of the Grand Trunk Pacific Railway Company, that it was perfectly feasible to construct a railroad through this portion of the country via the Zymoetz River route for local freight-haulage, but that there were difficulties to be surmounted which made it inadvisable to incorporate that section in a transcontinental route.

"The property is very favourably situated with regard to timber for mining, fuel, and a fair supply for lumber, the varieties being of hemlock and balsam, as well as some cedar. The water-supply furnished by Summit creek would be ample for all purposes, even to developing power for a plant of considerable magnitude.

"Mansel Clarke, the discoverer and locator of this property, informed the writer (Wm. M. Brewer) that he had found other outcroppings of both magnetite and limonite iron ore for a distance of about nine miles in a N. 75° E. direction, or on the extreme summit at the headwaters of the Telkwa river, but could not find any deposits that would begin to approach in extent the body on the group of mineral claims examined."

REPORT ON THE COPPER-GOLD-SILVER ORE DEPOSITS ON VANCOUVER AND ADJACENT ISLANDS.

BY WM. M. BREWER, M.E.

OUTLINE OF REPORT.

The field examinations made by the writer during the summer of 1916 included practically all the mineral claims on Vancouver, Texada, Quadra, and Hanson islands. Of the properties examined, those on which iron ore was found have been segregated together and are fully described in a separate report on the "Iron-ore Deposits of Vancouver and Texada Islands" (*see* page 274), and published as Bulletin No. 3, 1917, of Bureau of Mines.

This report therefore deals with the claims other than the iron-ore deposits, and includes the claims on which deposits of copper, gold, or silver ores occur. The greater number of these claims were originally staked on account of the copper content in outcroppings exposed by nature; these outcroppings are distributed over very extensive areas on the islands, and usually occur in association with iron pyrites, magnetite, and sometimes with pyrrhotite. The copper content is often quite high, and the surface dimensions of the outcroppings of considerable extent.

Some mineral claims on each of the islands, except Hanson, were staked for the gold values contained in quartz veins, and a few for the zinc content found associated with galena, magnetite, and iron pyrites. The majority of these mineral claims were staked between the years 1896 and 1905, since which time prospecting has not been very active owing, to a great extent, to the fact that most of the prospectors found timber-cruising more remunerative.

The examinations were made in order to describe the development-work that had been done, the character of the ore-deposits, the possibilities from an economic standpoint, and the conditions with regard to transportation, water, and timber.

The occurrences of metalliferous minerals are more numerous along the west coast of Vancouver island than elsewhere on the island. These are found in a series of zones or belts which in a general way strike north-westerly, roughly parallel to the coast-line for a distance of about 230 miles, or from Sooke harbour near the south end of the island to Quatsino sound near the north end. If considered as a whole, the surface area over which the mineralized zones are distributed is elliptical in shape, but the southern part is much wider than the northern. From near the centre, for several miles northward, there has been practically no prospecting-work done; in fact, most of that portion of Vancouver island is unexplored. The northerly zone on Quatsino sound is about twelve miles wide by about twenty-four miles long. The southern portion of the series of zones reaches its maximum width of about twenty-four miles in the Alberni Canal district, and its narrowest width of about three miles on the East Sooke peninsula at the extreme south-western end of the island.

Other occurrences of copper ore on Vancouver island are found on Mounts Sicker and Brenton, also in the vicinity of Cowichan lake and the Koksilah river in the south-eastern portion of the island.

During 1916 there have been shipments of copper ore made from three mining properties on Vancouver island and from three on Texada island.

Those on Vancouver island are as follows: *Willow Grouse*, on the Sooke peninsula, and *Viva*, on the Koksilah river, in the Victoria Mining Division; *Monitor*, on the Alberni canal, in the Alberni Mining Division; and *Indian Chief*, on Sidney inlet, in the Clayoquot Mining Division.

Prospecting and development work has been done on several properties, most of which have been idle for years. These are as follows: *Yreka*, *Old Sport*, and *June*, on Quatsino sound, in the Quatsino Mining Division; *Crow*, *Jumbo*, *Indian Chief*, and *Ormond*, in the Clayoquot Mining Division; *Torse* and *Monitor*, in the Alberni Mining Division.

The shippers on Texada island are the *Marble Bay*, *Copper Queen*, and *Little Billie*. Prospecting and development work has been done on that part of the property of the Puget Sound Iron Company on the west coast of Texada island, on which copper ore occurs.

On Quadra island prospecting with diamond-drill has been done on the property of the Valdes Island Copper Company; also some mining done on the *Santa Anna* group of mineral claims near Bold point, on the east coast of the island.

Occurrences of gold-bearing quartz veins and deposits are, so far as known at present, confined to comparatively small areas on both Vancouver and Texada islands. On the first named such are found at the head of Granite creek, in the Alberni Mining Division, also near the head of Kennedy lake, in the Clayoquot Mining Division. On Texada island gold-bearing quartz veins occur along the northern base of Surprise mountain, also near Kirk and Spectacle lakes.

Occurrences of chalcocite or copper-glance are found in a few sections on Vancouver and Quadra islands in narrow veinlets, or associated with some of the bornite deposits.

INTRODUCTION.

Owing to the fact that during the summer of 1916 the owners of most of the metalliferous mineral claims were absent from the districts in which the claims are located, the writer had considerable difficulty in making thorough examinations. In many instances the original locations had been allowed to lapse, and in many others Crown grants had been secured years ago, since when work has been suspended; consequently considerably more time than necessary was consumed in searching for development workings.

Courtesies and favours received are cheerfully acknowledged by the writer to: A. W. Waterhouse, C. T. Green, and Anthony Watson, of Port Alberni; Joe Drinkwater, W. T. Gibson, George and Andrew Smith, of Alberni; Clarence Dawley and James Beck, of Clayoquot; Wm. Clancy, D. A. McDonell, and Henry Sherberg, of Quatsino; Wm. H. Lee and W. S. Bacon, of Texada island; also to all of the Mining Recorders of the Mining Divisions visited.

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HISTORY.

The earliest activity in prospecting for lode or metalliferous minerals in the district under review dates back to about 1880, when Hugh Kirk, a coal-miner of Nanaimo, began prospecting on Texada island, where he discovered some quartz veins carrying free gold, and, until his death some years later, made a living by working his claims in a crude manner. His success attracted other prospectors, but it was not until about 1895 that any great number of lode mineral claims were staked for gold or copper ore on Vancouver island, although considerable placer-gold mining was done on Leech river and also on China creek, in the Alberni district, as early as 1862.

In the Minister of Mines' Report for 1895 there is a long report by W. J. Sutton on the Alberni district, in which several gold-bearing quartz veins are referred to, also the occurrence of chalcopyrite copper ore. In the same report, Thomas Fletcher, the Gold Commissioner for that district, states that 141 mineral claims were recorded, and that "Extensive development-work is going on in the *Mineral Creek* group, exposing several veins of free gold, the most noted being the *Alberni*, *Missing Link*, *Mountain Rose*, *Champion*, *Ace of Spades*, and *Last Dollar;* average assay about $30 per ton."

The greatest activity in lode-mining on Vancouver and adjacent islands was noticeable from 1898, when there were about 200 prospectors exploring the mountains, until about 1907, during which years the following named mining properties shipped copper-gold-silver ore to the Coast smelters, viz.: From Vancouver island, *Tyee*, *Lenora*, and *Richard the III.*, on Mount Sicker; *Yreka*, on Quatsino sound; *Monitor*, *Three Jays*, *Cascade*, *Gladys*, *W.W.W.*, *Southern Cross*, on Alberni canal; *Indian Chief*, on Sidney inlet; and *King Solomon*, on the Koksilah river. From Texada island, *Marble Bay*, *Copper King*, *Cornell*, *Loyal*, *Little Billie*, and *Lake*. From Quadra (Valdes) island, *Copper Cliff* and *Lucky Jim*. It is a notable fact that the *Marble Bay* mine has been in continuous operation since 1897, and the workings have reached the 1,500-foot level at a vertical depth of 1,360 feet.

Between 1898 and 1902 three smelters were built. The Tyee smelter at Ladysmith, and the North-western at Crofton, on Vancouver island; and the Vananda, on Texada island. The last named is a small matting plant, which was closed down in 1902, when the larger plants were erected. The North-western was sold to the Britannia Mining Company in 1905 and closed down 1907, and the Tyee was operated continuously from 1902 until the autumn of 1911. During December, 1916, it was sold to the Ladysmith Smelting Company, and it is expected that smelting operations will be resumed in the near future, or as soon as a converter and other extensive improvements are installed. Since the above-mentioned smelters have been idle ore mined on the islands has been treated at the Tacoma Smelting Company's plant at Tacoma, Wash.

Activity in mining operations on the islands has been limited since 1907 for several reasons, but chiefly to insufficient systematic prospecting and developing work.

GEOGRAPHY.

Occurrences of copper ore are distributed on Vancouver island over a very large area from the southern end to the northern. They are not confined to any one section, but are found in the following localities, viz.: In the southern part of the island—on Mounts Skirt, Malahat,

Sicker, and Brenton; on Sooke peninsula; near Cowichan lake; and on the Nitinat river. In the southern-central portion and adjacent to the west coast—on Alberni canal; Uchucklesit harbour, an arm of Barkley sound; Snug basin, at the head of the harbour; and Henderson lake, which empties into Uchucklesit harbour. In the central portion—near the head of Great Central lake. Following the west coast north-westerly from Barkley sound, occurrences of copper ore occur near Kennedy lake; in the mountains adjacent to the several arms of Clayoquot sound; on Sidney inlet; on the South-east arm of Quatsino sound; and in the mountains near Elk lake, about 20 miles south-easterly from the entrance to the arm.

All of the localities mentioned are quite accessible; those in the southern portion can be reached either by water, railroad, or wagon-road from Victoria. The southern-central occurrences are within easy access either by railway to within comparatively short distances of the various properties, or by weekly steamer from Victoria to Port Alberni. Those adjacent to the west coast north-westerly from Alberni are reached either by steamer from Victoria three times each month, or by steamer from Vancouver to Hardy Bay, on the east coast of the island; thence by trail across to Coal harbour, on Quatsino sound, a distance of about ten miles, and by launch to destination.

The occurrences of copper ores on Texada island are reached by steamer from Vancouver three or four times each week to Vananda, the regular port of call on the east coast, thence by wagon-road to destination.

Quadra (Valdes) island is reached by steamer from Vancouver almost daily to Campbell River Landing, on the east coast of Vancouver island, about 100 miles distant; thence by launch, from four to about twenty miles, according to the destination desired.

Hanson island is reached by steamer from Vancouver to Alert bay, distant 180 miles, about four times each week; thence by launch about fourteen miles.

The majority of the occurrences of copper-gold-silver ores are so desirably located as regards transportation facilities that comparatively short tramways will connect the mine-workings with deep-water harbours, and only a few are situated beyond a short distance from water transportation.

ORE-DEPOSITS.

The metalliferous minerals found on Vancouver, Texada, Quadra, and Hanson islands include gold, copper, silver, zinc, and iron. Copper ores are the most common and of the greatest commercial value, usually chalcopyrite with a small content of gold and silver. Oxidized ores of copper or bornite are rarely found on Vancouver island; indeed, the only instance where such ores occur in commercial quantities, noted by the writer, is in the *Indian Chief* group of mineral claims, on Sidney inlet, Clayoquot sound, west coast.

On Texada island bornite is found on all of the properties worked as copper-mines, and on the *Marble Bay* mine this ore predominates and occurs on all of the levels, from the surface to the 1,500-foot. The gold content usually carried by the Texada Island ores is higher than is generally found in the other localities, and is as a rule more evenly distributed than in the ores on either of the other islands referred to in this report.

On Quadra island some occurrences of chalcocite and bornite are found near Gowland harbour near the south end of the island, and in the same locality grains of native copper occur in amygdaloidal greenstone. In the northern part of the island, in the vicinity of Granite bay, chalcopyrite associated with iron pyrites and pyrrhotite is the prevailing ore.

On Hanson island there are occurrences of chalcopyrite, and this is apparently the only metalliferous ore represented on that island. Its distribution appears to cover only a limited area near the southern shore-line, so far as known at present, but on the opposite side of the island there is a belt of limestone lying in contact with greenstone, which presents an attractive locality for prospecting.

Gold is found occurring in quartz veins, cutting the porphyrites on Texada island, some of which have produced quite rich specimens of free gold, as well as free-milling ore of commercial grade, but so far not in great quantity. In the quartz gangue there often occur iron pyrites, arsenopyrite, galena, sphalerite, and sometimes magnetite, causing the ore to lose its free-milling character.

Free-milling gold ores are found on Vancouver island, but the occurrences are quite rare and confined to restricted areas in the Alberni and Clayoquot Mining Divisions.

Sphalerite (zinc-blende) occurs in two localities on Vancouver island—on Hesquiat lake, in the Clayoquot Mining Division, and near Alice lake, about six miles back from *June* Landing, on the South-east arm of Quatsino sound, in the Quatsino Mining Division.

The metalliferous-mineral deposits occurring on the islands are all more or less closely connected with the igneous rocks, usually with those designated as the *Vancouver* group, on Vancouver island, or their correlated contemporaries on the other islands.

There are three distinct types of metalliferous-ore deposits on the islands. These are generally referred to as the contact-metamorphic replacement type, the impregnated replacement shear-zone type, the Mount Sicker type, and the fissure-vein type.

The first of these is represented by ore-deposits that occur in zones at or near the contact between limestone (usually entirely crystalline) and igneous rocks, where metamorphism has as a rule altered the original rocks to such an extent that it is very difficult to classify them. The zones are particularly noticeable on account of the abundant presence of such contact-metamorphic minerals as garnet, epidote, tremolite, hornblende, and occasionally molybdenite. The copper ores in this type of deposits usually occur in lenses of irregular outline and extent.

The second type is represented by deposits of ore which occur as impregnations in crushed shear-zones in igneous rocks, where the original minerals have been replaced by metalliferous ores which have been precipitated in fractures and fissures, and often occur with a vein-like structure.

An exceptional type is represented by fissures in the schistose rocks in the vicinity of Mounts Sicker and Brenton, in which ore is found in large lenses of very clean ore, and which up to the present time have not been discovered elsewhere on the islands.

The third type is represented by quartz veins, usually narrow and gash-like, which generally cut porphyrites and granitic rocks and carry gold values.

The contact-metamorphic replacement type of ore-deposits may be said to be the prevailing type, and representatives of it are generally distributed throughout the mineral-bearing zones. This type of ore-deposits may be subdivided into two sub-types, as suggested by Clapp in his report on southern Vancouver island, page 158, as follows: "The contact deposits developed in the limestones appear to be capable of subdivision into two sub-types, which, however, merge into each other. They are those which occur at the contacts and those which occur in the zone of contact metamorphism at some distance from the actual contact. The former are characterized by a higher percentage of magnetite and pyrrhotite and the latter by a higher percentage of pyrite and chalcopyrite, these four minerals being the principal metallic minerals of the contact deposits."

Genesis, Contact Deposits.—Both McConnell and Clapp discuss the genesis of the copper ores that occur in the contact deposits; the former in his report on Texada island, in Memoir 58, Canada Department of Mines, Geological Survey Branch, and the latter in his report on southern Vancouver island, Memoir 13, same department and branch. The conclusions drawn by each of these authorities are, in a general way, very similar, and the writer copies from McConnell as follows:—

"The ore-bodies in their irregular shape, sporadic distribution, constituent metallic and non-metallic minerals, and geological relationship form typical examples of contact-metamorphic deposits now generally admitted to be of magmatic origin, and directly due to heated gaseous or liquid emanations holding various metals in solution rising from a cooling intrusive. The Texada deposits date from the closing stages of the great period of vulcanism which produced the Coast Range batholiths. The intrusives of this period on the island consist of quartz-diorite stocks and a later more basic series of diorite-porphyrite stocks and dykes. Copper ores occur in connection with both rocks, but the principal deposits followed the intrusion of the later series. The mineralization solutions ascending from the still liquid lower portion of the intrusive stock follow closely as a rule the contact between the upper solidified portion and the bordering crystalline limestone. The solutions acted mainly on the limestones, and large irregular areas have been more or less completely replaced by various metallic and non-metallic minerals. The diorites, while less affected than the limestones, often exhibit considerable replacement along the contact and in limited areas have also been converted into ore.

"It is noteworthy that the limestone in which most of the ore-bodies formed is remarkably free from siliceous and aluminous impurities, and, with the exception of lime, the material for gangue as well as ore minerals must have been largely derived from the ascending magmatic solutions."

The impregnated and replaced shear-zone type of copper-deposits is discussed very fully in Clapp's report, from which extracts are made by the writer. Clapp names it the Sooke type, because he only found representatives of this type on the East Sooke peninsula, on Vancouver island, in the rock he has classified as Sooke gabbro. He states, on page 177 in his report, that:

"The association of minerals, especially the presence of the hornblendes, proves conclusively that the deposits were formed under conditions of high temperature and pressure. The disseminated chalcopyrite is so intimately connected with the large-bladed and fibrous amphiboles of the shear-zones that the two minerals have doubtless been formed by a similar and continuous process.

"The conclusions reached regarding the origin of the 'hornblendites' of the shear-zones is that they were probably formed directly following the solidification of the gabbro through the influence of hot solutions, either liquid or gaseous, acting on the sheared rock, recrystallizing the basic constituents into amphibole. Following or virtually contemporaneous with the above changes, solutions carrying magnetite and sulphides of iron and copper were introduced and their contents were deposited as disseminations through the shear-zones. The metallic minerals may have been more abundant in the original gabbro along certain of these zones, formed by segregation in the primary gabbro magma.

"Metasomatic replacement has gone on to a very considerable extent, as is shown by the silicates with jagged, irregular, or obscure outlines that are included in the metallic minerals, even in the massive chalcopyrite. The large masses of sulphides and magnetite have apparently been formed in part where this process is most efficient. In the chalcopyrite-deposits marked replacement of hornblende has taken place only near the walls or at the intersection of two shear-zones. Replacement of the feldspar has, however, gone to a very considerable extent.

"Even after the formation of the 'hornblendites' in the shear-zones slipping has occurred, as is shown by the abundant slickensides. This movement continually opened up new passages for the solutions, so that the metallic minerals continually worked their way farther into the sheared rock, and more and more completely filled the small interstices between the hornblende crystals. The paragenesis of the minerals of the deposits always shows chalcopyrite to have been formed last."

The *Tyee* type of deposits of copper ore, or where the ore has developed in a syncline in the Sicker schists, is peculiar to the Mount Sicker district on Vancouver island. The genesis of this type of deposits is described by Walter Harvey Weed, M.E., in his notes on the *Tyee* copper-mine, published in the *Engineering and Mining Journal*, January 25th, 1908, page 200, as follows:—

"The *Tyee* ore-body resembles in features and occurrence the lenticular bodies of iron ore of the Lake Superior ranges, the origin of which has been so clearly disclosed by Van Hise, Leith, and others. The hypothesis that the copper is a concentration by shallow ground-water circulations of material extracted from sparsely disseminated particles of chalcopyrite and pyrite of the schists, liberated during gradual erosion of the country, gathered in shear-zone cracks or trunk channels and precipitated by graphitic matter with coincident replacement of crushed material, appears at first sight to be an adequate explanation for this and many other deposits. The chief objection to this, and apparently an insuperable one, is the fact that the *Tyee* deposit consists largely of barium sulphate, while the surrounding rocks are entirely free from it, showing that lateral moving waters have not furnished the ore. It is therefore evident that we must look to deep-seated waters as the source of the ore in this deposit."

VICTORIA MINING DIVISION.

The occurrences of copper ore which have been found to possess commercial value in the Victoria Mining Division are found on the slopes of Mount Maguire, on the Sooke peninsula; on Mount Sicker; on Mount Gordon, south-west of Cowichan Lake narrows; and on the Koksilah river. Three distinct types of ore-deposits are represented—the Sooke type, occurring in shear-zones in the Sooke gabbro, on Sooke peninsula; the *Tyee* type, occurring on Mount Sicker; and the contact type, occurring on Mount Gordon and the Koksilah river.

Willow Grouse Group.

This group of mineral claims comprises six full-sized claims and one fraction, known as *Golden Thrush*, *Willow Grouse*, *Willow Grouse Fraction*, *Blue Bird*, *Donaldson*, *Jack*, and *Sydney*. The property is on the north-west slope of Mount Maguire, on the East Sooke peninsula, about twenty-five miles

distant by wagon-road or by water from Victoria, and the mine-workings are about 3,000 feet from the nearest point in Sooke harbour, where vessels can lie well sheltered.

The group of claims was staked about 1901 by Alexander Donaldson for himself and associates. The property is at present owned by H. B. Thomson and others, of Victoria, but since May, 1915, has been operated under a lease and bond by a syndicate consisting of R. G. Mellin, R. Hincks and, others. Approximately 900 tons of copper ore has been shipped since that date to the Tacoma smelter, the copper content of which averages about 6 per cent., with about 50 cents in gold and silver values to the ton. The lessees mined from two lenses of ore exposed in the old workings, but were unable to continue further development because of the large quantity of water that flowed into the workings and lack of sufficient capital.

This occurrence of copper ore occurs in a shear-zone in gabbro country-rock, and is referred to by Clapp as belonging to the Sooke type of ore-deposits. The mineralization is chiefly chalcopyrite disseminated through a shear-zone striking N. 40° E., about 60 feet wide and of undetermined length, but with the richer portion of the ore-body along the north wall. A narrower shear-zone striking N. 3° W. and dipping 80° W. forms a junction with the wider one, near the south end of the mine-workings, at which point a body of solid chalcopyrite occurs that is 7 feet wide and, maintains that width for about 125 feet to the northward, following the narrower zone. The mine-workings consist of a deep open-cut about 125 feet long by about 20 feet wide, and shaft 50 feet deep, with crosscut at the bottom.

The mine-workings on this property cover a comparatively small area, but the wide shear-zones in the gabbro extend for a very considerable distance along the strike in both directions from the workings. No systematic prospecting-work has been done outside of the immediate vicinity of the workings, although the formation is favourable for the development of low-grade ore-bodies.

Margaret Group. This group of mineral claims consists of three—the *Margaret*, *Copper King*, and *Eureka*—situated on the southern slope of Mount Maguire, Sooke peninsula. These claims are located on Crown-granted land owned by the estate of the late A. R. Johnson, of Nanaimo, and B. H. Johns, of Victoria. Some development-work was done a few years ago by Dan Campbell and associates, who staked the claims on the presumption that the land was Government land and open to prospectors. During the past two years more development-work has been done by Mr. Johns on behalf of the owners of the Crown grant, who are entitled to all of the base minerals, including copper, found on the land, the stakers being only entitled to the precious metals (if any) that are associated with the copper.

On this property there is a shear-zone in the Sooke gabbro about 200 feet wide extending through the claims, striking N. 43° E., in which chalcopyrite occurs disseminated through the zone and sometimes occurring in small lenses, also as enriched shoots of considerable extent, with a vein-like structure similar to the occurrence described in the report on the *Willow Grouse* property.

The property was bonded early in 1917 by O. B. Gerle, of Pitt Meadows, B.C., who commenced development-work and building a wagon-road from the mine-workings to a wharf on the ranch owned by Dr. Francis on Sooke harbour. The distance between the two points is two miles, and the difference in elevation about 500 feet.

When the writer examined the property on May 7th he found that the wagon-road had been surveyed, the right-of-way cleared, about 400 feet of corduroy-work constructed across a swamp, and 1,150 feet of drain-ditch dug, averaging 2 feet deep, to lower the water in the swamp.

The mine-workings are at an elevation of about 500 feet on a low ridge that rises near the southerly end of the swamp. The ridge is made up of Sooke gabbro country-rock, and represents a mineralized shear-zone in that rock with outcroppings of chalcopyrite, with which are associated some pyrrhotite and magnetite. The gangue material is chiefly hornblende. These outcroppings occur in a fissure of undetermined width, with the strike along the axis of the ridge in a south-westerly direction. The dip appears to be at a steep angle towards the north-west, but is very difficult to determine, because no well-defined walls are exposed in any of the open-cuts made in the outcroppings. The ore-body appears to represent an enriched shoot in the fissured zone, and can be traced for a length of about 275 feet by outcroppings which maintain practically unbroken continuity for that distance.

The most work has been done at the north-easterly end of the outcroppings, where an open-cut is made in ore for a length of about 30 feet, a width of about 10 feet, and a height at the face of about 8 feet, with solid ore still exposed in each of the faces of the open-cut.

There are about 40 tons of ore on the dump, and a sample taken representing an average of the ore moved by the last shots assayed 8.3 per cent. in copper, while another sample representing about an average of the ore on the loading-platform at the entrance to the open-cut assayed 8.1 per cent. in copper.

Towards the south-west from the open-cut mentioned there are several other open-cuts in which chalcopyrite is exposed, apparently of about the same grade, but the cuts are not as large. Between the open-cuts there are natural exposures of ore of similar character, but the full width of the enriched shoot is not determined. At a point about 275 feet south-westerly from the first open-cut mentioned, an approach-trench 125 feet long is made to the portal of a proposed crosscut adit at about 25 feet lower elevation than the ore-outcroppings along the ridge. It is also proposed to drift from this adit along the strike of the ore towards the north-east to connect with a shaft to be sunk in the first-mentioned open-cut.

About 800 feet south-westerly from the proposed adit there is an old shaft, said to be 25 feet deep, which could not be examined on account of being full of water. This is sunk on an outcrop of hornblende mineralized with chalcopyrite, and apparently representing an extension of the shear-zone in which the ore-deposit, already described, occurs. There are several tons of mineralized ledge material on the dump, in which there are many lumps of almost solid chalcopyrite. The most of the dump is made up of lumps of hornblende carrying grains and particles of chalcopyrite as impregnations. No sample was taken, because it was evident that the dump had been thoroughly sorted over, and also because no data relative to the dimensions of the ore-body exposed in the shaft could be obtained.

No prospecting has been done south-westerly from the old shaft, so far as the writer could ascertain.

King George. This mineral claim adjoins the *Jack*, of the *Willow Grouse* group, on the north-west, and is about half a mile distant from the workings on that property. The *King George* was staked by Frank Caffery, of East Sooke, on June 20th, 1911, who started development on an outcrop of chalcopyrite that occurred in a shear-zone in the gabbro, having its strike N. 80° W. During 1916 more extensive development-work was done by making deep open-cuts and following an ore-body some distance, with the view of prospecting it near the surface to locate the most desirable point to start sinking. The results from this work were shown by a considerable tonnage of good chalcopyrite ore on the dumps that had been taken from the open-cuts. The prospect has promise, but needs systematic and extensive prospecting.

MOUNT SICKER.

It is not the intention of the writer to attempt any long description of the copper-mines on Mount Sicker, because an exhaustive examination was made by the Provincial Mineralogist in 1902, whose report was published in the Minister of Mines' Report for that year, and the history of the operations recorded annually since then. Descriptions in which the geology, genesis of the ore-deposits, and other features are exhaustively discussed have been written by Walter Harvey Weed, M.E.; Robert Musgrave, M.E.; and Charles Clapp, M.E.

No detailed report is made by the writer, as active operations ceased on the *Tyee*, *Lenora*, and *Richard III.* mines some years ago, and the workings were allowed to fill with water. No description of the occurrences of metalliferous ores on Vancouver island, however, would be complete without reference to these properties, which in the past have been practically the only commercially productive lode mines on the island; for some years the *Tyee* mine was one of the most important copper-mines on the north Pacific coast.

There have been rumours that some mining men have been considering the reopening of the three mines referred to above, which adjoin each other from east to west, the *Tyee* in the centre, with the *Richard III.* to the easterly and the *Lenora* to the westerly. The high price of metals has been the incentive to suggest such an arrangement, as well as the fact that in the *Tyee* mine a body of ore known as the north lode was not mined by the old management because of its low grade, and that also ore was left in the *Richard III.* mine for the same reason. The quantity of water in both of these mines caused an excessive cost for pumping when worked

separately, but if the old workings on the *Lenora* were extended easterly the workings on the *Tyee* and *Richard III.* would be drained to about their 300-foot levels, and ore could be transported through the *Lenora* main adit instead of being hoisted.

The production from the *Tyee* mine from 1900 to 1907 was approximately 200,000 tons of ore that yielded an average copper content of 4.5 per cent., besides about 3 oz. silver to the ton. The production from the *Lenora* approximated 80,000 tons of ore of about the same grade during the same period, and the *Richard III.* is credited with about 4,000 tons of ore about the same grade.

Clapp designates the Mount Sicker ore deposits as "virtually a single lens of ore extending through three claims from east to west—the *Richard III.*, the *Tyee*, and the *Lenora*. The ore is chalcopyrite associated with pyrite, sphalerite, and some galena, in a gangue consisting chiefly of barite, with some quartz and calcite. Outside of the lens are massive veins consisting chiefly of quartz and dolomite. The lens occurs in a synclinal trough of the quartz-talc and graphite schists of the Sicker series."

The Sicker series of schists extends over quite a large area of Vancouver island in the east-central portion, as well as a portion of Saltspring island, and is mapped by Clapp as extending from the southern end of that island, across it, and on Vancouver island from the coast opposite Saltspring island, in a north-westerly course, towards the Alberni canal, a distance of about forty miles as the crow flies and of an average width of about four miles. Of this area only a comparatively small portion in the vicinity of Mounts Sicker and Brenton has been prospected, and there is the possibility, as Mr. Clapp points out, that other ore-bodies than those referred to may be found if systematic prospecting is done.

In addition to the mines mentioned on Mount Sicker, there have been several mineral claims staked on that mountain as well as on Mount Brenton, to the westward, on the opposite side of the Chemainus river from Mount Sicker, notably the *Key City*, *Victoria*, and *Copper Canyon* group, the last-mentioned group containing the nine mineral claims, six of which are on Mount Brenton. Considerable development-work was done on all of these properties some years ago, but although they are all located in a belt of the Sicker schists, and under very similar geological conditions to the *Tyee* and *Lenora* mines, no extension of the *Tyee* ore-body of commercial value has been yet exposed in the workings.

Koksilah River Properties.

During 1916 some interest was revived in lode-mining on the Koksilah river, near Duncan, when Joe Gallo, of Cowichan Station, started work on the *Viva*, *Elsie D.*, and *Comet* mineral claims, from which he shipped about 250 tons of copper ore having a copper content of about 4 per cent.

Some years back considerable work was done on the *Bluebell* group and *King Solomon* mineral claims, and several shipments of copper ore were made despite the handicap of a wagon-haul of about four miles to Cowichan Station, on the Esquimalt & Nanaimo Railway; but since about 1907 little work has been done until during the past summer, when Gallo operated, as mentioned above.

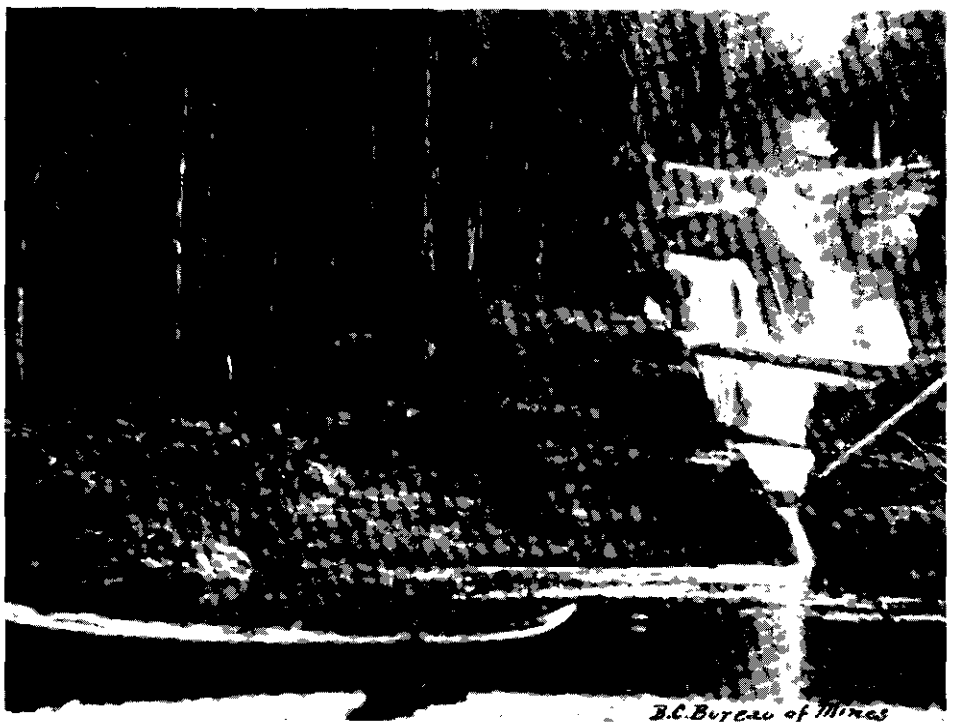
The occurrences of copper ore on the Koksilah ridge belong to the contact-metamorphic type of ore-deposits and occur in metamorphosed limestone, some distance from the contact with the main body of intrusive granitic rock, that, according to Clapp, is so much metamorphosed and sheared and so intimately associated with metamorphic and sheared volcanics that the two types of metamorphic rocks cannot always be distinguished. The deposits consist chiefly of impregnations of magnetite, pyrite, and chalcopyrite in the sheared metamorphic rocks.

Cowichan Lake Deposits.

Blue Grouse.

In a southerly direction from the narrows in Cowichan lake, and about six miles from the south end of the lake, an occurrence of copper ore occurs on the *Blue Grouse* group of mineral claims about one mile and a half from the westerly shore. The deposits belong to the contact-metamorphic type, and are developed under similar conditions to those prevailing on the Koksilah ridge. The *Blue Grouse* group was prospected to a considerable extent in 1915 and 1916, when underground development-work was

Nootka Indian Rancherie.



Myra Falls, Buttle Lake, Nanaimo Mining Division.

done, consisting of a crosscut adit and drifts driven in an ore-body at right angles to the adit. The property is referred to in the Minister of Mines' Report for 1915, page 290.

During the winter of 1916-17 this property was leased by a Victoria syndicate, which perfected an arrangement with the Empire Lumber Company, owners of the Crown-granted surface rights, allowing the syndicate to mine and ship ore. Since then some shipments to the Ladysmith smelter are reported that yielded satisfactory returns.

The development-work has been extended, but, as the writer has not seen the property since April, 1916, no detailed description is given in this report.

The adit, when examined by the writer, crosscut an occurrence of chalcopyrite ore in garnetite gangue for about 30 feet at a depth of about 40 feet below the outcroppings in a ridge or bench of a mountain which rises to an elevation of about 1,500 feet within a comparatively short distance south-westerly from the workings, and roughly parallels the shore of Cowichan lake.

There are several other outcroppings of copper ore on the property which apparently represent isolated lenses, but, as some of these are in line along the strike of the ore-body exposed by the workings mentioned, further development may determine continuity between the outcroppings.

NITINAT RIVER DEPOSITS.

It is only since the line of the Canadian Northern Pacific Railway has been under construction that much attention has been paid to prospecting north from the head of Cowichan lake, in the vicinity of the headwaters of the Nitinat river. This part of Vancouver island is included in the Victoria Mining Division, although the writer, when he visited it in 1916, travelled from the Alberni canal, following the tote-road parallel to the grade of the railway from Smith's Landing. The distance from Alberni canal to the summit, that is the dividing line between the Victoria and Alberni Mining Division, is about nine miles, and from there to a chain of lakes that are really the headwaters of the Little Nitinat river, the main tributary of the Nitinat, is about five miles. From there the distance to the north end of Cowichan lake is about fifteen miles via the line of the railway. The prevailing rock formation along the Little Nitinat and the main river is that classified by Clapp as the *Vancouver* volcanics of the *Vancouver* group, made up of andesite, amygdaloid, porphyries, tuff, etc. On the Nitinat side of the summit for a distance of about fourteen miles there is only one occurrence of limestone seen from the road. This occurs on the Little Nitinat river about one mile and a half southerly from the foot of Francis lake, the largest of the chain of lakes already mentioned. The limestone occurs in the shape of a large wedge surrounded by igneous rocks, with some mineralization at the contact made up of a little chalcopyrite associated with marcasite, pyrrhotite, and iron pyrites. An open-cut has been made on the bank of the river, evidently with a view of prospecting the outcroppings, but no work was in progress at the time of the visit, nor could any information be obtained.

Independence. About seven miles south-easterly from Francis lake, on the west bank of the Nitinat river, the *Independence* mineral claim is located. This was staked by Andrew Atkinson, of Port Alberni, who is prospecting a shear-zone in an igneous rock formation. Just above water-level in the river an open-cut 10 feet long has been made as an approach for a proposed adit. In the face of the cut there is a fracture in the country-rock about 16 inches wide filled with a black-coloured soft gouge material carrying marcasite and some iron pyrites that has been considered vein-filling. An assay of an average sample showed no values.

Dickson. This mineral claim, staked by George Dickson, of Port Alberni, adjoins the *Independence* on the north-west. At a point in the steep river-bank about 750 feet up the Nitinat from the work on the *Independence* a crosscut adit has been driven 28 feet long, in which two quartz stringers mineralized with iron pyrite and a little galena have been crosscut. One of these, which is 6 inches wide is at the portal; the other is 2 inches wide and is cut 4 feet from the portal; the remainder of the adit is driven in country-rock.

A sample of the full width of the first-mentioned stringer assayed: Gold, trace; silver, 1.4 oz.; copper, *nil.* A sample of the other assayed: Gold, trace; silver, trace; copper, *nil.*

In the bed of the river, about 400 feet up-stream from the work just mentioned, two parallel quartz stringers occur in igneous brecciated country-rock. One of these is about 8 inches wide

at the outcrop, and a sample of the full width assayed: Gold, trace; silver, 3.2 oz.; copper, *nil*. The writer was informed that some specimen samples from this stringer had assayed as high as $90 to the ton in gold and silver. The other stringer could only be seen under the water, as the river was higher than normal. This stringer can be easily seen beneath the water and shows greater width than any of the others, but as its line of strike appears to follow the bed of the river, which is of considerable size, it is very questionable whether it possesses any commercial value, as the difficulties to be overcome in mining operations are so serious that the cost for mining would be practically prohibitive.

Flora.

About two miles and a half down the Little Nitinat river from the *Dickson* mineral claim, Ike Holman, of Cowichan lake, has staked the *Flora* mineral claim on the easterly side of the railway-grade. On this claim, very near the grade, are strong outcroppings of mineral, made up of pyrrhotite, iron pyrites, marcasite, and chalcopyrite in a shear-zone in greenstone, very quartzose, much fractured, and highly altered. Epidote is associated more or less with the mineralization.

The mineralization at one point occurs in a fissure about 3 feet wide in the sheared greenstone, which can be traced for about 50 feet up a small creek, beyond which the rock surface is hidden. The strike of the fissure is N.E. (mag.) and dip 38° N.W. (mag.). The strike conforms with the strike of the shearing-planes. A drift has been driven 11 feet long in which is exposed vein-filling material mineralized with iron pyrites, pyrrhotite, marcasite, and some chalcopyrite, contained in a gangue of crushed country-rock.

A grab sample taken from a dump at the portal of the drift, containing about 5 tons of ore, assayed: Gold, trace; silver, 3.2 oz.; copper, 2.1 per cent.

To the north-west from the drift described, about 300 feet from the railway-grade, and about 100 feet higher elevation, there occurs an outcrop of practically solid pyrrhotite about 20 feet long and 3 feet wide, striking N.E. (mag.) and dipping 45° N.W. (mag.). This occurrence is almost parallel to the fissure on which the drift described is driven, and occurs in a similar shear-zone in igneous rock.

Whenever the Canadian Northern Pacific Railway is completed this section of Vancouver island will have excellent transportation facilities, and should be attractive to prospectors, as the indications of mineralization are sufficiently promising to warrant thorough and systematic exploration.

During the summer of 1916 there was more interest shown in this section of the Victoria Mining Division than in the past, with the result that between the Little Nitinat river and the north end of Cowichan lake twenty-three mineral claims were staked and recorded. Most of these claims are in the near vicinity of the grade of the Canadian Northern Pacific Railway, as well as near the main Nitinat river.

As the discoveries were made late in the season after the writer had visited the Nitinat district, he did not have an opportunity to make any examination of the discoveries, but has received the following particulars from Andrew Wright, of Victoria; C. H. Dickie, of Duncan; and P. J. Pearson, of Chemainus, who have lately organized the Nitinat Copper Company, Limited, to take over nine mineral claims situated about eight miles from the north-west end of Cowichan lake and five miles from Nitinat lake. The group of claims is about one mile and a half from the grade of the Canadian Northern Pacific Railway near the bank of the main Nitinat river. Some of these claims were staked late in 1916 by Ike Holman, of Cowichan lake, who, it is reported, has since died from exposure. He sold his interest to Andrew Wright, who, with his associates, staked several other mineral claims in the same vicinity. The chief exposure of copper ore is reported to occur at an elevation of about 1,600 feet above sea-level, in a cliff on the side of a ravine where a deposit of mineral containing a fair quantity of chalcopyrite, associated with iron pyrites outcrops.

ALBERNI MINING DIVISION.

GREAT CENTRAL LAKE DISTRICT.

Big Interior Group.

The most extensive occurrence of copper ore, so far as at present known in the Alberni Mining Division, is on the *Big Interior* group of mineral claims, about ten miles by trail westerly from the west end of Great Central lake, in the extreme north-west corner of the Division. This group was originally

staked in the autumn of 1899 by Joe Drinkwater and Davie Nichols, two prospectors of Alberni, when they were crossing Vancouver island from the head of Bear river, that flows into Bedwell sound, an arm of Clayoquot sound, to Alberni. Since then the history of the property has been a series of vicissitudes, but through all of the changes Drinkwater has retained his interest, and at the present time has associated with himself M. Tebo, of Alberni, in the ownership.

Early in October, 1916, the property was examined by Alex. Sharp, M.E., of Vancouver, and as a result bonded to his principals, who sent in a diamond-drill plant with gasolene-engine, preparatory to doing development-work as early as possible in 1917.

The group contains the *Big I. No. 1*, *Big I. No. 2*, *Big I. No. 3*, and *Big I. No. 4* mineral claims, staked in a square block, with the four initial posts in the centre and the No. 2 posts north, east, south, and west from the initial posts. The locations occupy a basin near the summit of the Big Interior range of mountains, as well as a portion of the summit, at an elevation of about 6,000 feet above sea-level. This is one of the highest mountain ranges on Vancouver island, and it forms the divide of three watersheds; that to the north is towards Buttle lake and to the east coast of the island; that to the east is towards Great Central lake and Alberni canal; and that to the south-west is towards Bear river and Clayoquot sound.

When the writer visited the property, accompanied by Joe Drinkwater, in the early part of October, 1916, he went in by way of Great Central lake, taking a launch from the foot of the lake and travelling twenty-three miles to the mouth of Drinkwater river at the west end of the lake, then walking the trail up the river to near its head, a distance of about ten miles in a westerly direction. The source of the river is a basin almost surrounded by lofty mountain peaks, and where a large volume of water, the overflow from Della lake, at the base of Big Interior mountain, pours over Della falls, a sheer drop of about 2,000 feet. The trail from the river camp, nearly under the falls, to Della lake does not exceed one mile in length, but the difference in altitude is 1,650 feet, and the rocky trail is necessarily very steep, so much so that hand and foot holds are essential aids in climbing. A light aerial tramway is installed for conveying supplies up the mountain from the river camp. The following elevations, given by Herbert Carmichael in his description of this property in 1906 were found by the writer to be as nearly correct as can be ascertained from casual aneroid readings; these are: Drinkwater River camp, 1,700 feet above sea-level; Della lake, 3,350 feet; Big Interior basin, 3,525 feet; summit of Big Interior mountain, 5,700 feet.

Della lake is about three-quarters of a mile long and a quarter of a mile wide. It is enclosed on the east, south, and west by snow-clad peaks rising over 2,000 feet above it, and in the middle is of great depth. It is fed by glacier streams that flow down the precipitous mountain-slopes, the most important of which is the creek that heads in the Big Interior basin half a mile distant to the north-west. This is filled with an immense glacier, the present surface of which is about 200 feet above the normal water-level in the lake.

The *Big I.* group of mineral claims is reached by crossing Della lake, following up the creek mentioned and crossing the glacier to its northerly side, where a precipitous cliff about 1,000 feet high forms the boundary on that side; above this are snow-capped peaks which reach an elevation of about 1,000 feet higher. The entire face of the cliff shows mineralization for nearly its full height from decomposition of pyrites for a width of about 3,000 feet from east to west, which is apparently along the strike of the mineral-bearing zone. The width of the zone from north to south is not so well defined, as the surface of the basin, which covers nearly one-half of the area of the group of four claims, is covered by the glacier, and the mineralization extends under the glacier an undetermined distance. This condition the writer was able to prove near the south-east corner of the *Big I. No. 2* claim by climbing down under the northerly edge of the glacier to the stream that flows under it along the bed-rock to the lake, a distance of about half a mile. As far under the glacier as it was possible to crawl, mineralization, consisting of chalcopyrite, iron pyrites, and pyrrhotite, is found in a siliceous gangue, apparently an altered granitic rock.

There has been considerable shearing stress in and around Big Interior mountain, also much movement which has resulted in the intrusion of almost innumerable dykes which cut the formation at several angles, and can be traced with the naked eye for long distances. Thousands of tons of low-grade ore have been broken down by erosion from the precipitous cliff that forms the northern boundary of the basin. This is piled up above the edge of the glacier in such immense slides that any attempt to sample the material and obtain any result that would represent an average is practically impossible. Apparently the most pronounced mineralization

with copper minerals occurs in the westerly portion of the cliff, and where there are many fissures and fractures in its face filled with these minerals. Towards the easterly end the mineralization appears to fade out into barren granitic country-rock, but no close examination can be made of this portion of the face of the cliff because of its precipitous structure.

Carmichael reports samples from the slides as follows: "Samples were taken from this talus from which it is judged that approximately the central portion of the mineralized zone will assay from 0.5 to 1 per cent. copper, with from 1.5 to 2 oz. silver per ton, and a trace of gold. These values extend over a width of about 1,500 feet."

Towards the north-westerly from the basin a body of limestone occurs in which secondary minerals are developed in the fracture-joints, including copper carbonates, garnet, and epidote. From this fact the writer assumes that the ore-deposit, taken as a whole, should be considered to belong to the contact type of copper-deposits.

Samples taken from two points near the south-east corner of the *Big I. No. 2* claim, under the glacier, one called sample No. 1 from about 50 feet below the edge, and the other called sample No. 2 from about 50 feet lower, on a slope of about 30 degrees, assayed: No. 1: Gold, trace; silver, 1 oz.; copper, 5.2 per cent. No. 2: Gold, 0.06 oz.; silver, 1 oz.; copper, 4.5 per cent. It is impossible to estimate what extent of the ore-body under the glacier is represented by these samples, which were taken from enriched parts of the ore-bearing zone, where apparently there are lenses, some of which are of considerable extent, of this grade of ore. These occur at irregular intervals in the mass of siliceous gangue material that is impregnated generally with copper and iron minerals, but carrying a smaller copper content than is shown by the samples assayed.

Another sample taken from the face of the precipitous cliff, above the edge of the glacier near the south-east corner of the *Big I. No. 2 claim, assayed: Gold, trace; silver, 1 oz.; copper,* 4.5 per cent. This sample was taken from one of the higher-grade lenses.

Near the westerly end of the precipitous cliff there appears to be a change in the character of the rock formation, which has the appearance of breccia mixed with calcite impregnated with some copper carbonates. In this an adit 31 feet long has been driven at an elevation of about 1,000 feet above Della lake. Owing to the slippery surface of the steep rocky face of the cliff, due to a recent heavy rainfall followed by frost, this adit could not be reached by the writer, but Drinkwater stated that only low-grade copper ore was exposed by the work which was done previous to Carmichael's examination in 1906, at a season when the snow on the edge of the glacier reached a much greater height than in October last.

The strike of the mineralized zone appears to be nearly west, and the mineralization extends in that direction on to the adjoining mineral claims owned by the Ptarmigan Mines, Limited, of Finsbury Pavement House, London, England. The dividing line between the *Big I.* group and the property of this company is very close to the summit of Big Interior mountain, where ore-outcroppings, referred to by Carmichael, occur on a peak known as West peak, which he describes as being the backbone of Vancouver island. Since his examination was made three short adits have been driven by the Ptarmigan Company at an elevation of nearly 5,700 feet above sea-level, and it is reported that ore is exposed in each of them, but the writer was unable to examine this work for the same reason that he could not reach the adit on the *Big I. No. 2* claim. With the exception of a small area of the *Ptarmigan* group, the bulk of that property is in the Clayoquot Mining Division on the Bear River watershed. The best road to reach it is from the south-west by a wagon-road from the mouth of Bear river, up that valley about seven miles, then by pack-trail to the camp near the summit of Big Interior mountain, instead of from the south-east by way of Great Central lake.

A sample of selected ore from the outcroppings near the West peak, on the *Big I. No. 2* claim, furnished by Joe Drinkwater assayed: Gold, 0.04 oz.; silver, 3.0 oz.; copper, 4.2 per cent.

When Carmichael made his examination near the end of August, 1906, he was able to reach the summit of Big Interior mountain, which the writer was unable to do in October, 1916; therefore the following extract is made from Carmichael's report, because, although the Ptarmigan Company has driven short adits near the dividing line between their claims and the *Big I. No. 3*, no work has been done on that part of the *Big I.* property since 1906:—

"On the top of the mountain is an area in which the mineralization seems to be more concentrated, producing in places ore of a grade to stand transportation and treatment charges. The higher-grade ore appears to occur along the lines of contact of alternating bands of granitic

15 per cent., and it was not possible to estimate reliably the proportion of waste to ore without systematic sampling.

At the north-easterly end of the open-cut an intrusion of the Vancouver volcanics occurs that appears to cut off the ore-deposit. A drift driven from the bottom of the shaft shows that ore has developed along the contact between the limestone and the intrusive volcanic rock, but that the line of strike has been deflected towards the east instead of towards the north-east, as it appears to be in the open-cut. The development-work had not progressed sufficiently far when the writer made his examination to warrant any estimate being formed as to the extent of the ore-body, but, when the grade of the ore is considered together with the opportunity for cheap transportation to a deep-water wharf-site, the proposition warrants further development, as it presents many promising possibilities.

The contact between limestone and the intrusive volcanics is well defined on the surface for about 20 feet in an easterly direction from the shaft, but beyond that point for about 10 feet the surface is covered with underbrush, ferns, and moss that hide the rock formation. Farther easterly there are bare rocky cliffs, and another line of contact occurs between the limestone and igneous rocks, with its strike north-easterly. There are some indications that in this contact deposits of ore may occur, but no prospecting has been done to determine that question.

The other occurrence of copper ore referred to as occurring at a point 1,350 feet above sea-level also belongs to the contact type of ore-deposits; its hanging-wall is an igneous rock of the Vancouver volcanic series, and foot-wall crystalline limestone. The mineralization consists of chalcopyrite, iron pyrites, pyrrhotite, and some little magnetite, in a gangue material chiefly composed of garnetite, with which is associated limestone that is altered and crushed.

An open-cut exposes a width of 12 feet of mineralized material, in which are disseminated kidneys and lumps of solid chalcopyrite that can be hand-sorted with ease from the gangue-matter and a commercial product produced, but the proportion of concentration necessary can hardly be estimated correctly until many experiments have been made, because of the irregularity of the impregnations.

A sample of sorted ore taken from the open-cut assayed: Gold, trace; silver, 0.8 oz.; copper, 5.2 per cent. An average sample taken along one wall of the open-cut across 12 feet of mineralized material assayed: Gold, trace; silver, 0.4 oz.; copper, 0.8 per cent.

Big Bluff. This mineral claim is about half a mile above the narrows at the foot of Henderson lake on the west side. It is located near the summit of a bluff and rising at an angle of nearly 45 degrees from the shore overlooking the lake, where at an elevation of about 350 feet above the lake outcroppings of copper ore occur.

In an adit 20 feet long a ledge of copper ore about 2 feet wide is exposed, dipping at an angle of 26 degrees towards S. 25° E. and striking S. 65° W.

The adit is driven in a S. 65° W. direction along the strike of the ledge, and at the face there is a well-defined slip or fault cutting off the ore. On the mountain-side below the adit the ledge outcrops and can be traced for about 40 feet on its dip to a point where the precipice is too inaccessible to be examined.

The ore mined from the adit has been sorted and a portion sacked for shipment. A sample of the sacked ore assayed: Gold, trace; silver, 0.6 oz.; copper, 15.7 per cent. A grab sample of the sorted ore from the dump assayed: Gold, trace; silver, 0.4 oz.; copper, 9 per cent.

The work was done several years ago and apparently stopped when the fault at the face of the adit was exposed. Since then, until the summer of 1916, the property has remained idle, but was restaked in June of that year, and preparations made to resume work owing to the abnormal price of copper.

Rainy Day. This mineral claim is on the east side of Henderson lake, about one mile and a half above the narrows at the outlet of the lake and about two miles from a deep-water wharf-site on Uchucklesit harbour. The claim was Crown-granted in 1903, and is owned by the Rainy Day Syndicate, Limited, of Victoria.

There are four mineral-bearing deposits striking parallel to each other and occurring as contact deposits in a metamorphosed zone, between crystalline limestone and an intrusive hornblendic igneous rock, belonging to the Vancouver series as classified by Dawson and Clapp. Each of these occurrences outcrop near the lake-shore and extend in a north-easterly direction for considerable distances, as is shown by tracing the outcroppings, which are quite prominent.

The fissure is filled with rusty, iron-stained quartz, mineralized with iron pyrites, arsenopyrite, and occasional crystals of galena. The quartz usually carries some values in free gold.

The fissure can only be traced along its strike for a length of 50 feet, being cut off towards the south by a glacier creek and towards the north by a ravine, but in both directions, beyond the creek and ravine, narrower fissures occur in a similar country-rock filled with quartz resembling that mentioned, and may possibly represent extensions of the first-mentioned fissure, or more probably belong to a series occurring in the pyroxenite rock. The lines of strike of the last-mentioned fissures are more westerly, and the dips at flatter angles than those of the first mentioned. The total distance that fissuring can be traced by several outcroppings of rusty iron-stained quartz is about 400 feet. Shafts have been sunk and open-cuts made on nearly all of the outcroppings, but as the shafts were all full of water they could not be examined, neither could much data be obtained from the open-cut work, because most of these were filled with debris.

The main work is done on the fissure first mentioned, and consists of an open-cut 35 feet long, 8 feet deep, by about 5 feet wide, with a shaft sunk at the northerly end of the cut, of unknown depth, as it was full of water.

A sample was taken from the dump at the south entrance to the open-cut that appeared to represent about an average of the pile; this assayed: Gold, 1.68 oz.; silver, 2.8 oz.

Practically all of the ore seen by the writer on this property carried so much iron pyrites and other sulphides as to place it amongst smelting or concentrating ores, rather than in the free-milling class, but none of the quartz on the *Della* claim appeared to carry any copper.

TAYLOR RIVER DISTRICT.

Columbia Group.

This group of mineral claims contains the *Columbia No. 1*, *Columbia No. 2*, *Columbia No. 3*, and *Highlevel* claims, located and owned by Robert W. Lindsay and associates, of Alberni, and is situated on the north bank of Taylor river, three miles above the head of the Taylor arm of Sproat lake, in the Alberni Mining Division. The property is about twenty-four miles nearly due west from Alberni, and is reached by wagon-road to the east end of Sproat lake, distance about six miles; thence by boat to the head of Taylor arm, at the extreme western end of Sproat lake, and by trail three miles up Taylor river to Lindsay's river camp, on the *Columbia* claim.

The first work examined by the writer during his examination on October 18th, 1916, is about 400 feet up the mountain in a northerly direction from the river camp, where there is an open-cut approach to an adit called No. 1 adit. The open-cut is 12 feet long and the adit 10 feet long, driven on a fissure-vein in a shear-zone in diorite country-rock. The vein is 4 feet wide and is filled with lenses of quartz and brecciated country-rock mineralized with iron pyrites and arsenopyrite. The vein strikes north (mag.) and dips vertically between well-defined walls.

An average sample taken across 1 foot in the floor of the adit near the face assayed: Gold, 0.56 oz.; silver, 1 oz.; copper, 0.2 per cent. Another sample taken from the dump of selected ore at the entrance to the open-cut assayed: Gold, 1.3 oz.; silver, 0.6 oz.; copper, trace.

From this point the mountain-side rises very steeply, and the fissure can be traced for some distance up it, but no further work has been done.

Another fissure occurs in a shear-zone in the diorite, about 150 feet easterly from No. 1 adit. This has been exposed by an open-cut called No. 2 cut, made along the strike of the fissure in a N. 40° E. (mag.) direction. The dip of the vein is vertical and the walls are well defined. The cut is 16 feet long and 8 feet deep at the face. The vein is about 5 feet wide, filled with quartz and brecciated diorite, mineralized with iron pyrites and some arsenopyrite. There appears to be a pay-streak in the vein at this point about 1 foot wide, from which an average sample was taken that assayed: Gold, 0.18 oz.; silver, 1.2 oz.; copper, 0.9 per cent.

From the No. 2 cut the mountain rises at an angle of nearly 45 degrees, and apparently the same fissure as is exposed in the No. 2 cut can be traced up a watercourse for about 100 feet to an open-cut approach and adit, called No. 3 adit, located on the *Columbia No. 2* claim. The open-cut is 18 feet long, and the adit is 9 feet under cover, along the strike of the vein in a N. 50° E. (mag.) direction. The dip of the vein is 88 degrees in a N. 40° W. (mag.) direction. The width of the vein is about 5 feet, which is made up of about 30 inches of rotten iron-stained

quartz, and the remainder brecciated diorite between well-defined diorite walls. The quartz is mineralized with iron pyrites and arsenopyrite.

A grab sample from the dump of sorted ore assayed: Gold, 1.7 oz.; silver, 0.6 oz.; copper, trace.

The *Highlevel* mineral claim is northerly from the *Columbia No. 2* and near the summit of the mountain, where a fissure dipping 60 degrees to the south-east occurs in a shear-zone in diorite. The fissure is crosscut diagonally by a creek for about 50 feet. Whether this zone is related in any way to the shear-zones down the mountain on the *Columbia* group of claims would require a survey to determine, and none has been made.

Some of its characteristics are very similar to those already described, but the defined fissuring is from 8 to 10 feet wide, with the brecciated vein-filling material predominating, while the quartz that carries iron pyrites and some arsenopyrite, and forms the pay-streak, is only about 18 inches wide.

An average sample taken across 18 inches of the mineralized quartz assayed: Gold, 0.14 oz.; silver, 0.1 oz.; copper, *nil*.

From appearances, the vein-filler in the fissures examined would be well adapted to treatment by concentration. If further development demonstrated that the veins are persistent along their strikes and maintain continuity to a reasonable depth, the property would possess considerable value, particularly when the favourable conditions with regard to the water and timber supply are considered, as well as the probability that the concentrates would be amenable to treatment by cyanidation on the property.

ALBERNI CANAL DISTRICT.

Alberni canal is the extension of the eastern arm of Barkley sound and penetrates into the west coast of Vancouver island for about forty miles in a north-easterly direction from Cape Beale. The canal proper is about twenty-five miles long from the mouth of the Somass river at the north-eastern end to its confluence with the three channels of Barkley sound, north of Tzarzoos or Copper island. This waterway, which practically crosscuts the rock formations, has afforded a splendid opportunity to prospectors to explore the mountains which form the boundaries on both sides of the canal, as well as the several streams which flows into it, which explorations have resulted in the discovery of several occurrences of copper- and iron-ore deposits. The deposits generally belong to the contact-replacement type, and are found to be developed at or near the immediate contact of crystalline limestone and igneous rocks.

Most of the ore-bodies are lenticular in structure, with the walls irregularly defined, and the ore usually merging gradually into the igneous country-rock, or filling cavities in the limestone, which it has replaced.

The mineralization is almost always a combination of magnetite, chalcopyrite, pyrrhotite, and iron pyrites. The gangue material is generally garnetite, calcite, and epidote. The igneous rocks are noticeably much altered, fractured, sheared, faulted, and fissured.

The canal affords excellent transportation facilities for shipping ore, because, although its great depth interferes with anchorage, yet wharves can be built at very many points at which vessels can load cargoes at any stage of the tide and season of the year.

Up to the present time the mineral claims that have been worked, with a few exceptions, are located within a mile or two, and often a much shorter distance, from the shore-lines of the canal, and the mine-workings can be connected with bunkers on deep water by comparatively short aerial tramways.

From 1898 to 1901 there was great activity in mining for copper ore in the mountains adjacent to the canal, but the slump in the price of copper during the latter year, as well as the erratic occurrence of ore of commercial grade in the *Three Jays* and *Monitor* groups of mineral claims, caused suspension of operations. These groups were recognized as the most important properties in the district and had been the most extensively developed and equipped; consequently, when the work closed down, the result was a state of depression that has only been removed since the high price of copper, due to the war, has prevailed.

During 1916, when the writer was engaged in an examination of the district, there was renewed activity in prospecting and developing mineral claims on which deposits of copper ore occur, and especially was this the case in the Alberni Canal district, where some of the old mine-workings were reopened and the adjacent neighbourhood more thoroughly prospected.

During the summer of 1913 Alberni canal and vicinity was visited by D. G. Forbes, M.E., who examined the several mineral claims, and his report is published in the Minister of Mines' Report for that year.

Previous to that time the district has been examined and reported on by W. J. Sutton, in the Minister of Mines' Report for 1895; by Herbert Carmichael, in the Minister of Mines' Report for 1899 and 1906.

Kitchener.

This mineral claim, owned by Barclay Bonthrone, of Vancouver, is located on Chesmuknet creek, which flows into Alberni canal on the east side at Smith's Landing, about fourteen miles below Port Alberni, the head of navigation. The property is about half a mile from the canal and is reached by boat from Port Alberni. The grade of the Canadian Northern Pacific Railway is only about 500 feet from the work that has been done on the claim to expose an occurrence of copper ore belonging to the contact type of deposit. The ore-body occurs in limestone, a short distance from a well-defined contact between the limestone and granodiorite intrusive. The strike of the limestone is east (mag.) and its dip 70 degrees towards the north (mag.).

The mineralization consists chiefly of copper carbonates, with some chalcopyrite, and the origin is unquestionably from the replacement of limestone.

This deposit is opened up by some open-cuts and an adit 23 feet long, driven about 15 feet below the surface, preceded by an open-cut approach 27 feet long. In this work a body of oxidized copper ore is exposed for 22 feet. Apparently this is the width across the ore-body, which seems to strike towards the north, but its length appears to be quite short, so far as can be judged by outcroppings, as only one more outcrop is noticeable. This is about 20 feet northerly from the work described, where the ore is exposed in an open-cut for a width of 8 feet. Whether continuity exists between the two exposures is undetermined, as no work has been done to prove it. No attempt is shown to determine depth.

A fairly average sample from the dump at the entrance to the first-mentioned open-cut assayed: Gold, trace; silver, 0.3 oz.; copper, 9.2 per cent.

Canadian.

This mineral claim is owned by George Dickson and William Hutton, two prospectors of Port Alberni, and was staked in the spring of 1916. It is located about one mile from Smith's Landing on the east side of and adjoining the grade of the Canadian Northern Pacific Railway.

An occurrence of chalcopyrite, filling a fissure in a shear-zone in granodiorite, is exposed in an open-cut alongside of the railway-grade. It was examined by the writer soon after the claim was staked and before the prospectors had an opportunity to do much work, and, as the surface along the assumed strike of the ore is covered with rock blown out when the grading was being done, there were no natural outcroppings exposed.

The open-cut exposes ore 3 feet wide for a length of 15 feet and a depth of about 8 feet, but an examination of the cut showed that the full width of the ore-body was not exposed, neither the full length.

Apparently the occurrence is a lens, and the sheared condition of the country-rock indicates that probably other lenses occur in the near vicinity, and most likely will be found occupying positions *en echelon* to the one examined.

A grab sample from the dump at the open-cut assayed: Gold, trace; silver, trace; copper, 7.2 per cent.

Three Jays Group.

This group of mineral claims, or the *Hayes* mine, as the property is known locally, is situated on the west side of Alberni canal, nearly opposite to Smith's Landing. This group of mineral claims had been practically abandoned about six years ago by the Nahmint Mining Company, which carried on mining operations and equipped the mine with camp buildings, aerial tramway, wharf, bunkers, and air-compressor previous to 1902. The caretaker was relieved about 1910, the buildings sold for old lumber, and the machinery dismantled and removed. The Crown-granted claims later reverted to the Provincial Government for unpaid taxes, and the *Hayes* mine had passed into history, until an Act was passed by the Legislature in 1916 empowering the Government to grant leases on any Government mineral claims that reverted to it for unpaid taxes.

During the autumn of 1916 this Act was taken advantage of by W. G. Tanner and associates, of Seattle, who secured a lease from the Province and propose to reopen the mine and attempt to operate it by treating the ore, which is too low grade to ship direct, by the oil-flotation process.

Marble-quarry, Nootka, Quatsino Mining Division.

Marble-quarry, Nootka, Quatsino Mining Division.

In the Minister of Mines' Reports for 1900, 1901, and 1906 this property is referred to and the development-work described.

Edith. This mineral claim is on the southerly side of Alberni canal, a short distance below Hell Gate, about seventeen miles from Port Alberni. It is owned by A. E. Waterhouse, and was one of the early locations recorded in the Alberni Mining Division. It is an interesting proposition because of being one of a few instances found on Vancouver island where a comparatively high copper content occurs in chalcopyrite disseminated through pyrrhotite. Very little magnetite is found in the ore-deposits, the gangue of which is garnetite and limestone. This characteristic is shown in the assay of a grab sample taken by the writer from the dump at one of the open-cuts. This sample assayed: Gold, trace; silver, 2.2 oz.; copper, 8.2 per cent.

The claim has been prospected by several open-cuts made on outcrops that occur as contact deposits, and appear to be separate lenses, lying between crystalline limestone and granodiorite. A survey and further development may show relationship between some of these outcroppings, or at least some connection, so that mining operations could be carried on more economically than if each outcrop represented an individual lens of ore that would have to be mined separately.

In addition to these seemingly separate lenses of ore, there are two fissures in granodiorite that occur parallel to each other, and can be traced on the surface for about 200 feet along the strike towards the north-west. The vein-filling in these fissures is made up of iron pyrites, pyrrhotite, and chalcopyrite in a garnetite gangue. The width of the fissures varies from about 1 to 2 feet.

An average sample across 2 feet is reported by D. G. Forbes, M.E., in the Minister of Mines' Report for 1913, who examined the property during that year, as assaying: Gold, 0.1 oz.; silver, 4 oz.; copper, 5 per cent.

Gladys Group. This group of mineral claims was not being operated during 1916, and, as there was no one at hand representing the property, it was not examined by the writer. During 1913 D. G. Forbes, M.E., made an examination of this group, and his report is published in the Minister of Mines' Report for that year, and, as practically no work has been done since, that report is copied, as follows:—

"The *Gladys* group of mineral claims is situated about a quarter of a mile west of the *Edith* group. The country-rock is limestone; the occurrence of the ore is similar to that in the *Edith* claim, except that the strike of the lenses is north or south (mag.). The property was equipped with a small 2-bucket tram from the mine to salt water, but which is now in a bad state of repair.

"A small opening has been made on the line of the tramway, 200 feet above sea-level, which shows a little garnetite containing pyrite and a little chalcopyrite, the vein striking north and dipping to the east at an angle of 75 degrees. At an elevation of 350 feet and 1,200 feet from salt water, a little above the upper terminal of the tramway, there is a large open-cut from which an incline shaft has been sunk and some ore stoped; these workings were full of water and could not be inspected, but the shaft was sounded and appeared to be about 30 feet deep.

"About 150 feet farther up the hill, at an elevation of 400 feet, another shaft has been sunk, which also was full of water. On the south side of this shaft the streak of ore, about 6 inches in width, has been cut off by a diabase dyke, striking north-west. Some further prospecting has been done to the south of this dyke, but nothing of promise was found. Recently an attempt was made to trace the ore down the mountain below the upper terminal of the tramway, but without success."

Monitor Group. This group contains the *Monitor No. 1*, *Monitor No. 1 Fraction*, *Nawitka*, *Uncle Sam*, *John Bull*, and *Monitor No. 2* Crown-granted mineral claims, situated on the north side of the Alberni canal, eighteen miles from Port Alberni. The group is one of the earlier locations on Alberni canal; it was staked about 1898 by a prospector named Captain Hanson, for himself and partners, and acquired in 1899 by a New York syndicate, of which the late Dr. G. W. Maynard was the head.

After doing fairly extensive development-work and equipping the mine camp with buildings, wharf, bunkers, aerial tramway, compressor, and pumping plants, as well as making regular shipments of copper ore to the Tacoma smelter from late in 1900 until the winter of 1901-2, operations were discontinued.

The present owner of the *Monitor* group is Leonard Frank, of Alberni, who acquired the property at tax sale about three years since.

Since then, until the summer of 1916, when it was leased to James A. Skene, of Seattle, the property has remained idle, except during a short time in 1910, when it was bonded to the National Finance Company, of Vancouver, which did not exercise the option.

The *Monitor* mine is described in the Minister of Mines' Report for 1900 and 1901. In the latter is a report on it by Dr. T. Rhymer Marshall on page 1096.

The writer in this report will confine himself to a description of the work done during 1916, as the old workings remain in the same condition as described in the reports referred to.

The new workings are on the *Nawitka* mineral claim, about 1,000 feet from the aerial tramway terminal at the shore-line in a north-easterly direction, and about 250 feet elevation.

These new workings have exposed a mineralized zone occurring at the contact between crystalline limestone and an igneous rock which is very feldspathic, hornblendic, and very much altered. This rock apparently belongs to the Vancouver volcanics of the *Vancouver* group, as classified by Dawson and Clapp.

The zone strikes nearly true north, and at the contact the cleavage-plane dips 67 degrees west, but the dip of the ore varies from nearly vertical to a much flatter angle on the limestone-wall.

The mineralization is a combination of chalcopyrite, magnetite, some iron pyrites, and a little pyrrhotite. The structure of the ore-deposits, that occur irregularly through the mineralized zone, is lenticular, and much systematic prospecting is necessary to locate the deposits, as well as to determine their extent. Surface stripping and open-cuts expose the mineralized zone for a length of about 150 feet and a width of about 20 feet.

The longest ore-lens is exposed in an open-cut 10 feet deep and about 50 feet in length; this averages 3 feet in width of solid ore, principally chalcopyrite. A rough sample from this ore-body assayed: Gold, trace; silver, 1.10 oz.; copper, 13 per cent.; and a shipment of about 45 tons taken from this ore-body yielded about 9 per cent. in copper at the Trail smelter.

In addition to the 3 feet of solid ore, the workings expose a width of about 8 feet of lime silicate, next to the solid ore on the east or foot-wall side, that is mineralized, and could possibly be concentrated. Another lenticular deposit of ore, of a similar character to that described, occurs lying *en echelon* to it and extending for 25 feet in a southerly direction. This deposit is exposed by stripping and open-cut for an average width of about 2 feet.

A third lenticular lens of ore, very similar in its characteristics to the others referred to, occurs *en echelon* to the last mentioned and extends for about 30 feet in a southerly direction. This lens was not as well exposed as the others, as there was less work done on it at the time of the writer's examination; it appears to average about 2 feet in width.

On the *Monitor No. 1 Fractional* mineral claim, at an elevation of about 70 feet above sea-level and about 100 feet from the northerly shore of the canal, there is an outcrop of a contact deposit of chalcopyrite that was only discovered in September, 1916. When the writer saw this outcrop only a small open-cut had been made. This exposed ore for a width of 3 feet, and a body of garnetite and epidote mineralized to some extent with impregnations of chalcopyrite for a width of about 14 feet in the face of a low bluff. The strike of this occurrence of ore is N. 35° W. and the dip N. 55° E. at an angle of 74 degrees, but the surface in the direction of the strike was at the time of the writer's examination so covered with brush and fallen timber that it was impossible to trace the occurrence beyond the outcrop. A sample of the solid chalcopyrite taken from the open-cut assayed: Gold, trace; silver, 1.4 oz.; copper, 13.7 per cent.

With the very limited amount of work done, it is, of course, impossible to arrive at any conclusions as to the extent of the deposit.

During the winter of 1916-17 the discovery of another mineralized zone on the *Monitor No. 1 Fractional* claim was reported by the lessee, but, as no work had been done, no description of this reported recent discovery is made by the writer.

Happy John Group.

This group contains the *Happy John No. 1*, *Happy John No. 2*, and *Happy John No. 3* mineral claims, located west of and adjoining the *Monitor* group of mineral claims. The *Happy John* claims are owned by Leonard and Bernard Frank, of Alberni, and Alvin Engvik, of Vancouver. There has been considerable prospecting-work done on the *Happy John No. 1* claim, on the steep bank of Handy creek, which has exposed several lenses of chalcopyrite mixed with iron pyrites, pyrrhotite, and

magnetite, but the work has not demonstrated that the lenses are of sufficient extent to be considered of commercial value.

The most promising showing on the group is that exposed on the *Happy John No. 2* claim, at a point about 2,000 feet from the confluence of Handy creek and Alberni canal and at an elevation of about 1,000 feet above sea-level. A contact between crystalline limestone and the Vancouver volcanics occurs near this point, with an occurrence of mineral, made up of magnetite, iron pyrites, and chalcopyrite, developed at the contact, which can be traced by the iron-capping almost continuously for about 400 feet towards the south-east. A shaft, said to be 25 feet deep, but full of water at the time of the writer's examination, is sunk on the mineralized outcrop. This exposes an ore-body of the contact type, 5 feet wide, dipping vertically. A grab sample from the dump at the collar of the shaft assayed: Gold, trace; silver, 0.6 oz.; copper, 7.2 per cent.

An adit has been driven for a length of 30 feet, about 400 feet south-easterly from the shaft, in an effort to crosscut the mineralized contact, but apparently this adit has not been driven far enough, as the face shows indications rendering it possible that an ore-body occurs within a few feet. It is the purpose of the owners, if an ore-body is exposed, to crosscut it and then drift along it on the strike in a north-westerly direction towards the shaft, where the drift would have about 200 feet of backs.

Cascade. This mineral claim was located in 1903 as the result of the discovery of the outcroppings of a deposit of high-grade chalcopyrite. It is situated in Uchucklesit harbour, about twenty-three miles from Port Alberni, and extends from the water-front back into Cascade mountain about 1,500 feet. Later in the same year the Cascade Copper Mining Company was organized and commenced systematic development-work, erecting a gravity three-rail tramway about 600 feet in length, ore-bunkers, and wharf.

After a shipment had been made in 1904 of about 90 tons of ore that yielded a net return of $1,992.34, a survey proved that the workings were partly located on Crown-granted land owned by the Wallace Fisheries Company, which was entitled to all the copper content in the ore.

The Cascade Copper Mining Company then suspended work, and the property remained idle from that time until 1916, when Thomas Rowley, of Port Alberni, made an agreement with the Wallace Fisheries Company to lease the *Cascade* claim. He has done some prospecting-work since the writer's visit to the district, the result of which, however, is not known.

Torse Group. This group contains the *Torse No. 1*, *Torse No. 2*, *Torse No. 3*, *Torse No. 4*, *Torse No. 5*, *Torse No. 6*, *Torse No. 7*, and *Torse No. 8* mineral claims. The group was staked in 1898 as the *Bluebell* group, but the record was allowed to lapse, and the *Torse* group was staked over practically the same ground by Anthony Watson and associates, of Port Alberni. During the spring of 1916 the *Torse* group of mineral claims was bonded by H. Humphrey Jones, of Victoria, and during May last he began prospecting the claims, and developed the most promising occurrences of copper ore found on them.

There are several outcroppings of mineral at various elevations on the property, usually composed of pyrrhotite, iron pyrites, and chalcopyrite. These occur along contacts of crystalline limestone and hornblendic igneous rock, in which occurs considerable epidote near the contact. The iron and copper minerals occur generally in a gangue material made up of epidote, garnetite, altered limestone, and brecciated igneous rock. The occurrences are lenticular in structure, with irregular boundaries, and so far as shown by the work done they vary considerably in extent.

The most promising deposits occur at two points, one at an elevation of 550 feet above sea-level, the other about half a mile distant in a northerly direction and at an elevation of about 1,350 feet above sea-level.

The first-mentioned deposit is exposed by an open-cut made from south-west to north-east, 41 feet long by a maximum width of about 15 feet, and 15 feet deep at the north-east face, where a shaft is sunk 30 feet below the floor of the cut.

The floor of the open-cut showed chalcopyrite ore in masses of considerable size, mixed with limestone, as well as impregnations disseminated through the limestone. In the shaft the same irregularity occurs, the width of solid chalcopyrite varying from about 4 feet to a few inches.

From the bottom of the shaft a drift is driven in a south-easterly direction for about 60 feet, along which the same character of ore is exposed and the same variations in width are noticeable.

No sample was taken by the writer from this work, because the solid ore sorted from waste limestone showed unmistakable evidence that the copper content of such ore is from about 9 to

15 per cent., and it was not possible to estimate reliably the proportion of waste to ore without systematic sampling.

At the north-easterly end of the open-cut an intrusion of the Vancouver volcanics occurs that appears to cut off the ore-deposit. A drift driven from the bottom of the shaft shows that ore has developed along the contact between the limestone and the intrusive volcanic rock, but that the line of strike has been deflected towards the east instead of towards the north-east, as it appears to be in the open-cut. The development-work had not progressed sufficiently far when the writer made his examination to warrant any estimate being formed as to the extent of the ore-body, but, when the grade of the ore is considered together with the opportunity for cheap transportation to a deep-water wharf-site, the proposition warrants further development, as it presents many promising possibilities.

The contact between limestone and the intrusive volcanics is well defined on the surface for about 20 feet in an easterly direction from the shaft, but beyond that point for about 10 feet the surface is covered with underbrush, ferns, and moss that hide the rock formation. Farther easterly there are bare rocky cliffs, and another line of contact occurs between the limestone and igneous rocks, with its strike north-easterly. There are some indications that in this contact deposits of ore may occur, but no prospecting has been done to determine that question.

The other occurrence of copper ore referred to as occurring at a point 1,350 feet above sea-level also belongs to the contact type of ore-deposits; its hanging-wall is an igneous rock of the Vancouver volcanic series, and foot-wall crystalline limestone. The mineralization consists of chalcopyrite, iron pyrites, pyrrhotite, and some little magnetite, in a gangue material chiefly composed of garnetite, with which is associated limestone that is altered and crushed.

An open-cut exposes a width of 12 feet of mineralized material, in which are disseminated kidneys and lumps of solid chalcopyrite that can be hand-sorted with ease from the gangue-matter and a commercial product produced, but the proportion of concentration necessary can hardly be estimated correctly until many experiments have been made, because of the irregularity of the impregnations.

A sample of sorted ore taken from the open-cut assayed: Gold, trace; silver, 0.8 oz.; copper, 5.2 per cent. An average sample taken along one wall of the open-cut across 12 feet of mineralized material assayed: Gold, trace; silver, 0.4 oz.; copper, 0.8 per cent.

Big Bluff. This mineral claim is about half a mile above the narrows at the foot of Henderson lake on the west side. It is located near the summit of a bluff and rising at an angle of nearly 45 degrees from the shore overlooking the lake, where at an elevation of about 350 feet above the lake outcroppings of copper ore occur.

In an adit 20 feet long a ledge of copper ore about 2 feet wide is exposed, dipping at an angle of 26 degrees towards S. 25° E. and striking S. 65° W.

The adit is driven in a S. 65° W. direction along the strike of the ledge, and at the face there is a well-defined slip or fault cutting off the ore. On the mountain-side below the adit the ledge outcrops and can be traced for about 40 feet on its dip to a point where the precipice is too inaccessible to be examined.

The ore mined from the adit has been sorted and a portion sacked for shipment. A sample of the sacked ore assayed: Gold, trace; silver, 0.6 oz.; copper, 15.7 per cent. A grab sample of the sorted ore from the dump assayed: Gold, trace; silver, 0.4 oz.; copper, 9 per cent.

The work was done several years ago and apparently stopped when the fault at the face of the adit was exposed. Since then, until the summer of 1916, the property has remained idle, but was restaked in June of that year, and preparations made to resume work owing to the abnormal price of copper.

Rainy Day. This mineral claim is on the east side of Henderson lake, about one mile and a half above the narrows at the outlet of the lake and about two miles from a deep-water wharf-site on Uchucklesit harbour. The claim was Crown-granted in 1903, and is owned by the Rainy Day Syndicate, Limited, of Victoria.

There are four mineral-bearing deposits striking parallel to each other and occurring as contact deposits in a metamorphosed zone, between crystalline limestone and an intrusive hornblendic igneous rock, belonging to the Vancouver series as classified by Dawson and Clapp. Each of these occurrences outcrop near the lake-shore and extend in a north-easterly direction for considerable distances, as is shown by tracing the outcroppings, which are quite prominent.

as the rock formation rises from the shore in a series of bold cliffs comparatively bare of underbrush and moss. These deposits are later referred to as ore-bodies A, B, C, D.

Ore-body A outcrops about 150 feet from the shore at the immediate contact of crystalline limestone and an intrusive igneous rock. The width of this ore-body is undetermined, as only shallow prospect-holes have been made. The mineralization is an association of iron pyrites and some chalcopyrite in a garnet and limestone gangue.

Ore-body B, which strikes north-easterly and dips vertically, outcrops about 100 feet north-westerly from A and about 25 feet above the normal water-line in the lake. This deposit fills a fissure in a shear-zone in the metamorphosed rock. The fissure is 10 feet wide, as proven by a crosscut adit driven across the ore from wall to wall. The mineralization is chiefly pyrrhotite carrying low copper values. This body has been drifted on for about 40 feet in solid ore the entire length, with the face still in ore, and a winze is sunk to a depth of 20 feet below the floor of the drift, also in solid ore. A crosscut 42 feet long is driven from the adit towards the south-east to intersect the ore-body A on that level, but has not been continued far enough. Although this drive is through metamorphic rock in which hornblende predominates, the rock in the north-east wall is more or less mineralized, chiefly with iron pyrites.

Ore-body C outcrops 20 feet north-westerly from B at the contact of crystalline limestone and the same belt of igneous rock in which ore-body B occurs. The strike of ore-body C is north-easterly and the dip nearly vertical. Its width is 13 feet where it is crosscut. The mineralization is chalcopyrite, pyrrhotite, and some magnetite in a gangue made up of garnet, epidote, hornblende, and crushed limestone. An adit is driven 70 feet along a fault or slip in the igneous rock towards the east, with a crosscut at the end about 10 feet to the ore-body and 13 feet across ore and gangue material. This adit was not started on the ore-outcrop, but is driven nearly parallel to the ore-body that is exposed in the crosscut at the face of the adit. A winze is sunk 20 feet deep in the ore-body near the crosscut and a drift started along the strike of the deposit.

Although selected samples from this ore-body have shown copper contents varying from 4.5 per cent. to 16 per cent., the body as a whole is quite low grade and concentration is advisable to secure a commercial product.

Ore-body D outcrops along the lake-shore about 50 feet north-westerly from ore-body C. This outcrop is about 40 feet wide, made up of iron pyrites, marcasite, some chalcopyrite, hornblende, epidote, and garnet. No work is done on this ore-body, except a few prospect-holes near the lake-shore to determine the mineralization.

Further prospecting and development work should be done on this property, because the possibilities are promising, especially so when considered in conjunction with the low cost for transportation, which can be by water to any Coast smelter direct from the mine-workings as soon as a channel is dredged through the narrows, which has already been partially done by the Dominion Government.

HEAD OF HENDERSON LAKE.

During the summer of 1916 there was quite a revival of the interest shown several years ago by the prospectors who make headquarters in the Alberni district, which resulted in many of the old locations near the head of Henderson lake being restaked. One of the most promising of these mineral claims is that recorded by George Brown, of Victoria, in the autumn of 1916, and from which he obtained specimens of good-grade chalcopyrite from an outcrop about three-quarters of a mile from the head of the lake.

Azogie Group.

This group is owned by T. Golby, of Victoria, and contains the *Azogie King* and *Azogie Queen* mineral claims, on the Sechart peninsula, Barkley sound, about thirty-five miles from Port Alberni. This property, which is Crown-granted, represents one of the earliest locations made on Vancouver island, and is referred to in the Minister of Mines' Report for 1896 by W. A. Carlyle, the Provincial Mineralogist at that time, as follows: "The *Sechart* quicksilver claim half a mile up Pot-hole creek, which empties into the sea about a quarter of a mile from the wharf, has three tunnels and two shafts close to the creek in which it is reported native mercury was first found by hunters. The rock on the sump appears to be diorite or a diabase, and some good specimens of the ore were found which, on being broken, disclosed the cinnabar disposed along the extremely narrow invisible cracks, while decomposed rock was found carrying the metallic *quick*."

Since that year but little has been done on the property, except some diamond-drilling with a crude home-made drill, until it was acquired by Golby and associates about 1915, when they drove a tunnel 45 feet long through a narrow ridge to turn the water from the creek to permit them to sink a shaft in the old bed of the creek; this shaft is said to be 16 feet deep, but was full of water when the writer made his examination. It is also reported by the owners that a vein of cinnabar ore a few inches wide is exposed in the shaft. Apparently any cinnabar ore occurring on the group is found in narrow crevices in the country-rock in the creek-bed, and, as the old adits and drill-holes were directed in the opposite direction, they only prospected the country-rock to the east of the fractured zone in which the ore occurs. The owners inform the writer that it is their purpose to continue prospecting and development work during 1917 to determine the value of the group.

No samples were taken by the writer, as it was not possible to obtain any from the *Golby* shaft, the only place where cinnabar in-place could be secured; pieces of float showing some mineralization by cinnabar were seen, but the source of origin was doubtful.

NANAIMO MINING DIVISION.

Independent Group.

This group contains the *Independent*, *Eureka*, and *Albion* mineral claims, owned by S. Moore, John Taylor, and Wm. Moore, of Nanaimo. The group is located on a mountain stream, one of the headwaters of the Englishman river, about twenty-one miles westerly from Parksville Junction Station, on the Alberni branch of the Esquimalt & Nanaimo Railway, at an elevation of about 3,000 feet above the sea-level. At the present time the property is reached by a wagon-road from Parksville Junction to Errington, about six miles distant, then by a poor trail to the property, distant about fifteen miles.

A more direct and shorter route to reach this property, provided a road was contemplated, is by leaving the railroad at Cameron Lake Station, and following the private tourist-road built by the railway company towards Mount Arrowsmith for a few miles, then branch off to the left and cross the mountain range through a pass known to pioneer hunters. By this route it is claimed the *Independent* group could be reached in about four or five miles from the railway, but there is no trail after leaving the tourist-road.

All of the work done on the group has been on the *Independent* claim, where several gash-veins occur in a shear-zone in an igneous rock resembling diorite. Generally these veins strike parallel to each other in a north-westerly direction and dip about 65 degrees to the north-east.

The veins vary in width from 6 to 18 inches and are mineralized with iron pyrites and chalcopyrite in a gangue made up of quartz and crushed country-rock. The ore appears to be an ideal concentrating material. Several open-cuts have been made and two adits have been driven, one 30 feet long and the other over 100 feet long. In all of these more or less ore is exposed, but the longest adit has been driven most of its length through country-rock.

A grab sample taken from the dump of sorted ore at the entrance to the shorter of the two adits assayed: Gold, trace; silver, 2.2 oz.; copper, 9.7 per cent.

Big G. Group.

This group of mineral claims is located near the head of Little Campbell river, about six miles north-westerly from the mouth of the upper Campbell river, which flows into Campbell lake near the north-westerly end. During 1916 this group was acquired by J. B. Woodworth and brother, of Vancouver, who have been working on the property previous to August 16th, the date of the writer's visit; but at that time there was no representative of the owners in the vicinity, consequently he had to depend on a local guide to show him the mine-workings.

The property is reached either by steamer from Vancouver or Victoria to Campbell River Landing, on the east coast of Vancouver island, or by railway or automobile from Victoria to the landing; thence by auto-road to Campbell lake, by launch across the lake to the landing at the Corduroy road, a few miles up the upper Campbell river, and from there follow the corduroy road which is built to the *Big G.* group. This road is about six miles long and was built by the Woodworth Bros. to enable them to haul ore from the mine to the river, where it was transferred on to a scow, which was towed by a gasolene-launch to the lower Campbell Lake Landing, and from there hauled by wagon-road to the ocean dock at Campbell River Landing, ten miles distant.

The mine-workings are on the side of a deep precipitous canyon, through which the Little Campbell river flows, and about 100 feet above the river-bed. They consist of several large open-cuts and two adits; one of the latter is 60 feet long with an upraise about 30 feet high at the face of the adit, and the other adit is 30 feet long. Outcroppings of considerable extent, made up of gossan and pyrrhotite with some chalcopyrite, form the summits of bold cliffs.

The occurrence of ore exposed by the workings has the appearance of being a blanket outcrop covering a bluff rather than a deposit filling a fissure in a shear-zone in an igneous rock. The country-rock resembles andesite, but is very much altered and fractured.

In the first-mentioned adit no well-defined ore-body occurs, but the country-rock is mineralized to some extent with iron pyrites, some chalcopyrite, and pyrrhotite.

In the other adit there is a lens of ore that is about 3 feet wide at the entrance, but this width gradually contracts until at the face of the adit the ore is only a few inches wide. This ore is an association of pyrrhotite and chalcopyrite. The body dips 23 degrees to the west (mag.).

Whether the writer saw all the workings or only a portion he is unable to state. It is, though, very unsatisfactory to attempt to examine mineral claims in the absence of some owner or representative fully conversant with the showings and mining-work.

It is reported that a shipment of about 40 tons of copper ore of good grade was made from the *Big G.* group during 1916, and that the ore shipped was taken from some of the openings examined.

Sumpter Group.

This group contains eight mineral claims, located along the north-westerly shore of Upper Campbell lake near the north-east end of the lake. The group is owned by John Smith and associates, of Campbell River Landing, who have driven about 200 feet of adits and sunk about 30 feet in a shaft, besides making several open-cuts. All of this work is done on the *Beatrice* and *Solomon* mineral claims, which appear to be the most promising in the group.

The *Solomon* mineral claim is located with its south end line roughly paralleling the shore of the lake, and location-line extending in a northerly direction into the mountain range that borders the lake and rises to an elevation of about 1,500 feet within a comparatively short distance. An occurrence of mineral, made up chiefly of copper carbonates developed between limestone-walls in a gangue chiefly composed of garnetite with some iron-stained crushed limestone, occurs at a slight elevation above the lake and within 300 feet from the shore. The outcrop of this deposit is traceable for about 60 feet along the strike towards the north; the dip as it appears in an open-cut is vertical, and the width of mineralized material is about 9 feet.

There does not appear to be sufficient solid ore of a shipping grade in this deposit to warrant any extensive mining operations, unless it is shown by practice that the mineralized material can be successfully concentrated to a commercial product.

An adit is located about 30 feet lower than the outcrop and is said to be 60 feet long, but, as the portal was covered by a rock-slide and the roof had caved, the adit could not be examined.

On the *Beatrice* mineral claim, one of the *Sumpter* group that adjoins the *Solomon* claim on the south-west, there is a lens of copper ore that outcrops in limestone at a point about 300 feet from the shore and about 200 feet elevation. There is a shaft sunk on this outcrop 28 feet deep, in the bottom of which there is a stringer, 18 inches wide, of bornite mixed with chalcopyrite. After the shaft was sunk the owners drove an adit 150 feet long, from a point about 60 feet lower elevation, in the hope of intersecting the ore below the bottom of the shaft, but no ore had been exposed in this adit up to the time of the writer's examination on August 17th, 1916.

A sample from the bottom of the shaft assayed: Gold, trace; silver, 2.8 oz.; copper, 3 per cent.

CLAYOQUOT MINING DIVISION.

The Clayoquot Mining Division embraces the central part of the west coast of Vancouver island, including the numerous small islands situated in the many inlets which penetrate into the coast-line, usually for several miles. These afford excellent opportunities for prospectors and others to travel in small boats in protected waters, as well as safe harbours and good

wharf-sites for shipping facilities. Since 1896 this part of Vancouver island has been a popular section for prospectors to explore, but up to the present time there has only been one property (the *Indian Chief* group, on Sidney inlet) that has ranked as a producer on a commercial scale. There are several reasons for this condition, foremost among which is lack of systematic development-work. There are many Crown-granted mineral claims in the Clayoquot Mining Division that were located years ago, and on which were discovered outcroppings and lenticular bodies of copper-bearing ore of good grade, which have lain idle since the Crown grants were issued. In some cases on account of the lack of sufficient capital to carry on the development-work necessary to determine extent of ore-bodies, and also because of the cost of installing the shipping facilities.

The high price of copper since 1915 has caused a revival in the lode-mining industry, which has resulted in causing the reopening of the workings on some of these old locations, and has also been responsible for the visits of several mining engineers, who have been making examinations and in some cases bonding groups of mineral claims for their principals.

The contact-metamorphic replacement type of ore-deposits prevails almost universally in the Clayoquot Mining Division, except in the neighbourhood of the mouth of the Elk river, which flows into Kennedy lake, at the head of the North-east arm, where there are some well-defined fissure-veins filled with gold-bearing quartz.

Rose Group.

The most prominent illustration of this quartz-vein type of ore-deposits is found on the *Rose* group of mineral claims, containing the *Rose*, *Maggie*, *Marie*, and *Sadie*, owned by Anthony Watson, of Port Alberni, and associates. The property is reached by steamer which sails four times each month from Victoria to Clayoquot settlement, on Stubbs Island, the headquarters for the Gold Commissioner and Mining Recorder; thence by launch to the mouth of the Kennedy river, which flows into Tofino inlet near the Brewster Cannery; from there up the Kennedy river and through the rapids by canoe into Kennedy lake; then up the lake to the head of the North-east arm, and on to the rapids in the Elk river, about three miles from its mouth.

Kennedy lake is navigable for light-draught steamers and scows, as is also Kennedy river except through the rapids. The harbour at the cannery affords most excellent anchorage for fairly deep-draught vessels; consequently the transportation facilities from the *Rose* group are good, except through the Kennedy rapids, a distance of about 500 yards, around which a surface tramway can easily be built with a grade of about 20 feet in that distance.

The *Rose* group is located on a portion of the ground located in 1897 as the *Rose Marie* group of eight mineral claims, on which a concentrator plant was erected in 1898, and worked for about two years by the Rose Marie Mines, Limited, but later the title was allowed to lapse and the present locations were made. The heavy snows of the winter of 1915-16 ruined the concentrator and camp buildings, as well as the machinery.

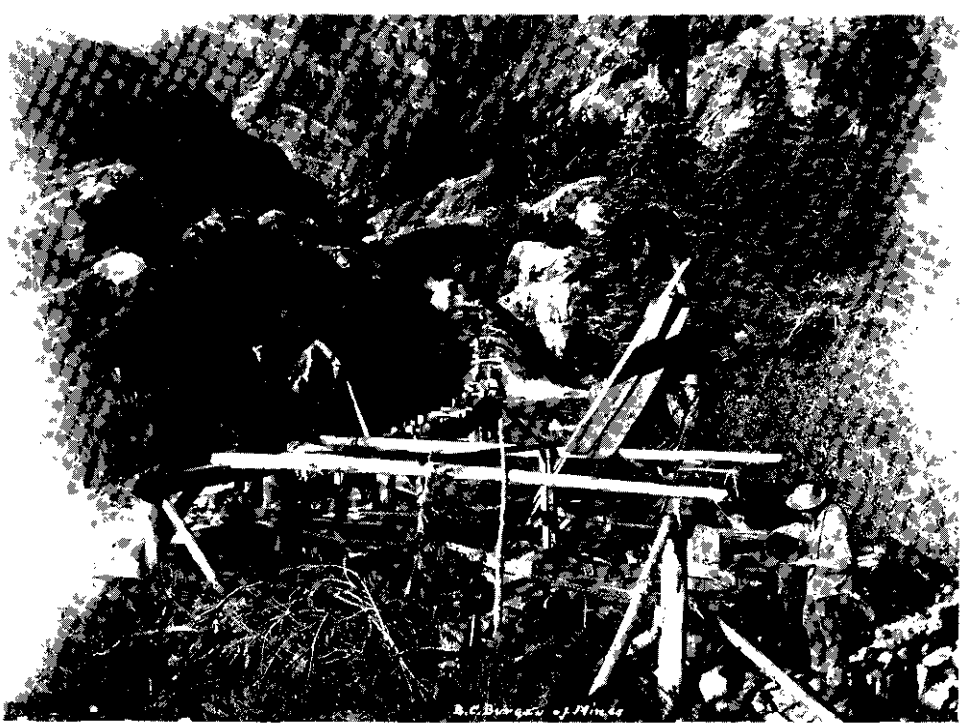
The mine-workings consist of open-cuts and an adit driven about 400 feet long in the direction of the line of strike of a well-defined fissure vein, varying from 15 inches to 2 feet in width in diabase rock, with a slight porphyritic structure, at an elevation of nearly 1,000 feet above sea-level. The strike of the vein is N. 70° E. and dip about 60 degrees N. 20° W. The open-cuts are about 200 feet higher elevation than the adit; they are made along the outcroppings, and the ore mined from them was treated in the concentrating-mill in 1899. The outcrop of the vein can be traced by the open-cut and outcroppings beyond that work for a distance of approximately 1,000 feet. There is approximately 200 tons of ore on the dump at the entrance to the adit.

The quartz vein is banded and mineralized with iron pyrites and some arsenopyrite. The oxidized quartz pans a fair prospect in free gold, and the vein-matter has the appearance of forming an ideal ore for treatment by concentration. The values in the ore vary very considerably, as is usual with gold-bearing quartz ores.

Herbert Carmichael, who made an examination in 1899, and whose report was published in the Minister of Mines' Report for that year, states that the ore carries about $12 in gold to the ton.

D. G. Forbes, M.E., who examined the property in 1913, and whose report was published in the Minister of Mines' Report for the year, obtained a sample from the then face of the adit that assayed 1.5 oz. in gold to the ton, but states: "The sample was a fair average sample taken in the face of the tunnel at the time of my visit. It showed no visible free gold, consisting

Big Interior Basin, Alberni Mining Division.



Della Mine, Arrastra.

apparently of quartz carrying pyrite, the latter not exceeding 1 per cent. of ore. The return obtained is, however, above the average value of the ore in the mine."

The writer took a cold-blooded average across 16 inches, the width of the vein at the face of the adit, in June, 1916, which assayed: Gold, 0.06 oz.; silver, 1.2 oz.; copper, trace.

Leora.

This mineral claim is on the east side of Elk river, about two miles above its mouth. The claim is owned by D. W. Hanbury and associates, of Victoria. During 1914 and 1915 the property was operated by W. W. Gibson, of Victoria, who erected a small quartz-mill, designed similar to the type known as the "Chilean" mill, in which he treated a considerable tonnage of free-milling quartz, and is reported to have saved about $9 in gold to the ton.

When the writer visited the property in June, 1916, all work was suspended, and there was no one in charge. The mill and camp buildings had been wrecked by the weight of snow during the previous winter. The workings consist of a shaft, an adit 350 feet long, and a winze. The shaft was full of water, and, although the drift-adit was examined, but little material information could be obtained, because all of the workable ore that could be found had been stoped, both from above and below the adit level, from the portal to the winze, 120 feet from the portal. The winze was full of water, as well as the underhand stope. The country-rock is diabase and is very much altered and sheared. In places the shearing action has been so great that the rock is almost a schist. A quartz vein occurs filling a fissure that is very persistent. The width of the vein varies from 12 to 18 inches for the length it has been stoped, but it maintains its continuity for about 225 feet longer, or to the face of the adit. The width of the vein beyond the winze is much narrower than from the portal of the adit to the winze, and no attempt has been made to carry stoping beyond that point. The walls of the vein are well defined, and there is a narrow seam of gouge between the wall-rock and the quartz. The strike is nearly true east and dip about 50 degrees to the north.

The *Leora* claim was examined by D. G. Forbes, M.E., in 1913, whose report was published in the Minister of Mines' Report for that year. Forbes reported that a sample taken from near the winze assayed "1.4 oz. in gold to the ton." The mineralization consists of iron pyrites and arsenopyrite in a gangue of quartz and calcite.

Other Mineral Claims.—There are several mineral claims located within a few miles of the mouth of Elk river, farther up the river than the *Rose* group, to which trails were built some years ago when prospecting-work was being carried on.

At the time the writer visited this section, in the beginning of July, 1916, these trails were so thoroughly obliterated by the excessive growth of underbrush and downed timber that several weeks' time and a force of four or five men would have been required to clear out the trails, so that they could be travelled, and, as no work has been done on any of the claims since they were examined by D. G. Forbes, M.E., in 1913, the writer did not consider he would be justified in incurring the expense necessary to enable him to reach them. The following extracts are made from the report of Mr. Forbes, published in the Minister of Mines' Report for 1913:—

"*Bessie B.*—The *Bessie B.* mineral claim is situated a quarter of a mile west of Elk river and two miles and a half from Kennedy lake, and at an elevation of 175 feet above the lake. No defined ledge has been found on this property, but some work has been done on a diabase dyke, in porphyry, bearing S. 45° W. (mag.), which contains some small quartz stringers from which good assay values in gold have been obtained.

"The principal exposure is in a bluff some 50 feet high, in which the quartz stringers can be seen in the dyke, dipping from 75 to 80 degrees to the north-west. It appeared to the writer that these occurrences were due to cooling cracks in the dyke, which had since been filled with quartz.

"An open-cut has been put in some 50 feet in length on one of these stringers, a tunnel driven 15 feet, and at the time of my visit, June, 1913, a winze had been sunk 16 feet, and was still being continued in the hope that the stringers exposed above would come together and form a quartz of workable size.

"*Bear Group.*—The *Bear* group of mineral claims is situated at an elevation of 500 feet above Kennedy lake, and half a mile west from Elk river and three miles and a half from its mouth. The group, which consists of three claims, *Black Bear*, *Cinnamon Bear*, and *Grizzly Bear*, is owned by W. Wilson, Jno. Irving, and Spidal.

"The principal development-work has been done on the *Cinnamon Bear* claim, a tunnel being driven 246 feet on a strong quartz ledge 3 to 4 feet wide; strike S. 60° W. (mag.), dipping 45 to 50 degrees to the north-west. The gangue is quartz, feldspar, and calcite, and the mineralization pyrite and arsenopyrite. The best ore is said to be 1 foot wide on the foot-wall. The diorite foot-wall and porphyry hanging-wall can be traced on the surface for 400 feet. The hanging-wall is soft, decomposed vein-matter, in which the tunnel has been driven. The tunnel is in an unsafe condition, the soft material in the hanging-wall having 'winded' and several falls taken place. An average sample of the ore assayed 0.10 oz. gold.

"*Ruth.*—The *Ruth* mineral claim is situated about 1,800 feet south-east from the *Bear* group at an elevation above Kennedy lake of 600 feet, and shows a quartz vein 18 inches to 2 feet in width, exposed for about 100 feet on the surface; a small diabase dyke accompanies the ledge on the foot-wall; the hanging-wall is porphyry. Limestone occurs from 6 to 10 feet to the eastward of the ledge; no development-work has been done. Strike N. 30° E. (mag.); dip 75 degrees to the south-east. The gangue is quartz and the mineralization pyrite and chalcopyrite. An average sample assayed: Gold, trace; silver, 2.8 oz.; copper, 1.9 per cent.

"*Olympic.*—The *Olympic* and *Titanic* mineral claims are situated half a mile west from Elk river and four miles from Kennedy lake, at an elevation of from 350 to 450 feet. A quartz ledge shows up in these claims, having a strike N. 73° E. and dipping to the north-west. No development-work has been done; the outcrop shows a little pyrite and chalcopyrite. The claims are intersected by a creek running in a deep canyon, and, owing to high water, it was not possible to visit the other outcroppings of this ledge. From an exposure farther up the creek a sample over a width of 20 feet is said to have yielded $20 in gold. A sample taken on the *Olympic* claim assayed 0.03 oz. a ton in gold.

"All the claims visited were situated at comparatively low elevations within easy reach of Elk river, and, as far as could be ascertained, very little prospecting has been done, and no claims located higher up the mountains, which rise on both sides of Elk river to a height of 3,000 to 4,000 feet.

"The ledges have all been located on or near diabase porphyry, their strike being approximately, in most cases, about N. 45° E. (mag.).

"This belt appeared to be about two miles in width, bounded by limestone, and striking in about the same direction, and it appeared to the writer to be a section of country that is well worth further attention from the prospector."

B.C. Wonder. This group consists of eighteen full-sized and fractional Crown-granted mineral claims, owned by General James M. Ashton, of Tacoma, Wash., U.S.A. The claims are located in a block comprising a surface area of 633 acres on Tranquil creek, which flows into Tofino inlet north from and nearly opposite to the Brewster Cannery. The writer visited the *B.C. Wonder* group of mineral claims in the early part of July, 1916, after General Ashton had sent three men on to the property to clear out the trails and mine-workings, on which no active operations have been carried on since about 1903. These men also had instructions to assist in the examination by guiding the writer to the various showings and openings; consequently he was not handicapped as Mr. Forbes had been in 1913, when he (Forbes) was unable to find all of the workings in the absence of any guide acquainted with the property.

A mill and terminal site comprising about 75 acres of Crown-granted land, located at the head of Tranquil arm of Tofino sound, is also owned by General Ashton, and is the starting-point of the main trail leading to the various claims. Surveys have been made for a main line aerial tramway 12,800 feet long to connect the terminal with the *Gen. James M.* mineral claim, also for branch tramways to the *American Wonder* and *Iron Duke* claims.

After leaving the beach terminal a wide belt of igneous rock is traversed to a point about midway on the *Iron Duke* claim, where a contact occurs between the igneous rock and crystalline limestone. This contact appears to extend across several claims in a north-westerly direction to that boundary of the *B.C. Wonder* group, and in a south-easterly direction across the divide between Tranquil and Deer creeks. The ore so far found on the *B.C. Wonder* group occurs on this contact as isolated lenses of undetermined extent.

The principal showings of ore occur on the *Iron Duke*, *American Wonder*, and *Gen. James M.* claims, on which all of the work has been done.

The *Iron Duke* mineral claim is the nearest of these claims to the beach camp. The southern boundary-line of it is about 9,000 feet distant in an air-line in a northerly direction from the mouth of Tranquil creek and at an elevation of 1,370 feet above sea-level. The claim is reached by a fair trail, with several switchbacks, and about two miles and a half long.

An occurrence of magnetite associated with some chalcopyrite outcrops on the *Iron Duke* claim about 700 feet northerly from the south boundary and close to the line of the *B.C. Wonder* claim. The outcroppings occur in a garnetite gangue at the contact between crystalline limestone and diabase, or possibly diorite, with the igneous rock on the southerly side. Apparently the line of strike of the ore-outcroppings is north-west and generally conformable with the strike of the contact, and the dip about 70 degrees to the south-east.

The only work done at this point to expose ore is an open-cut made along the strike of the outcrop, about 10 feet long, in which the width of mineral is not shown. From this an average sample was taken which is representative of all of the ledge material shown in the cut. This assayed: Gold, trace; silver, 0.4 oz.; copper, 2.0 per cent.

A crosscut adit intended to intersect the ore-body at a depth of about 200 feet is driven from a point in the bank of Clark creek, below the outcrop described, on the *Iron Duke* claim, but with its portal on the *B.C. Wonder* claim, adjoining the *Iron Duke* on the west. This adit is driven 85 feet long, in limestone, except for a few feet in the open-cut approach and for about 15 feet in from the portal, where it is driven through syenite gneiss. The adit has not yet been driven sufficiently far to expose any ore, which, if the body maintains continuity from the outcrop to the adit level, and retains the dip as shown at the outcrop, would not be exposed until the adit is driven about 30 feet farther.

After crossing the *B.C. Wonder* claim in a westerly direction from the portal of the adit just described, and climbing the mountain about 300 feet higher, an outcropping made up of magnetite, chalcopyrite, and some pyrrhotite occurs at the contact of crystalline limestone and an igneous rock similar to that which contacts with the limestone on the *Iron Duke* claim. This outcrop is near the intersection of the *American Wonder*, *B.C. Wonder*, and *Yankee Blade* claims. The ore-body represented by it has been exposed in an adit driven across the formation a few feet below the outcrop for a length of 26 feet. This adit is driven for 10 feet from the portal through a black metamorphosed rock, apparently a highly altered argillite, carrying some iron pyrites; then garnetite and some epidote occurs with disseminations of magnetite, chalcopyrite, and pyrrhotite, which is crosscut for about 14 feet or to within about 2 feet of the face of the adit. A portion of the ore-body exposed is fairly solid chalcopyrite, but the most of the mineralized material suggests that concentration is necessary in order to produce a commercial product. A grab sample from the dump of such ore as appears to be of shipping quality, but with its proportion to the entire body of mineralized material undetermined, assayed: Gold, trace; silver, 1.8 oz.; copper, 8.6 per cent.; iron, 16.2 per cent.; sulphur, 11.2 per cent. It is impossible to determine the length of this ore-body or to form any conclusion as to its persistency to deeper levels until further work is done, but apparently the outcropping represents a lens of ore, which has no relationship with that exposed on the *Iron Duke* claim, except that it occurs in the contact of limestone and igneous rock, which is apparently continuous between the two exposures.

The *Gen. James M.* mineral claim is reached by following the trail from the *American Wonder* claim in a north-westerly direction across the *Yankee Blade* and *Princess* mineral claims, which also belong to the *B.C. Wonder* group.

The trail in a general way parallels the line of the main contact between crystalline limestone and igneous rock, and in some places crosses the contact, but no ore-outcroppings are seen until a point is reached near the north-west corner of the *Gen. James M.* claim at an elevation of about 1,450 feet above the sea-level. There outcrops of magnetite and copper minerals occur, which are approximately 4,000 feet distant from the outcrops on the *American Wonder* claim in a north-westerly direction.

The mineralized outcroppings occur on the bare face of a bold precipitous bluff and can be traced along its face for some little distance. The effects of severe erosion appear to have worn away such comparatively large masses of the original face of the mountain, which was formed of igneous rock, as well as mineralized outcroppings, that at present the remaining outcrops show as splotches on the limestone, which shows as the face of the bluff at the present

time and forms the foot-wall of the mineralized body as shown in an adit driven below the outcropping.

The open-cut approach to the adit and a few feet under cover are driven through mineral made up of magnetite, pyrrhotite, iron pyrites, and some chalcopyrite in garnetite gangue; then limestone is exposed and the adit continued through that rock to its face, a distance of about 100 feet. A grab sample of the dump at the portal of the adit assayed: Gold, trace; silver, trace; copper, 2.2 per cent. The mineralized material requires concentrating to produce a commercial product.

No effort has been made to drift on the mineralized body or to determine whether it maintains continuity to any appreciable depth.

Crow. This mineral claim is about one mile north-easterly from the mouth of Deer creek, at the head of Tofino inlet, and the mine-workings are at an elevation of about 800 feet above sea-level. The owners are Joe Drinkwater, of Alberni, and Jensen, of Hesquiat. The *Crow* claim is one of a group of mineral claims which were located in 1898 and prospected to some extent annually by the locators until 1916. It was then bonded to Sam Silverman and associates, of Seattle, who continued development-work and propose to determine the extent of the ore-body previously opened up, and if the results are satisfactory, to equip the property to ship ore by connecting the workings with the beach by an aerial tramway.

An occurrence of chalcopyrite associated with magnetite outcrops on the property near the steep bank of a mountain stream, at the contact between igneous rock, similar to diabase, and crystalline limestone. The strike of the contact is N. 60° E. (mag.) and the dip 65 degrees N. 30° W. (mag.). The limestone forms the hanging-wall and the diabase the foot-wall of the occurrence of ore. The most important development consists of two adits, in both of which the body of copper ore is exposed; one of these adits is about 40 feet lower elevation than the other.

The upper adit is driven about 30 feet in limestone along the contact beyond the open-cut approach, which is 25 feet in length. The lower adit is driven about 65 feet along the contact beyond the open-cut approach, which is about 15 feet in length. The open-cut approach to the upper adit is made through outcroppings of solid ore for the last 10 feet before the portal of the adit is reached.

The ore-body at the portal of the upper adit is 8 feet wide, and the ore is exposed behind sets of timbers on the right side of the adit, paralleling it. The adit is driven for a length of 20 feet in limestone, which appears here to temporarily cut off this ore-body. About 7 feet beyond this point the limestone is replaced by ore, which is continuous to the face, where there is a width of about 2 feet of magnetite impregnated with chalcopyrite, and the body for that width contains about 3 per cent. in copper. On the dump there is about 60 tons of ore, averaging about 5 or 6 per cent. in copper.

In the open-cut approach to the lower adit the ore-outcrop is 5 feet wide, but the adit beyond the portal is driven in limestone parallel to the strike of the contact and no ore is exposed for 38 feet. At that point the course of the adit is turned to the right, and some magnetite with a little chalcopyrite is exposed along its left side for about 16 feet, or to the face.

Jumbo. This mineral claim is on Copper creek, a tributary of Deer creek, and is owned by Drinkwater & Jensen. The mine-workings on the claim are about half a mile from the mouth of Deer creek and only about 50 feet above sea-level. This claim was located in 1898, when an outcropping of bornite was discovered in the bed of Copper creek, and it was then bonded to the Jumbo Mining Syndicate. A shaft was sunk about 40 feet deep in mineralized vein-matter close to the bed of the creek, below the outcrop, but was later abandoned because of the excessive quantity of water. On the outbreak of the Boer war the members of the syndicate left for the front and cancelled the bond. Since then more or less prospecting and development work has been done. In the spring of 1916 the property was bonded by H. W. E. Canavan, of Victoria, who with a force of about ten miners started development in a systematic way by extending the underground workings from the bottom of a new shaft, which had been sunk about 100 feet easterly from the old one. This work was progressing at the time the writer examined the claim early in July, 1916.

The mineralized surface outcroppings on the *Jumbo* mineral claim are made up chiefly of bornite and chalcopyrite, occurring in a contact-zone between limestone and igneous rocks in which the limestone is very much altered, fractured, and replaced by garnetite and epidote, as well as by the copper minerals. The igneous rock adjacent to the contact is also very much altered, sheared, and crushed. The average width of the contact-zone in which the alterations occur is about 40 feet for a length of about 125 feet, so far as can be judged from the surface exposures. Beyond that length the rock formation is hidden by debris, underbrush, and down timber. An ore-body is exposed in the underground workings which could be examined. These consist of a shaft 67 feet deep, a drift driven in both directions from the bottom of the shaft, and crosscuts driven from the drift. The ore-body is made up of chalcopyrite, with occasionally grains of bornite, and some little iron pyrite disseminated through the gangue, usually in grains and small kidneys, but sometimes the chalcopyrite occurs in solid masses and lumps weighing several pounds. The drift from the bottom of the shaft is not driven in ore, but in the country-rock along a fracture-plane, which is one wall of the shaft, and the exposures of ore are those opened up in the crosscuts driven in a southerly direction from the drift on the west side of the shaft.

There are three crosscuts within 91 feet from the bottom of the shaft in which ore is exposed. No. 1 crosscut is 30 feet long and is started from a point 24.5 feet from the shaft. This crosscut is driven through 5 feet of ore and gangue that appears to form a good material for concentration.

No. 2 crosscut is 30 feet west from No. 1; it is 10 feet long and driven through 4 feet of ore and gangue similar to the body exposed in the No. 1 crosscut.

No. 3 crosscut is 24.5 feet west from No. 2; it is driven 13 feet long through country-rock, with no ore exposed so far.

On the east side of the shaft the drift is 40 feet long, with a crosscut driven 24 feet towards the south, in which no ore is exposed.

A grab sample taken from the dump at the collar of the shaft assayed: Gold, trace; silver, 0.8 oz.; copper, 4 per cent.

The property is equipped with water-power for pumping and hoisting from the 67-foot shaft. The power is obtained from Copper creek and is developed by an overshot wheel 12 feet in diameter by 4 feet wide, carrying 23 buckets.

Bounce.

This mineral claim is on the east side of Deer creek, about two miles above its mouth and about 300 feet elevation above sea-level. The ground was located about 1898 as one of the claims in the *Hetty Green* group, and some years afterwards was operated and produced a few hundred tons of copper ore of a fair grade. This ore was sacked and hauled to the beach in wagons, but as soon as the higher-grade ore was mined from the surface outcroppings it was found unprofitable to continue operations, and the claims reverted to the Government.

During the summer of 1915 a prospector named Wm. McKay, of Clayoquot, restaked the ground covered by the *Bounce* claim, in the hope that he could sell it because of the great demand for copper ore.

So far as the old workings, which are all wide, deep open-cuts, show, there is practically no ore left except on the old dump, where a considerable tonnage of chalcopyrite of low grade still remains, but the zone of contact metamorphism between crystalline limestone and diorite is well defined, and apparently the ground has promising possiblities and merits further prospecting.

BEAR RIVER DISTRICT.

Bear river flows from the north into Bedwell sound, the northern arm of Clayoquot sound, at a distance of about twenty-five miles from the settlements of Clayoquot and Tofino, at the entrance to the last-named sound. There is a weekly steamer service from Victoria to these settlements during the summer months and a service three times each month during the winter season.

During 1898, 1899, and 1900 there was considerable activity in mining operations in this section of the Clayoquot Mining Division, which was examined by Herbert Carmichael in 1899, whose report is published in the Minister of Mines' Report for that year. Since then and until 1914, when the Ptarmigan Mines, Limited, commenced operations on the mineral claims acquired on the Bear River side of the Big Interior mountain, there was practically no interest taken in

the section. The prospectors merely continued to hold their claims by either doing the annual assessment-work or restaking the ground, as it reverted to the Government.

Until the commencement of the war the Ptarmigan Mines, Limited, was engaged in building a wagon-road and bridges up the Bear River valley in order to reach the property of the company, which is situated about fifteen miles from the mouth of Bear river, at an elevation of about 5,300 feet above sea-level, but since then that company has suspended operations.

During 1916 there was some revival of interest by prospectors in the Bear River section and some new locations were made late in the season.

The surface ores found in the mountains adjacent to the river are usually of rather exceptional value. The outcroppings occur as gossan, under which ore-lenses of chalcopyrite mixed with magnetite are found, belonging to the contact-metamorphic replacement type of ore-deposits. The development-work done has not been sufficient to warrant the expression of an opinion as to the possibilities that may result from further development.

A selected sample from the *Galena* mineral claim, owned by Joe Drinkwater, situated about five miles above the mouth of Bear river, taken from the bottom of a shallow winze, assayed: Gold, trace; silver, trace; copper, 21.4 per cent.

Another sample from same claim at the face of an open-cut approach to an adit assayed: Gold, trace; silver, 0.2 oz.; copper, 3.1 per cent.

Ormond Group.

This group of mineral claims is on Flores island, in the Clayoquot Mining Division, on the west coast of Vancouver Island, and contains nine claims having a total area of approximately 375 acres. The property is owned by James Beck, of Victoria, but is under bond to H. W. E. Canavan, of Victoria, B.C. The rock formations in the region belong to Dawson's Vancouver series, composed chiefly of volcanic rocks interbedded with argillites and limestones.

The ore-bodies on the *Ormond* group occur in sheared zones in igneous rocks having a slight porphyritic structure, and apparently the most important occurrence fills a fissure in these rocks which has a breccia structure. The line of strike of this fissure is true north, the dip 70 degrees to the east. Judging from a series of open-cuts in which the most prominent ore-bearing body is exposed, the fissure is at least 500 feet long and about 15 feet wide. The ore in the fissure varies in width from about 4 to 8 feet.

The vein material is composed of chalcopyrite, mixed with iron pyrites and pyrrhotite in a gangue of brecciated country-rock, garnetite, epidote, calcite, and quartz. Samples from the various openings show marked uniformity in the copper and silver values carried by the ore. The ore averages about 3 oz. silver to the ton and about 5 per cent. in copper. The mine-workings are about 4,500 feet from the beach of a good deep-water harbour, and at an elevation of about 1,100 feet above sea-level.

The supply of timber on the property is ample for building, mining, and fuel for many years to come. The supply of water is ample for mining and domestic purposes, and if a small lake on the property is used for a reservoir a water-power can apparently be developed, but the capacity is undetermined.

Transportation facilities for conveying ore from the mine to the beach can be installed with little difficulty and at a reasonable cost.

When the writer examined the *Ormond* group of mineral claims on June 27th, 1916, work was being carried on by a force of miners in the employ of Mr. Canavan. The writer was accompanied by James Beck, the owner, through whose courtesy a thorough examination was made possible.

Flores island was examined in 1902 by Arthur Webster, of the Canadian Geological Survey, whose report is published in the Annual Report for that year, Vol. XV., page 70A, and is as follows: "On the north-east and north-west sides of Flores island, including Steamer cove and Rocky passage and south to within two miles and a half from the mouth of Matilda creek, fine-grained granites are met with. Thence southward, including Matilda creek and the shore past Ahousat village, on to White Sand bay, only greenstones of the Vancouver series are exposed."

Geography.—Flores island has an area of about thirty-six square miles and is on the west coast of Vancouver island, on the north side of Clayoquot sound. It is separated from Vancouver island by the fiord called Sidney inlet. The west side of Flores island is open to the Pacific ocean and has no harbours; but on the south-east side Matilda creek affords a safe deep-water shelter and good anchorage.

There is mail-steamer plying between Victoria and west coast ports as far as Clayoquot, about fourteen miles south from Flores island, four times each month during the summer and three times each month during the winter; this steamer continues beyond Clayoquot twice each month, the year through, and on these voyages calls at Ahousat, on Flores island, about two miles from the beach camp of the *Ormond* group, and would call at that camp to deliver supplies if sufficient work was being carried on.

Flores island is mountainous and thickly wooded, the shores are steep, rugged cliffs, except for a short distance in front of the Indian village of Ahousat, where there is a white sandy beach.

Geology.—The rock formations on the west side of Matilda creek comprise traps, greenstones, and other igneous rocks of the Vancouver series. Some of these are sheared and also show a porphyritic structure, especially in the vicinity of the ore-bodies, where garnetite and epidote are found with the brecciated gangue material.

On the east side of Matilda creek is a narrow peninsula on which a belt of granite occurs that contacts with greenstone. On the contact about a quarter of a mile from the beach bodies of magnetite occur.

Ore-deposits.—The history of prospecting on Flores island dates back to the autumn of 1902, when James Beck discovered gossan outcropping on the beach between high- and low-tide marks on the east side of Matilda creek. He also found a body of chalcopyrite which he attempted to work by an open-cut, but after sinking about 6 feet was driven out by the inflow of water. Prospecting on the west side of Matilda creek, in the mountain, about three-quarters of a mile north-west from the beach, he discovered bodies of magnetite, and later discovered the body of chalcopyrite that makes the property attractive.

Four mineral claims were staked in the autumn of 1902 by Mr. Beck, two on the peninsula on the east side of Matilda creek and two in the mountains on the west side of that creek. Those on the east side are called the *Ormond No. 2* and *Ormond No. 2 Fraction;* those on the west side are called the *Ormond* and *Ormond No. 3.* During the summer of 1916 Mr. Beck staked five more claims, four of them adjoining the *Ormond* and *Ormond No. 3;* these are called the *Ormond Nos. 4, 6,* 7, and *8;* the fifth claim, called the *Ormond No. 5,* is located on the beach and takes in the beach camp. This is located for a mill-site.

The Character of the Ore-deposits.—Flores island contains good illustrations of deposits of chalcopyrite and magnetite in sheared zones. On the *Ormond No. 3* mineral claim such occur at a point about one mile and a half by the present trail from the beach camp in a north-west direction, but only about half that distance by an air-line. The ore-mineral is chalcopyrite, with pyrrhotite, iron pyrites, and magnetite associated, and they occur as large masses in a wide sheared zone in an igneous country-rock. Chalcopyrite unaccompanied by the associated mineral just mentioned also occurs as kidneys or lenses in the brecciated gangue material.

Development.—On the *Ormond No. 3* mineral claim, along a ridge at an elevation of about 1,100 feet above sea-level, six trenches have been made, crosscutting the fissure in the sheared igneous rocks and carrying chalcopyrite. These cuts are in line from true south to north for a distance of about 500 feet; also an open-cut approach to a short adit, with a shallow winze at the face of the adit, has been made in the bank of a gulch at the south end of the ridge 100 feet below the level of the ridge. Another adit was commenced about 100 feet lower, but subsequently abandoned.

Available Ore.—The work described has exposed an ore-body that apparently maintains continuity along its strike to the north for a distance of about 500 feet. Seemingly the same body has been drifted on by the short adit, indicating that the ore has extended to that depth.

In each of the open-cuts on the ridge the brecciated zone shows an average width of about 15 feet, with chalcopyrite occurring in it in masses, lenses, and veinlets of varying widths, but the percentage of ore in the vein material can hardly be determined from the work done. In the open-cut, adit, and winze practically the same conditions are shown.

No well-defined walls are proved in any of the openings. At the lowest level the open-cut was made along a so-called wall on the west of the ore, but by continuing the cut to the west, across the formation, a body of sheared country-rock associated with considerable garnetite and epidote carrying a little ore was found, and for the next 5 feet the cut crossed the same material, but with a greater proportion of chalcopyrite.

Chas. H. Clapp, in Memoir No. 13, page 176, Canadian Geological Survey, says, with regard to the shear-zone type of ore deposits, as follows: "There is every reason to believe that these shear-zones extend to considerable depths."

To what depth the ore-body on the *Ormond No. 2* claim may maintain its continuity is a question that work alone will solve; apparently it is found to have done so to a depth of 100 feet. No estimate of tonnage of available ore can be made from the data supplied by the work so far done, but apparently a considerable tonnage might be shown by further systematic work.

At a point about 160 feet north from the fifth open-cut on the ridge there is a bluff 20 feet higher than the average level, in which occurs an outcropping of more or less oxidized copper ore associated with chalcopyrite wider than is exposed in any of the open-cuts. This is practically in line with the other exposures. The bluff forms the south bank of a dry gulch, which affords a good opportunity to prospect for the ore at a considerable depth, and open mine-workings nearer to the beach on Sidney inlet than if permanent workings were opened from the dry gulch at the south end of the ridge.

Samples and Assays.—Owing to the obvious uniformity of the copper content in the ore-body as exposed in the various open-cuts the writer took only one sample; this was a fair average from the dump at the adit, and assayed: Gold, trace; silver, 3.4 oz.; copper, 5.2 per cent.

The following assay results were reported by Mr. Canavan: At the adit, silver, 3.2 oz.; copper, 4.61 per cent.; at second crosscut, silver, 4.16 oz.; copper, 7.38 per cent.; at the adit, silver, 3.6 oz.; copper, 6.5 per cent.; at second crosscut, silver, 3.6 oz.; copper, 3.4 per cent.; at the second crosscut, silver, 3 oz.; copper, 6.1 per cent.; at the dump at the adit, silver, 4.2 oz.; copper, 5.7 per cent.; at the face of the adit, silver, 1.2 oz.; copper, 6 per cent.; at the face of the adit, silver, 2 oz.; copper, 6.1 per cent.; at second crosscut, silver, 4 oz.; copper, 7 per cent.

Ormond No. 2.—Magnetite-deposits of the contact-metamorphic type occur on this mineral claim on the east side of Matilda creek, at an elevation of about 100 feet above sea-level and about a quarter of a mile from the beach. These outcroppings of magnetite occur along a contact-zone between granite on the south-west side and greenstone on the north-east; the zone strikes south-east and extends across a portion of the *Ormond No. 2* claim on to the *Ormond No. 2 Fraction.*

The masses of magnetite occur at irregular intervals. Some open-cuts have been made to prospect the extent of some of the masses, but the work has been insufficient to determine the full width and length of the various outcrops.

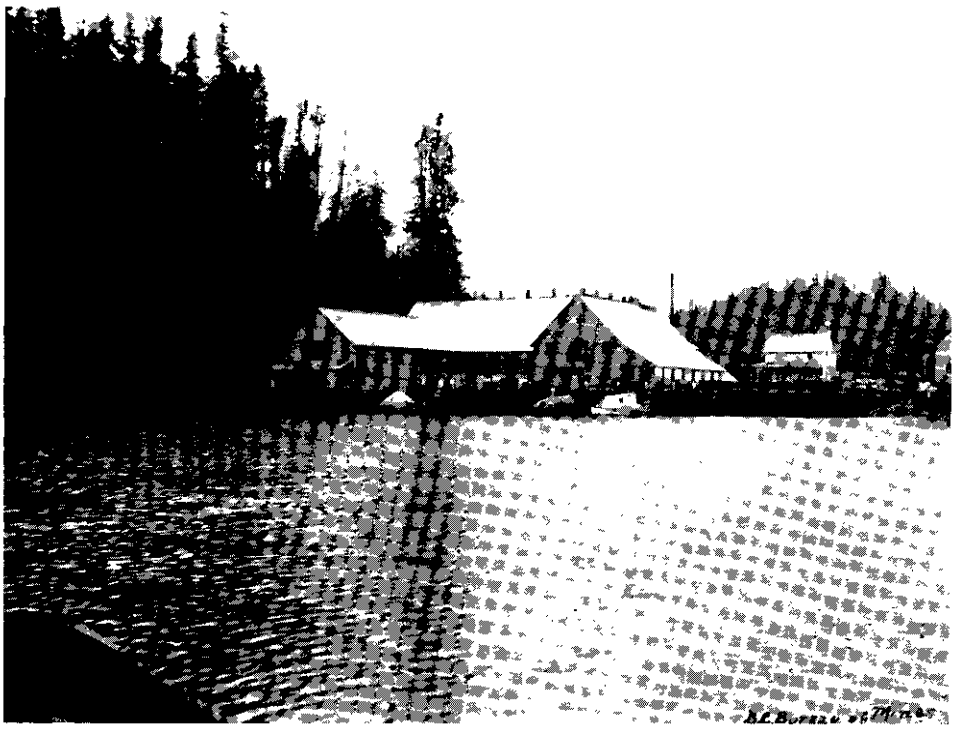
A sample typical of the average grade of the ore assayed: Iron, 53.5 per cent.; sulphur, trace; phosphorus, *nil;* silica, 24.8 per cent.

On the *Ormond No. 2* claim a wide outcrop of gossan occurs near the beach, striking N. 50° E. (mag.). This has been prospected by a trench about 30 feet long made across the outcrop at one point, but not deep enough to reach the unaltered material, the source of the gossan. About 200 feet from the trench, along the beach below high tide, is another trench, from which Mr. Beck stated 100 sacks of good copper ore was taken some years ago, but that the work was abandoned because of the inflow of water. Whether this occurrence has any connection with the gossan-outcrop has not been determined. The country-rock adjacent to the copper ore is greenstone associated with epidote and garnetite. These occurrences of magnetite and gossan are of sufficient importance to warrant further prospecting, especially when the accessibility for shipping is considered.

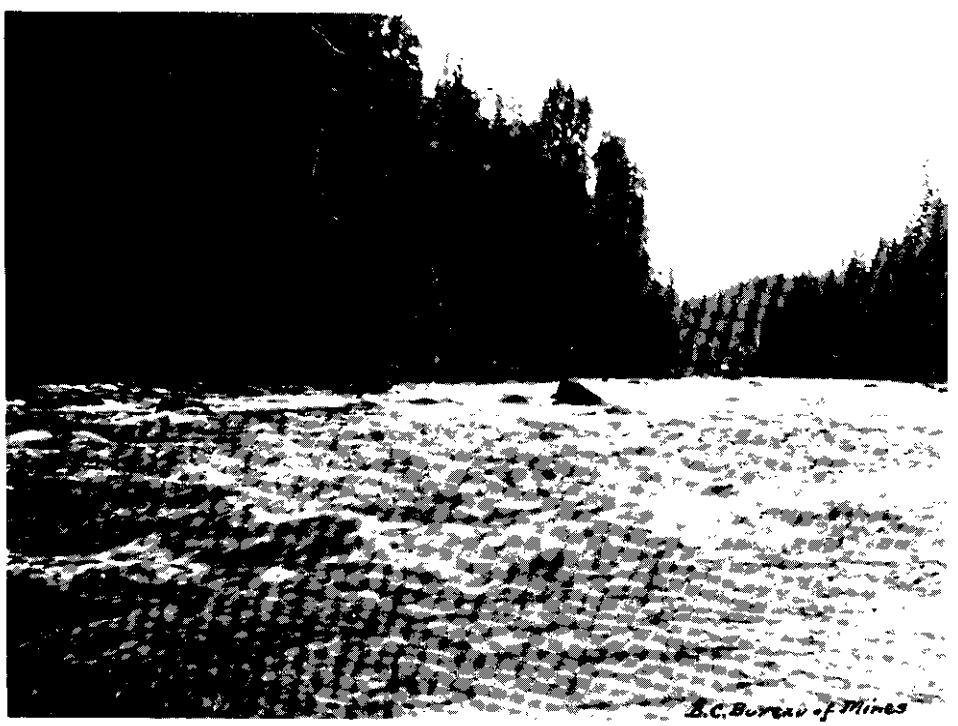
SIDNEY INLET DISTRICT.

Sidney inlet is a fiord which penetrates the west coast of Vancouver island about twelve miles, with its entrance between the north-west corner of Flores island and Sharp point, about twelve miles south-easterly from the entrance to Hesquiat harbour. On the west side of Sidney inlet there are several mineral claims which have been worked at irregular intervals since 1899, and from which a considerable tonnage of copper ore has been shipped previous to 1911. Since then, until the autumn of 1916, after the writer had finished field-work, when the *Indian Chief* group of mineral claims was bonded, there had been practically no interest manifested in this section of the Clayoquot Mining Division; for which reason, also because of lack of time, the writer did not visit Sidney inlet.

Early in 1917 a shipment was made from the *Indian Chief* group, of about 400 tons of copper ore, carrying about 5 per cent. in copper.



Brewster's Cannery, Clayoquot Mining Division.



Kennedy River Rapids, Clayoquot Mining Division.

Indian Chief Group.

This group contains the *Tinnecanem*, *Scotlett*, *Victor*, *Brutus*, and *Leschi* Crown-granted mineral claims, owned by the Dewdney Canadian Syndicate; at present held under bond by Sam Silverman, of Seattle. The most extensive mine-workings are at an elevation of about 1,400 feet above sea-level, where occurrences of copper ore occur in a contact-metamorphic replacement zone. The copper minerals are chalcopyrite and bornite, with which are usually associated some magnetite and a little pyrrhotite. The gangue material is chiefly calcite, garnetite, and some epidote. The development-work consists of a series of long drift-adits, crosscuts, and open-cuts from which the ore that has been shipped was mined.

The property is equipped with an aerial tramway, ore-bunkers, and wharf, as well as camp buildings. It is reported that a concentrating-mill is to be erected in the near future, in which will be treated the lower-grade ore, of which there is a considerable tonnage.

HESQUIAT LAKE DISTRICT.

Brown Jug Group.

This group contains the *Brown Jug*, *Brown Jug No. 2*, *Frankfort*, *Frankfort Fraction*, *Sapphire*, and *Nimrod* mineral claims, owned by George and Andrew Smith, of Alberni. The group is located at an elevation of about 300 feet and about half a mile from the southerly shore of Hesquiat lake, a short distance from the narrows at the outlet of the lake, in the Clayoquot Mining Division. This property is reached by steamer from Victoria twice each month.

A wide shear-zone in trap-rock is traceable for about 1,500 feet in a northerly direction on the *Brown Jug* and *Brown Jug No. 2* claims. In many places this rock is so much altered, crushed, and sheared that it is serpentinized and talcose for considerable widths. There are fractures and fissures occurring in the zone, which are filled with quartz mineralized with iron pyrites, sphalerite (zinc-blende), and some chalcopyrite. These fissures appear to be lenticular in form, and vary very much in width. Although prospecting-work has been done to some considerable extent, the development is not sufficient to determine many material facts relative to the possibilities of the property.

A sample taken from a small dump at the portal of an adit assayed: Gold, 0.08 oz.; silver, 1.6 oz.; copper, 1 per cent.; zinc, 10.4 per cent.

A sample taken across 5 feet near the face of an open-cut 21 feet long assayed: Gold, 0.12 oz.; silver, 5.4 oz.; copper, 1.7 per cent.; zinc, 6 per cent.

A selected sample taken from the dump at the same open-cut assayed: Gold, 0.62 oz.; silver, 8 oz.; copper, 3.5 per cent.; zinc, 12 per cent.

QUATSINO MINING DIVISION.

During 1916 there was considerable activity in the Quatsino Mining Division, as compared with the conditions during past years since about 1907. Most of the mineral claims were being actively operated at the time of the writer's visit to the district during September, 1916.

Up to the present time all of the lode-mining operations are confined to the country tributary to the South-east arm of Quatsino sound, which is reached by two routes. The most direct is by steamer from Victoria twice each month, to either the *Yreka* or the *June* Landing in the South-east arm. The alternative route is up the east coast of Vancouver island by steamer from Vancouver to Hardy Bay; thence by trail across the island to Coal harbour, on the West arm of Quatsino sound, a distance of about ten miles, and by launch to destination.

Yreka.

The property known as the *Yreka* mine consists of two groups of Crown-granted mineral claims situated on the west shore of the South-east arm of Quatsino sound, about four miles from the entrance. The groups are known as the *Comstock* and *Superior*. The *Comstock* group contains eight claims—viz., *Mountain Queen*, *Mountain King*, *Eva*, *New Comstock*, *Asa*, *Thor*, *N.S. Fractional*, *Yreka Fractional*, and *Edith Fractional* mineral claims. The *Superior* group contains eight claims—viz., *Superior*, *Pocohontas*, *Tuscarora*, *Quatsino Chief*, *Mohican Fractional*, *Hiawatha Fractional*, *Ready Cash Fractional*, and *Omega Fractional* mineral claims.

These claims are located from the shore-line to the summit of Comstock mountain, which is the highest peak in the range of mountains that rises from the shore at an angle of about 40 degrees to an elevation of about 2,200 feet above sea-level, with the axis roughly paralleling the shore-line in a N. 40° W. direction.

The mineral claims that make up the property were originally located and grouped in 1898 and 1899 by several of the settlers on Quatsino sound, and from that time until 1903 active mining operations were carried on. During 1903, while the North-western Smelting and Refining Company, of Crofton, Vancouver island, was working the mine under bond and lease, an examination was made by Herbert Carmichael, whose report was published in the Annual Report of the Minister of Mines for that year. Later in that year work was suspended, and the property remained idle until 1916, when work was resumed by N. S. Clarke and associates, of Spokane, U.S.A. It was examined by the writer on September 22nd, 1916.

The old workings were found to have been practically abandoned, and, as these were fully described in Carmichael's report, it is not necessary to repeat in this report.

Recent prospecting had exposed the occurrence of deposits of chalcopyrite, associated with some pyrrhotite and iron pyrites at a higher elevation than those previously mined, and farther along the precipitous mountain-side, in a north-westerly direction, on the *N.S. Fractional* and *Superior* mineral claims.

Apparently the old workings had been opened near the south-easterly end of a mineralized zone. These were abandoned when the former operators found that the ore, which occurs as lenses in the zone, decreased as work progressed in that direction, and that the underground workings failed to expose continuity of the ore to deeper levels, as it was considered that the mine was worked out. The great demand for copper created by the war encouraged N. S. Clarke and his associates to secure a bond on the property and thoroughly and systematically prospect for other occurrences of ore towards the north-west, where the rock formation showed indications favourable to the occurrence of ore-deposits of the contact-metamorphic replacement type.

On the *N.S. Fractional* claim, at a point about 100 feet higher elevation than the old No. 2 adit and about 150 feet distant in a north-westerly direction, a long open-cut has exposed an occurrence of chalcopyrite, associated with pyrrhotite, and iron pyrites in a gangue made up of garnetite and lime silicate. It is a deposit of the contact type, with limestone for the foot-wall.

The hanging-wall of the deposit is a rock similar to the specimen submitted by Carmichael to the Petrographer of the Canadian Geological Survey, and classified by that authority as: "A highly altered rock, probably of the pyroxenite class."

The strike of this ore-body is north-westerly, and the dip, as far as can be determined, south-westerly, or into the mountain. At the time of the writer's visit an adit was being driven in garnetite and metamorphosed limestone to expose the ore seen in the outcrop, at a depth of about 50 feet, but the adit has not been driven sufficiently far to reach the ore.

By continuing to climb along the mountain-side for a short distance north-westerly from the outcrop referred to, and gradually gaining higher elevation, another open-cut is reached that is called by the miners the No. 3 cut.

This cut is about 200 feet long, with its face about 50 feet high and floor about 20 feet wide. It is made along the strike of an occurrence of ore similar in its characteristics, as regards the mineralization, gangue material, strike, and apparent dip, as the occurrence exposed in the open-cut already mentioned.

The origin of the ore in these deposits is evidently from replacement of the metamorphosed limestone, which is found as a portion of the gangue material, and also forms the foot-wall wherever that wall is exposed, but in many places along the mountain-side it has been removed by erosion.

The extent in width of the ore-deposit exposed in the No. 3 cut cannot be determined until a crosscut is made in the floor of the cut, because no hanging-wall was exposed at the time of the writer's visit. The angle of the dip is not determinable because the foot-wall has been carried away by erosion, but apparently the dip is to the south-west, or into the mountain.

Beyond the dimensions of the open-cut no estimate of the tonnage of ore in the deposit is warranted, but there are many tons of ore already quarried, and on a dump, confined by a log bulk-head built along the steep mountain-side.

A sample taken from the dump, in an attempt to obtain as near an average as possible, assayed: Gold, 0.02 oz.; silver, 2.6 oz.; copper, 2.9 per cent.

There is another open-cut, called the No. 2 cut, a short distance to the north-west from the end of the No. 3 cut. This has also been made along the strike of an occurrence of ore similar in all its characteristics to that exposed in the open-cuts already referred to, and is apparently an extension of the ore exposed in the No. 3 cut.

It is quite possible that further work between the cuts will demonstrate that the ore is continuous from the open-cut at the lower elevation, under which an adit is being driven, to and beyond the north-westerly end of the No. 2 cut, which is about 100 feet long, in ore the entire distance. The face of the No. 2 cut exposes a continuous body of ore about the same average height as is exposed in the No. 3 cut, and the floor of the cut is about the same width. No walls are exposed, because the foot-wall has been carried off by erosion, and the cut has not been made wide enough to crosscut to the hanging-wall.

No sample was taken, as the grade of the ore is evidently about the same average in copper content as that on the No. 3 dump. Near the north-westerly end of the No. 2 open-cut is the dividing line between the *N.S. Fractional* and the *Superior* mineral claims, and about 200 feet beyond the No. 2 open-cut, in a north-westerly direction and at a somewhat higher elevation, on the *Superior* mineral claim, there is another open-cut, called the No. 1. This is also made along the strike of an occurrence of ore similar in all its characteristics to that exposed in the other open-cuts described. The No. 1 open-cut is about 75 feet long, with the face stripped up the mountain for about 25 feet high, showing a continuous body of ore, but not exposing the hanging-wall. This cut exposes the limestone foot-wall as well defined, dipping 47 degrees to the south-west, or into the mountain.

An average sample taken across 4 feet next to the foot-wall assayed: Gold, trace; silver, 1.9 oz.; copper, 3 per cent.

The writer was informed that the No. 1 open-cut was the highest working opening of any extent on the mountain at the time of his visit. The elevation of this open-cut is about 1,000 feet higher than the mining camp, which is about 1,100 feet above sea-level.

The old No. 1 adit below the camp and at the lowest elevation of any of the workings was examined by the writer, because he was informed that prospecting in it had exposed an ore-body that had apparently been overlooked by the former operators.

About 125 feet from the portal of the old No. 1 adit the former operators stoped down some ore, and then continued to drive a drift, apparently in the hope of intersecting a body of ore under an outcrop on the surface about 200 feet distant, which they failed to do, and appear to have abandoned further search. Last summer the foreman prospected to the north-west beyond the wall of the old stope, and next to a limestone foot-wall exposed some good-grade chalcopyrite mixed with limestone and garnetite, apparently the beginning of a lens of ore lying *en echelon* to that which had been stoped.

A drift was being started on this ore-body when the writer was making his examination, and an average sample was taken across 2 feet of the face, as it appeared at that time, which assayed: Gold, 0.02 oz.; silver, 2.4 oz.; copper, 6.2 per cent.

Until further work is done it is impossible to form any judgment as to the extent of this occurrence.

Summary.—The writer, after having carefully examined the *Yreka* mining property, has formed the following conclusions:—

First: That the new work done on the *Yreka* mine has exposed a large ore-body, especially important when the extremely favourable transportation facilities by which ore can be freighted to smelters at a very low cost are considered. The fact that an aerial tramway about 7,000 feet long will transport ore directly from the mine-workings to the bunkers on the beach, where ocean-going vessels can load at any stage of the tide or condition of the weather, is another consideration that adds to importance of the property.

Second: That the work that was done at the time of the writer's examination shows it is probable that there is 20,000 tons of ore that can be quarried and available for shipment, with a reasonable possibility that further work will expose a much greater tonnage.

Third: That while the writer's samples from the new ore-body showed assay values of only about 3 per cent. copper content in addition to a low silver value, there can, by hand-sorting, be found ore that carries considerable higher values. There is also, in addition to the tonnage of ore, a large tonnage of mineralized garnetite and altered limestone carrying low copper values that is of importance if tests prove that such material can be successfully concentrated.

Fourth: That the old wagon-road from the beach to the mine camp requires some repairs, and, although on Crown-granted land, this road has always been used as a public highway and adds very materially to the convenience of prospectors in reaching the mountains farther back from the beach.

Old Sport Group. This is the name given to a group of mineral claims composed of five groups with eight claims in each. These groups are known as the *Penstock*, *Old Sport No. 1*, *Idaho*, *Edith*, and *Machete*. The north end lines of these groups adjoin each other from west to east and are parallel to the south shore of Elk lake. The northern boundary of each group extends to the water-front of the lake. From the north line each group extends southerly into the mountains the length of eight mineral claims, thereby forming an oblong block approximately 12,000 feet from north to south and 7,500 feet from east to west. The entire block of mineral claims is under bond to the Consolidated Mining and Smelting Company of Canada, Limited, of Trail, B.C., and has been operated by that company since September, 1916.

Elk lake is the farthest south-easterly of a chain of lakes that are connected by the Benson river, which flows into the Rupert arm of Quatsino sound. The property is reached from the *June* landing on the South-east arm of that sound by a trail about seven miles long to Alice lake; thence across that lake by boat to another trail about three miles long to the foot of Kathleen lake; then up that lake by boat to the head and along a short portage to the outlet of Elk lake, where the main mining camp is located near the northern line of the *Penstock* group.

The most important mine-workings are on the *Old Sport No. 2* mineral claim, one of the *Idaho* group, at an elevation of about 500 feet above the level of Elk lake and about two miles from the main camp. In a southerly direction from the workings the mountain range rises rapidly towards the summit, which is about 3,000 feet elevation above the level of Elk lake.

The occurrence of ore which is being developed occurs as a contact-metamorphic type of deposit, with crystalline limestone showing in some places on the surface as the hanging-wall, but underground no limestone had been exposed and the ore-body there appears to fill a fissure in a shear-zone in igneous rock.

Outcroppings of magnetite associated with some chalcopyrite are traced for a distance of 3,000 feet, and the ore is exposed in a series of deep crosscut trenches, cut to solid bed-rock for that distance. The trenches are 50 feet apart and are located along the strike of the vein or ore-zone, which is in a north-west direction, with the dip at an angle of 37 degrees to the south-west. The writer was informed that the average samples taken across a width of 15 feet from all the trenches assayed 1.29 per cent. in copper.

These trenches are made across the strike of the ore-zone and extend for 1,500 feet on each side from the main adit on the *Old Sport No. 2* claim, and expose the ore-body on parts of the *Old Sport No. 3*, *Edith Fraction*, *Old Sport No. 2*, and *Old Sport No. 1* mineral claims.

Average samples across 8 feet taken from the trenches from information furnished the writer showed that for that width the values in copper average about 2.5 per cent.

The main adit on the *Old Sport No. 2* claim is driven as a crosscut towards the south-west for a distance of 400 feet through igneous rock resembling gabbro with a slight porphyritic structure. It intersected the ore-body at about 400 feet from the portal and was continued 40 feet farther through the ore into the hanging-wall. At this point both walls which enclose the ore are igneous rock and are well defined.

The mineralization is chiefly magnetite with chalcopyrite disseminated through it. The gangue material is made up of epidote, garnetite, and some crushed country-rock.

Drifts are driven in the ore at right angles to the adit in both directions. The drift to the north-west is 250 feet long, and that to the south-east is also 250 feet long. The faces of both drifts are in ore. Near the north-west face there is a fault crossing the drift at right angles and dipping about 75 degrees to the north. This fault apparently has thrown the ore-body upwards, because, after driving through it, the ore is found in the roof of the drift, with the foot-wall about 3 feet higher than it is on the south-east side of the fault.

The adit crosscuts the ore-body at a vertical depth of 85 feet below the outcrop, and on the dip at a depth of 125 feet at the south-east face of the drift, and 150 feet at the north-west face.

The development-work that was being started at the time of the writer's visit was sinking an inclined winze in the ore from the adit, which it was proposed to sink to a depth of 500 feet.

The portal of the adit is connected with the compressor plant, located on the shore of Elk lake, by an air-pipe line one mile and a half in length. Steam-power has been used, but water-power is being developed from Canyon creek, a mountain torrent about three miles long, which flows into Elk lake from the south and has a very considerable fall. It is estimated by

Wm. Clancy, the superintendent in charge of the development-work, that the creek will furnish a maximum of 400 horse-power at low water, but the present development is estimated to produce 75 horse-power, or sufficient to run the compressor plant and a dynamo for an electric-light plant. The length of the flume is 7,000 feet, with a 350-foot head of water.

In addition to the development-work on the mine already described, there are two other adits and five diamond-drill holes. The diamond-drill holes have prospected the ore-zone on the *Old Sport No. 2*, *Old Sport No. 3*, and *Edith Fraction* claims to a vertical depth of 205 feet below the outcrop, and determined the continuity to that depth in each of the borings.

The second and third (or Nos. 2 and 3) adits are on the *Edith Fraction* mineral claim, about 1,000 feet south-east from the main adit on the *Old Sport No. 2* claim. These adits are driven as crosscuts to expose an occurrence of ore which appears to lie parallel to the extension of the ore-deposit crosscut in the main adit, and are driven at two levels with about 20 feet between them. The upper adit is 30 feet long and crosscuts mineral 22 feet wide, measured horizontally, with mineral still showing in the face. The lower adit is 70 feet long and crosscuts mineral 19 feet wide, measured horizontally, with mineral in the face.

Drifts have been driven in ore to the southward and northward from the lower adit, the former drift being 30 feet long and the latter 20 feet. The mineralization exposed in these openings is chiefly magnetite impregnated with disseminations of chalcopyrite, which apparently would require treatment by concentration in order to produce a commercial product.

In some parts of the ore-body exposed in the main adit the copper values run as high as 14 per cent. for a width of 4 or 5 feet, but, so far as known at present, these enriched shoots are irregular and of such limited extent that the value of the property is based on the much larger tonnage of ore of low grade.

Merry Widow Group.

This group contains six mineral claims, located about two miles by trail south-easterly from Elk lake, at an elevation of about 2,600 feet above sea-level. The property is reached by following a steep trail, in a very bad condition, from the *Old Sport* camp. The writer was considerably handicapped in making his examination of the *Merry Widow* group, for the reason that he had no guide to show him the property and had to search for the location of the workings alone, and may have overlooked some of the showings.

The trail traverses a wide belt of limestone with occasional intrusions of igneous rock for some considerable distance before the workings on the *Merry Widow* property are reached. On that property, so far as the writer could observe, all of the occurrences of mineral occur as replacement deposits in the limestone rather than as contact deposits, as no igneous rock was observed in the vicinity of any mineralized outcropping.

Magnetite and gossan outcrops occur along ridges and in a basin at the summit of a pass through a high mountain range, which is a continuation of the range situated southerly from the *Old Sport* group, and which forms the main divide between the east and west coasts of Vancouver island.

These outcroppings have been prospected and partly developed by a series of open-cuts, one short adit, and a shaft. The shaft was full of water and covered with heavy logs and brush, so could not be examined. The open-cuts cover a considerable area and represent a total length of several hundred feet of trenching. Occurrences of magnetite are exposed in all of the cuts. Some chalcopyrite occurs irregularly disseminated through the magnetite.

In all of the cuts bodies of magnetite are exposed with some grains of chalcopyrite disseminated irregularly in the magnetite. The work done is insufficient on which to base an opinion regarding the possibilities of the property.

June Group.

This group of mineral claims contains the *Amazon*, *Helen*, *June*, *Olga*, and *Iron Knob* claims, owned by the Copper Mountain Mining and Development Company, of Tacoma, U.S.A. The group is situated about six miles easterly from *June* Landing on the east side of the South-east arm of Quatsino sound. The claims are staked from east to west, one claim wide, with the *Amazon* the farthest to the east, and the other claims in the order in which they are named above. With the exception of a fractional mineral claim between the *Olga* and *Iron Knob*, called the *Minerva Fraction*, owned by D. A. McDonell, the *June* group occupies a solid block of ground, approximately 1,500 feet wide by about 7,500 feet long.

The *June* group was located about 1899 as a copper proposition, because of quite extensive outcroppings of magnetite and gossan which occur on the claims. The most important of these occurrences are on the *June* and *Helen* claims in the ridge which forms the divide between Victoria lake on the east and the South-east arm of Quatsino sound on the west.

Several of the outcroppings occur as prominent cliffs, and on one of these, which faces to the west, a large open-cut about 40 feet square and 25 feet high at the face exposes a body of magnetite in which are impregnations of chalcopyrite irregularly disseminated through the magnetite, but it is doubtful if in sufficient quantity to give the ore commercial value for its copper content, unless it is treated by concentration. There are about 500 tons of such ore on the dump on the floor of the open-cut, but no sample was taken by the writer because it was not practicable to make a systematic sampling in the time at his disposal.

An adit was driven several years ago at a level about 100 feet lower elevation than the summit of the magnetite cliff just referred to, in the expectation of intersecting that body of ore on the adit level. This hope was not realized, although the adit is 450 feet long and the face presumed to be under the face of the open-cut already mentioned.

After this work was done the property lay idle for some years, or until the summer of 1916, when N. S. Clarke and associates, of Seattle, started work under a lease and bond from the owners.

During 1916 a system of thoroughly prospecting other parts of the *June* group was inaugurated, and this work was well done under the superintendence of D. A. McDonell, who selected the eastern slope of the ridge, under which the adit already mentioned had been driven by a former management, as offering the most favourable location for the new work.

Several extensive outcroppings of gossan and magnetite, with which more or less chalcopyrite is associated, were found, and trenching was done to determine their superficial extent and locate their boundaries.

On the eastern side of the summit of the ridge, and near the No. 2 post of the *June* claim, a trench was made about 100 feet in length from north to south, across an outcropping made up of gossan which is stained from copper carbonates and which carries low values in copper from the presence of some chalcopyrite.

On the eastern slope of the ridge trenches were made for a distance of about 300 feet parallel to that on the summit, in which similar gossan carrying low copper values occurs, mixed with much epidote and garnetite.

On the northerly side of the mass of gossan white metamorphosed limestone occurs, and on the southerly side there is an igneous rock with a slight porphyritic structure.

A grab sample was taken from the trench near the No. 2 post of the *June* claim which assayed: Gold, trace; silver, trace; copper, trace; iron, 59.4 per cent.; sulphur, 14 per cent.; phosphorus, *nil;* silica, 5.1 per cent. From the crosscut trench on the slope of the ridge open-cuts have been made diagonally across the strike of the gossan-outcropping down the slope to near the base of the ridge, which is quite steep, towards the east.

This work exposes similar mineralization, for a distance of about 200 feet, to that in the other trenches.

The east end of the open-cuts is on the *Helen* mineral claim, where the ground is much flatter, and the thickness of overburden becomes too heavy to remove in order to continue open trenching.

The most of the mineral exposed by the trenching is iron ore capped in several places by a lime-silicate rock with considerable epidote and garnetite. The iron ore which is found under the capping carries some chalcopyrite, but, so far as the work showed at the time of the writer's visit, apparently not in sufficient quantity to give the mass of mineral commercial value for its copper contents unless it is concentrated, although some parts of the body do carry commercial values.

The mineralized outcroppings exposed by the trenching described cover an area approximating 300 feet by about 200 feet, but no depth below about 15 feet has been prospected.

Pilgrim. This mineral claim adjoins the *Amazon* claim, one of the *June* group, on its north-east corner, near the Amazon river, and is owned by Henry Sherberg, of Quatsino. An occurrence of zinc-blende ore associated with iron pyrites occurs in a wide belt of limestone near the centre of this claim, about 700 feet in an air-line from the Amazon river. The deposit strikes nearly due east, and apparently dips vertically, but the open-cuts in which the ore-body is exposed are not sufficiently deep to determine whether

this dip will remain persistent to a much greater depth. As the ore occurs between limestone walls, it is very probable that the dip will vary as development progresses.

The deposit of ore is developed by a deep open-cut about 37 feet long, which is made diagonally across the presumed strike of the ore, and is about 10 feet wide, with three prospect-holes, each about 7 feet square, sunk in ore to a shallow depth in the floor of the open-cut.

There are about 200 tons of ore on the dump alongside of the cut, a grab sample of which assayed: Gold, 0.02 oz.; silver, 2 oz.; copper, *nil;* zinc, 37 per cent.; iron, 26.8 per cent.

Minerva Fraction.

This mineral claim is located to the west of and adjoining the *Olga*, one of the claims in the *June* group, and between the *Olga* and the *Iron Knob* claims. It is owned by D. A. McDonell, of D'Arcy, B.C., and is reached by a trail that branches off from the main *June* Landing-Alice Lake trail nearly opposite to the *June* camp.

At an elevation of about 500 feet higher than and distant about 1,500 feet west from the trail there occurs an outcropping of magnetite, iron pyrites, zinc-blende, and pyrrhotite at the contact between metamorphosed limestone and an igneous rock with a slight porphyritic structure. The strike of the mineralized outcrop is nearly due east, and dip 45 degrees to the north. The width of the deposit varies from 2 to 4 feet of solid mineral, in a gangue made up of crushed country-rock and some garnetite.

The occurrence is exposed for a length of about 60 feet by an open-cut made on the summit of a ridge and a depth of about 10 feet. Apparently an extension of the deposit is shown in another open-cut at a deeper level.

A grab sample taken from the dump at the open-cut on the ridge assayed: Gold, trace; silver, trace; copper, *nil;* zinc, 46.6 per cent.; iron, 26.8 per cent.

HANSON ISLAND.

Princess Group.

This group contains three mineral claims situated on Hanson island, in Broughton strait, off the east coast of Vancouver island and about ten miles east from Alert Bay, the port of call for all north-bound vessels from Vancouver and the general distributing centre for that portion of the Nanaimo Mining Division.

In Memoir No. 23, Canada Department of Mines, which contains the report made by J. Austen Bancroft on the Geology of the Coast and Islands, he classifies the rock formation on the south-east shore of Hanson island as belonging to the volcanic greenstones of the Valdes formation, which have been very much altered. He also refers to the fact that epidote and quartz are abundant in the altered volcanics, and that calcite, chlorite, and zeolites also occur.

The *Princess* group of mineral claims was located about 1900 by Raper, Law, and Hamilton, three prospectors from Texada island, who discovered outcroppings of copper ore on the beach, which occurred in a shear-zone in the greenstone country-rock.

A shaft was sunk in the outcroppings close to high-tide mark and the ore mined from it was shipped to the Vananda smelter on Texada island.

An adit is driven into the bluff that rises above the shore in a northerly direction from the shaft. The adit is nearly 500 feet in length, and is driven along a fracture-plane in a shear-zone which was evidently presumed to form one wall of a fissure in which ore would probably occur.

An examination of the adit showed that there was no ore of commercial importance until about 100 feet from the portal near the 80-foot station of a new shaft sunk on the summit of the bluff in which the adit is driven. The adit crosscuts a body of chalcopyrite in a quartz gangue about 4 feet wide at the point referred to. The ore appears to strike towards the east, and may prove to be an extension of an ore-body that outcrops on the surface on the west side of the fracture-plane along which the adit is driven.

The surface outcroppings are iron pyrites and chalcopyrite, which, inclusive of the quartz gangue in which the ore occurs, are 7 feet wide and are exposed for about 60 feet in length, striking in an easterly direction. On the north side of the outcrop there is an enriched shoot of practically solid chalcopyrite 1 foot wide which assays about 8 per cent. in copper, with low gold and silver values, but the remainder of the ledge-matter has so much quartz gangue mixed with the ore that it only assays about 3 per cent. in copper.

The shaft sunk on the summit of the ridge is said to be 160 feet deep. It is sunk about 75 feet east from that end of open-cut made on the outcrop described. At a depth of 80 feet this

shaft, which is a double compartment and well timbered, connects with the adit, and is continued below that level to a depth of 80 feet, but was full of water when the writer made his examination, so that he was unable to examine the conditions below the adit level.

QUADRA ISLAND.

As Quadra island is the only one of the Valdes group of islands on which metalliferous ores have so far been discovered, it is the only one described in the following report.

Quadra island is separated from the east coast of Vancouver island by Discovery passage, of which Seymour narrows is the narrowest portion, and which connects Johnstone strait on the north with the strait of Georgia on the south. Seymour narrows is only about half a mile wide at the narrowest place, and the bridging of it has been strongly advocated for years by the residents of Victoria.

Quadra island is very accessible, as all of the vessels north and south bound along the east coast of Vancouver island pass through the narrows. Most of them call at either of the ports of call on the west side. These are Granite Bay, the terminus of a logging-railroad five miles long that affords access to the interior of the island, Gowland Harbour, and Quathiaski Cove. The port of call on the east side of the island is Heriot Bay, about seven miles from Cape Mudge, at the south end, to which there is a semi-weekly steamer service from Vancouver.

A portion of Quadra island was examined by Herbert Carmichael in 1910, and his report is published in the Minister of Mines' Report for that year.

In 1911 a portion of the island was examined by J. Austen Bancroft, of the Canadian Geological Survey, whose report is published as Memoir No. 23, Geology of the Coast and Islands between the Strait of Georgia and Queen Charlotte Sound, B.C., Canadian Department of Mines, 1913.

During 1913 Donald G. Forbes, M.E., made an examination of the mineral claims in the vicinity of Granite bay, and describes several in the Minister of Mines' Report for that year, and about the same time a geological survey of the same district was made by D. D. Cairnes, of the Geological Survey of Canada, whose report is published in the Summary Report, Department of Mines, Geological Branch, for that year.

During 1914 portions of Quadra island were examined by J. W. Astley, M.E., whose report was published in the Minister of Mines' Report for that year.

There are two well-defined mineral-bearing zones on Quadra island; the more northerly is known as the lime-belt, because of the occurrence of a wide belt of limestone which extends across the island from Granite bay, in the north-western portion, towards the south-east to Open bay, in the south-eastern portion; the southerly mineral-bearing zone occurs in the vicinity of Gowland harbour, in the *Valdes* formation, made up of volcanic rocks, and is called the Gowland Harbour belt.

THE LIME-BELT.

The north-easterly boundary of the lime-belt contacts with intrusive granites belonging to the Coast Range batholith, and the ore-deposits developed in this zone are mostly representatives of the contact-metamorphic type, although occasional fissure-veins occur. The occurrences of ore-deposits in the southerly zone appear to be flows or blanket deposits lying at almost flat angles on the greenstone country-rock.

In the northerly zone, or lime-belt, prospecting has up to the present time been confined to the limestone and Coast granite contact along the north-easterly side of the limestone, and no attention appears to have been paid to the contact on the south-westerly side, where the limestone contacts with the volcanic rocks of the Valdes formation.

The mineralization of the contact-metamorphic type of ore-deposits is a mixture of pyrrhotite, magnetite, chalcopyrite, iron pyrite, arsenopyrite, and occasional flakes of molybdenite occurring in a gangue made up of quartz, calcite, epidote, garnetite, and hornblende. In the fissure-veins iron pyrites, with occasional particles of sylvanite, and native gold make up the mineralization, and occur in a quartz gangue associated with some calcite.

There are about a dozen groups of mineral claims located in the lime-belt, but the writer was only able to examine a few of these, because during his visit, the latter part of August, 1916, the majority of the owners were away from the island. None of the properties were in active operation, although the *Lucky Jim*, the most important, had been worked earlier in the season.

Alice Lake Landing, Quatsino Mining Division.

Old Sport Mine Camp, Quatsino Mining Division.

Trilby Group. This group of mineral claims contains the *Trilby* and *Eastern* claims, owned by Mrs. Polly Fox, of Granite Bay. The group is situated about two miles and a half south-easterly from the beach at Granite bay, and about half a mile from the logging-railroad. An occurrence of pyrrhotite outcrops in a metamorphosed zone of greyish to dark-greenish volcanic rock of andesitic appearance near its contact with the granitic intrusives, and about 50 feet from the limestones. Associated with the pyrrhotite is some chalcopyrite. The gangue material is made up of quartz, garnetite, epidote, hornblende, and some masses and particles of the andesitic country-rock.

The strike of the ore-body is nearly west, and dip towards the south at angles varying from 30 degrees to almost vertical. A narrow andesite dyke occurs in the ore-body, and is exposed in the workings following roughly the strike of the ore. This dyke is well defined, very persistent, and has ore on both sides of it, with a narrow gouge between it and the ore.

The workings consist of a series of open-cuts along the strike of the ore-body, in which it is exposed for a distance of about 300 feet; also an incline shaft sunk in ore for about 20 feet at an angle of about 30 degrees. The maximum thickness of the ore exposed in the shaft is about 8 feet. The ore-body has the appearance of a blanket covering the volcanic rock, but dipping quite steeply at the bottom of the incline shaft. A grab sample from the dump at the mouth of the shaft assayed: Gold, 0.1 oz.; silver, 2.6 oz.; copper, 6.2 per cent.

Lucky Jim. The *Great Granite* mining property is better known as the *Lucky Jim* group. Practically all of the development-work has been done on the *Lucky Jim* claim, located close to the logging-railroad, about three miles from Granite bay. As there was no one at the property when the writer visited Granite bay, and the workings were full of water, no examination could be made underground.

Herbert Carmichael describes the *Lucky Jim* workings in detail in his report in the Minister of Mines' Report for 1910, and the writer is informed that, except for extending the underground workings and making some more shipments of gold-copper ore, there is not much change since his (Carmichael's) report was made.

The property is owned by the Great Granite Development Syndicate, of Vancouver, and is equipped with a hoist, pump, and compressor plant driven by steam-power.

The following extracts are made from Carmichael's report:—

"On the *Lucky Jim* the shaft has been continued to a depth of 110 feet, and follows the vein at an angle of 80 degrees. At the time the property was visited a change was being made from hand-drilling to machine-work, and an 8-drill Rand compressor and hoist were being installed. While this was being done the shaft had been allowed to become half filled with water and it could not be examined.

"The management stated that there was good ore for the entire depth of the shaft, and that 184 tons, taken from about 75 feet down, gave $22 in gold, 8 per cent. copper, and 3½ oz. of silver per ton, and at the bottom of the shaft the ore was even of a higher grade; an examination of the ore on the dump would seem to confirm the above statement.

"The ore-zone runs in a south-easterly direction; about 300 feet south-east of the shaft a prospect-tunnel has been run in 150 feet and has cut across the ore-body diagonally; while this has not developed up any large ore-body, yet the ore is amply proved to extend in this direction and to be of the same nature and quality as that obtained from the shaft. The tunnel is 55 feet lower than the collar of the shaft.

"To the north the country-rock is a great granite batholith, while to the south a crystalline limestone extends for miles. The ore in these claims seems to have been formed alongside diabase dykes of considerable size, but the ore-bearing solutions appear to have come up at a later date, during a second period of movement along old fracture-planes. The gangue-matter is a crystalline limestone in which the ore occurs as bands and masses. There is very little evidence of calcite or quartz, the main ore-body being in solid crystalline limestone, the latter enclosing large fragments of the original diabase dyke.

"In an open-cut in the *Lucky Jim* a cross-dyke of still later date is seen, cutting the ore-body and also the larger diabase dyke. This smaller dyke is more porphyritic in character and the appearance of tellurides in quartz may be associated with the latter dyke.

"Two parallel zones of mineralization occur 300 feet to the north and 300 feet to the south of the *Lucky Jim* shaft. It is intended to crosscut these zones when the shaft has been sunk to a depth of 200 feet.

"The main ore-zone has been prospected for a distance of 1,500 feet by open-cuts and gives indications of ore at all points; the general outlook for the property is encouraging."

From a general examination of the surface outcroppings at and near the contact of the limestone and granitic rocks in the vicinity of the logging-railroad, which is built roughly paralleling the line of contact, it would appear as though further prospecting and development work are advisable. Up to the present time the so-called lime-belt has only been scratched over along the north-easterly side of the limestone, while the contact on the south-westerly side has so far been neglected.

GOWLAND HARBOUR BELT.

J. Austen Bancroft, of the Canadian Geological Survey, made a close study of the southern portion of Quadra island, and was able to devote ample time to his examination. For those reasons and because the island is to-day receiving more attention from mining men than has been the case for some years back, the writer quotes the following extracts from his report:—

"The deposits of copper ore which are associated with the volcanic rocks of the Valdes formation occur chiefly in the form of chalcocite, chalcopyrite, bornite, and native copper. Within this region chalcocite was only noticed to be present in this Valdes formation. In addition to these minerals, which have been mentioned in the apparent order of their abundance, malachite, azurite, and the black and red oxides of copper are occasionally present in small quantities near the surface of the deposits. These ores occur along joint planes and shear-zones, often irregularly impregnating the rock on either side; in veins and veinlets associated with calcite, quartz, and epidote; or as grains disseminated throughout the more amygdaloidal and highly epidotized and chloritized portions of the basalt. Occasionally, while walking over the surface of such an altered amygdaloidal bed, irregular patches may be met with which are characterized by the presence of small quantities of native copper or chalcocite, or both, which seem to bear no connection to existing fissures. Calcite, quartz, epidote, and prehnite are often associated with these copper minerals in filling the amygdules.

"Two theories may be advanced to explain the origin of these ores: First, that the copper-bearing solutions emanating from the batholiths of the Coast range, while they were cooling down, ascended along certain shear-zones and joint planes in the Valdes formation, impregnating the adjacent rock with the sulphides of copper, especially along those horizons where the beds are highly amygdaloidal. Second, that these deposits were formed by the concentration in favourable localities of copper-bearing portions of the volcanic rocks, the copper in which originally existed as minute particles of some copper sulphide, probably chalcopyrite. Sufficient development-work has not been done to indisputably determine as to which theory is correct, but because of the manner of occurrence and the character of the mineralization in at least the majority of cases, the writer is inclined strongly in favour of the second theory. It is a well-recognized fact that such volcanic rocks frequently contain small amounts of copper. In those localities where downward percolating waters have enjoyed an easy passage, as along shear-zones or where joint planes are close together, or in the more amygdaloidal horizons, these waters have not only largely altered the original minerals of the igneous rock to such secondary minerals as epidote, calcite, quartz, and zeolites, but have concentrated the original small copper content.

"It is, however, not beyond expectation that within the neighbourhood of contacts between the volcanics and the intrusive batholiths, or along pronounced shear-zones in the former rocks, mineralization took place as outlined by the first theory.

Copper Mountain Group.

This group contains several mineral claims located from near the head of Gowland harbour towards the north-west, and owned by the Valdes Copper Company, Limited, of Victoria. During 1916 the property was under bond to H. W. Treat, of Seattle, and at the time the writer visited it in August, 1916, a diamond-drill was being used on the *Ingersoll*, one of the group of claims, for prospecting. The results of this work were not made public, nor was the bond exercised. Early in 1917 a contract was entered into between the owners of the group and Jones & Rant, of Victoria, under which the latter constructed a wagon-road from Gowland harbour to the workings on the *Ingersoll* claim, and began shipping copper ore to the Ladysmith smelter.

Ingersoll.—This mineral claim is about one mile from the beach and appears to have been more thoroughly prospected than any of the other claims in the group, and the workings are the

most extensive. These consist of deep open-cuts and surface stripping, at an elevation of about 540 feet above sea-level, over an area of about 375 feet long by about 60 feet wide.

Occurrences of copper ore, chiefly chalcocite, are found impregnating a fractured zone in a dark-green amygdaloidal igneous rock, in which the ore occurs as grains, and sometimes as fair-sized lumps, from the surface down to varying depths. The deepest mineralization is shown about 15 feet deep at the face of an open-cut about 80 feet long that practically crosscuts the general formation. A considerable quantity of ore that appeared to be of rather high grade is piled on a long dump beside the open-cut from which it was mined. Apparently the ore-body occurs as a blanket overlying the igneous rock, and no attempt has been made to determine by working openings the conditions at any deeper level than the 15-foot face of the open-cut, but at the time of the writer's visit a diamond-drill hole was being bored a short distance from the long open-cut. As the records from boring were not made public, no results can be included in this report.

Copperopolis.—This claim is another of the *Copper Mountain* group. It is located at a slightly higher elevation than the *Ingersoll*, and adjoining it on the north-west.

Similar dark-green amygdaloidal igneous rock to that noted on the *Ingersoll* claim occurs as the country-rock on the *Copperopolis*, and appears to be the prevailing rock throughout that part of Quadra island on which the *Copper Mountain* group is located.

A very similar occurrence of copper mineralization to that on the *Ingersoll* claim also occurs on the *Copperopolis*, where it is found outcroppings for about 300 feet from a south-easterly to a north-westerly direction, and averaging about 20 feet wide. At the north-westerly end of the outcroppings an open-cut has been made about 75 feet long, with the apparent strike of the ore-bearing zone, and about 8 to 10 feet wide, in which grains and lumps of chalcocite and chalcopyrite occur as impregnations in the country-rock for a depth averaging about 4 feet. A sample taken from the dump along the edge of the cut, that represented about such an average as could be taken by grabbing without selecting, assayed: Gold, trace; silver, 0.7 oz.; copper, 6 per cent.

Other open-cut workings are situated on the *Copper Mountain* and *Copper Flat* mineral claims, also belonging to the *Copper Mountain* group, and adjoining each other, with the last named adjoining the *Copperopolis* on the north-west. On these there are similar occurrences of copper ore in similar country-rock.

It is to be regretted that no effort appears to have been made to prospect except by stripping and open-cut work, in order to determine whether the occurrences of copper ore are of blanket structure as they appear where work has been done, or whether at some point not yet located a more decided fissuring in the country-rock can be found with the ore continuing to deeper levels. At present the genesis of the ore is undetermined, but the writer is reliably informed that Jones & Rant propose doing some very thorough prospecting, as well as shipping all of the ore they can find of sufficiently high grade to be profitable.

Copper Cliff. This mineral claim occupies a steep bluff at the water's edge on the west side of Quadra island, a short distance below the south end of Seymour narrows, and close to a small bay where launches can lie with safety from the fast-running tides and tide-rips. The claim was located some ten or twelve years ago by two prospectors, and soon afterwards was bonded to Seattle parties, who made some shipments of good-grade copper ore to the Tyee Company's smelter at Ladysmith, but closed down work about 1908, since which time the property has remained idle, except for the annual assessment-work that has been done by the present owner, P. W. Hall, of Gowland Harbour.

Outcroppings of copper minerals occur in a dark-green igneous rock, slightly amygdaloidal in structure, along the face of a steep cliff directly overlooking the sea. The copper-stained rock forms quite a landmark and can be seen from a considerable distance from the shore.

The mineralized outcrop appears to have a blanket structure. It dips about 20 degrees to the south-west and strikes towards the north-west. The thickness of the ledge material as shown in an open-cut and adit varies from about 6 to 12 feet. The mineralization is chiefly chalcocite, with which is associated some malachite and azurite. The gangue is crushed amygdaloidal country-rock.

The workings consist of an open-cut about 75 feet long and 16 feet deep at the deepest part, and an adit 90 feet long driven at right angles to the open-cut, with a winze 15 feet deep sunk on the dip of the ore-body. At the face of the incline winze, ore is exposed dipping at a much

steeper angle, and the same fact is noticeable at the face of the adit, about 30 feet beyond the winze.

An average sample taken across 5 feet at the face of the adit assayed: Gold, trace; silver, 0.3 oz.; copper, 3.2 per cent.

J. W. Astley reports samples taken in 1914 as follows: "An average sample was taken by the writer (Astley) from the face of the 92-foot tunnel. The sample was moiled from top to bottom and represents 5 feet taken through the ore-bed. The assay result was as follows: Gold, trace; silver, trace; copper, 2.8 per cent. A typical sample of the ore assayed: Gold, trace; silver, 0.3 oz.; copper, 3.3 per cent."

Copper Bell.

This mineral claim is at the north-east corner of Gowland harbour, and is owned by P. W. Hall, who resides on a ranch in the near vicinity. The boundaries of the claim reach from the beach over the summit of a bald, steep, rocky cliff made up of a dark-green amygdaloidal volcanic rock similar to the general formation through the Gowland Harbour belt.

The occurrence of impregnations of native copper in the country-rock is noticeable on the beach at the base of a steep bluff on the sides and in the face of an open-cut, but whether such mineralization is sufficiently general and extensive through the country-rock to make it commercially valuable is a question that work alone will determine. So far as the outcroppings are concerned, it appears as though the distribution of the grains of native copper is so irregular that very close sorting would be necessary to obtain a commercial product.

On the flat summit of the ridge or bench at the top of the bluff, about 300 feet elevation, the country-rock is sheared and fractured, and there is considerable epidote associated with it, especially in the vicinity of the fracture-planes. The bench is about 700 feet long from south-east to north-west by about 300 feet across. At places on the surface in this area the igneous amygdaloidal rock is impregnated with grains of chalcocite, oxides of copper, and an occasional speck of native copper. The mineralization is so general as to lead to the suggestion that the surface of the entire summit is covered with low-grade copper ore, with enriched shoots in some of the fractures. There are several shallow open-cuts on the summit of the ridge in which copper minerals are exposed. A grab sample taken from one of these assayed: Gold, trace; silver, trace; copper, 3 per cent. This claim was under bond to H. W. Treat, of Seattle, during the summer of 1916, who proposed boring with diamond-drill to determine the conditions as to mineralization below the surface.

Santa Anna Group.

This group contains the *Santa Anna*, *Eureka*, *Green Meadow*, *San Lucas*, *Lucky Jack*, and *Happy Chance* mineral claims, which are situated near Bold point, on the east coast of Quadra island, about four miles northerly from Heriot Bay. This is the regular port of call for steamers from Vancouver which sail through the channels on the east side of Quadra island. The group is owned by the Santa Anna Mining Company, of Vancouver, and during 1917 was operated under lease by John McConville and Matthew and Isaac Little.

On the *Eureka* mineral claim there is an occurrence of pyrrhotite, with some chalcopyrite, averaging about 3 feet wide, in a gangue of brecciated country-rock, felsite, and garnetite. The outcroppings can be traced for approximately 200 feet along the strike in a south-easterly direction. The dip of the ore-body where it is exposed is towards the north-east at varying angles, usually about 60 degrees.

Apparently the outcroppings represent several lenses of ore that occur in the contact between limestone and granite with gneissic structure. The granite is badly fractured and faulted. One of the most prominent faults occurs cutting across an adit that was started as a drift along the above-mentioned ore-body. The fault appears to have cut off the ore about 20 feet from the portal of the adit, which is continued for about 70 feet farther in granite.

Outcroppings of copper minerals extend up the face of a mountain for about 200 feet at an angle of nearly 45 degrees, and the adit mentioned was driven in the expectation of exposing ore at that level.

There is about 20 tons of sorted ore on the dump and in a bin at the portal of the adit, a sample from which assayed: Gold, trace; silver, 3.8 oz.; copper, 7 per cent.

Several other outcroppings, chiefly of pyrrhotite, occur in the same contact for a distance of about 400 feet north-westerly from the adit, but, except at one point, no work has been done to determine the extent or grade of the ore. At that point an adit is driven about 120 feet in

length, at a depth of 80 feet below an outcropping of pyrrhotite in a quartz gangue that is 10 feet wide where exposed in an open-cut. No ore is exposed in the adit. The lessees have erected a wooden chute on an incline of 40 degrees, 220 feet in length, with ore-bins at the upper and lower ends, and have also improved the wagon-road that connects the mine-workings with the wharf near Bold point. There is a considerable quantity of material mineralized with copper on the property, which would require concentrating to make it a commercial product.

STEEP ISLAND.

Bluebird. This mineral claim occupies practically the entire surface area of the greater part of Steep island, in Gowland harbour. It is owned by the Valdes Copper Company, Limited, and since it was examined by J. W. Astley in 1914 the company has built bunkers on the beach and made some shipments of copper ore to the Tacoma smelter. The grade of the ore is not sufficiently high to be considered of commercial value unless treated by concentration, and at present no work is being done.

The occurrence of copper ore on the island is very similar in all its characteristics to the occurrences already described on the *Copper Mountain* group, but the grade is generally lower. No attempt has been made to determine conditions below a shallow depth.

CAMPBELL RIVER DISTRICT.

Menzies Bay Group. This group of mineral claims is situated about one mile northerly from the mouth of Deer creek, which flows into the northern end of Menzies bay, near the south end of Seymour narrows. There has been no work done on the property for some years, but previous to closing down it was equipped with an upright boiler, small hoist, and compressor plant. These were enclosed in a log cabin which is a wreck to-day. A shaft, well timbered, of unknown depth, and full of water, is the most important development-work.

This shaft is sunk on a narrow vein outcropping 10 inches wide in a shear-zone in an igneous rock resembling basalt, but this country-rock is so considerably altered as to render it difficult to classify, except by a microscopical examination. The vein-filler as exposed in the face of an open-cut back of the shaft is made up of quartz, calcite, and varying quantities of chalcocite, disseminated through the gangue material usually as grains, but sometimes as solid stringers 2 or 3 inches thick. An average sample across 10 inches of vein-filler assayed: Gold, trace; silver, 0.6 oz.; copper, 9 per cent.

There are several open-cuts in a northerly direction from the shaft mentioned, in which fissuring of the igneous rock is exposed, and mineralization from iron, but no copper ore.

MAINLAND COAST—FANNY BAY.

Galena Group. This group contains the *Wild Rose*, *Bluebell*, *Lilly*, and *Sunflower* mineral claims, staked adjoining each other from north to south, in the order named, parallel to the shore-line in that part of the bay, and situated about midway between the entrance and head of the bay. Fanny bay is near the southern end of a promontory on the mainland between Bute inlet to the west and Ramsay arm to the east.

About 450 feet elevation above sea-level and 1,000 feet from the shore, on the *Bluebell* mineral claim, there is an occurrence of mineral containing some galena and zinc-blende, in a gangue of quartz and feldspar, filling a fissure about 6 feet wide in granite country-rock.

The strike of the vein is south-west and dip of the walls vertical. The wall on the north-west side of the vein is very well defined, with several inches of gouge between it and the mineral, but the opposite wall is not as well defined, and there is some question whether the fracture-plane that is considered a wall is not merely a local fracture in the mineralized body.

An open-cut 40 feet long by 5 feet wide by 15 feet deep at face is made in mineral the entire distance, with the face in mineral when the writer saw it. On the surface the fissuring, showing mineralization, can be traced for some distance in a south-westerly direction, but no work had been done on the outcropping at the time the property was examined.

Four average samples were taken, as follows: Across 1 foot 9 inches at the face of the open-cut assayed: Traces in gold, silver, copper, and antimony. Across 2 feet at the face of the open-cut, next to the sample above mentioned, assayed: Traces in the same metals. Across

2 feet at the face of the open-cut, next to the second sample above mentioned, assayed: Gold, trace; silver, 0.6 oz.; lead, 12 per cent. Selected sample from the open-cut assayed: Gold, trace; silver, 1.2 oz.; lead, 16 per cent.; zinc, 19.5 per cent.; antimony, trace.

TEXADA ISLAND.

Lode-mining has been actively carried on on Texada island since 1898, when the *Marble Bay*, *Copper Queen*, and *Cornell* mines were in course of development prior to the erection of a small matting plant by the Vananda Copper and Gold Company, to which plant all of these mines as well as other prospects shipped ore for treatment until 1901, when it was closed down, and has never been reopened.

The most complete report on Texada island is that published by the Canada Department of Mines, Geological Survey Branch, in 1914, as Memoir No. 58, by R. G. McConnell, which is based on field-work done by him in the seasons of 1908, 1909, and part of 1912. In 1914 J. W. Astley examined several of the mineral claims on the island, and his report is published in the Minister of Mines' Report for that year.

During the season of 1916 the writer visited this island and examined all of the mining properties that were being worked.

The northern and north-western parts of Texada island, in which copper-gold ores occur, are made up of round-topped hills comparatively low in elevation, none exceeding 1,000 feet, but often bordered by rugged cliffs and separated by low-lying rough areas. Surprise mountain is the most conspicuous elevation in the northern part of the island. This is a long ridge that rises from the west shore with quite steep slopes to an elevation of nearly 1,000 feet.

The area in which metalliferous ores have been found up to the present time is about seven miles from north-west to south-east by a maximum width of four miles. This occupies the portion of the island lying north-westerly of Gillies bay on the west coast, and North-east point on the east coast, and extending to Blubber bay at the north-west end. Within this area there are several lakes and short streams, some of which may be improved to develop a limited quantity of power, but at present the water-supply on the northern part of the island is only utilized for domestic and ore-washing purposes. The most important of the lakes are Paxton, Priest, and Spectacle, all of which drain into the sea on the east coast, the two first named into Vananda bay and the last named into Raven bay.

The general geology of the northern part of the island is described by McConnell on pages 12 and 13 of the memoir already referred to, as follows:—

"The geology of Texada island, while not free from debatable problems, is simple, viewed broadly. The formations represented are few, are mostly of igneous origin, and if the glacial deposits are excepted, are confined to the central portion of the geologic column. The ages assigned the different formations are tentative only, as definite fossil evidence, except in the case of the Cretaceous, is wanting.

"The greater portion of the island is underlaid by basic, massive, volcanic rocks, mostly porphyrites, all belonging to one period of eruption or intrusion, and probably of Lower Jurassic age. Rocks older than the porphyrites are represented by a series of tilted tuffs, agglomerates, schists, amygdaloids, etc., at the southern end of the island, and by a number of small and large limestone areas, all evidently portions of one formation partially destroyed by the porphyrite invasion in the northern part. The tuff formation and the limestone are both considered to be Lower Mesozoic in age. They were nowhere found in contact, and the greater age assigned the former is based on its most disturbed and altered condition.

"The porphyrites were followed by an instrusion of quartz diorites. They occur in small stocks, irregular in shape and dimensions, and represent outliers of the great Coast Range granitic batholith of the neighbouring mainland. Later on in late Jurassic or early Cretaceous time, a number of small bosses and a widely distributed system of diorite dykes intruded the older rocks.

"The dykes represent the last outbreak of vulcanism or even of disturbance on the island. Sedimentation occurred in the Cretaceous, but the beds laid down still preserve their horizontal attitude, and in places are scarcely indurated. The Cretaceous beds are distributed in small areas along the west coast. Some fossils were collected from an area situated a short distance east of Cook bay. The collection is small, but sufficient to correlate the beds with the Nanaimo group, the coal-bearing series of Vancouver island. Only the basal beds have been preserved on Texada island, and no coal-seams of value were found in these.

"During Tertiary time Texada island remained above sea-level, and vigorous erosion, the marks of which are everywhere apparent, was in progress. It was buried in ice moving southeastward during the Glacial period, and partially covered with boulder-clays, silts, and sands in the lowlands, and scattered erratics in the uplands.

"Recent deposits are represented by occasional accumulations of coarse angular debris at the foot of some of the steep slopes, small amounts of creek-gravel, and peaty beds in the pond and lake basins.

"The formations occurring on the island have been classified as follows, in descending order:—

Quaternary	Recent	Creek-gravels, peat, etc.
	Glacial	Boulder-clays, sands, silts, etc.
Mesozoic	Upper Cretaceous ...	Soft sandstones, sands, clays, and shales.
	Lower Cretaceous or upper Jurassic	Diorites and diorite porphyrites in small stocks and dykes.
	Upper Jurassic (?)..	Quartz diorites referred to the period of Coast Range batholith.
	Lower Jurassic (?)..	*Texada group*; porphyrites. Texada group of LeRoy (in part).
	Triassic or Jurassic..	*Marble Bay formation*; limestone.
	Triassic	*Anderson Bay formation*; schists, tuffs, agglomerates, amygdaloids, and marbles. Texada group of LeRoy (in part)."

THE MINES.

Marble Bay.

McConnell and Astley, in the reports made by them already referred to, have described the *Marble Bay* in detail from the surface down to the level known as the 1,400-foot, which is at a vertical depth of 1,260 feet. The ore-bodies that occur in the *Marble Bay* mine belong to the contact-metamorphic replacement type, consisting of intimately associated borite and chalcopyrite, often in nearly equal quantities, which are found in a gangue made up chiefly of lime-iron garnet, epidote, tremolite, and calcite.

Most of the development done during 1916 was diamond-drill boring between levels numbered 13 and 15, which are respectively 1,160 and 1,360 feet vertical depth. The main (or No. 1) shaft is sunk to the fifteenth level and a drift driven northerly about 700 feet, which connects with the winze sunk from the tenth level, known as the No. 2 shaft.

A series of diamond-drill borings located ore between the thirteenth and fifteenth levels, and at the time of the writer's examination the management was deliberating as to the most advisable method to adopt to mine it as economically as possible.

At the same time stoping was being done above the thirteenth level, and the shipments of ore were made at about the same average tonnage as for several years past. These shipments returned about the usual net value, owing to the increased price of copper and silver, although the grade in copper was somewhat lower.

The following is a synopsis of McConnell's report of the mine-workings from the surface to the thirteenth level:—

"While copper minerals in some quantity are distributed all through the altered and replaced limestone areas at the *Marble Bay* mine, they only occur in portions of them in commercial quantities. Ordinarily one side of the replaced areas is rich in copper minerals, ending somewhat abruptly against massive crystalline limestone, and the other is comparatively lean, the pay-minerals fading away gradually in a garnet-diopside gangue. Occasionally the replaced areas are ore-bearing throughout and the stopes are bordered on both sides by limestone-walls. The paying portions or ore-bodies are not dependent on fissures and are extremely irregular, pinching, widening, and branching with little warning. Often the same replaced area on one level contains several pay-shoots of different sizes separated by barren stretches of gangue minerals, and the whole mass requires exploration.

"The ore-bodies in the upper four levels are scattered erratically through a large area of secondary minerals replacing the limestone and are smaller and more irregular than those encountered below. The 280-foot or fourth level proved comparatively barren, but immediately below it, at a depth of 16 feet, the workings expose a large ore-body, the largest copper-ore body so far found on the island. It persisted through several levels down to a point 18 feet below the

ninth, a total distance of 502 feet. On the fifth level it has a length of 220 feet, with an average width of about 15 feet. Between the fifth and sixth levels it divided into two branches, the smaller one continuing down as a workable ore-body to the seventh level and a short distance beyond. The main branch from the sixth to the eighth level varied in length from 80 to 120 feet, and in places attained a width of over 40 feet. Below the eighth level it diminished gradually in size, and terminated a short distance below the ninth in nearly pure limestone.

"The tenth level, with the exception of a narrow streak holding some scattered mineral, was practically barren, and the future of the mine when the workings reached this depth was far from promising. Further exploration was, however, decided on by the management, and a winze was sunk which reached high-grade ore at a depth of about 40 feet. The ore-body rapidly lengthened out with depth, and on the eleventh level assumed the shape of a flattened V, the two arms known as the main stope and the extension having a total length of 190 feet and an average width of about 15 feet. It was subsequently followed upwards several floors past the drift on No. 10 level. Below No. 11 level it rapidly contracted and became very irregular. A spur from the south-easterly arm continued downwards for a distance of 50 feet, where it opened out into a large ore-chamber floored with diorite porphyrite. A spur from the north-eastern arm wound downwards through the limestone to a point 50 feet below No. 12 level, then bent suddenly upwards, terminating on the twelfth level.

"No ore was encountered on the lower 50 feet of the winze connecting the twelfth and thirteenth levels, but the working 120 feet north-west from the foot of the winze exposes and follows a small ore-shoot for a distance of 50 feet. The central portion of this shoot measures about 8 x 12 feet, and is bordered on all sides by limestone.

"The workings in the *Marble Bay* mine show that the line of ore-bodies followed pitches steeply but steadily to the north-west at an angle of approximately 17 degrees, and that while the ore-bodies occur in an interrupted manner, the garnet-diopside-tremolite mass which accompanies and often encloses them is practically continuous from the surface down to the top of the small diorite-porphyrite stock encountered above the twelfth level, and extends down the north-western side of this as far as exploration has gone."

McConnell draws attention to the fact that the relative importance of the two copper sulphides has changed to some extent with depth, the proportion of bornite, contrary to what would naturaly have been expected, having materially increased, and that there is no doubt that the bornite is a primary mineral deposited with and at the same time as the chalcopyrite.

Astley's report gives much detailed information relative to the mine-workings below the twelfth level, as follows:—

"At the 1,250-foot level the ore disappeared, but was picked up again 60 feet north. Between the 1,200- and 1,300-foot levels a large ore-body has been stoped. The larger part of this ore-body was some 15 feet above the level, lying flat, and did not come down to the level. It went up at one point 60 feet above the level, but would average 40 feet in height. This stope is the biggest in the mine, with a maximum length of 200 feet and from 30 to 60 feet wide. At the north-east end of this stope a winze shows the ore to be continuous for 50 feet down and pitching at a flat angle to the north. The winze is continued in the limestone to the 1,400-foot level. At the face of the north drift, 1,300-foot level, three flat diamond-drill holes, each 196-feet, failed to find ore. A hole put down at an angle of 65 degrees, pointing south-west, 200 feet deep, struck ore 16 feet down, and from that point to 180 feet the core showed more or less ore in garnetite and felsite. The second hole, at an angle of 45 degrees north-west, struck ore at 30 feet and continued in ore, graduating from mineralized gangue to bunches of solid ore, and was still in ore at 106 feet (the depth of the hole on June 17th).

"The mine is worked through a shaft and winzes. The main (or No. 1) shaft is down 860 feet vertical, but, owing to the levels being less than 100 feet apart, and there being ten levels, the bottom one has become known as the 1,000-foot level, and is recognized as such in this report to prevent confusion.

"At a point about 200 feet northerly on the 1,000-foot level, a winze has been sunk 300 feet and is known as the No. 2 shaft. This brings us down to the 1,300-foot level, and at a point 350 feet north another winze has been sunk 112 feet. A drift is now being driven to undercut the ore-body located by the two diamond-drill holes referred to.

"The bottom level, known as the 1,400-foot level, is actually 1,260 feet vertical depth.

"Most of the ore-body over the 1,300-foot level occurred on the west side of the dyke, the dyke forming the foot-wall to the ore-body, and I believe this has been the case on the levels above, but at the north end of the stope the ore also occurs and has been stoped on the east or underlie side of the dyke."

Copper Queen.

This mine is owned by the bondholders of the Vananda Copper and Gold Company, represented by H. W. Treat, of Seattle. It is located about half a mile south-easterly from the *Marble Bay* mine in the same belt of limestone, classified by McConnell as the Marble Bay limestone, and has been worked by several different lessees since 1901, when the Vananda Company ceased operations. During 1916 George Brister, Wm. Treloaur, and D. J. Weir, three miners, had a lease on the *Copper Queen* mine, and were stoping ore from the 200-foot level that had apparently been overlooked by former operators, and shipping to the Tacoma Smelting Company, of Tacoma. This ore carried $5 in gold, 2 oz. in silver, and about 4 per cent. in copper. Although there were only about 200 tons of ore shipped in 1916, the returns paid fair wages to the lessees, who did all the work without assistance, and have continued making regular shipments through the winter and spring of 1917 of ore of a similar grade. The old workings have not been unwatered for several years below the 200-foot level, where the present lessees were working when the writer visited the mine. These consist of a main shaft sunk 600 feet vertical, a winze sunk 240 feet from a drift driven 150 feet west from the shaft on the 500-foot level, 3,000 feet of diamond-drilling, as well as drifts and crosscuts on every level. The ore-body is presumed to be stoped out to the bottom of the winze below the 500-foot level.

McConnell in his report says:—

"The *Copper Queen* croppings consisted of a limestone area about 50 feet across, mostly replaced by garnet and diopside, but showing in one place copper sulphides partially altered to carbonates. The sulphide shoot enlarged in depth and was followed nearly vertically to the 300-foot level, below which it gave out. It varied in size, but seldom exceeded 40 feet in length. A break in the continuity of the ore of about 50 feet occurred between the 300-foot and 400-foot levels. A second ore-shoot situated somewhat farther to the west was picked up 20 feet above the 400-foot level, and this persisted to the bottom of the workings, a total distance of 360 feet. Between the 400-foot and 500-foot levels it measured for some distance 40 feet in length by 30 feet in width. Lower down it lengthened out to 100 feet in places, but became much narrower. The bottom of the stope is reported to be still in ore. Dykes occur in connection with both ore-bodies, and the lower one rests throughout on a large diorite-porphyrite dyke dipping steeply to the south. The dyke is altered near the ore-body and partially replaced by secondary minerals, including the copper sulphides. Some fissuring occurs between it and the enclosing crystalline limestones, both rocks being fractured parallel to the course of the dyke.

"The *Copper Queen* ores, like those of the *Cornell* and *Marble Bay* mines, are made up of bornite and chalcopyrite in a gangue of garnet, diopside, and calcite. The gold tenor is reported to have been higher than in the other mines, some shipments averaging over $25 per ton. The range in copper values is given at from 6 to 12 per cent., and in silver from 4 to 6 oz.

"The *Copper Queen* mine has suffered from leaseholders even more than the *Cornell*. Development-work stopped at the 500-foot level. Below this the ore-body was followed down by a winze situated 155 feet west from the shaft, and the ore scooped out as far down as it could be mined at a profit. A considerable body of good ore is reported to exist at the bottom of the present workings 740 feet below the surface, but a new shaft will probably be required to reach it."

Cornell.

This mine is owned by the bondholders of the Vananda Copper and Gold Company, represented by H. W. Treat, of Seattle. The mine-workings are situated about three-quarters of a mile south of the *Copper Queen* shaft, at an elevation of 239 feet above sea-level near the head of Emily lake. The mine was not being worked when the writer visited Texada island in August, 1916, and as all of the mine-workings, which extend down 560 feet, were full of water, no examination could be made.

In 1914 J. W. Astley, M.E., made an examination of the property, while Embleton & McLeod were working under a lease and employing about 25 men, and as his report, published in the Minister of Mines' Report for that year, is the most recent, it is reproduced here, as follows:—

"The ore occurrence is similar to that of the *Marble Bay* mine. The ore is usually bounded on three sides by limestone, the diorite dyke forming one wall, except in the case of small

bunches or kidneys of ore which may occur in the tremolite or felsite, some distance from the dyke. The ore consists of bornite and chalcopyrite in a gangue composed of felsite, tremolite, and calcite. The ore has a general strike east and west with the dyke. All the known ore has been stoped out down to the fourth level.

"At the fifth level a fair-sized body of ore has been stoped up 60 feet, and is still being carried up in a fair-looking ore, although not as solid as it was at the level. A large amount of drifting and crosscutting has been done on this level, following the main diorite dyke. Small lenses and kidneys of good ore have been found along the dyke, or in the felsite near the dyke.

"Crosscuts at several points on this level have partially penetrated the dyke, but, owing to a flow of water being tapped where the dyke was penetrated on the fourth level, these crosscuts were discontinued, so that very little is known of conditions north-east of the dyke. There may be just as good ore-bodies on the other side of the dyke, and this appears to me to be very favourable ground for exploration.

"On the sixth (the bottom) level vigorous prospecting is being carried on, and various drifts and crosscuts have followed up favourable indications, and in some cases bunches of ore have been found in the brecciated areas, usually in the tremolite, but nothing so far of any appreciable size. Favourable indications, and some ore, have been located at a point a little east of the ore stope located on the level above, and further development will probably prove this to be the same ore-body. Altogether the developments on the sixth level look favourable, although there is not much ore actually in sight.

"The conditions are very similar to the *Marble Bay* mine, although the ore-bodies are not as extensive. There is good reason to expect the ore to continue down to correspond with the depth of the *Marble Bay* mine.

"Since August, 1912, the present leasers, Embleton & McLeod, have shipped 2,200 tons of ore. Eighteen white men and five Chinamen are employed."

R. G. McConnell's report on the *Cornell* mine is also summarized, as follows:—

"The ore and gangue minerals in the *Cornell* are very similar to those at the *Marble Bay* mine. Chalcopyrite and bornite intimately commingled are the principal metallic constituents of the ores. Pyrite and magnetite occur in small quantities, and some molybdenite, tetrahedrite, and native silver are also present. The gangue minerals are mainly diopside, garnet, calcite, and epidote. The diorite bordering the replaced limestone areas is usually altered and in places passes into serpentine.

"The ore-bodies in the *Cornell* occur along a diorite-lime contact, mostly in the lime, but occasionally replacing the diorite. They are smaller and even more irregular and systemless in their distribution than in the *Marble Bay* mine.

"Two ore-bodies outcropped on the surface, one at the shaft and the other 480 feet eastward along the contact known as the Glory-hole ore-body, and both are continued downwards by interrupted lines of lenses. The shaft ore-body pitching slightly to the east was followed down to the 160-foot level. A stringer from it led to the Coney ore-body, an important mass of high-grade ore about 30 feet across extending from the 160-foot to the 260-foot level. East of it between the same levels is the smaller 4 B stope. No. 8 ore-body occurred a short distance east of the shaft on the 260-foot level, and was followed down to a point 25 feet above the 360-foot level.

"The Glory-hole ore-body, with its rich ores, terminated at the 80-foot level. Below it, but somewhat farther to the east, lower-grade ore-bodies were encountered at several points down to the 260-foot level, and a large body of good ore occurred almost directly beneath it looking northwards on the 360-foot level. This ore-body, the last important one discovered, was followed along the level or a short distance above it for a distance of over 150 feet, and extended upwards in three wide shoots about half-way to the 260-foot level. No commercial ore has so far been found on the 460-foot level, although over 400 feet of drifting has been done along the lime-diorite contact. The limestones are, however, altered and filled with secondary minerals in places, evidence that the downward limit of mineralization has not been reached, and that ore-bodies may exist beneath. No work has been done on the 560-foot level."

McConnell also draws attention to the fact that the ores in the various bodies in the *Cornell* mine differ in grade to a marked degree. The ore from the main shaft and No. 8 on the 260-foot level carried little bornite and was low in both copper and the precious metals, while the ore from the Glory-hole, the Coney, the No. 4 B stopes, and from the 360-foot level carried bornite

as the principal copper mineral. Shipments often yielded over 10 per cent. in copper and occasionally over an ounce in gold.

"The following smelter returns show the grade of the ore in No. 1 stope, 360-foot level: Coarse, 110 tons; gold, 0.72 oz.; silver, 3.82 oz.; copper, 9.35 per cent. Fines, 112 tons; gold, 0.36 oz.; silver, 1.92 oz.; copper, 4.66 per cent."

Little Billy.

This mine is owned by the bondholders of the Vananda Copper and Gold Company, and during 1916 was worked by E. A. Melville and associates under a lease. The mine-workings are situated on the east coast of the island, about half a mile south-east of Vananda bay, and about the same distance east of the *Marble Bay* mine.

In company with E. A. Melville, the writer, in August, 1916, examined the most recent work done by the lessees, from which they shipped during 1916 about 1,225 tons of ore to the Tacoma smelter. This ore yielded about $5 in gold, 1 oz. in silver, and 50 lb. of copper to the ton.

The ore was mined from an old stope between the 180- and 280-foot levels. The stope was 80 feet high when examined and the ore-body about 6 feet wide. Bornite is the predominating copper mineral, but there is a considerable percentage of chalcopyrite mixed with the bornite. The gangue material consists of calcite, garnetite, and tremolite.

On the 280-foot level there were two isolated lenses of copper ore, one to the north and the other to the south of the shaft. That to the south occurred lying almost flat on quartz diorite under a limestone roof. The ore had been stoped out when the writer examined the level, but from the appearance of the stope the ore must have been from 8 to 10 feet thick and about 20 feet square. A drift driven towards the south-east shows a contact of limestone and diorite dipping at an angle of about 45 degrees, with some bornite in a tremolite gangue in the contact and apparently continuing below the floor of the drift.

The ore-lens on the northern side of the shaft has been mined out down to the 280-foot level. Chalcopyrite was the predominating copper mineral in this ore-body, but there was some bornite mixed with the chalcopyrite. There are indications in places in the floor of the stope on the 280-foot level that the ore-body maintains continuity to deeper levels, and Mr. Melville expressed the intention of sinking to develop the possibilities.

In McConnell's report he describes the conditions on the upper levels in detail, and a summary of his report is as follows:—

"The principal workings at the *Little Billy* consist of a shaft 180 feet deep sunk through diorite, with drifts at the 80-foot and 180-foot levels. An extension of the shaft to the 280-foot level was in progress when the mine was visited. Other workings on the property include two shallow shafts and a short tunnel.

"The metallic minerals at the *Little Billy* consist of the two copper sulphides, bornite and chalcopyrite, occasional small bunches of molybdenite, pyrite, and magnetite. The gangue minerals include andradite, diopside, tremolite, actinolite, epidote, and calcite.

"The ore-bodies so far discovered on the *Little Billy* are comparatively small, and the grade in copper is somewhat lower than in the *Marble Bay* and *Copper Queen* mines. The first ore-body mined occurred near the surface at the end of a limestone point penetrating the diorite a short distance north of the main shaft, and had the shape of a flattened horizontal lens 10 to 15 feet thick and about 35 feet in length. The ground beneath it was explored at the 80-foot level from the main shaft, but no ore was encountered. The downward extension on this level may possibly be represented by a mass of secondary minerals, including some chalcopyrite, which replaces the diorite north of the shaft.

"An ore-body about 50 feet long and from 15 to 20 feet wide, including some barren areas, occurs on the 80-foot level near the lime-diorite contact about 100 feet east of the shaft. It has been stoped upwards for 35 feet, but has not been sunk on.

"In the 180-foot level a drift to the south-east through light-greyish quartz diorite reached at a distance of about 65 feet a large dark-coloured diorite-porphyrite dyke dipping at a high angle to the south-east and bordered on both sides by a band of contact-metamorphic minerals. A drift along the dyke exposed in a short distance a small magnetite mass holding some copper sulphides, and farther on an important ore-body about 75 feet in length was reached. This has been followed upwards for a distance of 30 feet and will be undercut by a drift from the shaft at the 280-foot level. The ore in the south-eastern portion of the ore-body is of good grade and consists mostly of bornite in a tremolite gangue. In the north-eastern portions chalcopyrite is the principal copper mineral, and garnet and diopside the predominant gangue minerals.

"A second rounded ore-body about 30 feet across occurs in the 180-foot level, 50 feet north of the shaft. It consisted mostly of bornite and tremolite below, but passed upwards into magnetite sprinkled with chalcopyrite. A drift from this ore-body westward for a distance of 200 feet along the lime-diorite contact exposed a continuous band of secondary copper and gangue minerals from 1 to 5 feet in width rich enough in places to constitute ore.

"The *Little Billy* ores usually carry from 4 to 8 per cent. in copper, but the precious metal tenor is much lower than in the other mines, seldom exceeding $3. As a rule, copper-ore bodies on the island lying against quartz-diorite stocks carry less gold and silver than those bordering the more basic diorite-porphyrite stocks.

"The equipment at the mine includes a 60-horse-power boiler, a Canadian Rand 3-drill compressor, a 25-horse-power hoist, and an electric-lighting plant. There is in addition a good machine-shop and a small sawmill."

Puget Sound Iron Co.

There are several occurrences of chalcopyrite associated more or less intimately with the magnetite-deposits on the property owned by the Puget Sound Iron Company on the west coast of Texada island. As the boundaries and area of this property are fully described in the writer's report in Bulletin No. 3, 1917, "Bureau of Mines Report on Iron-ore Deposits on Vancouver and Texada Islands," it is not necessary to repeat those descriptions in this report. The occurrences of copper ore are found as lenses usually embedded in limestone at or near its contact with the intrusive igneous rocks, and also disseminated in small quantities through some of the masses of magnetite. So far as development has shown, the ore is of the chalcopyrite variety, and the absence of bornite, so abundant in other parts of the island, is quite noticeable.

Several attempts have been made in recent years by lessees to develop copper-mines on this property. The workings are all comparatively shallow. The deepest are on the *Lake* iron-mine, near the summit of a ridge, a short distance north-westerly from the main open-cut made on the magnetite-deposit. At that point at the contact between limestone and porphyrite there are several outcroppings of chalcopyrite associated with pyrrhotite. A crosscut adit driven about 100 feet long from south to north exposes the following series of formations: Epidote, garnet, and some ore for 25 feet in an open-cut approach to the portal of the adit, then through 22 feet of igneous rock to a zone of mineralization made up of pyrrhotite and some chalcopyrite, about 40 feet wide. A drift is driven towards the east a distance of 74 feet along the mineralized zone, with mineral showing in the face. The main crosscut adit is continued towards the north beyond the drift to limestone, and a winze sunk near the face on the west side of the adit, that could not be examined because it was full of water.

The ore mined during this work was shipped to a smelter, but there was a dump of fines or second-grade ore at the portal of the adit, a sample from which assayed: Gold, trace; silver, 0.4 oz.; copper, 2 per cent. Another sample from the same dump assayed: Gold, 0.04 oz.; silver, 0.7 oz.; copper, 2.6 per cent.

On the north side of the ridge mentioned and at the contact between limestone and altered porphyrite there is another outcropping of copper minerals, about 60 feet long and averaging 3 feet wide. The strike of this occurrence of copper ore is towards the south-west and dip 74 degrees to the north-west.

The ore is exposed by an open-cut 60 feet long and 18 feet deep at the face. A shaft is sunk about 100 feet deep near the entrance to the open-cut, and a crosscut is driven for a length of 90 feet from the bottom of the shaft, in the hope of intersecting the ore-body on that level. The shaft was full of water when the writer examined the property, but he was informed by W. H. Lee, the local representative of the owners, that it was sunk through copper ore for a depth of 50 feet, where the ore dipped away from the shaft, and continued down in the foot-wall. Ore was not exposed in the crosscut driven from the bottom of the shaft, except at the face, but that at about 30 feet from the face of the crosscut iron ore was exposed, which was continuous to the face, where the copper ore replaced it.

Other occurrences of copper ore are found about 800 feet north of the *Paxton* iron-mine, about a quarter of a mile easterly from the *Lake* mine, where an open-cut about 125 feet long, from 6 to 12 feet wide, and about 10 feet deep in places is made at the contact between porphyrite and limestone. From this work a considerable tonnage of chalcopyrite was shipped some years back. A sample taken from some parts of the workings where a little of the ore was left in the cut assayed: Gold, 0.08 oz.; silver, 3 oz.; copper, 6.3 per cent.

Chalcopyrite is found disseminated in some of the magnetite at several points on the property, but usually in small quantities, although occasionally enriched lenses occur. There is one instance near the collar of the shaft on the *Prescott* iron-mine where a grab sample assayed: Gold, trace; silver, 1.6 oz.; copper, 6.2 per cent. Another sample from an outcrop near the same place assayed: Gold, trace; silver, 0.3 oz.; copper, 1 per cent.

During 1916 the property of the Puget Sound Iron Company was leased to G. J. Hammond, of Vancouver, who erected a new wharf, ore-bunkers, and tramway. He continued development-work and shipped copper ore to the Ladysmith smelter in the spring of 1917.

Other Mineral Claims.—In addition to the mineral claims already described on which occur copper-ore deposits of the contact-metamorphic replacement type, there are several others on Texada island which were being actively operated until about 1906, but have since then been practically idle. The most prominent of these claims are the *Loyal, Paris* group, *Canada* group, *Red Cloud, Volunteer, Security, Sentinel* group, *Commodore,* and some others. During 1916 no work was done on any of these claims, and although some of them were visited by the writer, no examination of the old workings could be made because the shafts were full of water and the owners absent.

QUARTZ VEINS IN FISSURE-ZONES.

There are several occurrences of quartz veins in the porphyrite formation west of the Marble Bay limestone-belt in the north-western portion of Texada island. As the outcroppings of most of these veins carried free gold in appreciable quantities, the discoveries were followed by stampedes of more or less magnitude, and considerable prospecting and development work was done on nearly all of the claims. A number of shafts, some of them said to be more than 100 feet deep, were sunk on some of the claims where the veins were the most promising, and a total of approximately $20,000 was obtained from rich pockets in the veins, where the values were in free gold. This work disclosed the fact that the commercial values found in the quartz at and near the surface usually decreased at comparatively shallow depths, below which the ore could only be considered as a concentrating proposition. Work was stopped after the high-grade quartz was mined, except in a few mineral claims, which are described by the writer in the following part of this report.

The most prominent of the claims which produced free-milling ore were the *Victoria, Nutcracker, Golden Slipper, Margorie* group, and *Laurendale*, which, with the exception of the *Margorie,* were all idle during 1916.

Margorie. This group contains the *Margorie, Fairview, Wild, Saga,* and *Tenas Fraction* mineral claims, situated on Texada island about one mile and a half west from the *Marble Bay* mine. The property is owned by the Grey Bros., of Seattle, and is being developed under a bond by the Lee Mines, Limited, of Vananda. The group was located in 1903 after a discovery of quartz-outcroppings on the *Margorie* claim carrying gold values. Many very fine specimens of free gold in quartz were found at shallow depths below the surface outcroppings, and W. S. Planta, the discoverer, says that about $6,500 was taken from a hole about 7 feet long and about 6 feet deep, but as development-work progressed to deeper levels the values decreased, and the unoxidized ore carried only low values. The mineralization of the quartz, in addition to free gold, is a combination of iron pyrites, chalcopyrite, sphalerite, magnetite, and galena. This occurrence of gold-bearing quartz veins is one of several that occur in the massive porphyrites in the vicinity of Spectacle and Kirk lakes.

There are two well-defined veins on the *Margorie* claim 26 feet apart, dipping almost vertical and striking parallel to each other in an easterly direction. The veins are most strongly developed about 400 feet south from a point nearly midway on the northern boundary of the *Margorie* claim, where the original discovery was made. Considerable development-work was done on the No. 1 (or south) vein, which is the widest, being from 10 inches to 2 feet wide. This work consists of a shaft said to be 65 feet deep, well timbered, but full of water when the writer visited it, and a line of deep trenches for about 165 feet along the strike of the vein.

The following analysis, made by J. O'Sullivan, of Vancouver, of a sample of the ore from near the surface shows the value and mineralization: Gold, 5.82 oz.; silver, 1.5 oz.; copper, 2 per cent.; arsenic, trace; iron, 21.8 per cent.; silica and insoluble silicates, 48.2 per cent.; alumina, 8 per cent.

About 2,000 feet south-easterly from the workings on the *Margorie* there are outcroppings of a quartz vein in massive porphyrite between well-defined walls, with a narrow seam of gouge on each wall, occurring on the *Saga* claim, one of the *Margorie* group. The strike of this vein is in an easterly direction and the dip vertical. Its width varies from 10 to 16 inches of quartz and brecciated country-rock mineralized with iron pyrites, chalcopyrites, sphalerite, magnetite, and galena, as well as some free gold. The values are variable, and, so far as shown by the workings, decrease at a comparatively shallow depth below the surface.

There are other quartz veins on the *Margorie* group which strike parallel to the main veins described, and dip at varying angles towards the *Saga* vein, but no work has been done. The ore in the occurrences on the group of claims has every appearance of being easily concentrated at a ratio of about 20 to 1.

The workings on the *Saga* claim consist of an open-cut about 100 feet long, about 8 feet deep, made along the strike of the vein, and a shaft, said to be 60 feet deep, well timbered, but full of water, so could not be examined. There is a boiler and hoist on the ground ready for installation when work is resumed.

Retriever. This group contains the *Westgate*, *Ram*, and *Retriever* mineral claims, situated on the west coast of Texada island, about one mile and a half north-westerly from the *Prescott* iron-mine on the property of the Puget Sound Iron Company, and owned by W. H. Lee and Wm. McDonald, of Texada island. The three claims are located *en bloc*, with the *Westgate* on the coast and its southern boundary along the shore; the *Ram* claim adjoins the *Westgate* on the north, and the *Retriever* adjoins the *Ram* on the north.

On the southern part of the *Ram* claim and northern part of the *Westgate* there is a shear-zone in the porphyrite country-rock, the shearing-planes in which strike in an easterly direction. The porphyrite is slightly amygdaloidal and sparingly impregnated with grains of chalcopyrite across a width approximately 1,000 feet and for a length of about 1,200 feet. In some parts of the mineralized zone there are outcroppings showing local enrichment, and on one of these, near the centre of the location-line, 500 feet north of the south boundary of the *Ram* claim, a shaft is sunk, said to be 40 feet deep, but was full of water when the writer visited the claim, so it could not be examined.

At a point about 200 feet southerly from the shaft, and about 50 feet lower elevation, there is an open-cut approach 20 feet long to a short adit driven across sheared porphyrite slightly impregnated with grains of chalcopyrite. A grab sample from the dump assayed: Gold, trace; silver, trace; copper, 0.3 per cent.

Near the summit of Surprise mountain, at an elevation of about 900 feet above sea-level, on the *Retriever* mineral claim, there occurs a well-defined fissure in the porphyrite country-rock filled with iron pyrites, associated with which is some galena, chalcopyrite, and sphalerite in a quartz gangue. The vein dips 65 degrees to the south and averages about 2 feet wide, as exposed in trenches along the strike in an easterly direction, for a total distance of about 350 feet; also in a shaft 130 feet from the east end of the trenching. The writer was informed by W. H. Lee, who accompanied him while making the examination, that the shaft is 20 feet deep, but was full of water, so could not be examined. An average sample taken across 18 inches of the vein-filler near the east end of the trenching assayed: Gold, trace; silver, 1.2 oz.; copper, 2.3 per cent.

There is a second quartz vein on the *Retriever* claim which averages 3 feet wide and is exposed about 100 feet southerly from the No. 1 vein by open-cuts for a length of about 50 feet along the strike of the vein; also in a shaft, that Mr. Lee informed the writer is 30 feet deep, but being timbered and partly full of water could not be examined. A grab sample from the dump at the shaft assayed: Gold, trace; silver, 0.2 oz.; copper, 0.7 per cent.

Highland. This mineral claim adjoins the northern boundary of the property of the Puget Sound Iron Company on the west coast of Texada island, and is owned by W. H. Lee and George McLeod, of Vananda. A quartz vein somewhat mineralized with iron pyrites, galena, and chalcopyrite occurs in porphyrite country-rock on this claim, and is exposed by an open-cut about 12 feet long and 7 feet deep. The vein is about 7 feet wide where it is exposed. It strikes nearly east and dips almost vertical. A grab sample from sorted ore assayed: Gold, trace; silver, 0.9 oz.; copper, 2.3 per cent.

LIMESTONE-QUARRIES.

Limestone has been quarried for the manufacture of lime for several years past on the shores of Sturt, Blubber, and Limekiln bays on Texada island, but during 1916 active operations were being carried on only at Blubber bay by the Pacific Lime Company.

The kiln at Sturt bay, near the *Marble Bay* mine, is owned by the Tacoma Steel Company, *which also owns the kiln, barrel and stave factory at Limekiln bay, south of Marshall point, at* the north end of the island.

The property of the Pacific Lime Company is on the western side of Blubber bay at the north end of the island, south-east from Marshall point, where the company's wharves, kilns, sawmill, barrel and stave factory, and hydrating plant are located. East of and adjoining the property of the Pacific Lime Company is the quarry, kiln, and wharf of the Texada Development Company.

The limestone quarried for the manufacture of lime is that classified by McConnell as the Marble Bay limestone, of which there is almost an unlimited supply suitable for the purpose.

Partial analyses of the magnesian and ordinary limestone which occur in the quarry of the Pacific Lime Company, made by H. A. Leverin, of the Canada Department of Mines, are as follows:—

	Magnesian Limestone.	Ordinary Limestone.
Calcium carbonate	(1) 85.00	(1) 98.39
Magnesium carbonate	(2) 11.32	(2) 0.71
Ferric oxide and alumina	2.16	0.30
Insoluble matter	1.26	0.20
	99.74	99.60
Equivalent to lime (CaO)	(1) 47.60	(1) 55.10
Magnesia MgO	(2) 5.42	(2) 0.34

The quarry of the Pacific Lime Company is about 250 feet across from east to west and about 125 feet from north to south, except at one point towards the west end, where the quarry is only about 50 feet for a short distance. The east and south faces are each 55 feet high, and the west face about 25 feet high.

There are three or four well-defined intrusive diorite dykes in the body of limestone, and one light-coloured dyke, which makes considerable trouble in sorting because of being almost the same colour as the limestone, and also resembling it in texture; this is known amongst the quarrymen as the "kidney" dyke.

The Pacific Lime Company's plant has a daily capacity to burn 150 barrels of lime of 185 lb. to the barrel. The hydrating plant has a capacity of treating 60 barrels of lump lime daily.

There are about 3,000 tons of limestone shipped monthly to the Granby Consolidated Mining, Smelting, and Power Company at Anyox, Observatory inlet, where it is used for fluxing purposes. The rock is quarried and transported to cars on the wharf by an overhead cable-haulage system.

The mining and haulage equipment consists of a 60 horse-power boiler and hoist for handling a scraper used in the quarry for moving broken rock; a 45-horse-power boiler and hoist for handling the cable-haulage for cars on the wharf; and a 3-drill compressor plant and a third hoist for handling the overhead haulage for transporting buckets of limestone from the quarry to the kilns.

MARBLE ON VANCOUVER ISLAND.

Nootka Marble Co.

This company's quarry is situated near the head of Deserted creek, which flows into Tlupana arm of Nootka sound, about twelve miles northerly from the Nootka Indian rancherie in Friendly cove, near the entrance of the sound.

The first development-work was done on the occurrence of marble in 1906. The Provincial Mineralogist refers to the establishment of the industry in the Minister of Mines' Report for 1908. Herbert Carmichael made an examination of the quarry in 1907, and his report is published in the Minister of Mines' Report for that year.

The writer visited the quarry on June 10th, 1916, in company with Dr. W. A. Parks, of Toronto, who was engaged in the examination of marbles and building-stone for the Canada Department of Mines. The quarry is on the beach close to deep water in a landlocked harbour,

and most conveniently situated for shipping. No work was being done at the time of our visit, but the caretaker, W. Smith, extended every courtesy possible to enable Dr. Parks and the writer to make a thorough examination of the property.

The occurrence of marble is in a mountain of crystalline limestone on the east side of Deserted creek that rises to an elevation of about 1,000 feet by a series of benches within about three-quarters of a mile from the beach.

There are three well-defined intrusive igneous dykes occurring within the boundaries of the quarry. One of these dykes, which strikes in an east (mag.) direction and dips nearly vertically, forms the northerly wall of the pit, or quarry, and extends downwards below the floor. This dyke is 4 feet wide, and on the beach can be traced towards the west (mag.).

A few feet southerly from the dyke just referred to there occurs another narrów dyke, barely 1 foot wide, with its dip also nearly vertical, but its strike has a wavy line towards the east (mag.) and apparently bends towards the north (mag.), and forms a junction with the wider dyke near the westerly side of the quarry.

The third dyke occurs near the centre of the quarry and dips 25 degrees to the south. Its width in the face of the quarry is 4 feet, but on the westerly side it is considerably narrower and appears to have intruded from farther south and flowed northerly, fingering out into several flows, one of which is represented in the face of the quarry.

There is no evidence of the presence of iron pyrites in the marble, which takes a good polish, and occurs as grey, white-grained, and variegated intermediary types.

The general characteristics of the marble show that it is well adapted for building purposes, and some of it for interior finishing and decorative uses. The surface rock in places is considerably checked, but in the lower floors of the pit the quality is much better, and, judging from the cores from still deeper diamond-drill borings, the quality improves as depth is attained.

There is a considerable number of blocks of marble measuring 5 x 5 x 5 feet and slabs 6 x 6 feet by 1 to 1½ inches thick on the yard and in the mill.

The quantity of marble available appears to be very considerable, especially if development proves that the mountain of limestone, of which the present quarry is at the base, contains as much marble of a commercial grade as the surface indications suggest.

After a careful examination of the bedding of the marble in the quarry, the strike appears to be N. 75° E. (mag.) and the dip varying from 26 to 45 degrees to the S. 15° E. (mag.), but at the camp, about 300 feet southerly from the quarry, the strike is N. 50° E. (mag.) and dip 55 degrees to the N. 40° W. (mag.), which shows how much dislocation, faulting, and movement have occurred.

The outside measurement of the upper floor of the pit is 50 feet square and the easterly face 20 feet high. The marble is channelled out in 5-foot cuts, and the water rises and falls in the lowest cut with the action of the tides, as the upper floor of the quarry is only 10 feet above mean tide, and the westerly side only 60 feet from the shore-line.

The plant consists of a mill building 100 feet long by 40 feet wide, in which is the following machinery: Two gang-saws, Patch type, single piston; one Sullivan swivel-head channeller; one 12-foot overhead Patch smoothing-table; centrifugal sand-pump; one Jenny Lind polisher; one lathe; one Patch boring and testing drill (4-inch core); one gasolene-motor; rock-drills; one wooden derrick, 12 tons capacity; one hoisting-engine; mill engine, 10 x 14 inches, manufactured by Houston, Stanwood & Gamble, of Cincinnati, Ohio; two boilers, one 26 horse-power, the other 10 horse-power; one water-heater and pump; one 6-inch Fairbanks pump in the quarry.

ALBERNI DISTRICT.

ALBERNI MINING DIVISION.

JOHN E. HOOSON, GOLD COMMISSIONER.

I have the honour to submit the annual report on mining in the Alberni Mining Division during the year ending December 31st, 1916.

At present there are few mines in this district that have reached a high stage of development, but I am pleased to say that a distinct revival is occurring and considerable work has been accomplished.

The *Monitor* group, near the Alberni canal, has been continuously worked by a force of ten men for some time past; a trial shipment of 45 tons of ore was made recently to the Trail smelter, which proved it to contain some 9 per cent. copper, with some gold and silver, a total gross value of approximately $50 a ton resulting.

The *Sunshine* group, situated on the north side of Uchucklesit harbour, has been further developed by an open-cut, from which was secured and shipped 147 sacks of ore that netted approximately $65 a ton. A cable-tram was recently installed on this property to facilitate shipping.

The *Black Prince No. 2* mineral claim, situated on Uchucklesit harbour, has been developed by open-cuts, which revealed some extensive deposits of magnetic-iron ore; no shipments have yet been made, but as a result of the showing made the property has been recently bonded.

The *Big I* group, near Great Central lake, has lately been acquired by P. Welch and associates. A diamond-drill and other mining equipment have recently been delivered on the property, so that it is expected that extensive development will ensue in the spring.

OFFICE STATISTICS—ALBERNI MINING DIVISION.

Mineral claims recorded	53
Certificates of work recorded	13
Certificates of improvement recorded	3
Bills of sale, etc., recorded	10
Free miners' certificates issued	55

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, 1916.

A more businesslike interest in mining matters has this past year been a welcome feature, and there are reasons for anticipating increased activity and production in the ensuing year.

Dewdney Group.—Situated on Sidney inlet, Clayoquot sound. This group of claims was the property of the late Hon. Edgar Dewdney, and is at present being operated by the Tidewater Copper Company (a subsidiary of the A.B.C. Metals Company, of New York) and managed by Samuel I. Silverman. This company has lost no time since work was started in October this year, a first shipment of about 600 tons of copper ore having been made to the Tacoma smelter about the middle of December. Between thirty and forty men are at present employed, and it is the stated intention of the management to at once take the necessary means to considerably increase the output.

The smelter returns for the above-mentioned shipment was not available at the time of compiling this report.

(NOTE BY P.M.—Tacoma smelter returns gave over 4 per cent. copper.)

Jumbo and Crow Group.—Situated on Copper creek, Tofino inlet. This well-known property, owned by Joseph Drinkwater and others, was bonded to the Tofino Copper Company, of New York, in April this year. This is also a subsidiary company of the A.B.C. Metals Company, of New York.

Active work was commenced on the *Jumbo* claim in April, and some 400 feet of drifting was done from the old workings. The results from this work, however, were not satisfactory enough to warrant the cost of installing shipping facilities for this property alone, and the work was suspended pending the development of the *Crow* claim, about half a mile distant.

Work on the *Crow* developed a body of high-grade chalcopyrite and pyrrhotite ore. An excess of water being encountered in the shaft, it was impossible to prove the extent of this ore-body without very considerable additional expense, and the work has therefore been temporarily suspended. Samuel I. Silverman, the manager of the company, intends to continue this work early in the New Year, and will erect bunk-houses on the property and drive a tunnel to strike the ore-body and drain the workings. There is every indication that this ore-body is of considerable extent, and when this is proven the construction of bunkers and tramway will be immediately undertaken.

The amount of money expended on the *Crow* and *Jumbo* during the season 1916 amounted to something over $10,000.

Ormond Group.—Situated on Flores island, Clayoquot sound. This property (Crown-granted) was bonded by the owner, James Beck, to H. W. E. Canavan, who since the transfer has done considerable prospecting-work on the surface showings in the way of opening up crosscuts, demonstrating the width and length of the ore-body.

W. M. Brewer, M.E., visited the property this summer, and describes it in his report.

Kalappa Group.—Situated on Mears island, Disappointment inlet, Clayoquot sound. This group consists of the *Kalappa*, *Golden Gate*, *Sninik Fraction*, and *Jack of Clubs* mineral claims, owned by Mrs. E. A. Chesterman, who has during the year advertised in the usual way her intention to apply for certificates of improvement with a view of obtaining Crown grants of these claims.

During the year 1912 the property was bonded to C. E. Cartwright, civil engineer, of Vancouver, B.C., and in the Annual Report of the Minister of Mines for that year, page 194, will be found particulars of the work done on the claims up to the close of that year.

In 1913 the Kalappa Mining Company, Limited (capital, $250,000), was formed and took over the interests of C. E. Cartwright and associates, and during that year shipments of ore aggregating 217 tons were made to the Tacoma smelter. The ore is stated to carry gold, silver, and copper.

The company, however, did not last long, for in 1914 financial difficulties arose, and ultimately the property was closed down. It may be added that excellent facilities are at hand for the shipment of ore to the smelter. A report of D. G. Forbes, M.E., on the above group appears in the Annual Report of the Minister of Mines for 1913, page 277.

Rose, Mamie, Sadie, and Maggie.—These mineral claims are situated on Elk river and are owned by A. Watson and C. Dawley. Crown grants of these claims were issued this year. Some data concerning these claims, under the heading of "*Rose Marie* Group," are contained in the Annual Report of the Minister of Mines for 1912, page 195, and again in the Annual Report for 1913, page 278, under the heading "*Rose Marie*."

B.C. Wonder Group.—This group consists of copper claims situated on Tranquil creek. The ownership of this Crown-granted property is almost entirely held by General James M. Ashton, of Tacoma, and considerable money has been spent from time to time in opening up the claims. During the summer W. M. Brewer, M.E., visited the claims and his report will be made public in the Annual Report, 1916.

White Mine.—This mineral claim is situated on Tofino creek and was staked in July this year, and is owned by Wm. Walton, a local prospector. Measured in a straight line, it is a little over a mile from salt water, where good shipping facilities are available. The property would appear to justify high expectations. It is stated that a lead showing at the surface is from 10 to 30 feet wide and can be traced to at least 600 feet; the ore is copper-bearing.

IRON-ORE CLAIMS.*

Stormont, Glengarry, and Texas.—Adjoining Crown-granted claims, situated at Head bay, Nootka sound, about half a mile from salt water, where good shipping facilities could be easily installed. The principal interest in this property is held by the Canadian Collieries (Dunsmuir), Limited.

The Mines Branch, Ottawa, some few years ago had Professor Lindeman inspect and report on the iron-ore deposits to be found on this Coast, and after visiting these claims he issued a report. It is stated the ore assayed 69 per cent. iron.

Chieftain and Iron Mountain.—These are adjoining and Crown-granted claims, situated about one mile from the mouth of Elk river, Kennedy lake. The ore is held to exist in large quantities and to assay 69 per cent. iron.

ASSESSMENT-WORK.

Assessment-work has been recorded as follows:—

Spittal.—*Situated on Elk river and owned by Wm. Spittal. Two open-cuts, 5 x 5 x 6 feet* and 4 x 5 x 6 feet, and other incidental work.

Lucky Jack.—Situated on Elk river and owned by Jas. Sloman. One open-cut in rock, 15 x 5 x 6 feet.

Lucky Jim.—Situated on Elk river and owned by Wm. Spittal. Two feet of tunnelling, 4 x 6 feet; open-cut in rock, 10 x 7 x 6 feet; and considerable stripping in several places showing lead.

Wolf.—Situated on Elk river and owned by W. J. Dunlop. Stripping, 4 x 6 x 2 feet 6 inches; rock-work, 10 x 3 x 3 feet and 6 x 1 x 1 feet; rock on ledge, 8 x 4 x 2 feet; rock-work and earth, 6 x 6 x 4 feet; earth-work, 8 x 8 x 4 feet.

Ex, Ten, You, and Eight.—Situated on Bear river and owned by J. D. McLeod, Vancouver, B.C. Grouped for assessment-work, which was done on the *You* claim, covering necessary work for the four claims—viz., 2,000 to 3,000 cubic feet of trench-work, together with other prospecting-work and 100 cubic feet of rock-work.

Northern Crown.—Situated on Clayoquot river and owned by J. E. Martin. Ten feet of rock tunnelling.

Lucky Jim.—Situated on Bear river and owned by J. D. McLeod, Vancouver, B.C. Sinking two shafts to a depth of 9 feet, a surface trench about 100 feet, and necessary trail-work.

Crown.—*Situated on Lone Cone mountain and owned by S. S. Stone.* Driving tunnel, 16 feet; stripping ledge, 100 feet; two open-cuts, each 2 feet deep, 2 feet wide, and 10 feet long.

Bounce.—Situated on Deer creek and owned by Wm. McKay. Extending tunnel, 3 feet deep, 6 feet high, and 6 feet wide; surface work, 6 feet wide, 8 feet long, and 2 feet deep; open-cut, 3½ feet deep, 4 feet long, and 4 feet wide.

OFFICE STATISTICS—CLAYOQUOT MINING DIVISION.

Free miners' certificates (individual)	32
Mineral claims recorded	50
Certificates of work recorded	18
Payments in lieu of assessment-work	4
Powers of attorney, transfers, etc., recorded	15
Other receipts issued	10

Revenue.

Free miners' certificates	$135 00
Mining receipts, general	679 25
	$814 25

* *See also* Special Report on Iron Ores by W. M. Brewer, M.E.

QUATSINO MINING DIVISION.

REPORT OF O. A. SHEBERG, 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, 1916.

In the early part of the year a bond was given on the *Old Sport* group to the Consolidated Mining and Smelting Company, of Trail, B.C., and work was started in August. The work so far consists in building a flume and pipe-line for water-power to drive the air-compressor. The power plant was completed and machinery installed and in running-order a few days before Christmas. The present work is to sink on the main lead to ascertain the extent of ore-bodies.

N. S. Clarke, of Vancouver, B.C., and associates have secured a bond on the *Yreka* mine, a Crown-granted property which has been idle since 1904. New ore-bodies have been uncovered and the showings are very promising. Building of wharf and ore-bunkers is already started on, and the intention is to put the property on a shipping basis as early as possible.

The *Quatsino King* group, at Teta river, has been bonded, but work will not be started until spring.

Work has been carried on all the year on the *A. T. Monteith* group, on Clayoquot sound, owned by the British Columbia Pottery Company, of Victoria, B.C., and several small shipments made of shale for use in the pottery.

With a few exceptions, assessment-work has been done on all individual claims.

OFFICE STATISTICS—QUATSINO MINING DIVISION.

Mining claims recorded	73
Certificates of work recorded	83
Powers of attorney, transfers, etc.	19
Free miners' certificates	72

Revenue.

Free miners' certificates	$320 75
Mining receipts	565 15
	$885 90

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, 1916.

During the past year not a great amount of mining was done in this district, the properties from which ore was shipped being the *Marble Bay* and other mines, situated on Texada island. For the year 1916 copper ore was shipped to the smelter from the *Marble Bay*.

The British Columbia, Alberta, and Northern Development Company, Limited, of Vancouver, has leased the mineral claims *Jack North*, *Goodall Fract.*, *L.M.C.*, *LeRoi*, *Boulder West*, and *East Gate* from the Puget Sound Iron Company's holdings on Texada island, and has made a shipment of ore to the Granby Consolidated Mining, Smelting, and Power Company, Limited, at Anyox amounting to 92 tons.

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	247
Certificates of work	225
Certificates of improvement	1
Bills of sale, etc.	68
Free miners' certificates	288
Record of placer claims	6

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, 1916.

LODE-MINING.

There has not been much metalliferous mining carried on in this Division since the closing-down of the copper-mines in the Mount Sicker district several years ago and the greater part of the mineral production of this Division has been derived from the non-metallic minerals.

The value of the mineral-output of this Mining Division for the year 1916 was about $700,000, which comes almost entirely from building materials. Two important Portland cement plants are situated in this Division on Saanich inlet and, in fact, they are the only operating cement plants in the Province.

The general re-examination of and in some cases the working of old properties has been widespread on the Coast during the past year, owing to the high prices of copper and other metals, and has included some activity in this Division.

On the west side of Cowichan lake a local syndicate has for the past two years been developing the *Blue Grouse* mineral claim, and during 1916 three car-loads of ore were shipped. The main working is a tunnel 87 feet long, with drifts 28 feet to the south and 52 feet to the north. This development has shown up a nice body of copper ore which averages about 5 per cent. copper. The first car of ore was hand-sorted and was shipped to Trail, giving returns of 11.10 per cent. copper, 1.5 oz. silver, and 0.08 oz. gold to the ton. The other two cars were mine-run ore and shipped to Ladysmith; the returns gave 4.48 per cent. copper and 0.84 oz. silver to the ton. Development of the property with occasional ore shipments is being proceeded with.

Two properties on Koksilah river were developed to some extent, but no information is available as to the results.

On Sooke harbour the Johns property was worked under option by O. B. Gerle, and a two-mile wagon-road constructed to the property. The showing here, which consists of a fairly well-defined vein carrying good copper values, is said to be quite promising.

A short distance from the head of Esquimalt harbour some work was done on a copper-showing, with, it is said, satisfactory results.

On the Jordan river a copper property has been prospected to some extent by Geo. Winkler. The showings consist of impregnations of chalcopyrite in shear-zones and are said to be quite extensive. An option of the property is now being arranged, and, if the deal goes through, the property would be prospected by diamond-drilling.

The *Willow Grouse*, on Sooke peninsula, was worked by leasers during the year, and 214 tons of ore was shipped to the smelter, which averaged about 5 per cent. copper.

The *Viva*, near Cowichan Station, owned by Joe Gallo, was developed during the year, and shipped 239 tons of ore to the smelter, averaging about 2.5 per cent. copper.

During the field season of 1916 W. M. Brewer examined a great many properties in the Southern Coast district for this Department. His report, which is included in this Annual Report, contains descriptions and details of the more important properties in the Victoria Mining Division.

One great handicap to prospecting in this Division is the fact that the greater part of the Division is within the "E. & N. Railway Land Grant," which land, as also most of the old Crown-granted property, of which there is much in this Division, carries with it the ownership of the coal and base metals, such as iron, copper, lead, etc., leaving in the possession of the Crown only the precious metals—gold and silver. Consequently, a prospector staking a claim on any of these lands only acquires the right to the precious metals, and, as these usually occur

associated with the base metals, he must, before mining, make some arrangement with the owner of the base metals, a matter sometimes difficult to arrange.

PLACER-MINING.

A little placer gold exists in the stream-beds of the Leech, Sooke, Jordan, and other rivers on the south-western end of Vancouver island, and each year a certain number of whites and Chinese do some work and take out a little gold, probably not sufficient to constitute standard wages, but enough to provide "grub."

The large gravel-banks on Sombrio river, which carry a little gold and have been held under placer leases, have not been worked this past year.

NON-METALLIC MINERALS.

The non-metallic minerals in this section have chiefly been utilized in some form of building material, and, as the building trade and allied industries have been nearly dormant for the past two years, this branch of the mineral industry has been seriously depressed.

Cement.—There are two large and well-equipped cement plants in the Division, both situated on Saanich inlet. The Vancouver Portland Cement Company, of Tod inlet (R. P. Butchart, president, Board of Trade Building, Victoria), made an output of about 200,000 barrels of Portland cement, of a value of approximately $280,000, in the production of which there was quarried about 45,000 tons of limestone and a proportionate tonnage of clay. This year's output is a little larger than that of 1915.

The Associated Cement Company, with works at Bamberton, made about 90,000 barrels of cement, worth approximately $156,000, which is a little less than the output the company made last year.

Lime.—The Rosebank Lime Company (W. F. McTavish, manager), Esquimalt, produced burnt lime to a value of about $6,000, which is only about one-third of last year's output.

Sir John Jackson, Limited, quarried, at Albert head, about $166,000 worth of riprap and about $6,000 worth of crushed rock for the company's use in the breakwater which it is constructing for the Dominion Government at Victoria.

Of pottery, tile, etc., there was produced, this past year, material valued at about $50,000, 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	401
Free miners' certificates (special)	6
Mineral claims recorded	58
Certificates of work issued	58
Bills of sale recorded	10
Certificates of improvements issued	2

Revenue.

Free miners' certificates	$4,090 00
Mining receipts, general	706 90
	$4,796 90

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, 1916:—

The following list gives the number and localities of the recorded claims in this Division:—

MINERAL CLAIMS.

Potlatch creek	12
Brew (Pacific Great Eastern)	16
Britannia creek	15
South valley	14
Furry creek (Britannia)	90
Howe sound	8
Hotham sound	2
Thornborough channel	4
Daisy lake	9
McNab creek	20
Lynn creek	7
Indian river	58
Alfa lake	8
Turn islands	1
Cheakamus lake	3
Cypress creek	11
Jervis inlet	29
North arm	5
Seymour creek	14
Alpha lake	2
Gambier island	17
Mons	15
Siwash creek	3
Pleasant lake	3
Egmont point	2
Copper creek	10
Diadem mountain	5
Staamus lake	1
Total	384

As you will see from the above list, the district around Furry creek has been the one most prospected. Most of the locations there are now held by the Britannia Mining and Smelting Company, Limited.

On Jervis inlet and vicinity a number of claims have been located near some of the old mining properties which were Crown-granted years ago.

A trail into Indian river was completed during the year by the Provincial Government, and this has greatly helped the miners in that district.

The Copper Exploration and Development Company, Limited, holds properties on the Indian river, about fourteen miles from the North arm of Burrard inlet. A camp consisting of cook-house, bunk-house, superintendent's cabin, and blacksmith's shop (fully equipped) was built on the property last summer. Prospecting was carried on during August, September, and October on the *Roy* group of claims by means of open-cuts and stripping, and a large amount of work was done in the section. The overburden was very heavy and only a limited area could be prospected, but a number of good showings of good copper ore were found, although no definite information was obtained as to the extent of the ore-bodies or the ore-zone. The showings, however, indicate the presence of good ore-bodies, and underground work is now necessary.

An assay of a sample across 8 feet, taken by the Provincial Government Engineer during a visit made by him to the property in August, gave the following results: Gold, trace; silver, 1.6 oz.; copper, 12.4 per cent.

The property was bonded during the latter part of October, and an additional cabin for the drill crew was constructed, as well as a stable, storehouse, wood-shed, and drill-house, in preparation for diamond-drilling during the winter months. Diamond-drilling has now been started, but not enough progress has been made to give any further information as to the ore occurrence at depth.

Another lot of claims in the Indian River district, held by W. J. Mogridge, was bonded in September, and the company handling this expects to start developing the property at the earliest time possible.

Eleven claims situated in South valley have been bonded, same having been recorded here in October. The bonding of a group of five claims situated in South valley was recorded in December.

Work has been carried on continuously at the *Bowena* mines, Bowen island, during the year, and Mr. Oliver, secretary of the company, has furnished me with the following particulars:—

"An additional bunk-house and ore-bunkers of 250-ton capacity have been erected and a gasolene-hoist and Klondyke tramway installed.

"A small tonnage of ore, averaging 5.5 per cent. copper and $10 in gold a ton, was mined by open-cut from the outcroppings of a vein paralleling the shore, and a sample taken at low tide across 3½ feet at the bottom of the cut by Alexander Sharp, M.E., gave assay values of: Gold, 0.70 oz. ($14) a ton; copper, 7.4 per cent. To secure further tonnage from this vein a shaft must be sunk farther inland and a drift run to the vein.

"In the meantime a shaft is being sunk on the No. 1 vein at a point 240 feet back from the shore and 150 feet above sea-level. A recent sample across 4½ feet at the bottom of this shaft ran 5.7 per cent. copper and 0.02 oz. gold. If values continue satisfactory to a depth of 50 or 60 feet, a crosscut will be run from the main tunnel, 120 feet, and an upraise made to the bottom of the shaft, thus providing ventilation and access to the ore-bunkers at the mouth of the main tunnel.

"During the year the main tunnel was extended 50 feet, and is now in a distance of 210 feet and continues in low-grade concentrating ore, a recent sample from the face running: Gold, 60 cents; silver, 0.66 oz.; copper, 1.64 per cent."

In regard to the operations of the Lynn Creek Zinc Mines, Gerald A. Kent states as follows:—

"During the whole of this year, with the exception of three months when work was shut down owing to heavy snowfall, the development-work on this property, which consists of fourteen claims, has been continuously carried on, from six to nine men being employed thereon under the directions of G. A. Kent, the bondholder.

"The summary of work now done on the property is as follows: 220 feet of main low-level tunnel, 5 x 7 feet in the clear; 250 feet of prospecting-tunnels; forty open-cuts in ore; large amount of surface stripping; construction of substantial mining camp to accommodate sixteen men, including two offices, bunk-house, cook-house, storehouse, powder-house, and blacksmith-shop; 330 feet of diamond-drilling; twelve miles of trail opened up; one mile and a half of 10-foot wagon-road.

"This work has been mainly confined to two separate veins, over a distance of 3,000 feet, which have proved to have widths varying from 150 to 155 feet. A very large tonnage of ore is now blocked out, which the bondholder estimates to amount to 700,000 tons.

"Under application made under the 'Mines Development Act," one mile and a half of 10-foot wagon-road has during the year been constructed by the Provincial Government, and it is hoped that early next year the remaining five miles and a half will be completed, which will enable the property to immediately enter the list of producers."

Mr. Donohue, secretary-treasurer of the Britannia Mining and Smelting Company, Limited, has furnished me with the following particulars concerning operations and constructive-work of the above company for the year 1916:—

"*Operations.*—Final figures are as yet not available, but should approximate:—

Tons mined	477,000
Tons product shipped to smelter	60,000

Latter containing—	
Lb. copper	17,000,000
Oz. silver	96,000
Oz. gold	800
Tons broken during year	800,000
Tons drawn during year	477,000
Tons added to reserve during year	323,000
Total tons broken	2,150,101
Total tons drawn	1,248,895
Total tons drawn	1,248,895
Total tons broken reserve	901,206
Footage of drifts, crosscuts, etc., during year—	
Drifts	8,731
Crosscuts	4,830
Winzes	90
Chutes	1,678
Raises	3,855

"*Development.*—A series of long raises were driven from the 500-foot level to the surface. The tops of these raises have been enlarged and the 'glory-hole' system of mining was commenced, which work was maintained with as large a force as possible during the fine weather in the fall. Some overburden had to be removed from places, but in parts high-grade ore continued to the cropping. Several thousand tons of good ore were taken from the 'glory-hole,' and mining at this point will again be resumed as soon as weather permits.

"In December a drift driven from the *Fairview* mine 1,000-foot level came into connection with a drift from the *Empress* mine, thus affording a passage-way through Britannia mountain on this level, as well as on the 500-foot level; the latter connection having been made in 1914.

"Considerable development-work has been completed on levels between the 1,000- and 2,200-foot levels; good ore having been shown up, especially on the 1,200-foot level.

"A new rock-raise is now being driven from the 2,200- to the 1,000-foot level to supplement the rock-raise completed last year and now being used as an ore-chute.

"At an elevation of the 1,200-foot mine level and located in Jane creek a tunnel 8 x 8 feet has been driven 1,100 feet in a southerly direction, crosscutting the ground between the *Jane* and *Bluff* mines.

"At an elevation of the 2,700-foot level a tunnel 9 x 13 feet is being driven from the head of the incline towards the main ore-zone on the general strike of the country. This tunnel has advanced 1,500 feet, and will eventually supplement the surface railway-line from the mine to the incline loading-bins.

"A crosscut tunnel 635 feet long has been driven from Mineral creek south at an elevation corresponding with the 3,100-foot mine level.

"At a distance of 250 feet from the top of the new mill at Beach a tunnel 9 x 13 feet (4,100-foot mine level) is being driven, and advanced 1,678 feet during the year. This tunnel, with a raise connection to the surface near the head of the incline, will form part of our transportation system.

"Several other smaller tunnels have been driven during the year; the following situated in South valley:—

Trout	6 x 5½	feet,	300	feet long.
Queen	6 x 5½	„	50	„
Lanz	6 x 5½	„	200	„
Harp	6 x 6	„	290	„
Tex No. 1	6 x 6	„	380	„
Tex No. 2	6 x 6	„	380	„
Uranus No. 3	6 x 6	„	440	„
Uranus No. 4	6 x 6	„	370	„

The Mountain Lake tunnel, 6 x 5½ feet, at the head of Britannia canyon, has advanced 440 feet during the year.

"*Equipment.*—Four storage-battery locomotives of the Westinghouse Oxide Cell type, each weighing 3½ tons, together with charging-panels for same, were installed on different levels during the year. These storage-battery locomotives are in addition to the two 3½-ton and 1-ton trolly locomotives which have been in service for some time.

"At the mine blacksmith's shop we installed new equipment, including shaper, drill-press, air-hammer, and a Case oil-burner. Additions to the list of drill-sharpeners, a total of five Leyners and two Sullivan now in service.

"The present equipment of machine-drills includes: 6 No. 44 Rand; 2 No. 43½ Rand; 4 3⅝ in. Woods; 30 No. 60 Dreadnaught water-machines; 12-30 Waughs; 20 Rand jack-hammers; 5 Denver clippers; 80 No. 14A Waughs; 15 No. 17v Waughs.

"The increased demand for compressed air in the mine was taken care of by the installation of two additional compressors; one Ingersoll Rand of the Rogler type, with a capacity of 3,600 cubic feet a minute, direct-connected to a 550-horse-power Pelton water-wheel and located at the tunnel power-house. The other installation was made at the Beach steam plant and consists of an Ingersoll Rand Class R.S.-3, with a capacity of 2,044 cubic feet a minute.

"*Transportation.*—The ore is handled from the loading-station at the foot of the raise on the 2,200-foot level by two systems of transportation to the old and new mills at the Beach. The railway and gravity aerial tramway deliver ore to the old mill, while the railway and incline serve the new mill.

"In addition to a 25,000-ton stock-pile established at the Beach in 1915, a new 70,000-ton storage has been created on the line of the aerial tramway, about 500 feet distant from the new mill. In order to get this storage a reinforced concrete wall was constructed, averaging 22 feet in height, with an outside batter of 2½ inches. The ore will be handled from this stock-pile to the new mill by large cars drawn by electric locomotives; the cars are loaded in a drift in 4,100 foot tunnel through raises tapping the bottom of stock-pile.

"*New Mill.*—The second half of the new mill was completed in 1916, giving a milling capacity of 2,500 tons daily, which with the old mill gives us a total capacity of better than 3,000 tons a day.

"*New Buildings.*—Several new buildings were constructed during the year, including, at the Beach: General office; warehouse; tram terminal; freight-wharf; Dorr settling-tank; extension to power-house; moving-picture theatre; 8 five-room houses; 4 four-room dwellings. At the Tunnel townsite: New school-house; fully equipped hospital, with three-bed ward, operating-room, dispensary, and nurse's quarters; engineer's office; three-story recreation-hall, with billiard-room, barber's shop, general reading-room, and dance-floor; moving-picture theatre, same as one at Beach; extension of main bunk-house 87 feet, present building providing accommodation for about 250 men; extension tunnel power-house and car-shop; central heating plant to furnish heat and hot water for main bunk-house and cook-house; 11 eight-room houses; 40 four-room houses; 1 five-room house.

"A new camp called the Barbara has been started on the south side of Britannia mountain at elevation of the 500-foot level. Two boarding-houses have been built with accommodations for a total of eighty men. Each room in this bunk-house is provided with hot and cold water and electric lights. The buildings are heated by hot-water system.

"*Power.*—Two 2,500-k.v.a. water-wheel generators have been installed in the Beach power-house. These are driven by two 3,750-horse-power Pelton water-wheels. Another unit of 2,500-k.v.a. capacity is under order. This will be driven by two Pelton water-wheels with combined power of 3,750 horse-power, water for which will be obtained from Furry creek and delivered through a system of tunnel and pipe, both wood and steel.

"Two 500-horse-power Babcock & Wilcox boilers have been added to the steam plant, making a total of four of this type and four Jenckes' boilers of smaller capacity.

"An unusually dry fall season, followed directly by cold weather, with no precipitation at the higher elevations, greatly reduced the water-supply for the upper intakes and created a shortage of power, which has retarded our output.

"We are at present completing a new battery of B. & W. boilers, and also prosecuting vigorously work on the South Valley water-power scheme, which should next year serve our needs during the times of water shortage at higher intakes along Britannia valley.

"The following table shows the amount of ore mined and the metals produced by the Britannia Mining and Smelting Company, Limited, during the past three years:—

	1914.	1915.	1916.
Tons of ore mined	239,174	202,971	434,063
Tons of ore and concentrates shipped to smelter	....	30,122	60,136
Latter containing—			
Lb. copper	11,841,232	9,058,045	15,957,719
Oz. silver	68,515	50,306	98,000
Oz. gold	213	398	791

"As you will see by the above, the amount mined in 1916 is more than double of either of the previous years, and the minerals produced are also largely in excess of former years."

Work is still being performed on the claims held by Saule Medici and associates, which claims are situate near Daisy lake, on the Pacific Great Eastern Railway, and the holders intend to install a stamp-mill on the property at an early date.

Assessment-work has been performed on most of the claims recorded during the past two years, and business in connection with this office is increasing steadily, as you will see by the accompanying statistics for the past two years.

OFFICE STATISTICS—VANCOUVER MINING DIVISION.

	1915.	1916.
Free miners' certificates issued	1,273	1,382
Special free miners' certificates issued	15	17
Quartz claims recorded	273	384
Abandonments recorded	2	10
Certificates of work issued	341	466
Surveys recorded as work	34	38
Receipts issued for money in lieu of work	...	5
Notices filed	41	44
Conveyances recorded	125	225
Certificates of improvement recorded	63	50
Crown grants applied for	...	74
Powers of attorney recorded	5	1
Revenue.		
Free miners' certificates	$7,700 75	$7,879 50
Mining receipts	2,250 25	3,538 90
	$9,951 00	$11,418 40

Many more records were issued during 1916, and there were 100 more conveyances than in 1915; and if the conveyances were counted in folios, there would be four times as many as in previous year, one conveyance alone of forty pages containing fifty-five folios.

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 1916:—

According to the office statistics there are more certificates of work issued this year than during the past year, but not so many free miners' certificates issued or new claims recorded. It would therefore appear that those interested in mining claims in the Division are steadily developing in a small way.

It is pleasing to report that a number of claims situated on Anaconda, Alexander, and Kennedy mountains, in the vicinity of Pitt lake, have been bonded to an American syndicate, and it is expected that active development will be undertaken during the coming summer.

The mineral claims recorded during the year were distributed as follows:—

Pitt lake	47
Stave river	6
Whonnock	1
Chilliwack and vicinity	12
Harrison lake and vicinity	36
	102

OFFICE STATISTICS—NEW WESTMINSTER MINING DIVISION.

Free miners' certificates issued (individual)	218
Free miners' certificates issued (company)	2
Mineral claims recorded	102
Placer claims recorded	16
Certificates of work issued	103
Certificates of improvement issued	3
Conveyances, etc., recorded	16
Grouping notices filed	6

Revenue.

Free miners' certificates	$1,055 75
Mining receipts	1,786 91
	$2,842 66

INSPECTION OF MINES.

REPORT OF THOMAS GRAHAM, CHIEF INSPECTOR.

I have the honour to submit my fifth annual report covering the year ending December 31st, 1916, as Chief Inspector of Coal and Metalliferous Mines.

The reports of the District Inspectors relative to production of coal and coke, the number of persons employed, list of accidents and prosecutions, and a brief description of the mines in the several inspectorates, and also reports of the Instructors in Mine-rescue Work and First Aid, are hereto appended.

PERSONNEL OF STAFF OF INSPECTORS AND INSTRUCTORS.

The personnel of the staff of Inspectors and Instructors is as follows:—

Inspectors.

Thomas Graham, Chief Inspector, Victoria.
James McGregor, Inspector, Nelson.
Robert Strachan, Inspector, Merritt.
John Newton, Inspector, Nanaimo.
T. H. Williams, Inspector, Fernie.
Henry Devlin, Inspector, Nanaimo.
George O'Brien, Inspector, Fernie.
J. H. McMillan, Inspector, Prince Rupert.
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.

Instructor, First Aid.

Dudley Michell, Instructor, Victoria.

TONNAGE OF COAL PRODUCED.

The year shows a marked improvement in the coal business, the demand during the latter half of the year being much greater than the production.

Much business was lost owing to scarcity of labour during the last few months of the year. The production was much below the capacity of many of the collieries, and also below the demands of the market; notwithstanding this, the production for the year was 2,487,820 tons, being an increase of 515,420 tons over 1915, but still 650,000 tons below the maximum production of 1910.

All of the coal-mining districts showed an increase in tonnage compared with the previous year. This increase of 515,420 tons was divided as follows: Vancouver Island, 92 per cent.; Nicola-Similkameen, 2 per cent.; East Kootenay, 6 per cent.

ACCIDENTS IN COAL-MINES.

The fatalities in and around the coal-mines during the year totalled twenty-eight, of which number twelve were killed in one accident, an explosion in No. 3 East mine, Michel Colliery. This total is a decrease of twenty-four from that of the previous year, but an increase of eleven over the figures of 1914, which was free from any large disasters.

During the year there were sixteen fatal accidents, and one subsequent death due to an accident which occurred in June, 1915; this is an increase of four in the number of fatal accidents, but, as already stated, a decrease in the number of persons killed compared with the figures of 1915.

There were 5,060 persons employed in and around the coal-mines, being an increase of sixty-nine over the number employed in 1915. The ratio of fatal accidents per 1,000 persons employed was 5.53, compared with 10.42 for 1915 and 2.97 for 1914. The ratio for the last ten-year period was 4.975.

The number of persons employed in and around the mines for the tonnage produced is much less than in former years; the tonnage of 1916 is only 55,000 less than that of 1913, whilst there were 1,611 less persons employed in the industry in 1916 than in 1913, reflecting steadier employment or more days' work for those employed, and a consequent greater risk for the number employed.

The following table shows the collieries at which the fatal accidents occurred:—

Canadian Collieries (Dunsmuir), Limited, Comox Colliery	6
Pacific Coast Coal Mines, Limited, South Wellington	1
Pacific Coast Coal Mines, Limited, Morden	1
Western Fuel Company, Nanaimo	3
Crow's Nest Pass Coal Company, Coal Creek	5
Crow's Nest Pass Coal Company, Michel	12
Total	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.	1916.		1915.	
	No.	Per Cent.	No.	Per Cent.
Falls of rock	7	25.00	4	7.69
Falls of coal	3	10.705	1	1.925
Haulage	5	17.86	3	5.77
Asphyxiation	1	3.57	1	1.925
Explosion	12	42.865	22	42.31
Drowning	..	....	19	36.54
Surface, miscellaneous	..	....	2	3.84
Totals	28	100.00	52	100.00

Again the loss of life by one accident—the explosion at No. 3 East mine, Michel—affects the percentage table in reference to accidents from falls of roof, falls of coal, and haulage, the three items which bulk largely in the percentage tables under normal years.

Last year it was pointed out that in 1913 and 1914 accidents from the three above causes were 85.19 and 64.72 per cent. of the whole respectively, whilst in 1915 they only showed 15.385 per cent.; this was due to the large number of men lost (forty-one) in two accidents. Again this year they are similarly affected by the twelve lives lost in one disaster, the percentage being 53.565; and to obtain the true proportion of these to former years it will be necessary to set aside the twelve lives lost by the major accident at Michel. This would bring the percentage of falls of roof, falls of coal, and haulage up to 93.75 for 1916.

TONNAGE OF METALLIFEROUS MINES.

The output from the metalliferous mines for 1916 was 3,188,865 tons, being an increase of 498,755 tons over the figures for 1915. This tonnage was produced from 169 shipping mines, eighty-one of which shipped over 100 tons.

ACCIDENTS IN METALLIFEROUS MINES.

There were sixteen separate fatal accidents in and around the metal-mines during the year, causing the death of twenty persons, being a decrease of one in the number of accidents, but an increase of three in the number of fatalities, compared with the figures of 1915.

There were 5,305 persons employed in and around the metalliferous mines, an increase of 1,251 persons, compared with the corresponding figures of the previous year.

The ratio of fatal accidents per 1,000 persons employed was 3.71, compared with 4.10 for 1915. The ratio for the last ten-year period was 4.32.

The mines at which the fatalities occurred are:—

Iron Mask, Kamloops	1
Granby, Phoenix	4
Granby, Anyox	5
Britannia, Britannia Beach	5
Silver Queen and Ruby mine, Atlin	2
Motherlode, Greenwood	1
Le Roi, Rossland	1
Hewitt, Silverton	1
Total	20

The following table gives the cause and percentage to the whole of the fatal accidents, with the corresponding figures for 1915:—

Cause.	1916.		1915.	
	No.	Per Cent.	No.	Per Cent.
Falls of ground	6	30.00	5	29.41
Falling into chutes, raises, winzes, etc	2	10.00	4	23.53
Shafts	1	5.00	..	....
Mine-cars and haulage	2	10.00	..	....
Picking or drilling into unexploded powder	..	....	2	11.77
Asphyxiation from powder-fumes	2	10.00	1	5.88
Returning on unexploded shots	1	5.00	1	5.88
Premature blasts	2	10.00	..	....
Electricity	1	5.00	..	....
Mine-fire	..	....	1	5.88
Sliding material in chutes	..	....	2	11.77
Hit with flying rock from shot	1	5.00	1	5.88
Broken compressed-air pipe	2	10.00	..	....
Totals	20	100.00	17	100.00

Explosives in the various forms account for six lives, or 30 per cent. of the whole number of fatalities, the percentage of this class of accident in 1915 being 23.53, an increase of 6.47 per cent. for this year. Falls of ground caused six deaths, or 30 per cent. of the whole, an increase of 0.59 per cent. over the previous year. Chute accidents caused the loss of two lives, or 10 per cent., compared with 23.53 per cent. in the previous year, a reduction of 13.53 per cent.

During the year the production of mineral in tons was greater than in any former year; the demand for underground labour was great, and the class of labour obtainable, generally, was less experienced than in former years, considerably increasing the risk of accident.

Much good 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.

EXPLOSIVES.

I am pleased to say that much progress has been made during the year in the large metal-mines in extending the practice of tamping shots, with beneficial results, reducing the quantity of explosives used, as well as the dangerous fumes from imperfectly detonated powder.

EXPLOSIVES IN COAL-MINES.

During the year two supplementary orders were issued, adding to the explosives contained in Explosives Order No. 2 of September 8th, 1915. The full list of explosives now on Permissible Order and Supplementary Orders are as follows:—

Monobel A1	British List.
Monobel No. 1	"
Polar Permitite*	"
Monobel†	United States List.
"Giant" Coal-mine Powder No. 5	" "
"Giant" Coal-mine Powder No. 6	" "
"Giant" Coal-mine Powder No. 7	" "
"Giant" Coal-mine Powder No. 8	" "
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 1916, together with number of shots fired, how shots were fired, tons of coal produced per pound of explosive used, and pounds of explosive per shot:—

Districts.	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.	Pounds of Explosive per Shot fired.
Vancouver Island.....	432,393	1,495,002	481,124	116,321	597,445	3.45	0.72
Nicola-Similkameen	25,770	110,549	45,166	....	45,166	4.28	0.54
East Kootenay.....	44,846	882,269	24,043	1,183	25,226	19.67	1.77
Totals.....	503,009	2,487,820	550,333	117,504	667,837	4.94	0.75

The production of coal per pound of explosive used is 1.03 tons less than that of the previous year. This is largely due to the heavy use of explosives in removing overburden from the coal in the open pit or surface workings of the Corbin Coal and Coke Company, Corbin, B.C., where 25,257 lb. of dynamite, stumping, and common black blasting-powder was used breaking the overburden for removal by steam-shovel. This reduced the yield per pound of explosive used in the East Kootenay from 42.17 tons in 1915 to 19.67 tons in 1916.

The Coal Creek Colliery of the Crow's Nest Pass Coal Company produced a little in excess of 500,000 tons of coal without the use of explosives in the coal; only 3,496 lb. of explosive was used at this colliery during the year, this being largely used in outside work.

The Nicola-Similkameen District showed an increase of 1.68 tons per pound of explosive used, the yield being 4.28 tons per pound.

The Vancouver Island mines showed a decrease in production per pound of explosive, the yield being 3.45 tons, compared with 4.75 tons for 1915.

MACHINE-MINED COAL.

During the year mining-machines produced 279,630 tons of coal, or 11.24 per cent. of the whole. This is a slight increase over the figures of 1915, when the percentage of machine-mined coal was 10.43.

Of the total machine-mined coal, the Western Fuel Company produced 229,541 tons, or 82.10 per cent.; the Canadian Collieries (Dunsmuir), Limited, 30,089 tons, or 10.76 per cent.; and the Princeton Coal and Land Company, Princeton, 20,000 tons, or 7.14 per cent.

* Polar Permitite is known on the British List as "Super-Rippite."
† Monobel is known in the United States List as "Monobel No. 1," but is designated "Monobel" in this list to prevent confusion with "Monobel No. 1" of the British List.
‡ Polar Brushite is known on the United States List as "Carbonite No. 1."

The following tables give the district, number of machines, how driven, tons of coal produced, and types of machines in use:—

District.	Number driven by		Tons of Coal produced.		Total in Tons.
	Electricity.	Compressed Air.	Electricity.	Compressed Air.	
Nicola-Similkameen	..	4	....	20,000	20,000
Vancouver Island	5	18	30,089	229,541	259,630
Totals	5	22	30,089	249,541	279,630

Type of Machines in Use.

Type.	District.		Total.
	Nicola-Similkameen.	Vancouver Island.	
"Percussive" Post	4	13	17
"Bar" Longwall	..	5	5
"Chain" Shortwall	..	5	5
Totals	4	23	27

Safety-lamps.

There were 3,764 safety-lamps in use in the coal-mines of the Province, an increase of 429, or 11.45 per cent. over the previous year. Of this number, 3,662 were flame-lamps of the Wolf type and 102 were electric lamps of various makes, an increase of seventy-eight in this latter type of lamp during the year. The following table shows the distribution of lamps by districts, method of locking, and the illuminant used:—

District.	No.	Method of Locking.		Illuminant.	
		Magnetic.	Screw.	Naphtha.	Electricity.
East Kootenay	1,145	1,140	5	1,140	5
Nicola-Similkameen	359	357	2	357	2
Vancouver Island	2,260	2,249	11	2,165	95
Totals	3,764	3,746	18	3,662	102

Mine-air Sampling.

During the year 176 mine-air samples were taken in the coal-mines of the Province. Of this number, twenty-three samples were spoiled in transit, accidents in laboratory, or by reason of incomplete record.

One sample was taken from every split and two samples from the main return of every operating coal-mine, and in the Crow's Nest Pass Collieries samples were taken on days when the mines were idle for comparative purposes.

Much valuable information has been obtained from these samples relative to the flow of methane from the various coal-seams being worked, and incidentally the data acquired goes to prove what has long been surmised, that the coal-seams operated by the Crow's Nest Pass Coal Company, Limited, at Coal Creek and Michel Collieries, may be classed as being among the most gaseous seams being operated anywhere in the world.

The following table shows the tabulated data obtained from the mine-air sampling during 1916:—

Returns from Mine-air Samples taken in the Various Coal-mines of the Province of British Columbia.

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 per Minute.	Volume of Air 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.				
	1916.																			
25	Feb. 23	No. 1 East	East side of tunnel	Idle	1,500	400	0.08	20.35	1.37	77.70	200	15,400	26.2	47	44	85	288.0	414,720	15,386	1,036
27	" 23	"	Main return	"	1,500	....	5.10	20.54	1.23	78.13	1,900	152,000	26.2	45	44	92	1,869.0	2,691,360	99,849	1,794
39	" 24	"	Diagonal	Work'g.	1,500	400	0.09	20.49	1.49	77.93	400	30,800	26.3	50	46	73	459.0	660,960	24,521	1,652
40	" 24	"	East side of tunnel	"	1,500	400	0.11	20.22	2.73	76.94	150	12,000	26.3	47	44	73	327.0	470,880	17,469	1,177
41	" 24	"	West side of tunnel	"	1,500	700	0.14	20.06	2.97	76.83	250	20,000	26.3	48	46	85	594.0	855,360	31,733	1,222
48	April 14	"	Main return	"	1,500	....	0.10	20.40	1.73	77.77	2,100	168,000	25.9	48	46	85	2,906.0	4,184,640	155,250	2,789
49	" 16	"	Diagonal	Idle	1,500	400	0.12	20.36	1.67	77.85	500	33,000	26.2	52	46	63	551.0	793,440	29,436	1,983
50	" 16	"	West side of tunnel	"	1,500	700	0.10	20.38	2.04	77.48	250	21,000	26.2	50	48	86	428.0	616,320	22,865	880
52	Aug. 4	"	10 East (Diagonal)	"	1,500	450	0.15	20.27	1.52	78.06	200	13,200	26.2	57	55	87	200.0	288,000	10,684	640
53	" 4	"	No. 14 East	"	1,500	450	0.09	20.41	1.28	78.22	230	18,400	26.2	57	55	87	235.0	338,400	12,554	752
54	" 4	"	West side of tunnel	"	1,500	600	0.12	20.30	1.55	78.03	350	32,000	26.2	58	57	93	496.0	714,240	26,498	1,190
55	" 4	"	Main return	"	1,500	....	0.13	20.37	1.11	78.39	1,400	112,000	26.2	54	54	100	1,243.0	1,789,920	66,406	1,193
66	Oct. 3	"	Diagonal	Work'g.	1,400	460	0.19	20.17	2.11	77.53	450	39,000	25.8	58	55	80	822.9	1,184,976	44,962	2,962
67	" 3	"	No. 14 East	"	1,400	400	0.14	20.14	2.57	77.15	180	13,000	25.8	59	55	76	334.1	481,104	17,848	1,202
68	" 3	"	West side	"	1,400	600	0.13	20.39	1.74	77.84	700	42,000	25.8	57	56	87	730.8	1,052,352	39,040	1,753
81	Nov. 2	"	Main return	"	1,400	...	0.15	20.21	1.72	77.92	2,000	160,000	25.8	53	53	100	2,752.0	3,962,880	147,022	2,830
43	Feb. 26	No. 1 South	"	Idle	400	....	0.05	20.66	1.14	78.15	250	19,250	26.2	44	43	93	218.0	313,920	11,646	784
46	" 28	"	"	Work'g.	400	....	0.08	20.56	1.28	78.08	275	21,000	26.2	45	44	92	268.0	385,920	14,317	964
60	Aug. 4	"	"	Idle	400	....	0.32	19.84	1.97	77.87	420	21,800	26.2	57	56	93	429.0	617,760	22,918	1,544
70	Oct. 3	"	"	Work'g.	400	....	0.36	19.76	2.44	77.44	540	27,000	25.8	50	50	100	458.8	660,672	24,510	1,651
23	Feb. 22	No. 1 North	"	"	170	....	0.11	20.63	0.33	78.93	140	8,400	26.2	54	52	86	27.0	38,880	1,442	228
44	" 25	"	"	Idle	170	....	0.07	20.85	0.27	78.81	125	7,500	26.3	52	52	100	20.0	28,800	1,068	169
64	Aug. 5	"	"	"	150	....	0.08	20.70	0.22	79.00	150	7,000	26.2	57	56	93	15.0	21,600	801	144
78	Oct. 6	"	"	Work'g.	150	....	0.09	20.60	0.63	78.68	150	13,860	26.0	56	56	100	86.9	125,136	4,642	864
32	Feb. 23	No. 2	"	Idle	300	....	0.09	20.40	1.42	78.09	350	15,700	26.2	53	53	100	223.0	321,120	11,903	1,070
33	" 24	"	"	Work'g.	300	....	0.09	20.48	1.39	78.04	400	18,000	26.3	53	53	100	250.0	360,000	13,356	1,200
59	Aug. 4	"	"	Idle	250	....	0.14	20.43	0.80	78.63	250	17,500	26.2	60	60	100	140.0	201,600	7,479	806
69	Oct. 3	"	"	Work'g.	230	....	0.16	20.42	0.98	78.44	350	21,000	25.8	60	60	100	205.8	296,352	10,994	1,288
28	Feb. 23	No. 3	Left side of slope	Idle	250	35	0.06	20.54	1.33	77.57	200	9,000	26.2	52	49	86	164.0	236,160	8,761	6,747
29	" 23	"	Main return	"	250	...	0.09	20.65	1.01	78.25	900	37,800	26.2	55	53	86	381.0	548,640	20,354	2,194
30	" 23	"	Right side of slope	"	250	40	0.12	20.66	1.10	78.12	130	6,000	26.2	50	48	86	66.0	95,040	3,525	2,376
31	" 23	"	South level	"	250	175	0.15	20.32	2.29	77.24	130	10,000	26.2	48	46	85	229.0	329,760	12,234	1,884
34	" 24	"	Right side of slope	Work'g.	250	175	0.16	20.30	2.05	77.49	130	10,000	26.2	57	55	87	205.0	295,200	10,951	1,686
35	" 24	"	Left side of slope	"	250	40	0.10	20.55	1.15	78.20	130	6,000	26.3	55	53	87	69.0	99,360	3,686	2,484
36	" 24	"	Left side of slope	"	250	35	0.11	20.36	2.26	77.27	200	9,000	26.3	54	50	75	203.0	292,320	10,845	8,352
47	April 14	"	Main return	"	250	....	0.15	20.38	1.89	77.58	900	40,500	25.9	56	54	87	765.0	1,001,600	37,159	4,006
56	Aug. 4	"	South level	Idle	230	200	0.15	20.42	1.40	78.03	200	14,400	26.2	60	58	88	201.0	289,440	10,738	1,447
57	" 4	"	Main return	"	230	....	0.11	20.54	1.11	78.24	750	41,800	26.2	55	54	93	463.0	666,720	24,735	2,898
58	" 4	"	Left side of slope	"	230	30	0.09	20.61	0.92	78.38	240	10,500	26.2	55	54	93	96.0	138,240	5,128	4,608
71	Oct. 4	"	South level	Work'g.	230	230	0.21	20.28	2.06	77.45	200	13,000	26.0	61	59	82	267.8	385,632	14,306	1,676
72	" 4	"	Main return	"	230	....	0.15	20.50	1.32	78.03	600	42,000	26.0	58	56	87	554.4	798,336	29,618	3,471
38	Feb. 24	"B" North	"	"	300	....	0.10	20.69	1.09	78.12	250	19,500	26.2	47	47	100	212.0	305,280	11,325	1,017
51	April 16	"	"	Idle	300	....	0.06	20.67	0.78	78.49	450	35,100	26.2	47	47	100	273.0	393,120	14,584	1,810
61	Aug 5	"	"	"	300	....	0.18	20.55	0.56	78.71	330	32,000	26.2	50	50	100	179.0	257,760	9,662	859
62	" 5	"	Incline split	"	300	200	0.10	20.60	0.86	78.44	90	8,100	26.2	51	50	93	69.0	99,360	3,686	496
63	" 5	"	Slope split	"	300	100	0.05	20.81	0.16	78.98	100	10,500	26.2	52	50	86	16.0	23,040	864	230

RETURNS FROM MINE-AIR SAMPLES—*Continued.*

Coal Creek Colliery—Concluded.

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 per Minute.	Volume of Air 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.
	1916.																			
*77	*Oct. 4*	*"B" North*	*Slope split*	Work'g.	250	36	0.09	20.73	0.40	78.78	200	8,000	26.0	50	50	100	32.0	46,080	1,709	1,536
79	Nov. 2	"	Main return	"	250	....	0.10	20.61	0.77	78.52	320	31,000	25.8	50	50	100	238.7	343,728	12,752	1,374
80	" 2	"	Incline	"	250	220	0.15	20.46	1.32	78.08	240	13,400	25.8	53	53	100	242.8	349,632	12,971	1,589
			Michel Colliery.																	
30	Jan. 7	Old No. 3	West incline split	Work'g.	375	65	0.08	20.79	0.07	79.06	100	4,000	25.5	45	43	85	2.8	4,032	149	62
31	" 7	"	No. 3 slope split	"	375	150	0.12	20.23	2.41	77.24	60	4,500	25.5	44	44	100	108.0	155,520	5,769	1,036
32	" 7	"	East side of mine	"	375	160	0.18	20.18	2.30	77.34	440	31,680	25.5	48	46	85	726.0	1,045,440	38,785	6,634
39	" 12	"	West incline split	Idle	375	65	0.16	20.16	2.04	77.64	260	3,640	25.8	51	50	93	73.0	105,120	3,899	1,617
40	" 12	"	No. 3 slope	"	375	150	0.10	20.30	2.09	77.51	70	5,200	25.8	44	43	92	108.0	155,520	5,769	1,036
41	" 12	"	East side of mine	"	375	160	0.15	20.19	2.18	77.48	400	25,200	25.8	49	48	92	549.0	790,560	29,329	2,108
42	" 12	"	Main return	"	375	....	0.16	20.21	1.83	77.80	600	60,000	25.8	48	47	92	1,098.0	1,581,120	58,659	4,216
43	Feb. 16	"	Main return	Work'g.	375	....	0.18	20.29	1.76	77.77	800	80,000	26.0	50	48	86	1,408.0	2,027,520	75,220	5,407
57	Oct. 9	"	No. 2 slope split	Idle	240	90	0.15	20.39	1.60	77.86	610	36,600	26.3	55	53	86	585.6	843,264	31,285	9,369
58	" 9	"	Main return	"	240	....	0.20	20.28	1.55	77.97	800	80,000	26.3	52	52	100	1,240.0	1,785,600	66,245	7,440
65	" 24	"	No. 3 slope split	Work'g.	240	150	0.14	20.35	1.44	78 07	675	27,000	25.9	50	50	100	388.8	559,872	20,771	3,732
66	" 24	"	No. 2 slope split	"	240	90	0.15	20.28	1.88	77.69	620	37,200	25.9	53	53	100	699.3	1,006,992	37,359	11,188
67	" 24	"	Main return	"	240	....	0.21	20.23	1.60	77.96	850	85,000	25.9	53	51	86	1,360.0	1,958,400	72,656	3,160
26	Jan. 7	No. 3 East	West side of slope	"	550	180	0.09	20.53	1.46	77.92	200	23,400	25.5	40	40	100	341.0	491,040	18,217	2,728
28	" 7	"	No. 8 West	"	550	130	0.05	20.71	0.83	78.41	225	24,750	25.5	36	36	100	205.0	295,200	10,951	2,270
29	" 7	"	Main return	"	550	....	0.10	20.47	1.27	78.16	1,500	120,000	25.5	40	40	100	1,524.0	2,194,560	81,418	3,990
34	" 12	"	No. 6 East	Idle	550	120	0.07	20.55	1.08	78.30	500	18,000	25.8	44	44	100	194.0	279,360	10,364	2,328
35	" 12	"	West side of slope	"	550	180	0.08	20.55	1.19	78.18	165	19,305	25.8	38	37	91	229.0	329,760	12,234	1,832
36	" 12	"	East side of slope	"	550	120	0.06	20.57	0.96	78.41	400	16,000	25.8	34	33	89	153.0	220,320	8,173	1,836
37	" 12	"	No. 8 West	"	550	130	0.06	20.53	1.28	78.13	160	16,500	25.8	34	33	89	211.0	303,840	11,272	2,337
38	" 12	"	Main return	"	550	....	0.10	20.43	1.22	78.25	1,500	120,000	25.8	40	40	100	1,464.0	2,108,160	78,212	3,833
44	Feb. 17	"	No. 6 East	Work'g.	550	120	0.06	20.54	1.24	78.16	550	19,800	26.0	42	40	84	245.0	352,800	13,088	2,940
45	" 17	"	*East side of slope*	"	*550*	*120*	*0.07*	*20.63*	*1.17*	*78.13*	*425*	17,000	26.0	36	34	82	198.0	285,120	10,557	2,376
52	Sept. 26	"	Main return (mine under repair)*	"	.....	....	0.10	20.60	0.88	78.42	1,600	105,600	25.6	47	47	100	929.0	1,337,760	49,630	.....
53	" 27	New No. 8	East side	"	450	420	0.10	20.74	0.10	79.03	280	22,400	25.7	49	47	85	29.0	41,760	1,549	99
54	" 27	"	West side	"	450	30	0.18	20 70	0.09	79.03	150	12,600	25.7	47	47	100	11.0	15,840	587	528
55	" 27	"	Main return	"	450	....	0.10	20.75	0.10	79.05	650	40,950	25.7	47	47	100	40.0	57,600	2,136	128
59	Oct. 9	"	East side	Idle	450	420	0.05	20.77	0.10	79.08	200	21,600	25.8	47	47	100	21.6	31,104	1,153	74
60	" 9	"	West side	"	450	30	0.05	20.87	0.02	79.06	160	13,440	25.8	49	47	86	2.6	3,744	138	124
61	" 9	"	Main return	"	450	....	0.07	20.75	0.07	79.11	650	40,950	25.8	50	50	100	28.6	41,184	1,527	91

* Mine had not produced coal since August 8th, 1916.

Corbin Colliery.

62	Oct.	18	No. 4.	"A" Level	Work'g.	175	....	0.06	20.77	0.08	79.09	150	8,400	24.0	40	40	100	6.7	9,648	358	55
63	"	18	"	500 and 600 Levels	"	175	145	0.06	20.77	0.13	79.04	112	11,200	24.5	38	38	100	14.5	20,880	774	144
64	"	18	"	400 Level	"	175	30	0.06	20.80	0.14	79.00	90	9,900	24.5	40	40	100	13.8	19,872	737	662

Princeton and Merritt Collieries.

10	Feb.	21	Princeton	Main return	Work'g.	100	....	0.18	20.53	0.19	79 10	460	36,800	27.8	53	53	100	69.0	99,360	3,825	993
22	Nov.	'10	"	"	"	227	....	0.08	20.64	0.14	79.14	450	36,000	28.2	35	35	100	50.4	72,576	2,794	319
12	May	8	Pacific Coal Syn.	"	"	3	...	0.09	20.82	0.05	79.04	110	10,500	27.5	67	60	65	5.2	7,560	291	2,520
24	Dec.	12	"	"	"	4	....	0.04	20.81	0.02	79.13	220	12,320	28.2	48	48	100	2.4	3,456	133	864
11	Mar.	1	Coal Hill No. 3	"	"	90	....	0.05	20.82	0.03	79.10	740	18,500	26.6	38	38	100	5.5	7,992	307	88
16	Sept.	7	"	"	"	125	....	0 14	20.58	0.11	79.17	200	4,000	26.9	50	50	100	4.0	5,760	221	46
17	"	7	"	Main return No. 5 seam	"	.....	75	0.14	20.58	0.06	79.22	160	7,500	26.9	51	51	100	4.0	5,760	221	76
14	May	12	Middlesboro No. 4	"	"	80	....	0.15	20.53	0.10	79.22	580	20,280	28.0	55	54	93	20.0	28,800	1,108	360
20	Nov.	3	"	"	"	70	....	0.07	20.64	0.08	79.21	500	18,000	27.4	53	52	93	14.4	20,736	798	296
23	Dec.	6	"	"	"	70	....	0.10	20.50	0.04	79.36	700	42,000	28.8	38	38	100	16.8	24,192	931	345
13	May	5	Middlesboro No. 4 E.	"	"	15	....	0.06	20.86	0.07	79.01	300	10,800	28.0	58	48	49	7.5	10,800	415	720
21	Nov.	2	"	"	"	22	....	0.07	20.78	0.10	79.05	180	11,520	28.0	51	51	100	11.5	16,560	637	752
15	May	12	Middlesboro No. 7	"	"	70	....	0.09	20.70	0.12	79.09	620	33,480	28.0	51	51	100	40.0	57,600	2,217	822
19	Nov.	3	"	"	"	115	....	0.05	20.78	0.05	79.12	500	27,000	27.4	51	51	100	13.5	19,440	748	169

Vancouver Island Collieries.

25	May	10	East Wellington	No. 1 split	Work'g.	220	98	0.10	20.85	0.08	78.97	600	32,000	29.5	55	55	100	26.0	37,440	1,602	382
26	"	10	"	No. 2 split	"	220	21	0.15	20.77	0.09	78.99	370	14,060	29.5	56	55	93	12.0	17,280	739	822
27	"	10	"	No. 3 split	"	220	101	0.15	20.69	0.27	78.89	380	12,540	29.5	58	57	93	34.0	48,960	2,096	484
28	"	10	"	Main return	"	220	....	0.14	20.77	0.15	78.94	1,200	65,000	29.5	56	55	93	90.0	129,600	5,546	589
35	Sept.	5	"	"	"	210	....	0.14	20.63	0.17	79.06	800	51,600	29.1	58	57	93	87.0	125,280	5,361	696
37	Oct.	13	South Wellington	"	Idle	280	....	0.22	20.39	0.19	79.20	300	18,000	30.1	57	56	93	34.2	49,248	2,107	175
22	April	12	Morden	"	Work'g.	400	....	0.05	20.72	0.56	78.67	470	55,930	30.1	48	47	92	313.0	450,720	19,290	1,127
36	Oct.	12	"	"	"	350	....	0.05	20.74	0.31	78.90	600	48,000	30.2	52	51	93	148.8	214,272	9,170	612
19	Mar.	8	Reserve	West side	"	340	100	0.09	20.65	0.71	78.55	360	18,300	30.2	53	51	90	130.0	187,200	8,012	1,872
20	"	8	"	East side	"	340	240	0.06	20.69	0.14	79.11	520	31,200	30.2	51	49	89	43.0	61,920	2,650	258
23	April	14	"	Main return	"	340	....	0.08	20.73	0.23	78.96	700	63,000	30.1	55	54	93	144.0	207,360	8,875	668
34	Aug.	11	"	Main return	"	355	....	0.06	20.63	0.32	78.99	780	62,400	30.1	68	67	94	199.0	286,560	12,265	807
29	June	15	No. 1 mine, N. side.	No. 2 slope	"	1,000	460	0.31	20.04	0.29	79.36	800	32,000	30.1	61	59	93	92.0	132,480	5,690	288
30	"	15	"	North of Nos. 1 and 3 slopes	"	1,000	460	0.25	20.26	0.37	79.12	300	12,000	30.1	56	55	93	44.0	63,360	2,711	137
31	"	15	"	North of No. 1 slope and part of No. 2.	"	1,000	80	0.26	20.36	0.20	79.18	1,000	30,000	30.1	64	63	94	60.0	86,400	3,697	1,080
38	Nov.	20	"	N.E. slope and No. 1 slope	"	970	....	0.34	20.08	0.25	79.38	800	42,500	30.2	61	60	93	106.0	152,640	6,532	157
40	"	20	"	No. 3 slope and N. side of No. 2 slope	"	970	....	0.27	20.25	0.30	79.18	360	20,880	30.2	60	58	93	62.4	89,856	3,845	92
14	Jan.	24	No. 1 Mine, S. side.	East dip	"	600	90	0.14	20.44	0.18	79.24	1,200	6,000	30.0	65	64	93	10.0	14,400	616	160
15	"	24	"	Diagonal	"	600	300	0.15	20.49	0.28	79.08	300	11,880	30.0	65	64	93	33.0	47,520	2,033	158
16	"	24	"	Diagonal, South side	"	600	90	0.29	19.90	0.59	79.22	500	4,000	30.0	65	64	93	23.0	33,120	1,417	368
17	Feb.	9	"	South heading	"	600	80	0.29	20.26	0.35	79.10	160	9,600	29.8	65	64	93	33.6	48,384	2,070	604
18	"	9	"	Main return	"	600	....	0.25	20.19	0.37	79.19	950	47,500	29.8	65	64	93	175.7	253,080	10,831	421
24	May	8	"	No. 4 split	"	640	64	0.38	19.80	0.72	79.10	1,400	4,200	29.9	65	64	93	30.0	43,200	1,848	675
32	July	7	"	Main return	"	700	....	0.30	19.89	0.39	79.42	1,050	52,500	30.0	65	65	100	204.0	293,760	12,572	419
30	Oct.	21	Extension No. 1	West side	"	280	120	0.20	20.49	0.13	79.18	240	12,720	29.3	54	54	100	26.5	38,160	1,633	318

RETURNS FROM MINE-AIR SAMPLES—*Concluded.*

Vancouver Island Collieries—Concluded.

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 per Minute.	Volume of Air 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.				
	1916.																			
31	Oct. 21	Extension No. 1	East side	Work'g.	280	160	0.16	20.61	0.06	79.17	190	10,450	29.3	55	55	100	6.2	8,928	382	55
32	" 21	"	Main return	"	280	....	0.21	20.37	0.09	79.33	640	35,400	29.3	56	56	100	31.8	45,792	1,959	163
36	Nov. 14	"	Main return	"	280	...	0.20	20.54	0.07	79.19	640	55,200	29.5	56	56	100	38.6	55,584	2,378	198
22	Sept. 27	Extension No. 2	West side	"	130	55	0.39	19.92	0.29	79.40	250	8,750	29.5	60	59	93	25.3	36,432	1,559	662
23	" 27	"	No. 2 East	"	130	38	0.39	20.01	0.07	79.53	200	7,000	29.5	57	56	93	4.9	7,056	301	185
24	" 27	"	No. 4 East	"	130	37	0.50	20.05	0.03	79.42	270	8,100	29.5	62	61	94	2.4	3,456	147	93
25	" 27	"	Main return	"	130	....	0.43	20.05	0.10	79.42	430	25,800	29.5	60	59	93	25.8	37,152	1,590	285
38	Nov. 20	"	Main return	"	230	....	0.39	20.06	0.10	79.45	700	31,500	29.6	60	59	93	31.5	45,360	1,941	197
19	Sept. 26	Extension No. 3	No. 1 split	"	200	150	0.44	19.94	0.19	79.43	300	15,000	29.2	62	61	94	28.5	41,040	1,756	273
20	" 26	"	No. 2 split	"	200	50	0.09	20.69	0.34	78.88	230	8,280	29.2	56	55	93	27.8	40,147	1,718	802
39	Nov. 20	"	Main return	"	275	....	0.49	19.72	0.20	79.59	450	27,000	29.6	62	61	94	54.0	77,760	3,328	282
33	Oct. 23	Extension No. 4	West side	"	250	70	0.07	20.77	0.09	79.07	310	10,850	29.7	52	50	86	9.7	13,968	597	199
34	" 23	"	East side	"	250	180	0.07	20.69	0.12	79.10	170	10,200	29.7	54	53	93	12.2	17,568	751	97
35	" 23	"	Main return	"	250	....	0.09	20.68	0.05	79.18	1,000	50,000	29.7	56	56	100	25.0	36,000	1,540	144
37	Nov. 17	"	Main return	"	250	...	0.09	20.65	0.06	79.20	700	49,000	29.7	56	56	100	29.4	42,336	1,811	169
4	April 11	Comox No. 4	East side, No. 2 slope	"	770	143	0.20	20.36	0.81	78.63	750	26,250	29.6	63	61	88	212.0	305,280	13,065	2,134
6	" 11	"	West side, No. 2 slope	"	770	200	0.23	20.09	0.70	78.98	1,000	25,000	29.6	66	62	78	175.0	252,000	10,785	1,260
8	" 13	"	East side, No. 1 slope	"	770	327	0.22	20.00	1.19	78.59	500	22,000	29.7	58	57	93	238 0	342,720	14,668	1,046
9	" 13	"	Main return	"	770	....	0.35	20.06	0.48	79.11	1,850	133,200	29.7	57	57	100	639.0	920,160	39,382	1,195
26	Oct. 6	"	No. 1 split, No. 1 slope	"	750	60	0.69	18.93	1.32	79.06	360	10,800	29.8	62	62	100	142.5	205,200	8,782	3,420
27	" 6	"	Main return	"	750	....	0.53	19 60	0.37	79.00	2,200	158,400	29.8	58	58	100	1,378.0	1,984,320	84,928	2,645
15	June 13	Comox No. 6	No. 1 split	"	563	212	0.13	20.34	0.30	79.23	600	22,500	29.8	58	56	87	67.0	96,480	4,129	455
16	" 13	"	No. 2 split	"	563	217	0.12	20.60	0.12	79.16	600	21,000	29.8	54	52	86	25.0	36,000	1,540	166
17	" 13	"	No. 3 split	"	563	134	0.10	20.63	0.10	79.12	370	11,100	29.8	54	53	93	11.0	15,840	677	118
18	" 13	"	Main return	"	563	....	0.10	20.52	0.15	79.23	1,300	70,200	29.8	54	54	100	105.0	151,200	6,471	268
29	Oct. 11	"	Main return	"	500	....	0.14	20.26	0.25	79.35	1,300	65,000	29.7	52	52	100	162.5	234,000	10,015	468
10	May 9	Comox No. 7	No. 3 East	"	690	210	0.12	20.72	0.17	78.99	500	22,500	29.7	48	48	100	38.0	54,720	2,342	260
11	" 9	"	Main return	"	690	....	0.11	20.65	0.23	79.01	2,200	169,400	29.7	48	48	100	389.0	560,160	23,974	811
12	" 10	"	No. 1 West	Idle	690	190	0.09	20.64	0.09	79.18	650	19,500	30.0	52	52	100	17.0	24,480	1,047	128
13	" 10	"	No. 2 West	"	690	200	0.05	20.80	0.02	79.13	550	16,500	30.0	54	54	100	3.0	4,320	184	21
28	Oct. 10	"	Main return	Work'g.	450	....	0.10	20.58	0.29	79.03	2,210	170,170	30.0	48	48	100	493.0	709,920	30,384	1,577

It will be noted that, for the purpose of comparison between idle and working days, the methane outflow a ton of coal is obtained by assuming the same tonnage on idle days as on working days. The period of idleness rarely exceeded one day, the samples being taken on either a holiday or a Sunday. The difference in volume of outflow is, as a whole, less on the idle-day samples than in those of working days, although rarely very marked, and in a few instances there is an increase for the idle day; the time lapsed between breaking down coal and taking of sample being from twelve to fifteen hours is insufficient to be a very reliable guide on what decrease in flow might occur from an extended period of idleness. An effort will be made to obtain such a series should opportunity offer.

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. Dr. Haanel has further consented to extend the mine-air sampling to the metal-mines of our Province, commencing January 1st, 1917.

USE OF GASOLENE IN MINES OF PROVINCE.

Several inquiries reached me during the year relative to the use of gasolene-driven motors, pumps, hoists, etc., underground. As neither the Coal nor Metalliferous Mines Acts touched upon the subject, the following circular was sent to the District Inspectors for guidance on the subject:—

"In view of frequent requests reaching the Department for permission to use gasolene-driven machinery in the mines of the Province, it is deemed essential that the attitude of the Department on the use of such machinery should be clearly defined.

"After careful study of the matter, the following rulings are laid down for your guidance in such matters:—

"No. 1. No gas-driven engine of any description shall be permitted underground in any coal-mine.

"No. 2. No gas-driven motor shall be permitted underground in any metalliferous mine.

"No. 3. No gas-driven stationary engine shall be permitted underground in any metalliferous mine where other sources or modes of power are available.

"No. 4. The Inspector of Mines may, with the approval of the Chief Inspector of Mines, grant permission to use gasolene stationary engines underground in metalliferous mines in prospecting or development work where no other mode of power is available, or where the location of the mine or prospect is so situated that the Inspector is of the opinion that the application of other power is not practicable; provided the following regulations are observed:—

"(*a.*) No person or persons shall be lowered or hoisted in a shaft or incline where the power is furnished by a gasolene-engine:

"(*b.*) The exhaust gases from the engine must be conveyed in pipes from the engine to the surface:

"(*c.*) Only sufficient gasolene to operate the engine for an eight-hour shift shall be kept underground:

"(*d.*) Notice of such regulations shall be posted in a conspicuous place at the mouth of the mine and at the point where the engine is situated in the mine."

OUTBURSTS OF GAS, "BUMPS," AND AIR-BLASTS.

On the 26th day of July, 1916, a blow-out of coal and gas occurred in a raise off the main West level in the Reserve shafts of the Western Fuel Company, Nanaimo, B.C. Fortunately the workmen had time to retire and no loss of life resulted.

In view of the explosion which occurred in this mine on May 27th, 1915, causing the loss of twenty-two lives, and in which it was assumed that the explosion was caused by an outburst of coal and gas in the upper counter of this same level, I am giving here some details of the outburst of July 26th, 1916, as furnished me by George Wilkinson, the mine manager in charge of the mine.

Place of Occurrence.

The place where the outburst occurred was in a raise or crosscut off the West level about 1,600 feet from No. 1 shaft-bottom. The face of the raise was about 70 feet from the level, the

inclination of pitch for the first 40 feet being about 45 degrees; then the pitch increased rapidly, and at the face 70 feet from the level was 75 degrees. The raise was 9 feet wide and the coal 11 feet thick.

Nature of Occurrence.

The miners noticed a slight splintering or spawling of the coal from the face; this gradually increased and they withdrew to the bottom of the chute. Shortly afterwards the blow-out occurred, filling up the raise with coal to within 10 feet of the level.

A large volume of free nitrogen was given off, fouling a ventilating-current of 14,000 cubic feet a minute and extinguishing the lights of the safety-lamps that the miners were using. Fortunately these workmen were in possession of an electric safety-lamp, which enabled them quickly to reach a place of safety in the fresh-air current.

Mr. Wilkinson arrived on the scene about ten minutes after the occurrence and found the ventilation of the whole district fouled. His safety-lamp was extinguished at the intersection of the returns of the West level and West slope splits, a distance of 2,000 feet from the place of occurrence.

In testing the mixture with a safety-lamp, not the slightest trace of a gas-cap could be observed; the flames simply turned black and died out quickly. This action was so quick that if the lamp was left long enough in the mixture to even notice the blackening effect on the flame, it was found impossible to save the flame on the safety-lamp.

With the exception of the place where the blow-out occurred, the ventilation in the district was clear in one hour and a half after the occurrence.

Four days later a sample of gas was taken from the raise and sent to the Department of Mines at Ottawa for analysis. At the time this sample was taken it was possible to detect a small flame-cap on the safety-lamp before the flame was extinguished, but it would not flash in the lamp like methane.

The returns of analysis were as follows:—

"DEPARTMENT OF MINES, CANADA.

"*Report of Analysis, Mine-air Sample.*

"Operator: Western Fuel Company.
"Mine: Reserve shaft, Douglas seam.
"Location sampled: No. 9 crosscut (in still air), West side No. 2 split.
"Sample taken by: John Newton. Date of sampling: July 30th, 1916.
"Sample No.: 33. Sample received at Laboratory: August 11th, 1916.
"Laboratory No.: 359.

"Chemical analysis—	Per Cent.
Carbon dioxide	0.3
Oxygen	1.8
Methane	4.5
Carbon monoxide	...
Nitrogen	93.4
"Technical analysis—	
Air	8.6
Fire-damp	4.5
Black-damp	86.9

"(Signed.) E. STANSFIELD,
"*Chief Engineering Chemist.*"

Quantity of Coal Blown Out.

The quantity of coal blown out was not determined, as the condition of the place made it unsafe to reopen. One hundred and fifty-six tons of coal was taken out and the progress made was 20 feet in length. At this point it was decided to abandon the reopening of the raise, and a bulkhead of strong timber was built across the place at the point where work was abandoned. With the exception of about 5 tons of lump coal, all of the 156 tons taken from the raise was very fine and powdery.

"BUMPS."

On November 7th and 8th, 1916, a series of "bumps" occurred in No. 1 East mine of the Coal Creek Colliery, operated at Coal Creek by the Crow's Nest Pass Coal Company, Limited, which completely wrecked the inner portion of the mine and caused the death of one man.

The details of the accident are given in a report by Thomas H. Williams, Inspector of Mines for that district, and is here reproduced:—

"*Report on Series of 'Bumps' which occurred in No. 1 East Mine, Coal Creek Colliery, on the Afternoon of November 7th, 1916, and Following Days.*

"About 3.45 a.m. on the morning of the 8th I received a telephone message from J. Irvine, of the Coal Company's staff, which was to the effect that a 'bump' had occurred in No. 1 East mine, and that as a result a number of men, including two firebosses, were missing. He said that a special train was about to leave for Coal Creek with W. R. Wilson and Dr. Bonnel, and I arranged to go along with them.

"Upon arriving at Coal Creek, Mr. Wilson and myself immediately went into the mine, and when about half-way in we met G. Michel, the electrician's assistant, who was coming outside with the news that all of the men except one had been accounted for.

"We hurried into the No. 14 East district where the 'bump' had occurred, and learned that all of the men who were reported missing were in No. 8 room, and that ten of them made their escape by going through a crosscut into No. 7 room, and thence out to No. 14 East entry. One man was still missing, and it was the general opinion of those who managed to escape that he was buried underneath a cave on the room parting, about 150 feet from the entry.

"I went to the mouth of No. 8 room and found it caved to within a few feet of the entry, and I made an attempt to get over the cave. I was not successful in this, as there was too much gas in the space above it. After consulting with Superintendent Caufield and Overman Martin, it was decided to hang a brattice-cloth across the entry at No. 8 room so as to divert as much air as possible into it. This was being done when another severe 'bump' occurred, and it was with great difficulty that those of us who were inside made our escape, as the dust created made it almost impossible to see anything or to breathe.

"This 'bump' occurred at 5.30 a.m., and after consulting with the officials it was decided to suspend operations for twenty-four hours, as the mine was still in a very unsettled state. The officials and myself were reluctant to abandon the attempt to get the entombed man, yet under the circumstances it seemed the only thing to do, as we did not consider it advisable to take further risks at this time. We were also assured by those who were in a position to judge that there was no possible chance of the man being alive.

"The following morning, in company with Superintendent Caufield, Overman Martin, and the morning-shift firebosses, I made an inspection of the main haulage-road and Nos. 14 and 10 East districts, and while the timber was 'pinching' a little, we thought the mine had become sufficiently settled to recommence the work of trying to get the entombed man. It was accordingly arranged that a shift should be started that afternoon, the work to be done to consist of timbering and repair-work, so as to make it safe to work at No. 8 room. This work was continued until Monday afternoon, the 13th, when about 6 o'clock another severe 'bump' occurred, and the men were all withdrawn from the mine and work was again suspended.

"I do not consider it necessary to refer to my subsequent examinations on the following days, as you were present, and I would only be duplicating the information you obtained.

"Upon making inquiries of the officials as to the condition of the mine on the afternoon of the 7th, I was told that a rather heavy 'bump' had occurred about 10 o'clock, and that a miner working in No. 9 room, No. 14 East, was slightly injured at the time. Fireboss Bell, who was in charge of this district, withdrew the men, but owing to a cave on No. 8 room roadway, a horse had to be left inside.

"While this 'bump' affected No. 14 East district more than any other part of the mine, yet it was not confined to this locality, as Fireboss Wilson, who was in charge of the West side and was in No. 12 West at the time, said that it raised considerable dust where he was, and that it shook things in this district, but did not do any material damage.

"When the night shift went on at 11 o'clock a number of men were sent into No. 8 room to try and get the horse out. These were accompanied by Fireboss John Caufield. The place

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, then sealed off. Work begins again a certain distance below these 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.

The ventilation of the section is produced by a 72- x 90-inch double-inlet Sirocco fan, rope-driven, ratio 3½ to 1, running 250 revolutions a minute, producing 195,000 cubic feet of air a minute, with a 4-inch water-gauge, and an engine of 350 horse-power. An emergency Sirocco fan of the same size, in every way modernly equipped, is kept under steam ready for use.

The haulage of this section is done by main-and-tail and endless-rope system, worked with very satisfactory results. The output of the mine is 1,650 tons a day.

In this part of the mine safety-lamps of the Wolf pattern and permitted explosives, fired by electric battery, are exclusively used.

To overcome the many dangers of drivers being caught by cars in the safety-lamp district, the company has installed fifty-two electric head-lamps, eight Westinghouse and forty-four Edison, which are giving good results.

When I made my last inspection I measured 46,800 cubic feet of air a minute passing into the South side of the mine, divided into four splits.

No. 4 South Heading (or No. 1 Split).—I measured 2,300 cubic feet of air a minute passing into the split for the use of nine men and two horses, or an average of 153 cubic feet of air for each unit employed.

Dips off the South-east Heading (No. 2 Split).—I measured 9,300 cubic feet of air a minute passing into the split for the use of thirty-two men and four horses, or an average of 211 cubic feet of air for each unit employed.

South-east Heading (No. 3 Split).—I measured 4,260 cubic feet of air a minute passing into the split for the use of eighteen men and six horses, or an average of 118 cubic feet of air for each unit employed.

No. 6 South Heading (or No. 4 Split).—I measured 8,400 cubic feet of air a minute passing into the split for the use of thirty-eight men and seven horses, or an average of 142 cubic feet of air a minute for each unit employed. No explosive gas found; timbering and roadways good.

On all the different 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 from the No. 1 shaft and Protection Island collieries for the year 1916:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	185,927			
" export to United States	237,211			
" " other countries	5,995			
Total sales		429,133		
Used in making coke				
" under colliery boilers, etc.	44,749			
Total for colliery use		44,749		
		473,882		
Stocks on hand first of year	10,753			
" last of year	4,676			
Difference taken from stock during year		6,077		
Output of colliery for year		467,805		

more in a form of development and as a feeler through the No. 3 mine to the east and the high line of No. 2 mine to the west, but no extensive operations have been conducted inby the affected area other than development, and this development has been singularly free from "bumps."

In 1911 a new mine, known as No. 1 East, was opened in a seam lying 150 feet higher in the coal series than the seam operated in Nos. 2 and 3 mines. This seam is about 16 feet in thickness and much softer in nature than the underlying seam. The lower 10 feet of this seam is operated; overlying this there is about 2 feet of soft, dirty coal, usually known as "rashings." This material interferes with the quality of the coke and is kept up by timbers, together with about 3 feet of coal of a fairly firm nature and 1 foot of roof clod or following.

Remembering the difficulties encountered in the lower seam through small pillars, this mine was laid out with a view to overcoming this fault, and the plans were rigidly adhered to. The main tunnels were driven due south; East and West levels were turned off these in pairs every 800 feet, pillars between the pairs of levels were 60 feet thick; from these East and West levels rooms were turned in pairs and driven 14 feet wide, with 60-foot pillars between the two rooms; a pillar of 150 feet is left between pairs of rooms, the rooms run south 800 feet to the next level, and the 150-foot pillar is cut only once in this distance. A plan of this mine appeared on page 326 of the 1915 Report.

The operations were conducted over the same territory previously worked in No. 2 mine, but, as formerly explained, 150 feet higher in the strata. The mine gave off large volumes of gas, but no difficulty was experienced with "bumps" until those of November last.

The operations in No. 1 East mine had at the time of the "bumps" passed beyond the line of face in the proscribed area in the No. 2 mine for a distance of from 300 to 400 feet, and the "bumps" appeared to develop the maximum force at points inby or south of the face-line of the underlying seam.

Under the mode of operation in No. 1 East mine, less than 25 per cent. of the coal was extracted in the first operations and no pillaring had been done; and in view of the passage into the solid ground inby the face-line of the underlying seam, a general feeling existed that the mode of operation had overcome the "bump" problem.

Following the "bumps" of November 7th and 8th, the area lying south of No. 10 East and West levels was very unsettled; "bumps" of more or less intensity were felt frequently each day, some of them being sufficiently severe to be felt outside the mine, and on November 13th a severe "bump" occurred at the mouth of No. 12 West level, which again destroyed all of the ventilating-doors in the mine and caused heavy upheaval of the floor on the Main tunnel for several hundred feet.

In view of this unsettled condition, I placed a prohibition on all operations beyond a line drawn south of No. 10 East level, and running from the extreme west side of the mine eastward to a point lying between Nos. 16 and 17 rooms off No. 10 East level, thence due south from this point, pending further investigation.

Being of the opinion that the "bumps" were due to a movement on a large scale of the overlying mountain mass, but being unable to determine whether this movement was due to the general subsidence caused by pillaring and irregular modes of operation in the underlying seam, or to a weak or shear zone in the mountain mass along the line of face represented in both seams, or to a combination of both these conditions, recommendation was made that a mining engineer be obtained to make an examination of the property, giving the Department the benefit of an outside opinion upon the general problem of the field, and, if possible, to suggest what steps should be taken to ensure the successful operation of the field free from the alarming and disastrous experiences of 1908 and 1916.

Through the courtesy of the Bureau of Mines in the United States of America, the Department, on November 21st, 1916, by telegram, secured the services of George S. Rice, Chief Mining Engineer of the United States Bureau of Mines. Mr. Rice arrived in Fernie on December 1st, 1916, Wm. Fleet Robertson, Mineralogist, and the writer being detailed to assist Mr. Rice in obtaining information and data on the field.

Much assistance was rendered the party by W. R. Wilson, general manager of the Crow's Nest Pass Coal Company, and his well-equipped engineering staff, which was placed at the disposal of the party.

At the time of writing Mr. Rice has not reported the result of his investigation. The report will likely be published in this year's Report of the Minister of Mines.

AIR-BLASTS IN METALLIFEROUS MINES.

During the past year several so-called "air-blasts" have been reported in the *Centre Star*, *War Eagle*, and *Le Roi* mines, operated by the Consolidated Mining and Smelting Company of Canada, at Rossland. Two of these air-blasts have proved fatal.

The term "air-blast" is applied to these because of the concussion set up in the mine atmosphere, and they are analogous to "bumps" in the coal-mines.

The phenomena is usually accompanied by a bursting of large slabs, without any previous warning, from the walls, these walls being apparently firm and solid just previous to the movement. The sudden displacement seems to set up a concussion in the mine atmosphere, varying in intensity with the quantity of material displaced.

The two fatalities recorded were due to workmen being caught with a slab of rock displaced from the walls.

Through the courtesy of M. F. Purcell and Fred Peters, superintendents of the *Centre Star*, *War Eagle*, and *Le Roi* mines respectively, I was shown the various localities where the movements have taken place.

It was noted that in each instance this movement had occurred in the vicinity of a dyke or fault-line, and is doubtless due to slight earth movements along the dyke or fault-line.

Similar phenomena is reported in the deep copper-mines of northern Michigan, being sufficiently severe to shake houses at some distance from the mines (as in the "bumps" at Coal Creek). This movement is often felt on the surface and upper levels of the mine, and yet the workmen in the lower levels have no indication of any movement.

EDUCATIONAL LITERATURE.

During the year several hundred copies of Bulletin 105, "Black-damp in Mines," and "Rescue and Recovery Operations in Mines after Fires and Explosions" were purchased from the United States Bureau of Mines and distributed among officials of both coal and metal mines.

MINE-RESCUE WORK.

There has been little change in the number of mine-rescue apparatus in use in and around the coal-mines during the year.

In the metal-mines the *Standard* mine, at Silverton, purchased five sets of 2-hour Draeger apparatus; eight resuscitating-machines were purchased by various metal-mining companies during the year. The Department also added three type B pulmotors to the former equipment.

Interest in training in the use of mine-rescue apparatus was well sustained throughout the year, and 103 certificates of competency were issued by the Department during 1916.

LIST OF CERTIFICATES OF COMPETENCY IN MINE-RESCUE WORK ISSUED IN 1916.

Date.	Name.	Station.	No.
Jan. 26th	Dykes, Joseph W.	Nanaimo	257
" 26th	Wilkinson, Edward	"	258
" 26th	Stobart, Ralph	"	259
" 26th	John, Francis	"	260
" 26th	Aitken, Thomas M.	"	261
" 26th	Dean, John	"	262
" 26th	Bonar, Robert	"	263
" 26th	Gould, Alfred	"	264
" 26th	Murphy, Andrew	"	265
" 26th	Neen, Joseph	"	266
" 26th	Taylor, Thomas	"	267
" 26th	Kenney, Clair F.	"	268
" 26th	Stewart, Aaron	"	269
" 26th	Jordon, Thomas	"	270
" 26th	Stewart, Adam	"	271
" 26th	Brough, William F.	"	272
" 26th	Hodgson, James	"	273
" 26th	Lewis, Thomas	"	274
" 26th	Patterson, John	"	275
" 26th	Brown, David	"	276
" 26th	Robertson, James H.	"	277
" 26th	Smith, Thomas	"	278
" 26th	Mason, Thomas	"	279
" 26th	Challoner, John A.	"	280
" 26th	Drake, Samuel	"	281
" 26th	Hunt, John	"	282
" 26th	Hunter, Frederick	"	283
" 26th	Richards, James	"	284
" 26th	Gibson, Edward	"	285
" 26th	Newberry, Arthur	"	286
" 26th	Marrs, John	"	287
" 26th	Waugh, Andrew W.	"	288
" 26th	Addison, Walker	"	289
" 26th	Taylor, Thomas H.	"	290
" 26th	Oswald, George L.	"	291
" 26th	Leynard, Paul	"	292
" 26th	Norris, Joseph	"	293
" 26th	Mottishaw, Samuel K.	"	294
" 28th	McKinnon, D. A.	Fernie	295
" 28th	McLaughlin, John A.	"	296
" 28th	Miller, John A.	"	297
" 28th	Nelson, N. E.	"	298
" 28th	Williams, William D.	"	299
" 28th	Johnson, Albion	"	300
" 28th	Davidson, Norman	"	301
" 28th	Freeland, P. B.	"	302
" 28th	Andren, Alfred	"	303
March 6th	Bunch, Alexander	"	304
" 6th	Mitchell, George	"	305
" 6th	Simpson, Ralph	"	306
" 6th	Fawcett, Albert	"	307
" 6th	Clarkstone, Wm. Walter	"	308
" 6th	Stephens, Ralph	"	309
June 22nd	Watson, Joseph	Nanaimo	310
" 22nd	Brown, Alexander	"	311
" 22nd	Houston, Robert	"	312
" 22nd	Ferguson, James N.	"	313
" 22nd	Davies, Stephen	"	314
" 22nd	Strang, James	"	315
" 22nd	Wright, John	"	316
" 22nd	Brough, John D.	"	317
" 22nd	Ewing, Robert F.	"	318
" 22nd	Meek, Matthew	"	319
" 22nd	Lauderback, Carl	"	320
July 15th	Phillips, James Henry	"	321
" 15th	Young, Joseph	"	322
" 15th	Moore, George	"	323
" 15th	Craig, James	"	324

LIST OF CERTIFICATES OF COMPETENCY—*Concluded.*

Date.	Name.	Station.	No.
July 15th	Scott, George	Nanaimo	325
" 15th	Male, Phillip	"	326
" 15th	Frater, George	"	327
" 15th	Todd, Henry James	"	328
" 15th	Bell, Wm. Ewart	"	329
" 15th	Sutherland, John	"	330
" 15th	Parrott, John	"	331
" 15th	Jolly, Andrew	"	332
" 15th	Irving, Thomas	"	333
" 15th	Park, Alexander	"	334
" 15th	Brunt, Henry	"	335
" 15th	Lee, George	"	336
" 15th	Kirkpatrick, James	"	337
" 15th	Black, James	"	338
" 15th	Roper, William	"	339
" 24th	Quinn, James	Fernie	340
" 24th	Ball, Alfred	"	341
" 24th	Marsh, John	"	342
" 24th	Almond, Walter	"	343
" 24th	Parkinson, Harry	"	344
Sept. 6th	Neilson, William	Nanaimo	345
" 6th	Lunan, George	"	346
" 6th	Maxwell, George	"	347
" 6th	Skimming, John	"	348
" 6th	Staton, Edward	"	349
" 6th	Nisbet, Robert	"	350
" 6th	Hollands, Alexander	"	351
" 6th	Hindmarch, Thomas	"	352
" 6th	Archibald, Thomas	"	353
" 6th	Walker, George M	"	354
" 6th	McGrath, James	"	355
Oct. 13th	Clements, Edwin F	"	356
" 13th	Bennett, Andrew M	"	357
" 13th	Potter, Robert	"	358
" 13th	Callow, Charles	"	359

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 1916:—

Company.	Draeger Apparatus.		Proto or Fluess Apparatus.		Total Apparatus.	Resuscitating Devices.			Total.
						Pulmotor.		Lungmotor.	
	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	..	..	..	..
Comox	4	..	..	..	4	..	..	..	..
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
Pacific Coal Syndicate	..	2	..	..	2	..	..	..	..
Princeton Coal and Land Co.	1	1	..	..	2	1	..	..	1
Crow's Nest Pass Coal Co.—									
Coal Creek	4	6	..	..	10	2	..	..	2
Michel	4	5	..	..	9	1	..	..	1
Corbin Coal and Coke Co., Corbin	2	1	..	..	3	1	..	..	1
B.C. Government	16	10	..	..	26	4	3	..	7
Totals	47	31	4	2	84	15	3	2	20

The following table shows the number of mine-rescue apparatus and resuscitating devices in and around the metal-mines of the Province in 1916:—

Company.	Draeger Apparatus.			Fluess or Proto Apparatus.	Total Apparatus.	Resuscitating Devices.			Total.
						Pulmotor.		Lungmotor.	
	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	..	..	1	..	1	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	9	3	1	8	21	12	4	4	21

The number of persons employed underground in the coal and metal mines was 7,050, giving one mine-rescue apparatus for every sixty-seven persons employed, and one oxygen resuscitating device for every 176 persons employed.

Hope is entertained that during the year 1917 steps will be taken to draft a new "Metalliferous Mines Inspection Act," in keeping with the progressive advancement made in the metal-mining industry of the Province.

MICHEL EXPLOSION.

A disastrous explosion occurred on August 8th at No. 3 East mine, Michel Colliery, of the Crow's Nest Pass Coal Company, Limited, in which twelve lives were lost. This disaster is fully treated by separate report.

Very little progress has been made in maintenance of technical classes on mining in and around the coal-mines of the Province. Considerable interest has been maintained in the work around some of the metal-mining districts, although even here the interest taken is far from encouraging.

SUPERVISION OF COAL-MINES.

During the year twelve coal companies operated fourteen collieries, with thirty mines. In these thirty mines 3,694 men were employed underground. In supervision of these underground employees there were eighteen first-class, twenty-eight second-class, and 177 third-class officials, or one official for every seventeen 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, 1916:—

The equipment on hand at the station at the present time is as follows: Six 2-hour Draeger apparatus and four adaptors for No. 1 potash cartridges; four ½-hour Draeger apparatus; one pulmotor with three face-masks and six spare rubber parts for face-masks, also four head-rings with straps for fastening same; one pulmotor, type B (complete); one litter with fresh-air hood; two high-pressure oxygen refilling-pumps with five sets of pump packing; twelve pairs of smoke-goggles; twelve oxygen storage-cylinders; ten 2-hour cylinders; twelve ½-hour cylinders; three water-gauges and two measuring-bags; four spare pressure-reducing valves for 2-hour apparatus; two spare pressure-reducing valves for pulmotor; twenty-seven 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-nine positive electrodes; forty negative electrodes; twelve lids for cell casings with tubes; seven lb. 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; eighteen lb. of Edison electrolite solution; one sheet celluloid paper; one 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, 1916.—400 cubic feet oxygen; 112 No. ½ potash cartridges; 136 No. 1 potash cartridges; 529 No. 2 potash cartridges.

Supplies received during the Year.—3,195 cubic feet oxygen.

The following supplies were shipped from this station during the year:—

To Robt. Strachan, Inspector of Mines, Merritt.—One hundred No. 2 potash cartridges; eight cylinder-valves with by-pass attachment; two rubber connecting-tubes; eight safety-guards for oxygen-cylinder valves; four complete cells for Ceag electric safety-lamps; fifteen diaphragms for reducing-valves.

To Charles O'Brien, Instructor, Mine-rescue Station, Fernie.—Twelve diaphragms for reducing-valves.

Supplies used during the Year 1916.—2,590 cubic feet oxygen; ten No. ½ potash cartridges; sixty-six No. 1 potash cartridges; 179 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 four spare tires (complete).

All Draeger apparatus at this station were during the early part of the year equipped with by-pass valves and safety-guards attached to the oxygen-cylinder wheel-valves, thus rendering them more safe and efficient.

Emergency Calls for Apparatus.—On Thursday, December 7th, 1916, under instructions from Inspector Newton, I had the apparatus conveyed out to the Jingle Pot mine, East Wellington, the property of the Vancouver-Nanaimo Coal Company, where a section of the mine was heating up, but the trouble was overcome without the men having to use the apparatus.

During the year twenty-three men have qualified themselves to receive Government certificates for mine-rescue work.

Western Fuel Company, Nanaimo.—George Frater, Thomas Irving, Charles Callow, Andrew M. Bennett, James Henry Phillips, Henry James Todd, George Moore, Phillip Male, Alexander Park, Edwin F. Clements, Robert Potter, William Ewart Bell, Joseph Young, George Scott, and Joseph Craig.

Pacific Coast Coal Mines, Limited, South Wellington.—George Lee, James W. Kirkpatrick, William Roper, James Parrott, Henry Brunt, James Black, Andrew Jolly, and John Sutherland.

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, 1916:—

During the months of January and February eight men presented themselves at the station for a course of instruction in the use of the mine-rescue apparatus. One of the men gave up his course after a week's training, as he was offered a position in Alberta and proceeded there without delay. Another man gave up his course on the tenth day of his training; he joined the 225th Battalion, C.E.F. Since then it has been very difficult to get men to take up training in mine-rescue work.

During the month of June a team of five men from Coal Creek mines requested the use of the apparatus with a view to preparing for a competition in mine-rescue work which was to be held at Coleman on July 1st. Permission having been granted these men, they used the apparatus under my supervision.

On July 1st I accompanied the apparatus to Coleman. Later in the month of July I proceeded to Michel to examine a crew of men who had received instruction in the use of the mine-rescue apparatus. After they had passed through the test as required by the Department I found them qualified to receive a certificate of competency in mine-rescue work, which, upon recommendation, they were granted. These men, as are also the other men at Michel, are trained in the use of the "negative" type of the Draeger apparatus. Upon my return from Michel I received a supply of by-pass valves from the Draeger people, and attached them to the apparatus, thus completing the remodelling of the apparatus.

On August 9th, at 2.20 a.m., a call for the apparatus was rung in from Michel. An explosion had occurred at No. 3 East mine of the Crow's Nest Pass Coal Company's Colliery at that place.

I immediately sent a call to Coal Creek Colliery for a crew of rescuers. The apparatus was aboard and checked at 2.50 a.m., but owing to the unavoidable delay in securing men from Coal Creek we did not set out until 4.10 a.m., arriving at Michel at 5 a.m. A rescue crew then prepared to enter the mine, but did not enter at once, as the mine was so badly wrecked by the explosion that, after consultation, it was decided to be inadvisable to attempt any exploratory work with the apparatus. The explosion was so violent that it was quite reasonable to assume that any persons in the mine at the time of the explosion must have been instantaneously killed or suffocated. Later investigation on the part of the management and the Department's Inspectors showed that this assumption was correct, and the apparatus was not called into actual use. I stood by until the 13th in case of emergency, when it was decided that I should return to Fernie with the apparatus. While at Michel I found it necessary to give the rescue crews—who were in readiness to enter the mine—a short lecture on the use of the by-pass valve. Upon my return to Fernie I got into touch with B. Caufield, mine manager of Coal Creek Colliery, requesting him to send all his trained men to this station with a view to them becoming familiarized with the new by-pass, finimeters, and new type B pulmotor. With the co-operation of Mr. Caufield, forty-two men received instruction in the use of these new additions to our equipment.

During the month of October I received a consignment of Edison electric cap-lamps. These cap-lamps will increase the efficiency of rescue crews doing rescue-work, insomuch that the crews will have their hands free to work with.

On November 19th Chas. Graham, mine manager of Corbin Coal & Coke Company, requested the use of part of our equipment. A fire had apparently broken bounds, and he desired to seal it off. The apparatus was shipped to Corbin, but evidently was not used.

The number of men trained in the use of the remodelled apparatus is forty-two. These men are located at Coal Creek Colliery. The number of men trained in the use of the "negative" type apparatus is fourteen. These men are located at Michel; giving a total of fifty-six men who have a knowledge of the apparatus, and employed at the Crow's Nest Pass Coal Company's Collieries.

The number of certificates of competency in mine-rescue work granted through this station during 1916 is eleven.

Literature dealing with mine-rescue work supplied by the Department has been liberally distributed amongst these men.

The following is an inventory of equipment in use at this station: Six 2-hour sets of apparatus complete with shipping-trunks; two spare head-mouth pieces; five spare pairs goggles; four spare breathing-bags with tubes to match; three automats; six spare 2-hour oxygen cylinders; one spare pulmotor cylinder; one pulmotor and inhalator complete; one type B pulmotor; 103 No 1 potash cartridges; eight adaptors for No. 1 cartridges; 514 No. 2 potash cartridges; one high-pressure refilling-pump; twenty-four oxygen storage-tanks with about 2,200 cubic feet oxygen; one oxygen litter; twelve Ceag electric lamps complete; seventeen spare accumulators; four spare "positive" electrodes; thirteen spare "negative" electrodes; six spare accumulator-tops; six Edison electric lamps complete; supply of spare parts; one automatic refiller; two hydrometers; one chargometer; one voltmeter; one rectifier with spare platinum contacts; one electro-magnet; 300 lead plugs; one lead-plug mould; two water-gauges; two measuring-bags; six canaries; one life-line; box of tools; vaseline; sodium hydrate; sulphuric acid; distilled water.

The following is the expense account for this station during the year 1916:—

Canadian Pacific Railway, freight on supplies	$ 57 32
City of Fernie, light, water, sewer	50 80
Compressed Gas Co., oxygen and repairs	126 35
Crow's Nest Pass Coal Co., fuel, supplies, freight	203 87*
Crow's Nest Trading Co., glass jars, samples	1 35
Dicken, W. M., wood	5 00
Dominion Customs, entry on supplies	1 50
Dominion Express Co., express on supplies	12 51
Draeger Oxygen App. Co., pulmotor, measuring-bags, etc.	303 67
Duthie Hardware Co., seed-cups	60
Fairbanks-Morse Co., Edison lamps and supplies	89 30
Falvo, Geo., waist-belts, cap-straps	7 75
Ferguson, A. E., plumbing repairs	2 00
Fernie Co-operative Society, bird-seed	1 00
Fernie Livery Co., draying	8 75
Hamilton, A. T., repairs to furnace	4 25
Instructor's salary	1,200 00
Kootenay Telephone Lines, rent of telephones	75 85
McDougall, Dan, bird-cage	1 00
McLean Drug & Book Store, red ink and mucilage	1 25
O'Brien, Chas., stamps, hotel expenses	33 15
Peacock Bros., Ceag supplies	41 50
Quail, J. D., supplies for repairs	6 25
Suddaby, N. E., toilet-soap, thermometers	5 25
Trites-Wood Co., supplies, towels, etc.	9 75
Total	$2,250 02

* Freight charges of $142.37 on sample coal paid by C.N.P.C. Co. to Great Northern is included in $203.87.

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; and the equipment of oxygen breathing apparatus, resuscitating devices, etc., in the metal-mines for the year ending December 31st, 1916.

During the year approximately 439 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 137. The location of the class, number attending lectures, and number passing final examinations is as follows:—

Place.	No. in Class.	Passed Examinations.				Total.
		First Year.	Second Year.	Third Year.	Fourth Year.	
Merritt	40	8	3	3	..	14
Corbin	18	5	..	..	..	5
Michel	25	7	4	4	..	15
Fernie	35	10	8	..	..	18
Nanaimo	30	7	3	..	..	10
South Wellington	13	7	1	1	3	12
East Wellington	9	2	4	..	..	6
Ladysmith	58	14	13	2	1	30
Extension	21	7	6	1	..	14
Anyox	40	13	..	..	..	13
Coal Creek*	25	..	..	..	..	..
Princeton†	15	..	..	..	..	..
Britannia†	50	..	..	..	..	..
Rossland†	45	..	..	..	..	..
Sandon†	15	..	..	..	..	..
Totals	439	80	42	11	4	137

* No examination held. † Class proceeding at present time.

Arrangements have also been made for classes at Hedley and Copper mountain.

With the close of this year I beg to say that first-aid classes have been organized in all of the larger coal and metal mines of the Province. The movement has been placed before the attention of practically every mine operator, both coal and metalliferous, and his co-operation respectfully solicited.

In order to encourage the first-aid training among the miners, competitions were held at Nanaimo on Labour Day, September 4th, 1916, and Rossland on September 27th. At Nanaimo there were eight teams of five men each competing for the Department of Mines Miners' First Aid cup and the Coulson cup. The mines represented were as follows:—

Name of Company.	Mine.	No. of Teams.
Western Fuel Co	Protection	1
Western Fuel Co	No. 1	1
Canadian Collieries (D.), Ltd	Extension No. 1	1
Canadian Collieries (D.), Ltd	Extension No. 2	1
Canadian Collieries (D.), Ltd	Extension tunnel	1
Canadian Collieries (D.), Ltd	Bevan No. 7	1
Pacific Coast Coal Mines	South Wellington	1
Vancouver-Nanaimo C. M. Co.	East Wellington	1
Total		8

The Department of Mines cup was won by the team of the Vancouver-Nanaimo Coal Mining Company with a percentage of 97. The Coulson cup was won by the "Tunnel" team from Extension with a percentage of 97.

At Rossland on September 27th a competition was held for the Department of Mines Miners' First Aid cup, West Kootenay district. There were three teams competing—namely, one team from the *Centre Star* mine, one from the *War Eagle* mine, and one from the *Le Roi* mine. The team representing the *Le Roi* mine won the cup with a percentage of 84.

Mine-rescue Work.

During the year I have conducted examinations in mine-rescue work at Extension, Merritt, and Phoenix; during these examinations there were thirty-one 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.
Phoenix	Jan. 15th	9	Granby Con. M. S. & P. Co.	N. E. Nelson.
Extension	June 22nd	11	Canadian Collieries (D.), Ltd.	J. Delaney.
Merritt	Aug. 15th	4	Middlesboro Collieries Co.	F. Bond.
Merritt	Aug. 15th	7	Inland Coal & Coke Co.	A. McKendrick.

At the close of this year I am pleased to say that resuscitating devices for persons overcome by powder-fumes, etc., have been installed at all of the larger metalliferous mines, there being twelve type A pumotors, four type B pulmotors, and four lung-motors. Most of the larger metal-mines are also equipped with self-contained breathing apparatus for use in entering a poisonous atmosphere and effecting the rescue of persons overcome by breathing irrespirable gases, etc. There are twenty-one sets of such apparatus at present at the mines, and an additional three sets on order at the end of the year.

During the year the mine-safety department at the Rossland mines of the Consolidated Mining and Smelting Company of Canada has pursued its work with successful results.

Early in the year a safety department was established at the *Hidden Creek* mine of the Granby Consolidated Mining, Smelting, and Power Company by E. E. Campbell, mine superintendent, and much good work has been accomplished thereby.

I am also pleased to say that a number of the mining companies are placing "safety first" and general warning and danger signs around the underground and surface operations.

I trust that the contents of this report will meet with your approval.

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's or other recognized ambulance society, showing that he has taken a course in ambulance-work fitting him, the said candidate, to give first aid to men injured in coal-mining operations.

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

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

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

EXAMINATION FOR MINERS.

In addition to the examinations and certificates already specified as coming under the Managers' Board, the Act further provides that every coal-miner shall be the holder of a certificate of competency as such. By "miner" is meant "a person employed 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, 1916.

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

The meetings are held in the office of the Board at Nanaimo. An examination for First-, Second-, and Third-class Certificates was held at Nanaimo, Cumberland, Merritt, and Fernie on May 30th, 31st, and June 1st, at which there were 41 candidates, as follows: For First-class there were 13, of whom 3 passed and 10 failed; for second-class there were 13, of whom 9 passed and 4 failed; for third-class there were 15, of whom 10 passed and 5 failed.

A list of the successful candidates are herewith enclosed, all of whom, with the exception of one third-class candidate, have fully complied with the Act, and certificates of competency have been issued accordingly.

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

LIST OF CANDIDATES TO WHOM CERTIFICATES WERE ISSUED AT THE EXAMINATIONS HELD IN MAY, 1916, AT NANAIMO, CUMBERLAND, MERRITT, AND FERNIE.

First-class Candidates.

NAME.	DATE.	No.
Alexander Brunton Hunter	May 30th, 1916	
Earnest Leonard Warburton	"	
John Graham Quinn	"	

Second-class Candidates.

NAME.	DATE.	No.
John Caufield	May 30th, 1916	B 199
Francis John	"	B 200
Henry Mitchell	"	B 201
Robert Lecce Spruston	"	B 202
Thomas Taylor	"	B 203
George Frater	"	B 204
William Touhey	"	B 205
Thomas Baybutt	"	B 206
George Gray	"	B 207

Third-class Candidates.

NAME.	DATE.	No.
James Brown	May 30th, 1916	C 625
George Brown	"	C 626
Harry Alexander Meikle	"	C 627
Joseph Leyland	"	C 628
William Gold Brown	"	C 629
James McGrath	"	C 630
Robert Houston	"	C 631
William Hynds	"	C 632
George Walker	"	C 633
William Halliday	"	C 634

Delinquents.—From Previous Examinations.

Third-class Candidates.

NAME.	DATE.	No.
Robert Walker	May, 1915	C 487
Samuel Lawson	"	C 613
John Dean	"	C 617
James Duncan	"	C 619

REGISTERED LIST OF HOLDERS OF CERTIFICATES OF COMPETENCY AS COAL-MINE OFFICIALS.

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

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

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

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

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

NAME.	DATE.
Biggs, J. G.	July 22nd, 1908
Bonar, Robert	October 28th, 1911
Brace, Tom	May 13th, 1915
Bridge, Edward	July 22nd, 1908
Brown, David	May 21st, 1914
Brown, Robert Joyce	" 13th, 1915
Caufield, Bernard	" 1st, 1909
Church, James A. H	June 10th, 1911
Cox, Richard	May 13th, 1915
Crowder, James	June 10th, 1911
Cunningham, John Howard	May 9th, 1912
Davidson, W. A	" 1st, 1909
Davies, David	June 10th, 1911
Davies, Thos. Owen	May 21st 1914
Derbyshire, James	November 9th, 1907
Devlin, Henry	May 1st, 1909
Dixon, James	October 31st, 1912
Elliott, Daniel	November 9th, 1907
Emmerson, Joseph	" 9th, "
Fairfoull, Robert	June 10th, 1911
France, Thos	November 22nd, 1906
Fraser, Norman	March 4th, 1905
Freeman, H. N.	May 1st, 1909
Galloway, C. F. J.	July 22nd, 1908
Gascoyne, Rowland B.	May 21st 1914
Glover, Francis	October 31st, 1912
Graham, Charles	November 14th, 1905
Graham, Thomas	" 9th, 1907
Gray, James	" 27th, 1909
Henderson, Robert	" 27th, "
Hewlett, Howe	May 27th, 1913
Holden, James	" 1st, 1909
Howden, Archibald	" 27th, 1913
Howells, Nathaniel	October 28th, 1911
Humphries, Clifford	June 10th, "
Hunter, Alex. B	July 8th, 1916
Jackson, Thos. R	November 9th, 1907
James, William	July 22nd, 1908
Jaynes, Frank	May 13th, 1915
Jemson, Jas. W.	" 27th, 1913
Kellock, George	June 10th, 1911
Kinsman, A. D.	September 10th, 1910
Knox, T. K	July 27th, 1909
Lancaster, William	" 22nd, 1908
Leighton, Henry	May 9th, 1912
Macauley, D. A	June 10th, 1911
McCulloch, James	September 10th, 1910
McGuckie, Thomas	July 22nd, 1908
McKendrick, Andrew	May 27th, 1913
McMillan, J. H.	September 10th, 1910
McVicar, Samuel	May 1st, 1909
Mazey, William John	October 31st, 1912
Miard Henry Ernest	May 9th, "
Millar, John K	November 22nd, 1906
Miller, Andrew Anderson	October 31st, 1912
Montgomery, John W	May 1st, 1909
Mordy, Thomas	September 10th, 1910
Musgrove, J. T.	October 28th, 1911
Newton, John	July 22nd, 1908
O'Brien, George	May 21st 1914
Ovington, John	" 27th, 1913
Peacock, Frank David	October 28th, 1911
Penman, Hugh	May 21st 1914
Phelan, Arthur	" 27th, 1913
Powell, J. W	June 10th, 1911
Quinn, John Graham	July 8th, 1916

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

NAME.	DATE.
Roper, William	May 13th, 1915
Russell, John	" 21st 1914
Saville, Luther	July 22nd, 1908
Shanks, John	May 1st, 1909
Shaw, Alex	November 14th, 1905
Shaw, William	May 9th, 1912
Shenton, T. J	September 10th, 1910
Shone, Samuel	May 1st, 1909
Sloan, Hugh	November 27th, "
Smith, A. E	October 28th, 1911
Smith, Joseph	July 22nd, 1908
Spicer, J. E	October 28th, 1911
Spruston, T. A	November 27th, 1909
Stevens, L. C	" 27th, "
Stewart, R. T	September 10th, 1910
Strachan, Robert	March 4th, 1905
Strang, James	June 10th, 1911
Thomas, J. D	September 10th, 1910
Thorne, B. L	" 10th, "
Touhey, James	May 21st, 1914
Wallbank, J	September 10th, 1910
Warburton, Ernest Leonard	July 8th, 1916
Willey, Edward	October 31st, 1912
Williams, Thos. H	November 22nd, 1906
Wylie, John	July 22nd, 1908

SECOND-CLASS CERTIFICATES OF SERVICE.

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

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

NAME.	DATE.	Cer. No.
Adamson, Robert	September 10th, 1910	B 120
Allan, Alex. McDairmid	May 27th, 1913	B 167
Barclay, Andrew	July 29th, 1905	B 25
Bastian, John	November 2nd, 1907	B 42
Baybutt, Thomas	July 8th, 1916	B 206
Bevis, Nathaniel	September 10th, 1910	B 123
Biggs, John	May 1st, 1909	B 94
Biggs, John G	November 2nd, 1907	B 40
Blair, James	May 13th, 1915	B 197
Brace, Tom	November 27th, 1909	B 96
Bridge, Edward	October 23rd, 1906	B 33
Brown, David	September 10th, 1910	B 108
Brown, James L	October 28th, 1911	B 136

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

NAME.	DATE.	Cer. No.
Brown, John C	October 23rd, 1906	B 39
Brown, John Todd	May 9th, 1912	B 150
Brown, R. J.	October 28th, 1911	B 134
Brown, Robert	May 21st, 1914	B 183
Brown, Robert Sneddon	" 13th, 1915	B 196
Bushell, J. P	" 1st, 1909	B 81
Carroll, Henry	July 22nd, 1908	B 62
Caufield, Bernard	October 23rd, 1906	B 30
Caufield, John	July 8th, 1916	B 199
Cawthorne, L.	May 1st, 1909	B 93
Challinor, Jno. Thomas	" 27th, 1913	B 169
Challoner, Jno. Arthur	" 21st, 1914	B 178
Churchill, James	July 22nd, 1908	B 65
Clarkstone, Wm. W.	May 21st, 1914	B 180
Commons, Wm	September 10th, 1910	B 115
Cooke, Joseph	July 22nd, 1908	B 64
Courtney, A. W.	October 28th, 1911	B 138
Cox, Richard	May 9th, 1912	B 143
Crawford, David	" 1st, 1909	B 88
Cunliffe, Thomas	" 1st, "	B 78
Dando, John	" 27th, 1913	B 164
Daniels, David	November 2nd, 1907	B 53
Derbyshire, James	October 23rd, 1906	B 32
Davidson, Hugh	May 27th, 1913	B 165
Davies, Stephen	September 10th, 1910	B 113
Dennis, Fred. W.	May 21st, 1914	B 174
Devlin, Ernest H	" 21st, "	B 179
Devlin, Henry	November 2nd, 1907	B 44
Dewar, Alexander	October 31st, 1912	B 162
Dickenson, Clifford	May 13th, 1915	B 189
Dunsmuir, John	November 14th, 1905	B 26
Dykes, J. W	May 1st, 1909	B 77
Eccleston, Wm	" 1st, "	B 87
Fairfoull, James	May 21st, 1914	B 186
Fairfoull, R.	" 1st, 1909	B 83
Finlayson, James	July 29th, 1905	B 21
Ford, Allan	May 27th, 1913	B 171
Foster, W. R.	November 27th, 1909	B 102
France, Thos	" 14th, 1905	B 27
Francis, David M	May 21st, 1914	B 182
Francis, Enoch	" 1st, 1909	B 86
Francis, James	July 22nd, 1908	B 63
Frater, George	" 8th, 1916	B 204
Freeman, Henry N.	November 2nd, 1907	B 45
Garbett, Richard	October 31st, 1912	B 161
Garman, Morris Wilbur	" 31st, "	B 155
Gillespie, Hugh	July 29th, 1905	B 24
Gillespie, John	October 23rd, 1906	B 36
Gillespie, John M.	June 10th, 1911	B 126
Gould, Alfred	May 13th, 1915	B 190
Graham, Chas	March 4th, 1905	B 1
Gray, David	May 1st, 1909	B 76
Gray, George	July 8th, 1916	B 207
Hamilton, Robert N.	May 21st, 1914	B 175
Henderson, Robert	July 22nd, 1908	B 60
Horrocks, Abner G.	June 10th, 1911	B 130
Howells, Nathaniel	November 27th, 1909	B 97
Huby, Norman W	May 13th, 1915	B 198
Hudson, George	September 10th, 1910	B 121
Hughes, John C.	" 10th, "	B 109
Hutton, Isaac	May 21st, 1914	B 185
Hutton, John	" 9th, 1912	B 154
Jackson, Thos. R	March 4th, 1905	B 5
James, David	November 2nd, 1907	B 58
Jarrett, Fred	May 1st, 1909	B 84
Jaynes, Frank	September 10th, 1910	B 111
John, Francis	July 8th, 1916	B 200

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

NAME.	DATE.	Cer. No.
John, Howell	September 10th, 1910	B 122
Johnson, Moses	May 1st, 1909	B 75
Jones, William T	July 22nd, 1908	B 66
Jordon, Thos	November 27th, 1909	B 104
Joyce, Walter	May 27th, 1913	B 168
Kirkwood, John Robertson	October 31st, 1912	B 160
Knowles, James E.	" 28th, 1911	B 137
Lancaster, William	November 2nd, 1907	B 50
Lander, Frank	May 13th, 1915	B 195
Lane, Joseph	" 9th, 1912	B 142
Lee, Robert John	September 10th, 1910	B 110
Littler, Matthew	October 31st, 1912	B 157
Luck, George	June 10th, 1911	B 128
Manifold, Albert	May 9th, 1912	B 145
Mason, Joseph	" 13th, 1915	B 193
Massey, H	November 27th, 1909	B 99
Mather, Thomas	June 10th, 1911	B 127
Matusky, A	May 1st, 1909	B 91
Mayer, Ralph Waldo	" 9th, 1912	B 144
Mazay, W. J.	November 27th, 1909	B 101
Merryfield, William	July 22nd, 1908	B 61
Miard, Hy. E.	September 10th, 1910	B 107
Michell, Dudley	May 13th, 1915	B 187
Middleton, Robert	July 22nd, 1908	B 72
Mitchell, Henry	" 8th, 1916	B 201
Monks, James	November 2nd, 1907	B 55
Moore, Wm. H.	May 21st, 1914	B 173
Morgan, John	November 2nd, 1907	B 43
Morris, John	July 22nd, 1908	B 67
Morton, Robert W	" 22nd, "	B 59
Mottishaw, S. K.	October 28th, 1911	B 135
Musgrave, J.	May 1st, 1909	B 90
Myers, Peter	" 9th, 1912	B 149
McDonald, J. A.	October 28th, 1911	B 133
McDonald, John	May 27th, 1913	B 172
McFegan, W	November 27th, 1909	B 106
McGarry, Martin	October 31st, 1912	B 156
McGuckie, Thomas M	" 23rd, 1906	B 35
McKelvie, J.	May 1st, 1909	B 92
McKendrick, And.	September 10th, 1910	B 112
McMillan, D.	June 10th, 1911	B 125
McNay, Carmichael	May 9th, 1912	B 151
McPherson, James E.	July 22nd, 1908	B 73
Neen, Joseph	June 10th, 1911	B 129
Newbury, Arthur	May 21st, 1914	B 184
Newton, John	October 23rd, 1906	B 31
Newton, Wm	September 10th, 1910	B 116
O'Brien, Charles	May 9th, 1912	B 148
O'Brien, George	" 1st, 1909	B 82
Ovington, John	November 2nd, 1907	B 52
Parkinson, T	May 1st, 1909	B 80
Parnham, Charles	November 2nd, 1907	B 49
Quinn, James	May 21st, 1914	B 181
Quinn, John	" 9th, 1912	B 146
Rankin, Geo.	November 27th, 1909	B 103
Raynes, M. T.	October 28th, 1911	B 139
Reid, Thomas	July 29th, 1905	B 23
Reid, Wm.	October 28th, 1911	B 132
Renny, James	" 28th, "	B 140
Richards, Thomas	November 2nd, 1907	B 57
Richards, Samuel	May 9th, 1912	B 152
Rigby, John	July 29th, 1905	B 29
Roberts, Ebenezer	September 10th, 1910	B 117
Robinson, William	July 22nd, 1908	B 69
Rogers, George	May 1st, 1909	B 79
Roper, William	" 9th, 1912	B 141

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

NAME.	DATE.	Cer. No.
Russell, John	November 2nd, 1907	B 47
Saville, Luther	" 2nd, "	B 51
Shanks, David	October 31st, 1912	B 159
Shaw, Alex	July 29th, 1905	B 19
Shaw, Thomas John	May 27th, 1913	B 166
Somerville, Alex	March 4th, 1905	B 4
Spruston, Robert Lecce	July 8th, 1916	B 202
Spruston, Thos. A	November 2nd, 1907	B 46
Stafford, Matthew	June 10th, 1911	B 131
Stewart, J. M	May 1st, 1909	B 95
Stobbart, Jacob	" 9th, 1912	B 153
Stockwell, William	November 2nd, 1907	B 56
Strang, Thomas	October 31st, 1912	B 158
Taylor, James	May 13th, 1915	B 194
Taylor, Thomas	July 8th, 1916	B 203
Thomas, J. B	November 27th, 1909	B 105
Thomas, Joseph D	October 23rd, 1906	B 38
Thompson, Joseph	September 10th, 1910	B 114
Touhey, James	May 9th, 1912	B 147
Touchey, William	July 8th, 1916	B 205
Tonge, Thomas	" 22nd, 1908	B 71
Vanhulle, Peter	November 2nd, 1907	B 54
Virgo, John	May 1st, 1909	B 89
Walker, William	" 13th, 1915	B 192
Warburton, Ernest Leonard	" 27th, 1913	B 170
Watson, Adam G	November 14th, 1905	B 28
Webber, John Frank	March 4th, "	B 3
Wesnedge, William	November 27th, 1909	B 98
White, John	" 2nd, 1907	B 48
Whitehouse, William	October 31st, 1912	B 163
Wilson, Robinson	May 21st, 1914	B 177
Wilson, Thomas	July 22nd, 1908	B 74
Wilson, William	" 22nd, "	B 70
Wood, Thos. James	May 21st, 1914	B 176
Worthington, Joseph	" 1st, 1909	B 85

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

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

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

NAME.	DATE.			CER. NO.
Bell, Fred	May	27th,	1913	C 514
Bell, John	"	9th,	1912	C 477
Bennett, John	October	14th,	1914	C 597
Bennie, John	June	10th,	1911	C 411
Beveridge, Wm	"	10th,	"	C 396
Biggs, John	March	4th,	1905	C 210
Biggs, Thomas	October	28th,	1911	C 449
Birchell, Richard	"	1st,	1907	C 266
Blair, James	"	31st,	1912	C 502
Blewett, Ernest	July	22nd,	1908	C 298
Bobba, Frank	May	21st,	1914	C 568
Bradley, William	July	22nd,	1908	C 291
Bridge, Edward	"	29th,	1905	C 223
Briscoe, F	"	22nd,	1908	C 309
Broderick, Matthew	January	21st,	1913	C 525
Brown, Arthur A	October	14th,	1914	C 596
Brown, David	November	1st,	1909	C 348
Brown, George	July	8th,	1916	C 626
Brown, James	September	10th,	1910	C 364
Brown, James	June	10th,	1911	C 412
Brown, James	July	8th,	1916	C 625
Brown, Jas. Millie	May	13th,	1915	C 615
Brown, John	September	10th,	1910	C 392
Brown, Robert	October	28th,	1911	C 451
Brown, Robert D	June	10th,	"	C 423
Brown, Robert S	"	10th,	"	C 408
Brown, Wm. A	May	21st,	1914	C 576
Brown, William Gold	July	8th,	1916	C 629
Brownrigg, J. H	"	22nd,	1908	C 276
Bullen, Thomas	September	10th,	1910	C 379
Bushell, Jas. P	October	1st,	1907	C 264
Cairns, Andrew	June	10th,	1911	C 420
Cairns, Robert	May	27th,	1913	C 539
Calverly, Joseph	September	10th,	1910	C 375
Camamile, Hollis	October	28th,	1911	C 443
Carr, Peter	"	31st,	1912	C 497
Catchpole, Charles	July	29th,	1905	C 227
Caufield, John	May	1st,	1909	C 321
Challoner, Arthur	October	28th,	1911	C 433
Cheetham, Ben	July	22nd,	1908	C 311
Chester, John	October	28th,	1911	C 440
Clark, Lewis	June	10th,	"	C 405
Clark, Walter Pattison	May	9th,	1912	C 480
Clarkstone, Wm. W	October	28th,	1911	C 431
Cleaves, Walter	May	9th,	1912	C 475
Clifford, William	July	22nd,	1908	C 313
Commons, William	"	22nd,	"	C 304
Cooke, Joseph	March	4th,	1905	C 209
Coomb, Alexander	May	27th,	1913	C 533
Cope, Frank	October	28th,	"	C 549
Coulthard, James	June	10th,	1911	C 407
Crawford, David	March	4th,	1905	C 208
Cunningham, G. F	November	11th,	"	C 229
Cunliffe, Thos	October	1st,	1907	C 265
Dabb, Owen	May	21st,	1914	C 578
Dando, John	"	9th,	1912	C 465
Davidson, Hugh	"	9th,	"	C 464
Davies, Evan Thomas	"	9th,	"	C 463
Davis, William	"	1st,	1909	C 339
Dean, Joseph	"	13th,	1915	C 611
Derbyshire, A	June	10th,	1911	C 401
Dewar, Alex.	September	10th,	1910	C 369
Devlin, Edward	October	23rd,	1906	C 241
Devlin, Ernest Henry	May	27th,	1913	C 538
Dickenson, Clifford	"	27th,	"	C 532
Dingsdale, Geo	October	28th,	1911	C 459

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

NAME.	DATE.	Cer. No.
Doherty, J. J	May 1st, 1909	C 340
Doney, John	March 4th, 1905	C 211
Donnachie, John	June 10th, 1911	C 425
Doodson, Robert	October 28th, "	C 455
Dorrance, Orlin William	January 21st, 1913	C 517
Douglas, D. B	October 23rd, 1906	C 235
Dow, And. Y	May 21st, 1914	C 587
Dunn, Wm	October 14th, "	C 606
Dykes, Isaac	June 10th, 1911	C 409
Dykes, Joseph W	October 1st, 1907	C 248
Edwards, John	May 27th, 1913	C 542
Elliott, John	" 27th, "	C 541
Elmes, George	October 31st, 1912	C 511
Evans, D	July 22nd, 1908	C 284
Ewart, Alex	September 10th, 1910	C 374
Ewing, Robert	May 13th, 1915	C 608
Fairfoull, James	October 28th, 1911	C 453
Fitzpatrick, T. J	" 28th, 1911	C 452
Flockart, David	January 21st, 1913	C 531
Ford, Allen	October 28th, 1911	C 445
Fowler, Robert	" 31st, 1912	C 495
Francis, David Morgan	" 28th, 1913	C 558
Francis, James	" 1st, 1907	C 250
Frater, George	May 13th, 1915	C 616
Freeman, H. N	November 14th, 1905	C 230
Frew, Andrew	" 27th, 1909	C 360
Frodsham, Vincent	July 22nd, 1908	C 282
Furbow, John	January 21st, 1913	C 528
Garbett, Richard	September 10th, 1910	C 377
Gascoyne, Rowland B	January 21st, 1913	C 513
Geater, Jas. Gordon	May 21st, 1914	C 573
Gemmell, James	October 31st, 1912	C 505
Gillham, John	May 13th, 1915	C 623
Glenn, James	October 28th, 1911	C 435
Gordon, Davis John	May 9th, 1912	C 474
Gourley, Robert	" 9th, "	C 470
Gray, George	" 9th, 1912	C 467
Greenhorn, John	" 21st, 1914	C 575
Griffiths, Edward	October 31st, "	C 508
Gunniss, Matthew	May 9th, 1912	C 460
Hallinan, William	" 1st, 1909	C 343
Halsall, J	July 22nd, 1908	C 307
Hamilton, John	October 28th, 1911	C 444
Hamilton, Robert Nesbitt	" 28th, 1913	C 550
Hartley, Thomas	" 31st, 1912	C 510
Harwood, Fred	September 10th, 1910	C 384
Harvey, Thomas	May 9th, 1912	C 466
Harvie, George	September 10th, 1910	C 378
Heaps, Robert	" 10th, 1910	C 373
Hemer, Herbert	October 14th, 1914	C 595
Henney, Jonathan	June 10th, 1911	C 424
Hendry, James	May 9th, 1912	C 471
Heyes, Edward	" 1st, 1909	C 320
Hilley, Fred	July 22nd, 1908	C 290
Hilton, R. G	September 10th, 1910	C 376
Hodson, R. H	March 4th, 1905	C 216
Holliday, William	July 8th, 1916	C 634
Horbury, Joseph W	June 10th, 1911	C 406
Horrocks, A. G	May 1st, 1909	C 324
Horwood, S	July 22nd, 1908	C 312
Houston, Robert	" 8th, 1916	C 631
Howells, Nathaniel	May 1st, 1909	C 316
Huby, Norman	June 10th, 1911	C 394
Hutchison, Ben	November 14th, 1905	C 232
Hutchison, Fred	" 27th, 1909	C 358
Hynds, William	July 8th, 1916	C 632

Third-class Certificates issued under "Coal Mines Regulation Act Further Amendment Act, 1904"—*Continued.*

Name.	Date.	Cer. No.
Ireson, John	October 31st, 1912	C 507
Irvine, David	June 10th, 1911	C 413
Jack, John	May 21st, 1914	C 582
James, Thos.	" 21st, "	C 588
Jardine, George Edward	January 21st, 1913	C 521
Jarrett, Fred. J	October 1st, 1907	C 256
Jaynes, Frank	July 22nd, 1908	C 277
Jemson, J. W	March 4th, 1905	C 205
Jenkins, John	September 10th, 1910	C 390
John, Howel	July 22nd, 1908	C 305
Johnson, Moses	October 1st, 1907	C 258
Johnston, Robert	May 9th, 1912	C 479
Jones, Alf. Geo	" 21st, 1914	C 584
Jones, Samuel	" 27th, 1913	C 518
Jones, William C	January 21st, "	C 556
Jones, William Ernest	October 28th, "	C 221
Jones, W. T	March 4th, 1905	C 544
Joshua, John	May 9th, 1912	C 478
Joyce, Walter	November 27th, 1909	C 361
Judge, Peter	September 10th, 1910	C 391
Keenan, Wm. James	June 10th, 1911	C 426
Kemp, Wm	October 14th, 1914	C 594
Kingham, Alfred	" 28th, 1913	C 559
Kirkeberg, H. S	November 27th, 1909	C 350
Lancaster, William	October 23rd, 1906	C 243
Lane, Joseph	" 1st, 1907	C 254
Leeman, T	May 1st, 1909	C 345
Lewis, Benj. J	September 10th, 1910	C 386
Leyland, Joseph	July 8th, 1916	C 628
Liddle, John	" 29th, 1905	C 228
Littler, John	June 10th, 1911	C 410
Littler, Matthew	" 10th, "	C 417
Littler, Robert	" 10th, "	C 418
Livingstone, Alex	October 28th, "	C 436
Loxton, George	June 10th, "	C 428
Loxton, John	" 10th, "	C 416
Lynch, Stewart	October 28th, "	C 432
Mackie, John	June 10th, "	C 421
Makin, J. Wm	September 10th, 1910	C 385
Malone, John	May 21st, 1914	C 585
Malone, Patrick	October 1st, 1907	C 247
Maltman, James	" 31st, 1912	C 501
Mansfield, A	May 1st, 1909	C 336
Marsh, Daniel Parks	" 27th, 1913	C 543
Marsh, John	October 1st, 1907	C 270
Martin, James	June 10th, 1911	C 398
Mason, Joseph	July 22nd, 1908	C 297
Massey, Henry	May 1st, 1909	C 317
Mather, Thomas	July 22nd, 1908	C 293
Matusky, Andrew	October 1st, 1907	C 259
Mawson, J. T	November 27th, 1909	C 359
Maxwell, Geo	May 21st, 1914	C 571
Meek, Matthew	" 9th, 1912	C 484
Meikle, Harry Alexander	July 8th, 1916	C 627
Mercer, Jas	October 14th, 1914	C 600
Merrifield, George	" 23rd, 1906	C 239
Merrifield, William	" 23rd, "	C 236
Michek, John	May 21st, 1914	C 563
Miles, John	June 10th, 1911	C 414
Millar, Peter	September 10th, 1910	C 388
Mitchell, Charles	May 1st, 1909	C 322
Mitchell, Henry	September 10th, 1910	C 366
Monks, James	November 14th, 1905	C 234
Moore, George	October 23rd, 1906	C 242
Moore, John	May 1st, 1909	C 335
Moreland, Thomas	July 22nd, 1908	C 299

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

NAME.	DATE.	Cer. No.
Morgan, John	July 29th, 1905	C 224
Morris, David	May 9th, 1912	C 472
Mottishow, Samuel K	October 23rd, 1906	C 237
Murdock, Jno. Y.	May 21st, 1914	C 564
Myers, Peter	October 28th, 1911	C 446
McAlpine, John	March 4th, 1905	C 217
McBroom, Al	July 2nd, 1908	C 287
McCourt, John	October 14th, 1914	C 605
McCulloch, James	May 1st, 1909	C 315
McDonald, John	October 28th, 1911	C 448
McFagen, Alexander	May 9th, 1912	C 490
McFegan, W	" 1st, 1909	C 319
McGarry, Martin	" 1st, "	C 326
McGrath, James	July 8th 1916	C 630
McGuckie, Jno. M	May 21st, 1914	C 562
McGuckie, Thomas	July 29th, 1905	C 226
McGuire, Thomas	October 28th, 1913	C 553
McIntyre, Neil	May 21st, 1914	C 574
McKelvie, J	July 22nd, 1908	C 285
McKenzie, Peter	June 10th, 1911	C 427
McKibben, Matthew	May 21st, 1914	C 580
McKinley, John	October 28th, "	C 442
McLaughlin, James	May 9th, 1912	C 485
McLachlan, Alex	June 10th, "	C 419
McLean, M.D.	September 10th, 1910	C 389
McLellan, William	March 4th, 1905	C 219
McLeod, James	July 22nd, 1908	C 296
McLeod, John	May 13th, 1915	C 609
McMeakin, James	" 13th, "	C 612
McMillan, D.	September 10th, 1910	C 363
McMillan, Edward	October 31st, 1912	C 493
McNay, Carmichael	July 22nd, 1908	C 306
McNeill, Adam L	" 22nd, "	C 281
McNeill, Robert	September 10th, 1910	C 387
Monks, John	May 13th, 1915	C 618
Nanson, T. H	July 22nd, 1908	C 280
Neen, Joseph	November 27th, 1909	C 352
Nelson, Horatio	October 1st, 1907	C 263
Neilson, William	May 9th, 1912	C 481
Newman, John	October 14th, 1914	C 603
Nicholson, James	May 9th, 1912	C 469
Nimmo, James	" 9th, "	C 461
Norris, Joshua	October 28th, 1913	C 557
Oakes, Robert	" 31st, 1912	C 498
O'Brien, Charles	November 27th, 1909	C 349
Odgers, Alfred	January 21st, 1913	C 529
Odgers, Eli	" 21st, "	C 523
Orr, Alexander	October 28th, 1911	C 434
Osborne, Hugh	" 28th, 1913	C 555
Oswald, Geo. L.	September 10th, 1910	C 370
Owen, Thomas	May 1st, 1909	C 347
Parks, Alexander	January 21st, 1913	C 519
Parker, L.	May 1st, 1909	C 341
Parkinson, T	July 22nd, 1908	C 289
Parrott, Jas. E.	May 21st, 1914	C 590
Parson, Herbert	" 13th, 1915	C 621
Pearson, Jonathan	" 9th, 1912	C 473
Penman, Hugh	October 28th, 1913	C 552
Perry, James	March 4th, 1905	C 215
Pickup, A	July 22nd, 1908	C 310
Picton, W	May 1st, 1909	C 333
Plank, Samuel	November 14th, 1905	C 233
Poole, Samuel	May 27th, 1913	C 536
Potter, Robert	October 31st, 1912	C 503
Price, Walter	September 10th, 1910	C 371

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

NAME.	DATE.	Cer. No.
Puckey, Wm. R.	September 10th, "	C 368
Quinn, James	October 28th, 1911	C 441
Quinn, John	" 28th, "	C 429
Radford, Albert	May 21st, 1914	C 579
Rallison, R.	July 22nd, 1908	C 279
Rankin, George	" 22nd, 1908	C 275
Rankin, Wm. Shaw	May 9th, 1912	C 489
Ratcliffe, Thomas	October 1st, 1907	C 253
Raynor, Fred	" 1st, "	C 257
Reid, Robert	September 10th, 1910	C 383
Reid, Thos.	May 21st, 1914	C 592
Reid, Wm	June 10th, 1911	C 403
Reilly, Thomas	July 22nd, 1908	C 303
Renney, Jas	November 27th, 1909	C 354
Richards, James	" 1st, 1907	C 249
Richards, Samuel	October 23rd, 1906	C 244
Richardson, J. H.	" 28th, 1911	C 458
Rigby, John	July 29th, 1905	C 225
Roberts, Ebenezer	May 1st, 1909	C 327
Robinson, Michael	" 1st, "	C 332
Robson, Thomas	" 21st, 1914	C 566
Rogers, Ellis	" 13th, 1915	C 624
Roper, William	July 22nd, 1908	C 274
Rowan, Alexander	October 31st, 1912	C 500
Rowan, John	" 14th, 1914	C 602
Rowbottom, Thomas	" 31st, "	C 492
Royle, Edward	" 31st, 1912	C 506
Russell, Robert	November 27th, 1909	C 351
Rutledge, Edwin	July 22nd, 1908	C 302
Scott, Henry	" 22nd, "	C 294
Saunders, Eustace L.	January 21st, 1913	C 520
Seggie, Robert	" 21st, "	C 524
Shanks, David	September 10th, 1910	C 372
Sharp, James	May 1st, 1909	C 325
Sharples, J. T.	September 10th, 1910	C 380
Shearer, L.	May 1st, 1909	C 330
Shenfield, W	November 27th, "	C 357
Shipley, John W.	October 28th, 1911	C 456
Shooter, Joseph	" 1st, 1907	C 261
Shortman, J	May 1st, 1909	C 331
Simister, J. H	November 27th, "	C 353
Simister, W	May 1st, "	C 334
Simms, Hubert Allan	January 21st, 1913	C 526
Sinclair, William	" 21st, "	C 527
Skelton, Thos.	May 1st, 1909	C 344
Smith, A. E.	September 10th, 1910	C 367
Smith, Joseph	March 4th, 1905	C 207
Smith, Richard Beveridge	October 28th, 1913	C 561
Smith, Thos. J	" 1st, 1907	C 271
Smith, Thomas	May 9th, 1912	C 486
Sopwith, Reginald Scott	January 21st, 1913	C 512
Sparks, Edward (C 314 issued in lieu of C 255 destroyed by Fernie fire)	October 1st, 1907	C 255
Spencer, G	May 1st, 1909	C 329
Spruston, R. L.	November 27th, "	C 355
Spruston, Thomas A	March 4th, 1905	C 206
Stafford, M.	September 10th, 1910	C 382
Starr, Wallace	May 9th, 1912	C 488
Staton, Edward	" 21st, 1914	C 581
Steele, Walter	October 28th, 1911	C 439
Stewart, George	May 27th, 1913	C 534
Stewart, James M.	October 23rd, 1906	C 240
Stockwell, William	" 23rd, "	C 238
Strachan, John	" 14th, 1914	C 604
Strang, James	May 13th, 1915	C 614

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

NAME.	DATE.	Cer. No.
Strang, Thomas	June 10th, 1911	C 409
Strang, Wm	" 10th, "	C 395
Luck, George	May 1st, 1909	C 318
Sutherland, John	" 27th, 1913	C 545
Taylor, Charles M	March 4th, 1905	C 213
Taylor, Hugh	January 21st, 1913	C 530
Taylor, James	May 21st, 1914	C 567
Taylor, J. T.	October 28th, 1911	C 447
Taylor, Leroy	September 10th, 1910	C 381
Taylor, Thomas	May 21st, 1914	C 577
Thacker, Geo	" 27th, 1913	C 537
Thomas, Thomas	September 10th, 1910	C 365
Thomas, John B	November 14th, 1905	C 231
Thomas, Joseph	March 4th, "	C 220
Thomas, Warriett	October 1st, 1907	C 273
Thompson, Thomas	" 1st, "	C 267
Thompson, John	" 31st, 1912	C 509
Thompson, Joseph	" 1st, 1907	C 269
Thomson, Duncan	March 4th, 1905	C 218
Touhey, William	May 27th, 1913	C 547
Tully, Thomas	" 9th, 1912	C 468
Tune, Elijah	" 9th, "	C 476
Turnbull, Matthew	October 14th, 1914	C 598
Vardy, Robt	May 21st, "	C 570
Vaughan, John Henry	October 28th, 1913	C 560
Walker, George	July 8th, 1916	C 633
Walker, Jas. Alexander	October 31st, 1912	C 496
Walker, Wm	May 21st, 1914	C 586
Wallace, Fred	October 1st, 1907	C 260
Warburton, Ernest Leonard	June 10th, 1911	C 399
Wardrop, James	October 31st, 1912	C 504
Watson, Adam G	March 4th, 1905	C 212
Watson, Arthur W.	May 27th, 1913	C 535
Watson, George	July 22nd, 1908	C 288
Watson, Joseph	January 21st, 1913	C 515
Watson, William	October 22nd, 1906	C 246
Webb, Herbert	" 28th, 1911	C 457
Weeks, John	March 4th, 1905	C 214
White James	October 31st, 1912	C 499
White, John	" 22nd, 1906	C 245
Whitehouse, Wm	June 10th, 1911	C 402
Wilkinson, Edward	October 28th, 1911	C 438
Williams, John Sam	June 10th, "	C 404
Williams, Watkin	" 22nd, 1908	C 301
Wilson, Robinson	" 10th, 1911	C 397
Wilson, Thomas M	October 1st, 1907	C 272
Wilson, William	" 1st, "	C 262
Winstanley, H.	July 22nd, 1908	C 283
Wintle, Thomas A	" 29th, 1905	C 222
Witherington, George	October 28th, 1913	C 554
Wood, Thos. James	" 31st, 1912	C 491
Worthington, J.	July 22nd, 1908	C 295
Wright, John	May 21st, 1914	C 593
Wright, Robert	" 21st, "	C 589
Wright, William	January 21st, 1913	C 522

COAL-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	Malpass, James	Nov. 7, 1904	C 113
Addison, Thos	Dec. 10, 1904	C 52	Marsden, John	May 3, 1904	C 21
Aitken, James	Oct. 24, 1904	C 44	Marshall, Howard	Dec. 6, 1905	C 127
Allsop, Harry	Oct. 11, 1904	C 34	Matthews, Chas	April 27, 1904	C 9
Ashman, Jabez	Feb. 5, 1907	C 131	Miard, Harry E	March 3, 1905	C 76
Auchinvole, Alex	March 29, 1905	C 89	Middleton, Robt	Feb. 11, 1905	C 71
Barclay, Andrew	April 27, 1904	C 19	Miles, Thos	Aug. 10, 1904	C 31
Barclay, James	April 27, 1904	C 20	Miller, Thos. K	Feb. 21, 1905	C 74
Barclay, John	April 17, 1905	C 111	McKenzie, John R	Oct. 12, 1904	C 40
Bickle, Thos	Oct. 11, 1904	C 37	McKinnon, Arch'd	April 3, 1905	C 102
Biggs, Henry	April 10, 1905	C 110	McMillan, Peter	March 29, 1905	C 94
Black, James S	April 3, 1905	C 108	McMurtrie, John	March 29, 1905	C 96
Bowie, James	May 13, 1905	C 116	Moore, Wm. H	June 17, 1905	C 119
Briscoe, Edward	Oct. 10, 1906	C 129	Morris, John	Dec. 27, 1904	C 57
Campbell, Dan	March 29, 1905	C 93	Myles, Walter	April 3, 1905	C 100
Carr, Jos. E	Oct. 11, 1904	C 36	Nash, Isaac	June 1, 1904	C 120
Carroll, Harry	March 29, 1905	C 98	Neave, Wm	Oct. 12, 1904	C 43
Clarkson, Alexander	April 27, 1904	C 18	Nelson, James	April 27, 1904	C 16
Collishaw, John	Feb. 7, 1905	C 68	Newton, John	Oct. 12, 1904	C 39
Comb, John	March 23, 1904	C 2	Nimmo, Jas. P	April 3, 1905	C 103
Cosier, Wm	March 29, 1905	C 86	Nimmo, Richard E	April 18, 1911	C 133
Courtney, A. W	Nov. 2, 1904	C 45	O'Brien, Geo	Feb. 6, 1905	C 66
Crawford, Frank	April 6, 1904	C 7	Pearse, Thomas W. H	April 14, 1916	C 138
Daniels, David	April 27, 1904	C 12	Perrie, Jas	March 15, 1905	C 81
Davidson, David	April 3, 1905	C 106	Perry, James	June 13, 1904	C 27
Davidson, John	March 29, 1905	C 87	Price, Jas	Nov. 8, 1904	C 50
Devlin, Henry	Oct. 12, 1904	C 41	Rafter, Wm	March 29, 1905	C 95
Dobbie, John	Nov. 27, 1905	C 126	Reid, Thos	Nov. 3, 1904	C 47
Dudley, James	March 22, 1905	C 114	Reid, James	March 23, 1904	C 1
Duncan, Thomas	Aug. 29, 1906	C 128	Richards, Thos	April 27, 1904	C 14
Dunlap, Henry	Nov. 21, 1904	C 51	Ross, John	April 3, 1905	C 101
Dunn, Geo	Dec. 19, 1904	C 56	Roughead, George	Jan. 30, 1907	C 130
Dunsmuir, John	March 29, 1905	C 90	Ryan, John	Dec. 28, 1904	C 59
Eccleston, Wm	March 15, 1905	C 80	Sanders, John W	April 3, 1905	C 107
Evans, W. H	March 14, 1905	C 79	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, Ralph	March 7, 1905	C 77
Findlayson, James	June 6, 1904	C 25	Smith, Geo	March 29, 1905	C 84
Fulton, Hugh T	April 3, 1905	C 105	Somerville, Alex	March 24, 1904	C 3
Gibson, Edward	May 30, 1905	C 118	Stauss, Chas. F	Feb. 9, 1905	C 69
Gilchrist, Wm	March 29, 1905	C 85	Steele, Jas	March 29, 1905	C 92
Gillespie, Hugh	April 6, 1904	C 8	Steele, John	June 4, 1913	C 4
Gillespie, John	April 6, 1904	C 5	Stewart, Duncan H	March 28, 1904	C 137
Gould, Alfred	April 17, 1906	C 112	Stewart, John	April 3, 1904	C 104
Green, Francis	Oct. 11, 1904	C 38	Stewart, Daniel W	May 16, 1904	C 23
Handlen, Jas	June 16, 1904	C 122	Stoddart, Jacob	Feb. 21, 1905	C 73
Harmison, Wm	Feb. 3, 1905	C 65	Strachan, Robt	April 27, 1904	C 15
Haworth, Geo	March 29, 1905	C 88	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

* Issued in lieu of No. C 132, lost.

EXPLOSION AT No. 3 EAST MINE, MICHEL, B.C.

REPORT BY THOMAS GRAHAM, CHIEF INSPECTOR OF MINES.

A disastrous explosion occurred in No. 3 East mine, Michel Colliery, owned and operated by the Crow's Nest Pass Coal Company, on August 8th, 1916.

The explosion occurred shortly following the change of the night, or 11 p.m., shift; all of the men who entered the mine (twelve in number) lost their lives.

The following list gives the names and occupations of those killed, the order being as found in the mine:—

No. 1. Thomas Phillips, fireboss.
„ 2. J. Mikus, labourer.
„ 3. J. Hepka, labourer.
„ 4. George Kometz, miner.
„ 5. David Davis, miner.
„ 6. Henry Evans, track-cleaner.
„ 7. A. Ficon, labourer.
„ 8. Daniel Hall, hoistman.
„ 9. Samuel Dmytriv, rope-rider.
„ 10. Thomas Hampton, miner.
„ 11. Oscar DeVolder, miner.
„ 12. Mike Marmol, bratticeman (body not yet found).

No. 3 East mine is situated on the south side of Michel creek and about half a mile south-east of the tipple. The mine is opened by a slope, the average dip of which is about 9 degrees. The Main slope with east and west or parallel slopes extend 2,400 feet from the portal. A Diagonal slope leaves the Main slope about 1,100 feet from the portal, running south-east 2,000 feet, and is commonly known as No. 6 East slope.

Just below the intersection of No. 6 East with the Main slope a fault was encountered and the seam was recovered by driving rock tunnels; below this point levels were turned off the Main slope in pairs east and west, the levels following the contour of the seam.

The seams vary in thickness from 6 to 12 feet, and in the immediate vicinity of the fault previously mentioned reached 30 feet in thickness.

The coal is bituminous and fairly firm; the analysis is shown in the general sample of the coal, as shown among the dust samples given elsewhere in this report.

FAN.

The mine is ventilated by an 8- x 16-foot double-inlet reversible, rope-driven Wilson fan, and was operating as an exhaust. The fan-engine is of the Tangye type, with 12- x 18-inch cylinder, and rated at 125 horse-power. In addition to the ordinary U type water-gauge, the fan was equipped with a Crosby self-recording water-gauge.

The fan running at 112 R.P.M. delivered 93,600 cubic feet a minute, with a water-gauge of 2 inches. Report of Inspector of Mines George O'Brien; inspection made July 19th, 1916.

OUTPUT OF MINE.

The output was normally about 550 tons on two shifts of eight hours each. The number of men in the mine on the day of the explosion was slightly under normal, and distributed as follows:—

Morning shift	52 men.
Afternoon shift	45 „
Night shift	12 „
Total	109 „

This number, as stated, was slightly below normal, due to labour troubles throughout the district. The mine had been idle for one week (July 31st to August 8th, 1916); operations were resumed at 7 a.m. on the day of the explosion.

During this idle period the fan was operated continuously and inspections made by the firebosses. The reports of the firebosses from August 1st to August 8th, together with the Gas Committee's reports for June and July, are given:—

THE CROW'S NEST PASS COAL COMPANY, LIMITED.

Firebosses' Daily Report.

Mine: No. 3 East, Michel Colliery.
District: 6 East, faces of 17 and 18 crosscuts; 6 East, Main slope; 6 West, Back slope.
Date: 1/8/16. Time: 6.45 a.m.
Roof and sides: Good.
Ventilation: Good.
General remarks: Little explosive gas above timbers in 18 crosscut, 6 East. Small cap, face of 6 East.

(Signed.) E. H.
T. C.
T. PHILLIPS.

THE CROW'S NEST PASS COAL COMPANY, LIMITED.

Firebosses' Daily Report.

Mine: No. 3 East, Michel Colliery.
District: Travelling-roads, airways, and working-places.
Date: 1/8/16. Time: 2.45 p.m.
Roof and sides: Good.
Ventilation: Good.
General remarks: A little explosive gas above timbers in 18 crosscut, 6 East.

(Signed.) T. C.
B. BALL.
E. HEYES.

THE CROW'S NEST PASS COAL COMPANY, LIMITED.

Firebosses' Daily Report.

Mine: No. 3 East, Michel Colliery.
District: Travelling-roads, airways, and working-places.
Date: 3/8/16. Time: 2.45 p.m.
Roof and sides: Good.
Ventilation: Good.
General remarks: A little explosive gas above timbers in crosscut 18, 6 East.

(Signed.) T. C.
T. PHILLIPS.
B. BALL.
E. HEYES.

THE CROW'S NEST PASS COAL COMPANY, LIMITED.

Firebosses' Daily Report.

District: Travelling-roads, airways, and working-places.
Mine: No. 3 East, Michel Colliery.
Date: 4/8/16. Time: 2.45 p.m.
Roof and sides: Good.
Ventilation: Good.
General remarks: A little explosive gas above timbers in 18 crosscut, 6 East; 17 crosscut, 6 East; fenced off.

(Signed.) T. C.
T. PHILLIPS.
E. HEYES.

THE CROW'S NEST PASS COAL COMPANY, LIMITED.

Firebosses' Daily Report.

Mine: No. 3 East, Michel Colliery.
District: Travelling-roads, airways, and working-places.
Date: 5/8/16. Time: 2.45 p.m.
Roof and sides: Good.
Ventilation: Good.
General remarks: A little explosive gas above timbers in 18 crosscut and 17 crosscut still fenced off.

(Signed.) T. C.
T. PHILLIPS.
B. BALL.
E. HEYES.

THE CROW'S NEST PASS COAL COMPANY, LIMITED.

Firebosses' Daily Report.

Mine: No. 3 East, Michel Colliery.
District:
Date: 7/8/16. Time: 2.40 p.m.
Roof and sides: Good.
Ventilation: Good.
General remarks: Little explosive gas above timbers in 9 West and 18 crosscut, 6 East.

(Signed.) T. PHILLIPS.
B. BALL.
J. MASON.

THE CROW'S NEST PASS COAL COMPANY, LIMITED.

Firebosses' Daily Report.

Mine: No. 3 East, Michel Colliery.
District: Airways, travelling-roads, working-places, and accessible parts of the mine.
Date: 8/8/16. Time: 6.45 a.m.
Roof and sides: Fairly good.
Ventilation: Good.
General remarks: A little explosive gas above timbers in 18 crosscut, 6 East.

(Signed.) J. M.
T. C.
T. PHILLIPS.

THE CROW'S NEST PASS COAL COMPANY, LIMITED.

Firebosses' Daily Report.

Mine: No. 3 East, Michel Colliery.
District: Airways, travelling-roads, working-places.
Date: 8/8/16. Time: 2.40 p.m.
Roof and sides: Good.
Ventilation: Good.
General remarks: Little explosive gas above timbers, face of 6 East. Small cap of gas, face of 18 crosscut, 6 East.

(Signed.) B. B.
T. C.
J. MASON.

THE CROW'S NEST PASS COAL COMPANY, LIMITED.

Firebosses' Daily Report.

Mine: No. 3 East, Michel Colliery.
District: 6 East, 9 West, and Main slope.
Date: 8/8/16. Time: 10.40 p.m.
Roof and sides: Good.
Ventilation: Good.
General remarks: A little explosive gas above timbers in 6 East face. A small cap of gas in 18 crosscut, 6 East.

(Signed.) T. P.
B. BALL.

GAS COMMITTEE'S REPORT.

No. 3 East Mine, Michel Colliery, 3rd June, 1916.
We, the undersigned Inspection Committee, have this day examined New No. 3 mine, and found as follows:—
Explosive gas in 2 room, 7 West; ½-inch cap in crosscut off 15 room East.
Roadways: Good.
Timbering: Good.
Airways: Good.
Quantity of air passing through the main intake is 75,920 cubic feet for sixty men and eight horses.

(Signed.) JOHN BRACKEN.
THOMAS HAMPTON.

GAS COMMITTEE'S REPORT.

No. 3 East Mine, Michel Colliery, July 8th, 1916.

This is to certify that we, the undersigned, have examined New No. 3 East, and found as follows:—

Explosive gas: None.
Airways: Good.
Timbering: Good.
Travelling-roads: Good.
Crosscut vent. Crosscut 11 West still fenced off.
Quantity of air passing through the main intake is 83,200 cubic feet a minute for sixty-two men and nine horses.

(Signed.) JOHN BRACKEN.
THOMAS HAMPTON.

Mr. Cunliffe, overman, gives the barometer readings for August 8th as follows: 7 a.m., 25.75; 3 p.m., 25.40; average barometer in district, 25.50.

THE NIGHT OF THE EXPLOSION.

The evening of August 8th was intensely close and sultry, with every indication of a thunder-storm. Shortly before 11 p.m., when shifts were changing, the storm broke over the valley, and was at its maximum force shortly after 11 to about half-past 11.

The electrical storm is cited by most witnesses as being the most severe they had ever experienced; the thunder was deafening, the lightning-flashes most vivid, and the rain almost torrential; and it is presumed that the explosion occurred during the height of this storm.

I have here said "presumed" because it is only by deduction that the actual time of the explosion is arrived at. No one heard it, or, if they did hear it, they at least did not associate it with the mine, but with the thunder-storm then in progress.

The valley at Michel is about one-quarter mile in width, and in this width lies Michel creek, the Canadian Pacific and Morrissey, Fernie & Michel railroad-tracks, and two streets. The Michel Hotel, the Trites-Wood store, and the public school are situated just across the creek from the mine, and many windows were broken in the store and school-house.

Thomas Russell, superintendent of the colliery, and George O'Brien, Mine Inspector for the district, both staying at the Michel Hotel, had retired for the night, but, following a terrific peal of thunder about 11.20 p.m., came out of their rooms to assist in allaying the fears of some lady guests who had become much alarmed by the storm. After reassuring the ladies they went down-stairs and out on to the hotel verandah. Seeing nothing unusual, and as they could hear the fans were running and observed the electric lights burning as usual, they concluded that no damage had been done, and decided to again retire; and it was not until nearly half an hour later, or midnight, that they were informed that something unusual had occurred at No. 3 East mine.

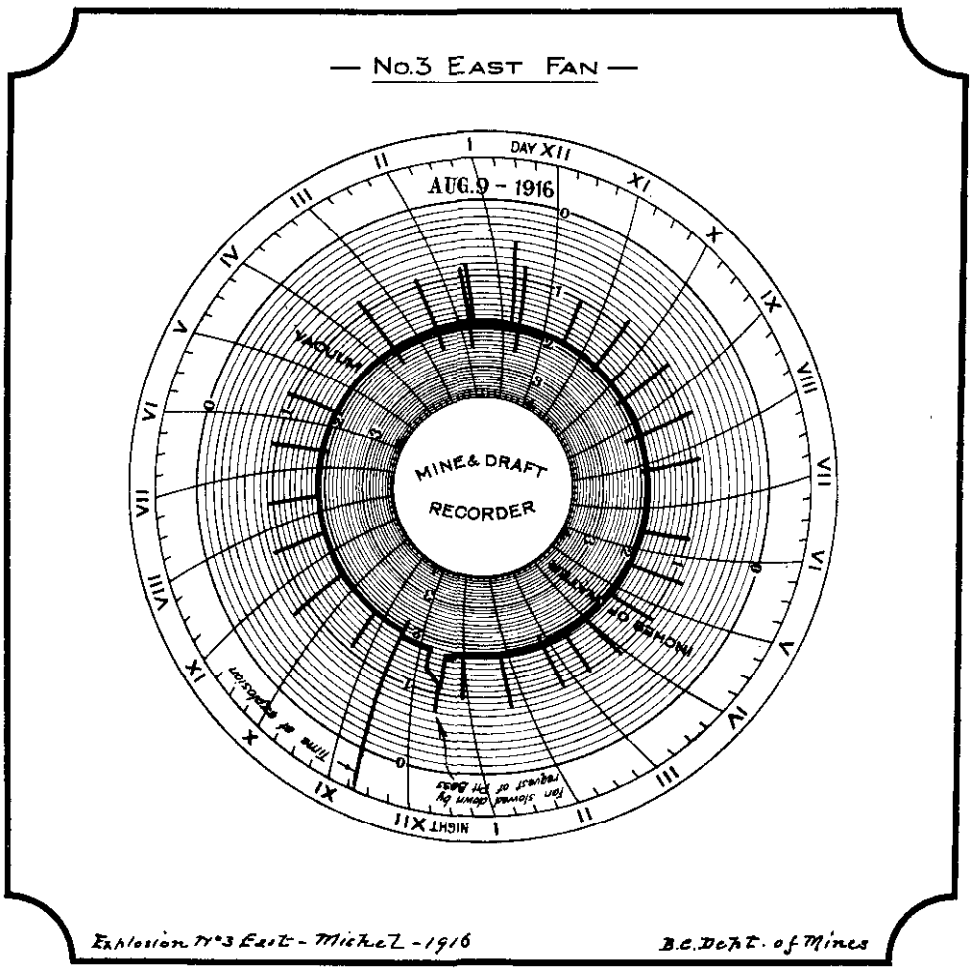
Benjamin Ball, the afternoon-shift fireboss, states that he came out of the mine about 10.45 p.m., and after writing and posting his report of the mine, he met Thomas Phillips, the night-shift or ongoing fireboss, and was with Mr. Phillips when he (Phillips) tested the safety-lamps of the shift going into the mine.

Owing to the severe storm in progress, Ball remained in the hoist-house with Phillips until about 11.10 or 11.15 p.m., and while there Phillips lowered an empty trip of cars down the Main slope to the place where it still stood after the explosion. Three labourers—Nos. 2, 3, and 7—were to clean up on the slope. During the time they were in conversation the storm was in progress, and Mr. Ball states that, following a peal of thunder, he thought the lightning hit the gear-wheel of the hoist. Both Phillips and he jumped and ran out of the building, Ball remarking that some one was taking a shot at them. Seeing no one around, they returned to the engine-room and found that the bulb of an incandescent lamp had burst. Mr. Ball further states that Mr. Phillips exclaimed: "Ben, I am going into the mine; it is safer in there than out here to-night." They then bid each other good night, Phillips going towards the mine-mouth and Ball towards the wash-house.

Ball further states that when crossing the bridge which spans Michel creek between that side of the valley and the tipple, there was another terrific peal of thunder, and the lightning seemed to hit the rails and run along them. He hurried on to the wash-house, and when undressing he seemed to smell fire and called the attention of the wash-house attendant, who

made an examination of the wash-house and reported everything all right, and it was midnight before he learned of the explosion at No. 3 East.

James Davey, a miner working in No. 10 West level, states he was coming out of the mine the night of the explosion. He had been delayed in erecting a set of timber, and it was a few minutes after 11 o'clock when he left the face. He was hurrying to get out as near on time as possible, and passed the three labourers who were cleaning track where the empty trip stood on the slope, and when nearing the portal he met Mr. Phillips, the night-shift fireboss, who was going into the mine, and states that Phillips said: "Jim, it is bombarding like hell outside."



Mr. Davey says the storm was very severe, and that a terrific peal of thunder, with a blinding flash of lightning, occurred when he was between No. 3 East and Old No. 3 fan-houses. When passing Old No. 3 fan-house he noticed Mr. Albright, the fan engineer, in the engine-room. He (Davey) hurried on to the lamp-room, turned in his lamps, and then went home; he had washed and was about to retire when he was notified that an explosion had wrecked No. 3 East.

The explosion must have occurred concurrently with the flash of lightning which occurred when Mr. Ball was crossing the bridge, when Mr. Davey was between the two fan-houses, and also when the lady guests at the Michel Hotel were so alarmed, for the following reason: Mr. Albright, the fan engineer, states he left Old No. 3 fan (where he was when seen by Mr. Davey)

at 11.30 p.m. to go to No. 3 East fan, distant 375 yards, and as it was raining hard he ran all the way. On arrival at No. 3 East fan he noted that the floor of the engine-room was strewn with debris, coal-dust, small pieces of wood-bark, and fungus; further, the outby door on the air-lock between engine-room and fan was open, the inby door was shut, and must have fallen back into place; the fan, however, was running as usual. Further examination showed that the relief-door on the fan-drift had also been blown open, but, like the inby door on the air-lock, had again fallen back into place. The self-recording water-gauge showed the drop in pressure on the chart was about 11.20 p.m.

The fan engineers took care of two fans—Old No. 3 and No. 3 East, about 375 yards apart; the self-recording water-gauges on both fans were arranged so that they also served as a time-clock to check the visits of the engineers. The engineers were without means of access to the charts; the clocks were locked, the key being in the possession of the master mechanic. At noon daily some person from the master mechanic's department changed charts, rewound and relocked the clocks; a relief-valve was placed on the air-pipe connecting the clock with the fan-drift; the fan engineers were required to open this valve on each visit to the fans; this action relieved the pressure on the water-gauge, permitting the pen on the self-recording chart to drop at the moment of release. (*See* lines shown on copy of chart in use at time of the explosion.)

The long line shown between 11.15 and 11.30 p.m. represents the drop of the pen through release of pressure when the fan-doors were momentarily opened by the explosion.

Mr. Albright, the fan engineer, at once proceeded to the mine portal and found several of the buildings partially demolished, the tracks strewn with timber and debris, and the mine-mouth completely closed. He immediately informed Mr. Cunliffe, mine overman, who lived close by, and was instructed by Mr. Cunliffe to raise a general alarm and obtain help at once.

The explosion must have developed intense force as the mine was badly wrecked; the main entrance was completely blocked by a heavy gravel and other caves, and required three weeks of continuous shifts to clean up this part alone. Entrance to the mine was obtained temporarily through a disused prospect opening.

Following the alarm sent out by Overman Cunliffe, there was, in keeping with other mine disasters the world over, plenty of willing hands ready to assist in the dangerous exploratory and relief work. These parties were ably led by Superintendent Thomas Russell, Inspector of Mines George O'Brien, and other colliery officials.

Telegraph and telephone connections with outside points were much delayed by reason of the electrical storm, but by 4 a.m. a special train arrived from Fernie, twenty-five miles distant, bringing General Manager W. R. Wilson, Superintendent Caufield, Coal Creek Colliery, T. H. Williams, Inspector of Mines, mine-rescue teams, and the rescue apparatus of the company from Coal Creek, as well as the Government apparatus from the Mine-rescue Station, Fernie, this being in charge of Charles O'Brien, Instructor at the Government station.

R. G. Drinnan, general manager of the Hillcrest Colliery, Alberta, and Charles Graham, superintendent of the Corbin Coal Company, arrived the following day and materially assisted in the exploratory work.

PROGRESS OF EXPLORATORY WORK.

Owing to excessive caving little progress could be made on the Main slope, and with the intention of reaching No. 6 East slope, where most of the men who entered the mine were supposed to be, it was decided to endeavour to reach that section by way of the main East level.

It now seems almost providential that the blocking of the Main slope made necessary this course, as it led to the discovery of a fire in its early stage that might soon have assumed alarming proportions with disastrous results. Considerable time was lost in getting the fire under control, and during the prosecution of the work the body of Fireboss Thomas Phillips was found on the level, about 150 feet from the intersection of the level with the Main slope.

The attempt to reach the workings of No. 6 East slope by this route failed owing to caving and presence of gas, and a return to the Main slope was made. Here all the permanent stoppings built of wood blocks 3 feet in length, set in and faced with lime, and the No. 6 East overcast, were found destroyed. Temporary stoppings of brattice-cloth were erected in crosscuts and a temporary overcast built to convey the East side return across the Main slope to the fan, but progress as a whole was slow owing to the exceedingly heavy caving and presence of much gas.

The evidences of force set up within the mine, as shown in the heavy caving, held little hope that any of the men who entered the mine could be alive.

Three bodies were found on the Main slope where the trip of empties stood, two were found on the No. 6 East slope a few feet below No. 16 room, and one body at the hoist near the top of the same slope. This left five bodies unaccounted for; four of these it was expected would be found on the parting on No. 13 room off No. 6 East slope, but this section was so heavily caved nothing could be done to recover the bodies until cars could be set in motion to remove the fallen ground.

After consultation between the management, representatives of the workmen, and the Mine Inspectors, it was decided that, in the interest of safety to all, the work of recovery should be conducted from the mine portal inward.

The work was carried on continuously three shifts a day, seven days a week; one cave alone near the entrance to No. 6 East slope required 636 cars of 2 tons capacity to remove the fallen material, and the bodies of the four men on No. 13 room parting were not reached until December 28th and 29th, 1916, and January 8th, 1917. At the time of writing one body is yet unfound.

VENTILATION.

The mine is very gaseous, being looked upon as one of the world's most gaseous mines, and gives off methane in excess of 3,000 cubic feet to the ton of coal mined.

As a result of this, production from a given area was small; that is to say, only a limited number of men could be employed in breaking down coal in any one split before the ventilating-current showed evidence of carrying gas. This number rarely exceeds twenty men. The mine was producing 550 tons in two shifts of eight hours, and employed 125 men in the twenty-four hours.

The quantity of air circulating in the mine was 93,600 cubic feet a minute. This was divided into four splits, two on the east and two on the west, and were known and carried ventilation as follows:—

	Cubic Feet.
No. 6 East split	28,800
No. 8 West split	17,800
East side split	14,000
West side split	16,800
Total	77,400

The splits were therefore carrying 82 per cent. of the total air being delivered by the fan.

Ventilation at the working-faces was reported good, exception being taken to the excessive amount of brattice-cloth carried at the face of No. 6 East slope, where two crosscuts were being driven in advance of the last break through. A little explosive gas was reported above the timber at the face of No. 6 East slope and a small cap of gas at the face of No. 18 crosscut, otherwise the mine was reported clear.

GENERAL CONDITION OF MINE AND ROADWAYS.

The mine was generally conceded to be in excellent condition; roadways were well timbered and kept free from accumulations of debris; the mine, whilst not wet, was generally damp, with no apparent accumulations of dust. That there was sufficient dust on the mine timbers and ribs to propagate an explosion is, however, now evident.

USE OF EXPLOSIVES.

The use of explosives in the mine was not excessive, and only permissible explosives used, Monobel being used in the coal and Polar Permitite in rock-work.

Explosives issued to employees in No. 3 East mine on August 8th, morning and afternoon, is shown by the company's books to have been as follows:—

Name.	Place.	Check No.	Amount.
			Lb.
V. Halaburdo	Crosscut off No. 13 room, No. 6 East	206	1
J. Lemancik	No. 11 room, No. 6 East	310	1
J. Bobrosky	No. 13 room, No. 6 East	230	2
L. Tortorilli	No. 12 room, No. 6 East	250	2
A. Lant	Crosscut, No. 12 room, No. 6 East	262	2
J. Hovan	No. 12, West	304	1
E. Marcon	Crosscut off No. 1 room, No. 9 West	315	1
	Total		10

No explosives were taken into the mine by any workmen in the mine on the night of the explosion. All explosive unused was taken out of the mine at the end of each shift.

Ben Ball, fireboss on the afternoon shift of the day of the explosion, reports having fired eleven shots—two rock shots in the Main slope, two shots in the coal in No. 10 West, two shots in the coal in No. 9 West, and three shots in crosscut off No. 12 room, No. 6 East slope, and two shots in No. 13 room off No. 6 East slope. The last two shots in No. 13 room were fired about 7 p.m., and were the last shots fired on that shift. Detonators were issued to shotlighters only.

EVIDENCES OF FLAME.

Nine samples of dust were taken at different points in the mine, together with a sample of fresh coal from the face. All of the dust samples, with one exception—No. 2, taken from parting at top of No. 6 East slope—showed distillation of volatiles.

LOCATION OF DUST SAMPLES TAKEN FROM NO. 3 EAST MINE, MICHEL COLLIERY.

Sample No. 1.—Off timber at mouth of crosscut on left side of Main slope, 30 feet below where body No. 2 was found.

Sample No. 2.—Off side of steel car on No. 6 East parting outby hoist.

Sample No. 3.—Off props on left side of No. 6 East slope, below No. 14 crosscut.

Sample No. 4.—Off edge of brattice-boards nailed to legs of sets on upper rib of No. 13 East slant, 15 feet from face.

Sample No. 5.—Off surface of water in Main slope, dust floating on water and could be scooped up by the hands.

Sample No. 6.—Soot from off props on floor and upper rib, about 75 feet from face of No. 14 West; soot deposited over coked dust on timbers and rails.

Sample No. 7.—Off inby side of centre props on No. 11 West, at inside slant.

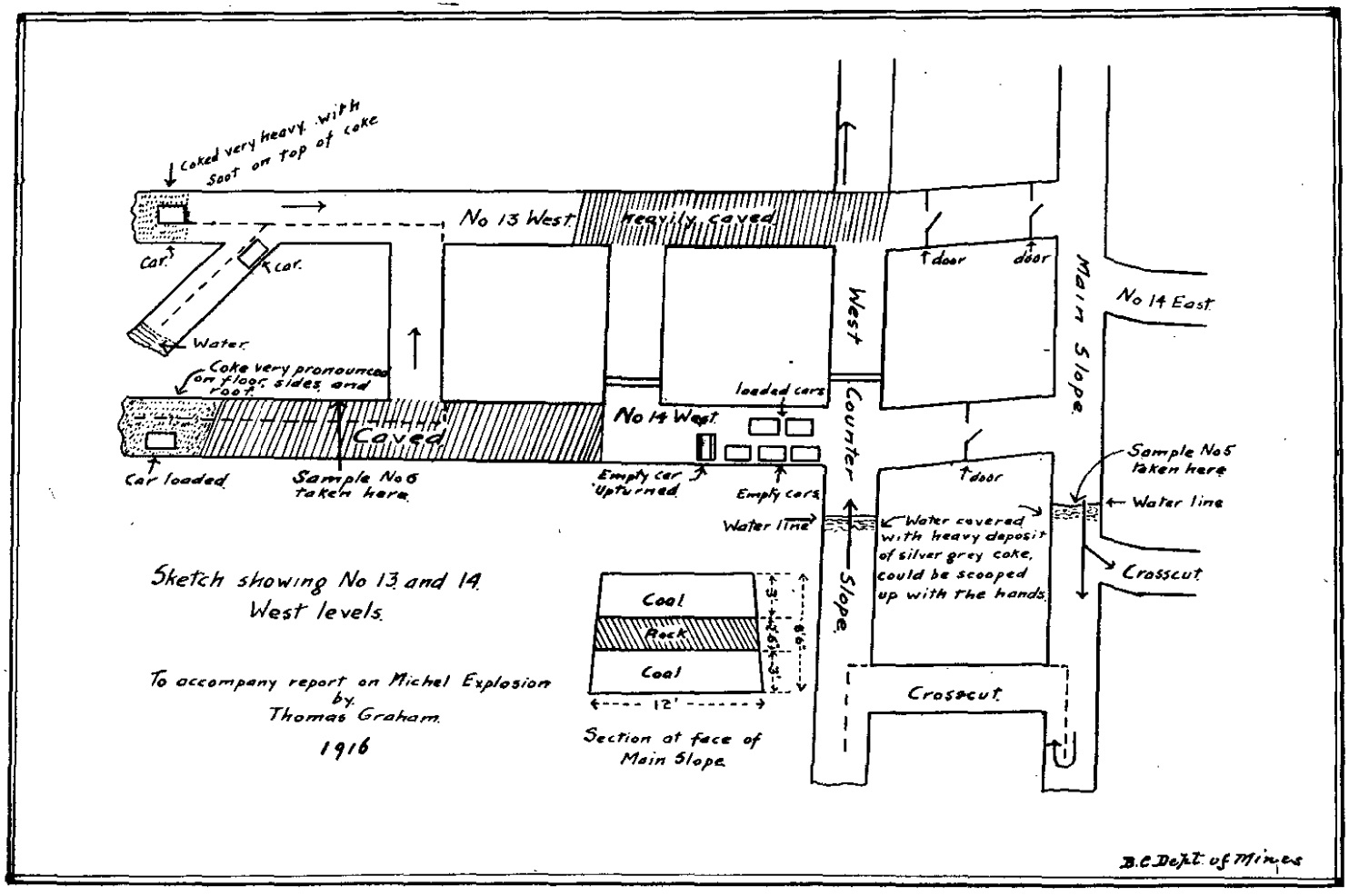
Sample No. 8.—Off posts on upper rib of No. 14 West, about 96 feet from face.

Sample No. 9.—Off floor at face of No. 10 West level, 6 feet from face.

Sample No. 10.—Sample of fresh coal from No. 3 East mine, Michel Colliery.

These samples were submitted for analysis to the Provincial Mineralogist, the returns being as follows:—

	Moisture.	Volatile Matter.	Fixed Carbon.	Ash.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
General sample of No. 3 East	1.0	20.3	71.7	7.0
Sample No. 1	1.5	13.9	72.3	12.3
" No. 2	1.0	20.5	65.0	13.5
" No. 3	1.3	14.8	72.3	11.6
" No. 4	1.7	14.0	62.6	21.7
" No. 5	0.8	17.0	50.6	31.6
" No. 6	1.6	15.6	70.6	12.2
" No. 7	1.6	12.7	73.6	12.1
" No. 8	1.5	11.2	68.4	18.9
" No. 9	1.7	13.6	73.4	11.3


Coked very heavy with Soot on top of coke
No 13 West
heavily caved
Car
Car
Water
Coke very pronounced on floor, sides and roof
Caved
Car loaded
Sample No 6 taken here
No 14 West
loaded cars
Empty car Upturned
Empty cars
Water line
West
Counter
Slope
door
door
Main Slope
No 14 East
door
Sample No 5 taken here
Water line
Water covered with heavy deposit of silver grey coke, could be scooped up with the hands
Crosscut
Crosscut
Coal
Rock
Coal
8'6"
12'
Section at face of Main Slope
Sketch showing No 13 and 14 West levels.
To accompany report on Michel Explosion by Thomas Graham.
1916
B.C. Dept. of Mines

LINES OF FORCES.

Careful examination of the mine shows that the explosion had traversed most of the mine, with much force evidenced in the Main slope. The general trend of force seemed to be up the Main slope, spreading east and west, the stoppings of wood blocks, already described, between the Main and East and West counter-slopes being in every instance blown from the Main into the counter-slopes; the trip of empty cars hanging on the rope in the Main slope had been blown up the slope; the clean-up on the slope showed considerable slack rope behind the trip.

In the lower levels off the Main slope, Nos. 13 and 14 East and West, there was evidence not only of much force, but also of great heat, as there was much coked dust on the floor, sides, and roof; the floor coke was covered with a heavy film of soot. When blown aside by the breath this revealed beneath a steel-grey coke. The surface of the water in the Main and counter slope was covered with a steel-grey coke that could be scooped up in handfuls. Sample No. 5 was collected here in this manner.

Owing to accumulation of water the face of the Main and counter slopes could not be examined and have not as yet been entirely unwatered.

A trip of cars in No. 14 West parting shows the forces as coming out of this level, these cars being forced together at the frog, one empty being turned over on its side, and another empty had the inby door driven into the car. The level was caved from the first crosscut inside the parting to near the face; a loaded car stood at the face, and much coke-dust was in evidence. The face was square up and down, and no explosives were used here; there is slight indication of force down the inside crosscut from No. 13; this face and slant had also evidence of heat in the burned and shredded brattice-cloth. A loaded car stood at the face of No. 13, and an empty car on the switch at the slant. The outer end of No. 13 was heavily caved, and has not been reached in the general recovery-work. Nos. 13 and 14 East showed the forces inward, as also did Nos. 12, 11, 10, 9, 8, and 7 East. These were all up to a fault and had not produced coal for some time previous to the explosion. There was much caving here, but little coke shown above Nos. 13 and 14.

On the West side Nos. 12, 11, 10, and 9 showed the forces clearly inward and were all heavily caved, especially Nos. 10 and 9. There was slight conflicting evidences of forces within the levels themselves, as if the forces had come down the crosscuts from the upper to the lower levels. These I deem can be accounted for by the fact that the upper level in each instance was the haulage-road for the pair, and as such would present more coal-dust for propagation of the flame, and it may thus have travelled faster in the upper than in the lower levels, which would account for the slight contradictory forces here shown. The faces of these four levels showed heavy coking, being covered with the same heavy film of soot as the lower levels, and the cars at the faces were driven off the rails against the face and much shredded and burnt brattice-cloth was plastered on the face. Explosives were used in Nos. 9 and 10, and several shots had been fired early on the afternoon shift. The faces were well squared up and in good condition.

Nos. 7 and 8 West levels also showed the forces inward, and were heavily caved for some distance inby the slope. The explosion seemed to have died out before reaching the face of these levels, as the last 1,000 feet showed no evidence of force; the brattice-cloth from the last crosscut to the face was intact. No. 6 West, which was the main return from the West side, and all of the West side from here to the fan showed little damage west of the counter-slope; ordinary board fences across the mouths of old rooms were undisturbed, and a loose board walk across a small swamp, near to the fan, where in the spring months a little water accumulated, was also undisturbed, and, as already stated, no injury was done at the fan. This entire section was old works and evidently contained no dust to maintain the explosion.

It will thus be seen that the main forces seemed to be along the haulage-ways, and undoubtedly the propagating element was the dust in these roadways.

NO. 6 EAST SLOPE.

In this section, or on the roadways leading to it, eleven of the bodies of the twelve men known to be in the mine were found.

Overman Cunliffe states he left a note for Fireboss Phillips to send the bratticeman, Mike Marmol, to Nos. 13 and 14 East off the Main slope to remove some brattice-cloth no longer in use, and take this to Nos. 13 and 14 West levels. It is the body of this bratticeman that is still

unfound. During the clean-up in No. 6 East slope a brattice-saw was found on No. 13 room parting, which leads to the belief that perhaps Marmol had gone to No. 13 off No. 6 East slope instead of No. 13 off the Main slope, but, as this section has been fairly well cleaned up, little hope is entertained that the body will now be found in No. 6 East section.

The forces in No. 6 East were also inby, despite evidences of an outward trend on No. 13 room parting, where the doors were blown outby or towards the slope. No. 1 East main level clearly shows the inby movement its entire length. This level connects with No. 13 room off No. 6 East slope, and was the return for that district.

The forces set up on No. 6 East slope below No. 13 room was very slight, although there is a slight indication of coking on some of the timbers at No. 16 room. The brattice at the face of the slope was only slightly disturbed, and the brattice in the raise of the counter-slope off No. 17 room was standing intact; the explosion evidently spent itself in the old works of this district. The miners from the No. 6 slope were found on the No. 13 room parting, where they were assisting the hoistman and rope-rider to replace a derailed trip left from the previous shift. They had been at the face of the slope, as their clothes and dinner-pails were found there.

The miners Kometz and Davis from No. 17 room were found on the slope between No. 17 and No. 16 rooms, and had evidently travelled from the face of No. 17 room to this point, as the safety-lamp issued to Davis was found hanging on a prop at the face, and was as clear of dust or smoke as when issued from the lamp-room. These men died from carbon-monoxide poisoning; a sample of blood was taken from the body of Davis and sent to Geo. S. Eldridge & Co., analytical chemists, Vancouver, a spectroscopic examination of which showed carbon monoxide in marked quantities. These bodies were quite sound, showing no evidence of violence nor burns.

The bodies of the four men on No. 13 room parting, which were not recovered until late in December, 1916, and January, 1917, were in such an advanced state of decomposition that no evidence as to how they died could be obtained.

The body of Henry Evans, track-cleaner, was found under a heavy cave at the hoist near the top of No. 6 East slope. The skull was badly fractured, and the doctor gives the cause of death as violence or shock. The bodies of Nos. 2, 3, and 7, the labourers who were on the Main slope, showed slight singeing and the skin on hands and face was raised, the doctor stating this seemed more from superheated moisture than from flame. He is of the opinion that these men died from carbon monoxide.

Body No. 1—Thomas Phillips, fireboss—found on main East level 150 feet inby the intersection of this level with the Main slope; body much broken up; only a slight singeing of hair; no burns; death due to violence or shock.

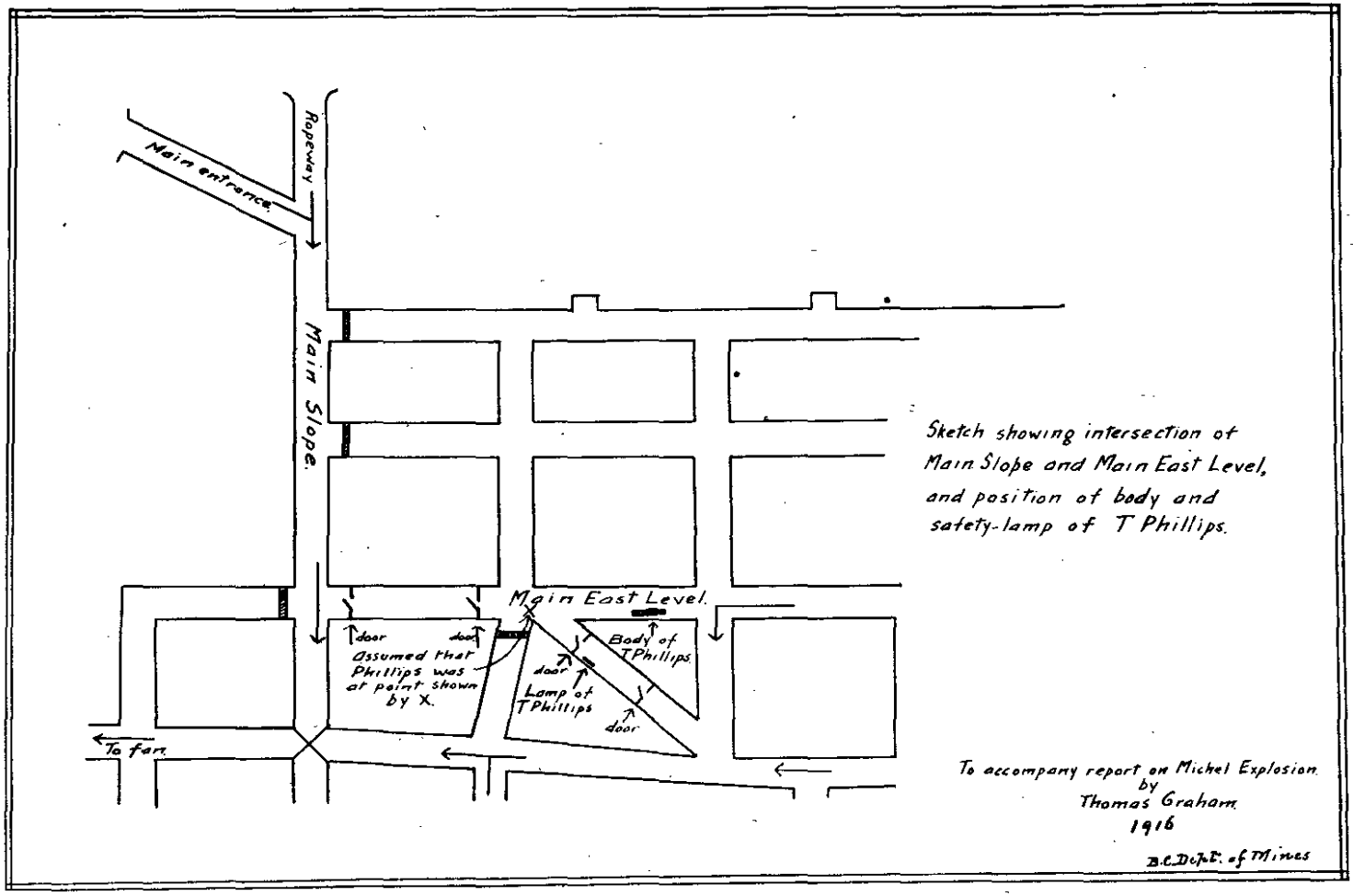
This body had evidently been hurled from a point just inby the door separating the intake and return here; this deduction is made from the location of the body and the lamp. It is assumed he had just got inside the doors when the explosion occurred, and that the body was carried with the doors and frames to the point where it was found, whilst the lamp, which was presumably in the right hand, had been released by the shock and thrown down the slant towards the overcast. (*See* sketch for position of lamp and body.)

LAMPS.

The lamps of Nos. 1, 2, 3, 4, 5, 6, and 7 were opened in my presence; all of them were intact and in good condition, excepting lamp No. 377, issued to J. Hrpka (body No. 3); this had a broken glass, otherwise it was in good shape. No. 5B, issued to Thomas Phillips, fireboss, was an aluminium Cramer-Wolf lamp with flat burner; this was badly broken; only the fount with lower standards and gauzes were found; the lower gauze ring was fairly clear; the gauzes were badly crushed, apparently by an outside force; both gauzes showed evidences of alkali-stain, as of the lamp having been heated.

The lamp of David Davis, which I previously stated was almost as clean as when it left the lamp-room, showed that gas had burned in the gauzes. This lamp had been left at the face, and I assume from its condition that it was not extinguished by the force of the explosion and was left burning. Through the cutting-off of ventilation the place would soon fill with gas, which finally extinguished the lamp.

The lamps of bodies Nos. 8, 9, 10, and 11, Inspector O'Brien reports were intact, excepting No. 288, issued to No. 10. This had a broken glass; the body with lamp was found under a cave,


Ropeway
Main entrance
Main Slope
Main East Level
door
door
Assumed that Phillips was at point shown by X.
door
Lamp of T Phillips
Body of T Phillips
door
To face
Sketch showing intersection of Main Slope and Main East Level, and position of body and safety-lamp of T Phillips.
To accompany report on Michel Explosion by Thomas Graham 1916
B.C. Dept. of Mines

and, as there were many pick-marks on the front of the lamp, it is assumed the glass was broken by the picks of the workmen in recovery.

The mine was heavily caved (*see* shaded portions on plan accompanying report), and much of this is still uncleaned, whilst part of the lower portions of the Main slope is still under water at date of writing.

PLACE OF ORIGIN AND CAUSE OF IGNITION.

I have so far been unable to determine the exact place of origin or the cause of ignition. Whilst the lines of forces and general conditions tend to indicate the possible point of origin as somewhere near the bottom of the Main slope, I have so far seen nothing upon which I could definitely fix as the point of origin, nor have I found anything that in any way accounts for the ignition. Careful search was made in Nos. 13 and 14 East and West levels off the Main slope for the body of the bratticeman, Marmol, without success; there were, however, many caves under which the body might be, and there was also the water in the Main slopes which prohibited examination.

The terrific thunder-storm in progress at the time of the explosion gave rise to a very pronounced sentiment that the ignition was due to lightning having entered the mine by means of rails, pipes, or signal-wires.

There are many cases quoted in mining journals and papers showing that lightning has entered mines, and there are men in Michel who claim to have seen and felt shock from lightning in both No. 8 and Old No. 3 mines of the Michel Colliery during the progress of the storm on August 8th, 1916.

I do not wish to be understood as treating the possible ignition from lightning lightly, or of even dismissing it; but in view of the fact that there is still one body not found in the mine, and that this man was supposed to be in that section where the general trend of forces lead me to suspect the origin, I hesitate to accept the lightning theory whilst this human element remains uncleared; and, as there is a likelihood of an early recovery of this body, which may or may not assist in establishing the cause, I am fully convinced that the circumstances and conditions surrounding this body should be cleared up before the final building of a theoretical case is adopted.

There was only one electric-bell system in the mine; this ran down the Main slope to a point just below No. 12 West. An examination of the battery-cells by Mr. Stacey, the electrician for the company, showed no indication of fusing at the terminals; the voltage used on this bell was very small. No. 6 East slope was equipped with a pull-bell.

As there seems little doubt but that lightning may enter a mine, it would seem prudent in this portion of the Province, where electrical storms are frequent and severe, that some effort should be put forth to protect the mines from entrance of lightning by means of the rails, pipes, signal or telephone wires.

A Coroner's inquest was held at Michel on the 28th, 29th, and 30th days of August, 1916. Thirty-three witnesses were examined. The jury returned the following verdict: "We, the jury empanelled to inquire touching the death of Thomas Phillips and others, find that these men came to their deaths as a result of an explosion in No. 3 East mine, Michel, B.C., on the 8th day of August, 1916, at or about 11.30 p.m.; the cause of which we are unable to ascertain from the evidence adduced at the inquest."

Attached to this report will be found a plan of the mine, showing the extent of the caving, lines of forces as shown in the mine, and location of bodies; fan chart; and analysis of blood sample from body No. 5.

Analyses of mine-air samples taken from this mine during the year are given in table under heading of "Mine-air Sampling." (*See* my annual report for 1916, page 379.)

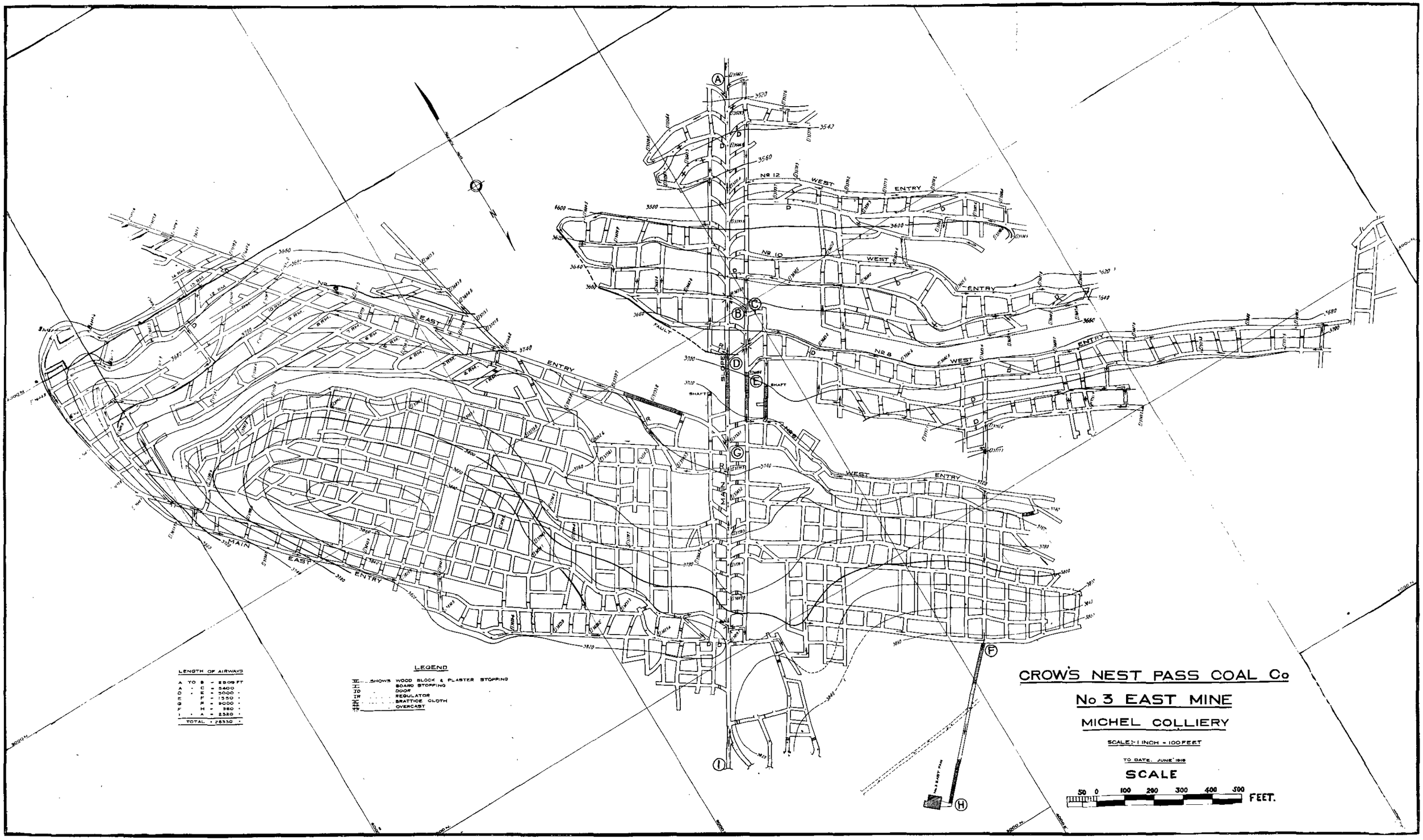
ANALYSIS OF BLOOD SAMPLE.

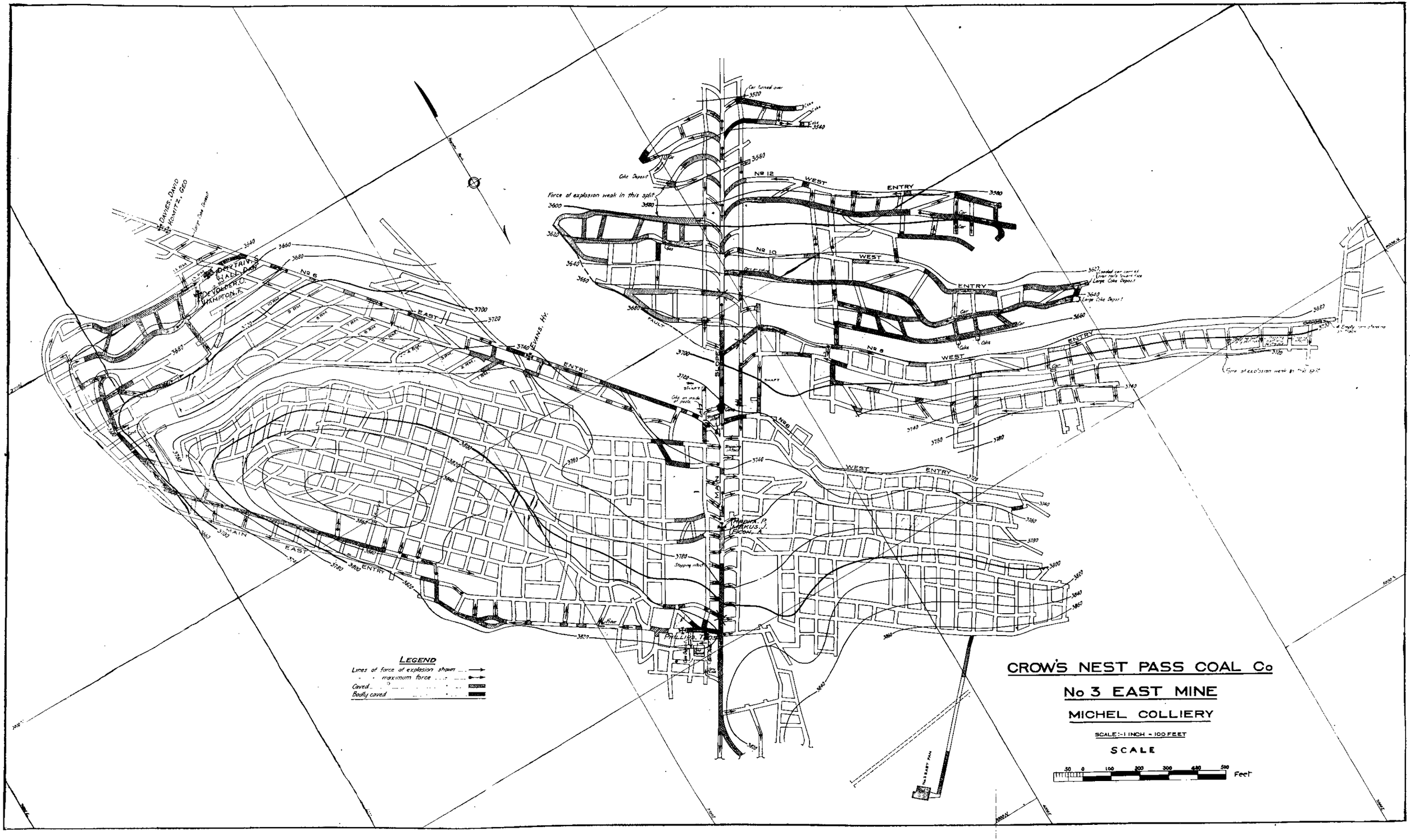
"VANCOUVER, B.C., September 26th, 1916.

"*Thos. Graham, Esq.,*
Chief Inspector of Mines, Parliament Buildings, Victoria, B.C.

"DEAR SIR,—We have made a spectroscopic examination of the sample of blood received from Michel on the 16th ultimo, and find that it contains decided amounts of carbon monoxide (CO).

"Yours respectfully,
"G. S. ELDRIDGE & Co.
"Per G. S. ELDRIDGE."


NO 12 WEST ENTRY
NO 10 WEST ENTRY
NO 8 WEST ENTRY
NO 6 EAST ENTRY
MAIN EAST ENTRY
WEST ENTRY
FAULT
SLOPE
SHAFT
MAIN
A
B
C
D
E
F
G
H
I
LENGTH OF AIRWAYS
A TO B = 2509 FT
A " C = 5400 "
D " R = 5000 "
E " F = 1350 "
G " R = 9000 "
F " H = 380 "
I " A = 2320 "
TOTAL = 26330 "
LEGEND
SHOWS WOOD BLOCK & PLASTER STOPPING
BOARD STOPPING
DOOR
REGULATOR
BRATTICE CLOTH
OVERCAST
CROW'S NEST PASS COAL Co
No 3 EAST MINE
MICHEL COLLIERY
SCALE:- 1 INCH = 100 FEET
TO DATE. JUNE 1916
SCALE
50 0 100 200 300 400 500 FEET.


DAVIES, DAVID
KOVITZ, GEO
Large Coke Deposit
DRY TRIVET
HAND PUMP
DEVELOPER O.
HAMPTON, R.
No 6
EAST
ENTRY
EVANS HY.
MAIN
EAST
ENTRY
Car turned over
3520
Coke Deposit
No 12
WEST
ENTRY
Force of explosion weak in this split
No 10
WEST
ENTRY
FAULT
Large Coke Deposit
No 8
WEST
ENTRY
Force of explosion went in this split
SLOPE
SHAFT
No 8
WEST
ENTRY
Stopping in Coal
Stopping in Rock
Pipe Line
Pipe Line
LEGEND
Lines of force of explosion shown
" " maximum force
Caved
Bodly caved
CROW'S NEST PASS COAL Co
No 3 EAST MINE
MICHEL COLLIERY
SCALE:- 1 INCH = 100 FEET
SCALE
50 0 100 200 300 400 500 Feet

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 1916.

AINSWORTH DISTRICT.

Mining in this district has demanded a great deal of attention during the year, many properties having developed considerable depth by long crosscut tunnels, some of them rewarding the efforts by exposing splendid showings of ore. Several of the shipping mines of this district have worked continuously during the year, while others have been operated for only part of the year. Taking the mining conditions of this district as a whole, it is a much more prosperous position than it has been for years.

Upon my inspections during the year I have found the provisions of the "Metalliferous Mines Inspection Act" fairly well complied with.

SLOCAN DISTRICT.

The Slocan District has had quite a revival in mining during the year; many of the old prospects have been opened up and developed into producers, while those which had been shipping have been actively and systematically developed, resulting in a much increased output for the year; in fact, it is a banner year for this district. The larger mines have worked continuously during the year, with an increased output over many of the previous years. I have found, upon making inspections of these mines, care being exercised in the handling of explosives and attention being paid to the requirements of the "Metalliferous Mines Inspection Act" in every respect.

LARDEAU DISTRICT.

The mining conditions in this district have somewhat improved during the year. A number of mining properties are at present being actively developed, and some shipments have been made, which has resulted in further development throughout the district.

NELSON DISTRICT.

There has not been any increase in the number of shipping mines in this district during the year, but considerable prospecting and developing is being carried on at the present time. I have found, upon inspecting those which are operating, that all the requirements of the "Metalliferous Mines Inspection Act" are being observed.

YMIR DISTRICT.

There has not been any noticeable change in the mining conditions in this district, very little ore having been shipped during the year. The only mine operating, when I made an inspection, I found in good and safe condition.

SHEEP CREEK DISTRICT.

There has been a decrease in the number of shipping mines in this district during the year, two of the larger ones having closed during the year. Those still in operation have not increased their output to any extent. I have found upon inspection the mines of this district in safe condition.

BOUNDARY DISTRICT.

The larger mines of this district have worked continuously during the year, producing about the same output as last year. Most of the mines of this district are worked on the pillar-and-

caving system, using very little timber. It is necessary to use a great deal of forethought and care in laying out the large stopes required to produce the output necessary to supply the smelter. A number of barmen are employed whose duty it is to travel around the mines and scale down any loose ground in the stopes, haulage-ways, travelling-ways, and what are known as trails throughout the stopes; they are also required to examine every stope after blasting before the miners return to set up their machines.

The consumption of powder in these mines is considerable; in the Granby alone they consume about 2 tons a day. I have found, upon inspecting these properties, great care being exercised in transporting the explosives from the surface to the underground workings. The thawing of the explosive has been eliminated by the use of the low-freezing powder, thereby doing away with the danger which is always present when powder is being thawed.

I have found upon inspections every care being taken to prevent accidents; danger-signals have been put up in all dangerous places, and "safety first" signs in all conspicuous places in and around the mines. The candle as a means of producing light underground has been discarded in these mines and the carbide-lamp introduced instead, which is a decided improvement, giving a much brighter light and lessening the opportunities for accidents. These large mines are kept in a sanitary condition and well ventilated.

ROSSLAND DISTRICT.

In this district at Rossland the mines are the most extensively worked metalliferous mines in the Province, and have operated continuously during the year. The production has greatly increased over last year. A large amount of systematic developing has been accomplished by diamond-drilling and drifting. Great improvements, both above and below ground, have been made by replacing wood with concrete, all of which tends to lessen the opportunity for accidents.

A great quantity of timber is necessary to allow of "square-setting" nearly all the stopes and many of the tunnels; the timber is all prepared on the surface by machinery and carefully placed in position underground where required. These mines are kept in a very sanitary condition and well ventilated throughout. Great interest is taken in the "safety first" movement; danger-signals are placed wherever a dangerous place exists; also signs are placed in conspicuous places requesting the employees not to be careless, and that carelessness will not be tolerated.

I have found, when making inspections of these mines, great care has been taken in keeping the machinery, ropes, guides, and safety appliances in good condition. The management is at all times living up to the requirements of the "Metalliferous Mines Inspection Act."

You will find a list of the accidents which occurred during the year 1916.

EAST KOOTENAY INSPECTION DISTRICT.

REPORT OF T. H. WILLIAMS, INSPECTOR.

I have the honour to submit my annual report as Inspector of Metalliferous Mines for the East Kootenay District during the year ending December 31st, 1916.

The mines operating in the district were: The *Sullivan* mine, Kimberley; the *St. Eugene* mine, Moyie; the *Paradise* mine, near Invermere. The latter is an old mine which has been closed for some years, but at the time of my inspection preparations were being made on the surface for again operating it. Shipments of ore from the old dump were being made by teams to the town of Athalmer, a distance of about twenty-two miles.

Upon each of my inspections of the other mines I found that the operations were generally being conducted in accordance with the requirements of the "Metalliferous Mines Inspection Act."

Only one accident was reported during the year, the particulars of which are attached.

SIMILKAMEEN INSPECTION DISTRICT.

REPORT OF ROBERT STRACHAN, INSPECTOR.

I have the honour to submit my annual report as Inspector of Metalliferous Mines for the Similkameen District during the year ending December 31st, 1916.

The properties operating were: The *Nickel Plate* mine, operated by the Hedley Gold Mining Company; the *Iron Mask* and *Erin*, operated by the Kamloops Copper Company; *Copper Mountain*, operated by the Copper Company of Canada; *Aberdeen* mine, operated by the Aberdeen Mines Syndicate; Stump Lake mines, operated by the Donohoe Mines Corporation; the *O.K.* mine, operated by the Highland Valley Mining and Development Company; the *Monarch* mine, operated by the Mineral Recovery Company; and a small property here known as the *Henderson* claim.

No active operations, so far as I know, were undertaken at the *Lake View-Dividend*, on Kruger mountain; the *Maggie* mine, near Ashcroft; or the *Highland Valley* mine, on Glossy mountain.

The *Pothook*, near Kamloops, was started up, and the water pumped out of the shaft to the No. 2 level, but no ore was extracted, although a car was loaded from the old dump and shipped for treatment.

Attached is a list of the accidents which were reported during the year, amounting to eleven, one of which resulted fatally.

One of these occurred in the *Nickel Plate* mine, the other ten in the *Iron Mask;* four were due to falls of rock, one in shaft (fatal), one while packing a pump, one due to carelessness handling tools, three to machinery, and one to poisoning. One proved fatal, three serious, and seven slight.

The large number of accidents reported from the *Iron Mask* would seem to indicate that a more strict discipline should be enforced, and an energetic movement started to interest the workmen in their own safety; unless we can get both the officials and workmen to take an intelligent interest in seeing the rules and regulations carried out, then there is no prospects of this accident list being reduced. I have taken up this question with the management at the *Iron Mask* mine with a view to have them give it their best consideration; all these accidents have been investigated and reports made thereon.

The following is a brief description of each of the mines:—

Nickel Plate. Operated by the Hedley Gold Mining Company, Limited. G. P. Jones, general manager; W. Sampson, superintendent; Wallace Knowles, engineer.

This mine is situated in the Osoyoos Mining Division, on the Nickel Plate mountain at an altitude of 5,500 feet above sea-level and 3,800 feet above the town of Hedley, where the mill for treating the ore is situated.

The mineral mined is arsenical iron pyrites carrying gold, and the mine has been developed by tunnels driven through the country-rock until the ore-bodies were reached.

No. 4 is the lowest of these tunnels, and all the ore mined during the year has been hauled through it. From this tunnel a large well-timbered incline, named the Dixon, has been sunk for 900 feet, levels being set off every 100 feet.

Practically all the ore, amounting to about 200 tons a day, has been taken from the Dixon incline, which dips at an angle of about 15 degrees and is fitted with double track and a travelling-way.

The skips, which are capable of handling 2 tons, are operated by separate engine, and are loaded from the chutes and dump into a common ore-bin at top of incline, from which the electric train takes its load. An arrangement of iron doors is provided at each station, so that no ore can run down the incline while the skips are loading.

The levels on the Dixon incline are connected with raises to the upper workings, so that a natural current of air is created which keeps the workings free from smoke or gases.

The average thickness of the ore-body is 35 feet, and it is worked by pillar-and-chamber method, the chambers being made by commencing work on the foot-wall and working upwards until the top is reached, using the broken ore to stand on. When the top is reached, slices are taken across the top of the chamber, and as the broken ore is removed the pillar is gradually

brought down to the floor. By this method very little timber is used, great care being taken, in leaving the top or roof, to bar down all the loose rock, and it indicates with what thoroughness this is done that we have very seldom received reports of accidents from this cause.

From the top of the Dixon incline the ore is taken by electric haulage to the top of the incline, where it is dumped into a storage-bin, from which it is drawn into the skips which operate on the gravity-tram to the mill.

The gravity-tram to the mill is operated in two stages; the skips have a capacity of 5 tons. In the first stage the skips are lowered 4,000 feet on the incline to the central station, where they are transferred to the lower tram, and continue for a distance of 6,000 feet, descending during the trip a vertical distance of 3,800 feet. The skips dump into a storage-bin at the foot of the main incline, from which the ore is drawn by a short tramway as required for the mill.

The tramway is a three-rail track with a passing in the centre, and is equipped with both bell and telephones. All the ore goes to the mill, and no sorting is done either at the mine or the mill.

The power plant consists of three 100-horse-power boilers and one 2,000 and one 3,000 cubic feet of free air capacity compressors, in addition to the hydro-electric plant, which is situated about three miles below the confluence of the Twenty-mile creek with the Similkameen river. The hydro-electric plant, which supplies about 1,500 horse-power, is the chief source of power, the boilers being a reserve, while the compressors are equipped so they can be run either by electricity or steam.

During my inspections I have always found conditions to be very good and the "Metalliferous Mines Inspection Act" strictly adhered to. Special rules are provided, which each workman must read or have read to him, and then sign before being employed. The discipline of the mine is very good, which is reflected in the small accident list—namely, one for the year. Good accommodation is provided for the workmen, in the shape of bunk-house and cook-house, while a large and commodious reading-room is maintained with a library.

Monarch.

Operated by the Metals Recovery Company, J. C. Nattel, manager. This mine is situated about three miles east of Field, in the Golden Mining District, and is 5,100 feet above sea-level; it was worked for the greater part of the year, but was closed down in September.

The mine is driven in for a distance of 300 feet on a large body of silver-lead ore, containing considerable zinc. The method of working is by large chambers, leaving small pillars here and there to support the roof. Very little timber is used, and, so far, no accidents have been reported; therefore great care must be taken to bar down all the loose rock.

The ore is loaded into cars and run out to a winze and dumped, from which it is taken and loaded into the bin which supplies the aerial tramway carrying the ore to the mill. The mill is built alongside the Canadian Pacific Railway track, and a spur furnishes facilities for shipping.

At the time of my last inspection there were only two workmen employed; the conditions were fairly good so far as safety was concerned, and the provisions of the Act seemed to be fairly well complied with. Polar Ammonia powder is used for blasting purposes.

Iron Mask.

Iron Mask and *Erin* mines are operated by the Kamloops Copper Company, Limited. A. Wallinder, manager. This property is situated in the Kamloops Mining Division, about seven miles south-east of the city of Kamloops. There are four shafts on the property, two at the *Iron Mask* and two at the *Erin;* there is no communication between the *Iron Mask* and the *Erin*, but a raise, at present up 150 feet, will in future connect the two mines.

The ore mined is copper sulphides and carbonates, and the *Iron Mask* shaft has been sunk on the vein for a distance of 750 feet. Levels have been set off at each 100 feet. The method of working is pillar and chamber, and later the pillars are either taken out entirely or, if required, small parts are left in to support the roof.

Timbering is by square sets and stulls, according to the ground, and I have generally found the mine well timbered. The ventilation is very good, due to natural draught assisted by compressed air. The shaft is well timbered, and the ladder-way, which is in a separate shaft, has been maintained fairly good during the year.

The *Erin* shaft is down a distance of 350 feet, and will, as I have already mentioned, connect with the *Iron Mask*. Three levels have been driven off and a separate shaft is maintained for escape and ventilation purposes.

The *Erin* is worked practically the same as the *Iron Mask*, pillars being formed and then reduced by shrinkage stoping. Square set or stulls are used, according to the ground. A 25-horse-power electric motor drives the hoist, and a skip with a capacity of 1 ton operated in the shaft, which lies at an angle of 70 degrees.

At the time of my last inspection I found twenty-seven men employed around the *Iron Mask* and twelve around the *Erin*. The power used is electrical, brought from the City of Kamloops power plant, at 11,000 volts and reduced to 400 volts for working purposes.

The hoist at the *Iron Mask* is 50 horse-power, and two compressors of 75 and 125 horse-power respectively provide air for the drills. Two electrically driven pumps on the 750-foot level handle all the water made in the mine. Polar Ammonia dynamite is used for blasting purposes.

Good bunk and cook houses are provided, and the sanitary conditions in and around the mine are very good.

Princess Group. Operated by the Canada Copper Corporation, Limited, of which F. S. Norcross is superintendent. This property, which is situated in the Similkameen Mining Division, on Copper mountain, about twelve miles from Princeton, has been working for the greater part of the year. The work consisted of driving a tunnel under the upper series of ore-bodies, with branches to tap each of these and also to connect with the *Sunset* shaft.

The main tunnel and branches are very well timbered, wherever the ground is soft, with square sets, and the conditions around are good. Ventilation is by an exhaust-fan, which is assisted in the inside with a "booster" fan so as to exhaust the foul air and gases. At my last inspection I found sixty men employed underground and twenty-one on the surface.

A steam plant at East Princeton furnishes electric power, which is carried twelve miles to the mine at 15,000 volts and reduced to 2,000 for working purposes. At the mine are two electrically driven compressors with 1,000 and 500 cubic feet of free air capacity for drilling purposes. Compressed air drives the ventilating-fans.

The general conditions in and around the mine are very good, and every endeavour seems to be made to comply with the "Metalliferous Mines Inspection Act."

A large number of buildings in the shape of dwelling-houses, bunk and cook houses have been erected, and the sanitary conditions in and around the mine are very good.

Aberdeen. Operated by the Aberdeen Mines Syndicate. T. J. Corwin, superintendent and agent. This mine, which is situated between Merritt and Ashcroft, has been working during the whole year. The ore is high-grade copper and is hauled by team to the Lower Nicola Station, and shipped from there to the smelter. The workings consist of a vertical shaft and two levels driven off the same; the vein varies from 6 to 12 feet wide and the timbering is by stulls and square sets. During my inspection there were seven men employed underground and eight on the surface, mostly on construction-work.

The conditions around the mine seemed to be very good, and the "Metalliferous Mines Inspection Act" well complied with. Explosive used is 40-per-cent. Polar Ammonia dynamite. The power plant consists of a 25-horse-power boiler and a 3-drill compressor.

The sanitary conditions in and around the mine are very good, and fair accommodation is provided in the shape of bunk and cook houses.

Stump Lake. Operated by the Donohoe Mines Corporation, of Seattle. Mr. Keirman, superintendent. The mines at Stump lake, which have been shut down for a long time, are being reopened by the above company, which started work on the *Joshua* shaft last May, and has since been engaged in taking the water out. At the time of my inspection the water was out as far down as the 100-foot level, and two miners were engaged in taking out some ore, with the idea of shipping it for testing purposes.

A new shaft-house has been erected, and hoist and boiler, which have been standing since the property was abandoned, is being used for hoisting. Before very much work will be undertaken it will be necessary to have the water taken out down to the lower levels.

In the shaft the timbers had been renewed as far down as the first level, and this will have to be continued as the water is lowered. I drew attention to the ladders in the shaft, which should have proper landings every 20 feet, also to the necessity of a partition between the hoisting and manway compartments in the shaft.

A portable sawmill was also in operation to furnish lumber for the buildings. Fair bunk and cooking accommodation is provided for the workmen, and the sanitary conditions in and around the mine were very good.

O.K. Operated by the Highland Valley Mining and Development Company. Mr. King, superintendent; Messrs. Keffer and Johns, engineers. This mine is situated on the wagon-road between Merritt and Ashcroft, about twenty-five miles from Ashcroft and thirty-six from Merritt; to reach the mine a wagon-road six miles long has been constructed, rising steadily up the hill until the elevation reaches 5,000 feet above sea-level.

The present workings consist of an adit level, with a parallel, a raise to the surface, and a considerable amount of trenching. The main level is in about 260 feet on a vein of copper about 10 feet wide, and in the form of carbonates, sulphates, and chalcopyrites.

There were only four workmen employed inside the mine at the time of my inspection, and twenty-two outside, who were mainly employed in the construction of a concentrator. Mr. Cowan, the mine foreman, informed me the force inside the mine would not likely be increased until such time as the concentrator was in operation.

The work done in the mine seemed to be very good, and the tunnel was well timbered with stulls; the explosives seemed to be kept in a safe place, Polar Ammonia dynamite, 40 and 60 per cent., being used. The discipline seemed good.

Good accommodation for the workmen is provided, and the conditions seemed all that could be desired from a sanitary point of view.

I also examined the property known as the *Henderson* claim, situated at Lower Nicola, on the south side of the Nicola river. At this property several tunnels have been driven in on some copper veins, the copper being mostly in the form of bornite. About seven workmen were employed at one time during the year, but later only three were engaged.

While no timber was used owing to the firm nature of the country-rock, the tunnels were all in safe condition, and the workmen seemed to be competent workmen; 40-per-cent. Giant is used for blasting purposes.

All the workmen are resident in and around Merritt, and there is no buildings at the mine, and the drilling is all by hand. This property was being operated by H. E. Johnstone, of the Aberdeen Mines Syndicate.

On Copper mountain the property known as *Voigt's* was also operated in a small way during the year. In September I visited it and found three men working in the tunnel, which has been driven in for a distance about 150 feet on a vein of copper ore. The work seemed to have been carried out very well, and while there was no timber in the inside of the tunnel, the sides and roof seemed hard and firm.

A steam-boiler of the locomotive type has been installed, and two small compressors, each of about three drills capacity. The work is under the charge of E. Voigt.

COAST INSPECTION DISTRICT.

REPORT OF JOHN NEWTON, INSPECTOR.

I have the honour to submit my annual report of the metalliferous mines in my inspectorate, together with a list of accidents, for the year ending December 31st, 1916.

TEXADA ISLAND.

The mines operating on the island are *Marble Bay*, *Iron Mine*, *Gold Bug*, and *Copper Queen*.

Marble Bay. This mine is operated by the Tacoma Steel Company, with A. F. Eastman, managing director. The company is operating on the 900-, 1,100- and 1,500-foot levels, all in good ore. A considerable amount of diamond-drilling has been done on the 1,100- and 1,500-foot levels, to prove the ore-bodies, with good success.

When I visited the mine in November 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-kw. generator.

Iron Mine. J. Hammond, lessee. This mine is situated about six miles from Vananda, on the west side of the island, and is known as the "old Iron Mine." The mine is operated by a small tunnel and is in a distance of 100 feet. A small wharf has been built, also ore-bunkers, connected to the mine by a gravity-incline.

When I visited the mine I found it well ventilated and in a safe condition. Only twelve men employed.

Gold Bug. This mine is situated about four miles north of Vananda. A small shaft 4½ x 8½ has been sunk a distance of 60 feet. Machinery installed: One small hoist; one 25-horse-power boiler.

Copper Queen. Only three men working in the mine on a royalty basis. Machinery installed: One return-tubular boiler; one small hoist.

The *Aladdin*, *Cornell*, and *Little Billie* mines were closed down at the time of my visit.

Viva. This mine is situated in the Helmcken district, on Vancouver island, on Lot 18 of the Esquimalt & Nanaimo Railway Belt, and about five miles west of Cowichan Station, and operated by Joe Gallo. A small shaft 4 x 6 feet in the clear has been sunk a distance of 35 feet. No machinery has been installed. Only four men working on the property.

Monitor. James A. Skene, foreman. This mine is situated about eighteen miles down the Alberni canal. No underground operations are carried on. An open-cut about 1,000 feet below the old *Monitor* mine is in operation, with the intention of striking the ore-body in the old mine. No machinery installed. Only seven men employed.

Bowena. This property lies about two miles south of Bowen Island Landing, and is reached by boat; no trail having been made to the mine necessitated engaging a boat to reach the mine. A tunnel 6 x 5 feet is in a distance of 800 feet. Only two men working on the property. No machinery installed.

BRITANNIA MINING AND SMELTING COMPANY.

J. W. D. Moodie, general manager; W. N. Wyllie, superintendent of the mine. The company's operations are situated up Howe sound, twenty-eight miles from the city of Vancouver, and reached by a daily steamship service operated by the Terminal Steamship Company, of Vancouver. During the present year a large amount of development-work has been done.

Development.—A series of long raises were driven from the 500-foot level to the surface. The tops of these raises have been enlarged and the "glory-hole" system of mining was commenced, which work was maintained with as large a force as possible during the fine weather in the fall. Some overburden had to be removed from places, but in parts high-grade ore continued to the cropping. Several thousand tons of good ore was taken from the "glory-hole," and mining at this point will again be resumed as soon as weather permits.

In December a drift driven from the *Fairview* mine 1,000-foot level came into connection with a drift from the *Empress* mine, thus affording a passage-way through Britannia mountain on this level, as well as on the 500-foot level; the latter connection having been made in 1914.

Considerable development-work has been completed on levels between the 1,000- and 2,200-foot levels; good ore having been shown up, especially on the 1,200-foot level.

A new rock-raise is now being driven from the 2,200- to the 1,000-foot level to supplement the rock-raise completed last year and now being used as an ore-chute.

At the elevation of the 1,200-foot mine level and located in Jane creek a tunnel 8 x 8 feet has been driven 1,100 feet in a southerly direction, crosscutting the ground between the *Jane* and *Bluff* mines.

At the elevation of the 2,700-foot level a tunnel 9 x 13 feet is being driven from the head of the incline towards the main ore-zone on the general strike of the country. This tunnel has advanced 1,500 feet, and will eventually supplement the surface railway-line from the mine to the incline loading-bins.

A crosscut tunnel 635 feet long has been driven from Mineral creek south at an elevation corresponding with the 3,100-foot mine level.

At a distance of 250 feet from the top of the new mill at the Beach a tunnel 9 x 13 feet (4,100-foot mine level) is being driven, and advanced 1,678 feet during the year. This tunnel,

with a raise connection to the surface near the head of the incline, will form part of the transportation system.

Equipment.—Four storage-battery locomotives of the Westinghouse Oxide Cell type, each weighing 3½ tons, together with charging-panels for same, were installed on different levels during the year. These storage-battery locomotives are in addition to the two 3½ton and 1-ton trolly locomotives which have been in service for some time.

The increased demand for compressed air in the mine was taken care of by the installation of two additional compressors; one Ingersoll Rand of the Rogler type, with a capacity of 3,600 cubic feet a minute, direct-connected to a 550-horse-power Pelton water-wheel and located at the tunnel power-house. The other installation was made at the Beach steam plant, and consists of an Ingersoll Rand Class R.S.-3, with a capacity of 2,044 cubic feet a minute.

Transportation.—The ore is handled from the loading-station at the foot of the raise on the 2,200-foot level by two systems of transportation to the old and new mills at the Beach. The railway and gravity aerial tramway deliver ore to the old mill, while the railway and incline serve the new mill.

New Buildings.—At the Tunnel townsite: A new school-house; a fully equipped hospital, with three-bed ward, operating-room, dispensary, and nurse's quarters; engineer's office; three-story recreation-hall, with billiard-room, barber's shop, general reading-room, and dance-floor; moving-picture theatre, the same as the one at the Beach; extension of main bunk-house 87 feet, present building providing accommodation for about 250 men; extension tunnel power-house and car-shop; central heating plant to furnish heat and hot water for main bunk-house and cook-house; 11 eight-room houses; 40 four-room houses; and 1 five-room house.

A new camp called the Barbara has been started on the south side of Britannia mountain at elevation of the 500-foot level. Two boarding-houses have been built with accommodations for a total of eighty men. Each room in this bunk-house is provided with hot and cold water and electric lights. The buildings are heated by hot-water system.

An unusually dry fall season, followed directly by cold weather, with no precipitation at the higher elevations, greatly reduced the water-supply for the upper intakes and created a shortage of power, which has retarded the output.

NORTHERN INSPECTION DISTRICT.

REPORT OF J. H. MCMILLAN, INSPECTOR.

I have the honour to submit my first annual report as Inspector of Metalliferous and Coal-mines for the Omineca, Skeena, and Atlin Districts of northern British Columbia.

During the year ending December 31st, 1916, the mining districts of Northern British Columbia have experienced an unprecedented period of activity.

Big mining interests have been attracted, notably to the mineral belt east of Prince Rupert, and, judging from the nature and extent of the preliminary development and the actual results of shipping mines, it is safe to say that these districts—namely, Pacific, Hazelton, and Telkwa—have a very promising future. The mineral belt is over 200 miles long by from twenty to fifty miles wide, and is traversed by the Grand Trunk Pacific Railway.

Development has to a great extent been retarded by the many difficulties met with in getting supplies and machinery in to the mines from the railroad. Owing to the heavy undergrowth the low-lying country is hard to prospect, and consequently the majority of the mines being operated at present are well above timber-line.

The principal producing mines, with the exception of the *Rocher Déboulé* and *Silver Standard* mines near New Hazelton, are confined to the Coast and adjacent islands. The many deep-sea water-channels running from the coast-line into the heart of the mineral belt afford economical transportation facilities, and in this way development along the Coast has been much more rapid than in the Interior districts.

The Alice Arm district has also been given considerable attention by mining interests during the year, particulars of which you will find in another part of my report.

In the Atlin district lode-mining was given some attention. The geographical position of the district, however, combined with the heavy freight charges on supplies and machinery going in, has to a very great extent retarded development.

SKEENA MINING DIVISION.

Hidden Creek.

Operated by the Granby Consolidated Mining, Smelting, and Power Company. E. E. Campbell, superintendent. This mine is situated on Observatory inlet, about one mile and a half from Anyox, B.C. The lowest working-level is at an elevation of 150 feet and the highest 800 feet above sea-level. The mine is operated by a series of tunnels which are connected by numerous raises from the 385-foot level upwards.

The stopes are generally very large and in various places break through on the surface, thus forming huge glory-holes. The ground between the 150- and 385-foot levels will eventually be connected as soon as the ore-bodies, which are supposed to extend below sea-level, are tapped by the tunnel that is being driven on the 150-foot level. The hill at the mine, which exceeds 1,000 feet in elevation, is practically one solid mass of ore. The formation consists of highly metamorphosed and folded sedimentary beds having a distinct schistose appearance, the rocks of which are mainly schists of mica and quartz associated with slate. The slate occupies the southern portion of the hill and the mica-schist the northern. Between the two is a thin bed of quartz-schist.

The ore-bodies are found in contact with the slate and quartz-schist and within the mica-schist, and are chiefly composed of sulphides of iron and copper in a mica- and quartz-schist gangue. Several small olivine basalt and andesite dykes are found throughout the ore-bodies, ranging from a few inches to several feet in thickness.

Development during the year has been highly satisfactory, and several exceptionally high-grade ore-bodies have been located that previously were not known to exist.

The daily tonnage from this mine runs from 2,000 to 2,500 tons, and is governed more or less by the requirements of the smelter. Up to the present time over 1,650,000 tons of dry ore has been shipped from the mine. Drifting and raising during the year amounted to 3,389 feet, the total drifting to date being 29,283 feet. The mine-haulage is being remodelled, the present 2-foot gauge, 5-ton cars, and 6-ton electric locomotives being replaced by a 3-foot gauge, 10-ton cars, and 12-ton locomotives. This change will allow for a considerable increase in the production, so as to meet the requirements of the additional plant to be erected at the smelter.

The "block" system of signalling is used on all main haulage-roads throughout the mine.

During the year a change was made in the type of rock-drill used throughout the mine, the former large piston type being replaced by a hammer type, using hollow steel. The steel used is now heated in oil-burning furnaces which produce a more permanent temper; and the steel is less liable to oxidize during the process of sharpening.

The 385-foot level, which is the main haulage from the mine to the crushers, has been widened out from the portal to the face, also Nos. 10 and 20 drifts, and plank sidewalks laid throughout. The electric trolly-wires have also been boxed in for some distance on each side of the loading-chutes, and at all places throughout the mine where there is the possibility of workmen coming in contact. Railings have been placed around all chute-platforms, and all abandoned and dangerous openings properly fenced off.

Blasting signal and telephone systems have been installed between the glory-holes, which warn the men employed in these glory-holes and vicinity when blasting is about to take place.

The various stope-walls are scaled regularly by men employed for this purpose, and all visible loose ground barred down.

The storage of explosives, of which there is a considerable amount used, is well looked after. During the year a new magazine built with concrete and fire-proof material, and capable of storing 4,000 cases of explosives, was built on a spur from the railway leading from the loading-station on the 150-foot level to the smelter. This magazine replaced a former wooden structure situated near the portal of the 150-foot level. The powder is taken from this magazine as required and deposited in a thawing-house cut out of the solid rock, convenient to the 530-foot level, and well clear of the workings.

The thaw-house is heated by electricity, an even temperature of 80° Fahr. being maintained constantly, a record of which is made by a self-recording mercury thermometer placed within the thaw-house.

The "safety first" movement has been organized during the year along the lines suggested by the National Safety Council. The various officials, from Mr. Campbell down, have taken a personal interest in the movement, and each foreman acts as chairman of a committee of the workmen under his charge. These committees meet at various times during each month and discuss any suggestions made by the employees as regards safety. The proceedings of these meetings are posted up in conspicuous places around the mine. Boxes are also placed under the bulletin-boards, and the employees requested to place therein written suggestions, or notice of any dangerous practices that may come under their observation.

"First aid" has also been given attention during the year, eleven men securing certificates of competency. The classes are still being continued, and at the present time three classes of ten men each are taking advantage of the lectures given by the resident physician, Dr. W. H. Dickson. A branch of the St. John Ambulance Association has recently been formed, called the Anyox Central No. 1.

A special building in connection with first-aid work is being installed at the mine; this will be furnished with all the necessary apparatus, including 3 Draeger outfits, pulmotor, pump, etc., and all other first-aid material.

A new mess-house has recently been completed, and has a seating capacity for 300 men. A large steam-heated wash-house has also been built and fitted up with shower-baths, wash-tubs, toilets, and 300 metallic lockers. In the same building, on the second floor, an emergency hospital has also been fitted up, the main hospital being situated at the beach. This building also includes men's waiting-room, billiard and reading rooms, and hall for public gatherings.

Considerable improvements and additions have been made to the plant at the mine; these include up-to-date machine and carpenter shops. New administration and drafting offices have also been built, and a number of miners' cottages with all the modern conveniences, including baths and toilets. The water system has also been remodelled and enlarged and several hydrants placed at various points throughout the works.

The entire plant at the mine is operated by electricity generated at the hydro station, situated at the beach, near the smelter.

This plant in part consists of the following: One Nordberg air-compressor, coupled direct to an 800-horse-power double-impulse Pelton water-wheel, capacity 4,200 cubic feet at 115 lb. a square inch; one Ingersoll Rand air-compressor, 2-stage, capacity 2,900 cubic feet at 115 lb. a square inch.

The steam plant consists of three 110-horse-power Jencks horizontal return-tubular boilers with oil-burners attached.

The electric units used in connection with mining operations are as follows: Two A. C. Westinghouse generators, generating respectively 750 kw. at 2,200 volts, and coupled direct to a 600-horse-power double-impulse Pelton water-wheel running under a water-head of 400 feet; one D. C. Westinghouse generator coupled direct to a 440-horse-power induction-motor, generating 300 kw. at 500 volts. The D.C. is transmitted to the mine for haulage purposes, lighting, etc. Another duplicate D.C. generating set is installed at the mine for emergency.

During my several visits to this mine I have always found the conditions fully in accord with the requirements of the "Metalliferous Mines Inspection Act."

Quartz-mine. Operated by the Granby Consolidated Mining, Smelting, and Power Company. E. E. Campbell, general superintendent. This mine is situated on the opposite side of the inlet, some distance east from the town of Anyox, B.C. The quartz mined here is used for fluxing purposes at the smelter. The workings extend from sea-level to an altitude of 100 feet above sea-level, the formation being somewhat similar to that of the *Hidden Creek* property. The rocks are mostly slate with quartz veins, and are faulted to a great extent with dykes running through the formation in all directions. The majority of the veins lie in an almost horizontal position and contain varying values in gold and silver. The daily output runs about 200 tons, the total ore mined to date being over 29,000 tons.

The power plant consists of the following: One 86-horse-power Jencks return-tubular boiler with oil-burners attached; two Ingersoll Rand compressors, capacity 550 cubic feet at 65 lb. a square inch; one 25-horse-power American hoist.

During my several inspections of this mine I have at all times found the requirements of the "Metalliferous Mines Inspection Act" strictly observed.

Maple Bay. Operated by the Granby Consolidated Mining, Smelting, and Power Company. E. E. Campbell, general superintendent. This mine is situated on the east side of the Portland canal, half-way between the Nass river and the town of Stewart, B.C. The claims run from 500 to 5,000 feet above sea-level, the ore occurring in well-defined quartz veins carrying copper values. The ore from this mine will take the place of that mined at the quartz-mine for flux.

Some development has been done on the property during the year; no shipments, however, have as yet been made, operations being chiefly confined to construction. The power plant consists of two 60-horse-power Jencks return-tubular boilers with oil-burners attached; one Rand air-compressor, capacity 750 cubic feet.

A new wharf and tramway with a 7-ton gasolene-locomotive have been installed. The tramway leads from the wharf to the ore-bunkers at the mine, and is 4,000 feet long, with a 2-foot gauge.

Once the nature and extent of the various veins are determined by the management, systematic development on a large scale will be commenced immediately.

Alice Arm District.

Dolly Varden. Operated by the Dolly Varden Mines, Limited. R. B. McGinnis, superintendent. This property, consisting of the *Dolly Varden* and *Wolf* claims, is located eighteen miles inland from the head of Alice arm, and is reached by a trail constructed during the summer, commencing from the head of the inlet. The ore mined is silver-lead, which carries exceptionally high values in silver. Some drifting and open-cutting was done during the summer; active development, however, was confined to diamond-drilling, and something like 6,000 feet of drilling was done on the various ore-bodies.

A boiler and a 3-drill air-compressor have been taken in recently, and installed on the *Dolly Varden* claim. Cook and bunk houses have also been built to accommodate fifty men. The company has also built a wharf and offices near the town of Alice Arm, at the head of the inlet.

Once the character and extent of the ore-bodies are fully determined by the management, systematic development will immediately commence on a large scale.

Ross Group. Operated by the Molybdenum Mining and Reduction Company. C. P. Riel, superintendent. This property is situated five miles from the head of Alice arm, and operated steadily for a few months during the summer. Owing to the abnormal heavy fall of snow, operations were suspended early in the winter, but will commence again as soon as climatic conditions permit. The vein is a contact-fissure, and can be traced for a considerable distance on the surface. At the time of my visiting the property two parallel tunnels were being driven on the main vein, and a raise being put up for ventilation purposes.

A gravity-tram 4,170 feet long conveys the ore from the mine to the mill, situated at the beach. The mill and concentrator has a capacity of 200 tons a day.

The power plant consists of two Leonard return-tubular boilers of 50 horse-power each, and one Leyner air-compressor with a capacity of 750 cubic feet a minute at 100 lb. pressure. Cook and bunk houses have been built to accommodate 100 men.

During my inspection of this property I found the various requirements of the "Metalliferous Mines Inspection Act" strictly observed, and operations proceeding along the lines of good mining practice.

Princess Royal Island.

Surf Inlet. Operated by the Belmont Canadian Mines, Limited. F. W. Holler, superintendent. This mine is situated on Princess Royal Island, inland from the head of Surf inlet. Considerable development-work has been done on the property, which consists of a series of lenticular masses of white pyritiferous quartz carrying gold, with smaller values in silver and copper.

The mine proper is situated seven miles inland from the head of the inlet, at an altitude of 1,000 feet. So far three distinct ore-lenses have been opened up and developed to a depth of 1,000 feet vertically from the outcrop, and over 13,000 feet of drifting done. At the time of my last visiting this property operations were confined to the 600-foot level, where some drifting and two parallel raises were being driven. A winze had also been sunk to the 1,000-foot level

from the 600-foot level, and levels were being turned off there. A crosscut tunnel was also being driven towards the hanging-wall of the zone, with the expectation of picking up other ore-bodies that are supposed to exist in that vicinity.

A hollow concrete dam 490 feet long and in places 75 feet high has been built across the lower end of Cougar lake, in connection with the hydro-electric plant that is being installed at the head of the inlet, near tide-water. This dam will raise the water in Cougar lake sufficiently to flood the Bear and Dear lakes, which formerly were connected by small streams, thus forming a water route from the head of the inlet to a point within one mile and a half from the mine, and at the same time create the head of water required for electric generating purposes.

An incline leading from the wharf at tide-water to the top of the dam has been built for the purpose of transferring material to barges placed on the lake. Another wharf has also been built farther up the lake, where the material is again transferred and hauled to the mine over a tramway one mile and a half long. This tramway will be electrically operated as soon as the power is available.

The hydro-electric station is being built near tide-water; the structure will be composed of concrete throughout, and the plant will be capable of generating 1,500 horse-power, with a water-head of slightly over 50 feet.

A mill and concentrator with a capacity of from 250 to 500 tons is being installed at the mine, also machine-shops, power-house, etc., which will be operated entirely by electricity transmitted from the hydro station at tide-water.

Considerable clearing has been done at the mine and a townsite laid out, on which the company will build up-to-date cottages for their employees, also stores, recreation-rooms, etc.

When in full operation this mine will give employment to 300 men.

During my various inspections of this property I have always found the conditions in full accord with the requirements of the "Metalliferous Mines Inspection Act."

Douglas Channel District.

Drum Lummon. Operated by the Drum Lummon Copper Mines, Limited. W. P. Sloan, superintendent. This property is situated about forty miles from Hartley Bay and two miles inland from tide-water. The entire workings consist of a tunnel, which at the time of my visit was in 390 feet. This tunnel will crosscut a faulted zone in the granites, which shows traces of copper on the surface. The mineralized zone on the surface can be traced for some considerable distance; the extent of the ore-body, however, cannot be determined without further development.

During my inspection of the property I found the general conditions fully complying with the requirements of the "Metalliferous Mines Inspection Act," with the exception of the ventilation. No provision had been made for ventilation, and I ordered the management to install a small portable fan without delay, so that the entire operations would conform with the Act.

Several other silver-lead and copper properties are located on this channel, and have been worked in a small way during the summer months. The isolated position of the majority of these properties made it impossible for me to visit them during the short time at my disposal while in the district.

OMINECA MINING DIVISION.

Hazelton District.

Rocher Deboule. Operated by the Rocher Déboulé Mining Company, Limited. D. J. Williams, superintendent. This mine is situated on the Rocher Déboulé mountain at an altitude of 5,200 feet, and ten miles inland from Skeena Crossing, a depot on the Grand Trunk Pacific Railway. The trail for the first few miles is in very good condition; the remaining distance, however, is in a bad state and at certain periods is practically impassable.

This property consists of a series of veins averaging from 2 to 8 feet in width, the general strike of which is N. 80° E. and dipping into the mountain with a grade of from 45 to 70 degrees. The mineral content of the various veins consists chiefly of copper, with varying values in gold. The main entrance to the mine is termed the 300-foot level, on which a little drifting and understoping is going on, the ground above having been worked out and abandoned. A shaft has been sunk to the 500-foot level from a point on the 300-foot; the vein here is exceptionally good and

carries high values, and at the time of my last visiting the mine the largest part of the output was being taken from the stopes on this level. The method of mining used is overhand stoping, very little timbering being necessary on account of the strong cohesive nature of the hanging-wall.

A crosscut tunnel has been commenced on the 1,500-foot level with the idea of crosscutting all the veins on the property to depth, and is now in over 2,200 feet from the portal. Two veins have been already crossed in this tunnel, which are being drifted on. The tunnel will be continued until the main or No. 3 vein is reached, and should this vein show persistence to depth and carry the values found in the upper workings, the possibilities of this property are very great. The general arrangements of the property are well laid out.

The ore from the upper workings is taken out on the 300-foot level and dumped into pockets near the portal of the tunnel, and from here it is hauled by a 16-ton Porter steam-locomotive over a narrow-gauge railway a little over a mile long to the aerial tramway terminal pockets The aerial tramway is three miles and a half long and consists of two sections with an intermediate transfer-station. The upper section is operated by gravity and drops 1,700 feet in a total distance of 3,400 feet; the lower section is mechanically operated and connects with the Grand Trunk Pacific Railway at Tramville.

The plant includes a machine-shop capable of taking care of all necessary repairs, also a small portable sawmill.

The motive power is electricity, the hydro station being situated on Juniper creek, about five miles from the mine, and consists of one Canadian General Electric A.C. generator, belt-driven from a double-impulse Pelton wheel, with a head of 210 feet. The capacity of the generator is 190 kw. at 2,200 volts, running at 900 revolutions a minute.

The water is caught by a diversion-dam placed across the creek, and conveyed to the hydro station in a 30-inch wood-stave pipe-line 3,000 feet long.

The plant at the mine consists of one Rand air-compressor with a capacity of 750 cubic feet at 100 lb. pressure, belt-driven from a 100-horse-power Canadian General induction-motor; one 175-horse-power Standard gas-engine, used as an auxiliary when short of power; also one 16-ton Porter steam-locomotive; and two 30-horse-power electric hoists, one of which is used at the shaft in the mine, and the other for raising and lowering material and men to and from the camp and the 300-foot level. The tramway from the camp to the 300-foot level is 1,800 feet long and has an average grade of 40 degrees.

The bunk-houses are all steam-heated, with wash-house attached, and are capable of accommodating 150 men.

During my several inspections of this property I have always found the requirements of the "Metalliferous Mines Inspection Act" strictly observed.

Silver Standard.

W. G. Norrie, superintendent. This mine is situated on Glen mountain, about eight miles from New Hazelton, at an altitude of 2,000 feet. The property consists of a series of well-defined quartz veins running from 2 to 8 feet in width, the principal content being silver-lead, copper, and zinc.

The various veins on the property have lately been cut by a crosscut adit-tunnel on the 250-foot level, driven in from the north side of the mountain. This tunnel will do away with the old shaft, which was sunk to a depth of 400 feet, and from which levels were turned off at 150 and 250 feet respectively. Very little mining is going on in the 150-foot levels, operations being principally centred on the higher-grade ore found in the 250-foot levels. The above tunnel has connected with the 250-foot level from the old shaft, and all ore mined will eventually be brought through this tunnel, and the shaft used a a manway and for ventilation purposes only.

The high-grade ore is hand-sorted and sacked at the mine, the lower grades, of which there is a considerable quantity, being left in the stopes and on the dumps.

Development-work during the year has been very encouraging, the ore reserves being now greater than at any time since the mine was opened up.

New ore-bunkers, sorting-sheds, blacksmith and machine shops have been built near the portal of the new tunnel.

The power plant consists of the following: One Robb-Mumford 25-horse-power return-tubular boiler; two Jencks return-tubular boilers, 40 horse-power; one Laidlaw air-compressor, capacity 300 cubic feet at 80 lb. a square inch; one 30-horse-power Lidgerwood hoist; and small electric generating plant for lighting purposes.

The bunk and cook houses are in good condition and are capable of accommodating forty men.

Other mines operating in this district are the New Hazelton Gold Cobalt Company, Limited, Spokane; Rocher Déboulé Mining Company; Harris Mines, Limited; *Highland Boy* mine; and the *Comeau* mine. These properties are as yet only in the first stages of development, and while they have possibilities, few have made steady shipments on account of conditions mentioned in another part of my report.

During my inspection of these properties I have found the requirements of the "Metalliferous Mines Inspection Act" being observed, with the exception of a few details, which have since been attended to.

Seaton Coal-mine.

Operated by the Wright Coal Company. A. Phelan, manager. This property is situated near the townsite of Seton, several miles east from New Hazelton. This coalfield takes the form of a synclinal basin, the line of folding being in an east and westerly direction, and is cut in two by the Bulkley river. There are several seams on the property ranging from 2 to 7 feet in height, the outcrops of which are visible on both banks of the river.

At the time of my visiting the mine operations were centred on what is termed the No. 1 seam, which was being opened up by a slope commencing from the eastern edge of the basin. This seam like all the others visited, contains considerable foreign material, which may possibly decrease as the workings develop to depth and away from the outcrop.

During my inspection of this mine I found the general conditions in accord with the requirements of the "Coal-mines Regulation Act"; no reports of the examination of the mine had been recorded as required by the Act, however, and I asked the manager to attend to this immediately. Copies of the "Coal-mines Regulation Act" were also left for reference. At the present time this mine is not being operated.

ATLIN MINING DIVISION.

Engineer.

Captain J. Alexander, superintendent. This mine is situated on the lower end of Tagish lake, south of Taku arm, and consists of a series of well-defined quartz veins carrying high values in free gold, the veins ranging from 2 to 48 feet in width. A considerable amount of open-cut work has been done on the various veins, which are all exposed and easily followed on the surface.

Operations are principally centred on what is known as the No. 4 vein, on which a shaft has been sunk to a depth of 230 feet. Levels have been turned away from the shaft at 75, 110, 175, and 230 feet, respectively, and in each of these levels the ore shows up well and carries even better values than found in the open-cuts on the surface.

The ore is hand-sorted and sacked at the mine, and shipped via the White Pass & Yukon Railway and water route to Tacoma. The mine in general is in good condition, and the work done so far has followed along the lines of good mining practice.

The bunk and cook houses are in good sanitary condition and are capable of accommodating eighty men.

The power plant consists of the following: One 30-horse-power Mussens return-tubular boiler; one Ingersoll Rand single-stage air-compressor, capacity 150 cubic feet; one 20-horse-power Lidgerwood hoist.

During my inspection of this property I found the requirements of the "Metalliferous Mines Inspection Act" fully observed, with the exception of a few details which the management promised to attend to immediately. I also left several copies of the Act as a guide to further operations.

Silver Queen.

Operated by the Silver Queen and Ruby Silver Mines, Limited. F. Storey, superintendent. This mine is situated at Pavey, on the east shore of Lake Bennett, and is reached via the White Pass & Yukon Railway from Skagway, Alaska. The main tunnel is on an elevation of 3,600 feet, and at the time of my visiting the property was in over 500 feet, the object being to prove the ore-body to depth.

A few weeks previous to my visit two men were asphyxiated, and as a result died, through going back into the tunnel too soon after blasting. It appears that the deceased men thought that they had tapped the ore-body, and in their anxiety to examine the results of the shots, proceeded immediately into the tunnel and were overcome by the gases resulting from the blast.

The ventilation of the tunnel had been given little attention, and on visiting the mine I immediately ordered the management to discontinue operations until such times as the ventilation was improved. I also left copies of the "Metalliferous Mines Inspection Act" for reference.

An aerial tramway 5,600 feet long runs from the railway landing to the tunnel, and is operated by a gas-driven hoist placed near the portal.

The bunk and cook houses are in good sanitary condition and are capable of accommodating forty men.

The power plant consists of the following: One 50-horse-power Marine return-tubular boiler; one Rand air-compressor, capacity 750 cubic feet at 80 lb. a square inch; one 30-horse-power gas-engine and hoist. These were found to be in good condition.

LIST OF ACCIDENTS IN METALLIFEROUS MINES, 1916.

REPORT BY JAMES McGREGOR AND H. H. JOHNSTONE, KOOTENAY DISTRICT.

No.	Mine.	Date.	Name.	Occupation.	Details.
1	Granby, Phoenix	Jan. 4	J. D. Williams	Pipeman	Right leg broken by being struck with with a plank.
2	Hudson Bay, Salmo	" 8	J. C. Hansen ..	Miner	Fall of ground struck him, breaking three ribs.
3	Granby, Phoenix	" 20	C. H. Nelson ..	Barman	Struck by falling slab of rock, causing Potts fracture of left leg.
4	Standard, Silverton	" 27	O. S. Smith....	Miner	Hammer-drill fell on his big toe of left foot, breaking it.
5	Granby, Phoenix	Feb. 18	John Linklater	"	Struck by falling rock, which knocked him into raise; fatal.
6	Granby, Phoenix	Mar. 5	Anton Svetich.	"	Killed by fall of rock.
7	Standard, Silverton	" 18	Joseph Blake .	Timber-hel-[per	Broken right thumb, caused by fall of rock.
8	Surprise, Sandon ..	Apr. 8	Con Caser	Miner	Slipped and fell down ladder-way, bruising and straining forearm and ankle.
9	Surprise, Sandon	" 25	N. G. Schmieg.	Labourer....	Broken bone in foot, caused by falling timber striking it.
10	Granby, Phoenix	" 28	Walter Geldert	Miner	Killed by a fall of rock.
11	Granby, Phoenix	May 2	Joseph Ciacco..	Mucker.....	Struck by oncoming car, causing compound fracture of left thigh, and internal hæmorrhage; fatal.
12	Granby, Phoenix	" 20	Frank Rung...	Crusherman.	Burns on face from explosion of powder.
13	Standard, Silverton	June 12	Alex. Barclay..	Miner	Bruised cartilage in foot, caused by piece of falling ore.
14	Granby, Phoenix	" 19	Owen E. Evans	Brakeman ...	Ribs fractured between car and timber.
15	Standard, Silverton	" 23	R. Geldsbury..	Mucker.....	Slipped and fell down ladder, causing contusion of side.
16	Standard, Silverton	" 30	Sam Kennedy..	Teamster ...	Broken bone in foot, caused by being crushed between two logs.
17	Hudson Bay, Salmo	" 30	John Dewar...	Shiftboss ...	Accidently struck in the eye by a miner's pick.
18	Standard, Silverton	July 5	Ben Kelsall....	Tramway-[man	Log fell off the tram on to his foot, breaking a bone in same.
19	Standard, Silverton	Aug. 7	Leslie McInnis.	Machineman	Rock rolled off pile on to his foot, causing contusion of calf of left leg.
20	War Eagle, Rossland ..	" 16	Harry Morrison	Miner	One eye totally destroyed, other injured badly, and three ribs broken, caused by drilling into unexploded powder.
21	War Eagle, Rossland...	" 16	Joseph Smale.	"	Eyes probably slightly injured; face and body peppered with small fragments of rock. Same accident as above.

KOOTENAY DISTRICT—*Concluded.*

No.	Mine.	Date.	Name.	Occupation.	Details.
22	Centre Star, Rossland..	Sept. 1	J. A. McLean..	Miner	Rock shot out by an air-blast struck his back, severing spinal cord and breaking one vertebra.
23	Motherlode, Greenwood	" 12	Nich. Gabrilo..	Chuteman...	Crushed between chute-post and car on motor-train; fatal.
24	Bluebell, Riondel	" 23	Frank Cannock	Mucker.....	Fall of rock caused fracture of leg above ankle.
25	Granby, Phoenix	" 29	Mike Vuich....	Chute-helper	Comminuted fracture of left leg, caused by fall of rock.
26	Standard, Silverton....	" 29	Mike Srdach ..	Machineman	Bruised muscles of leg, caused by fall of rock.
27	Hewitt, Silverton.....	Oct. 10	Harry Moore..	Mucker....	Rock slid off foot-wall, causing dislocation of left knee, broken right leg, internal injuries; fatal.
28	Bluebell, Riondel.....	" 16	Geo. Sorenson..	Miner	Rock fell on left leg, bruising same.
29	Standard, Silverton....	" 18	L. T. Gear	Driver	Foot caught between bumpers of two cars, bruising the heel.
30	Sullivan, Kimberley....	" 18	W. Anderson..	Machineman	A falling rock struck bar in his hands, driving same into the abdomen, causing a severe wound on left side near groin.
31	Standard, Silverton....	" 21	Oscar Johnson.	Mucker.....	Slipped and fell 15 feet down ladder, causing bruised hip.
32	Le Roi, Rossland	Nov. 16	Rodney McIver	Shoveller ...	Broken back, caused by fall of rock; fatal.

REPORT BY ROBERT STRACHAN, SIMILKAMEEN DISTRICT.

33	Iron Mask, Kamloops..	Feb. 5	F. Wilson Wil-[liams	Skip-tender..	Caught between station shaft set and skip, causing fractured skull; fatal.
34	Iron Mask, Kamloops..	Mar. 13	Jack Staight..	Pumpman ...	Top of first finger of left hand amputated when struck by falling packing-gland.
35	Iron Mask, Kamloops..	" 15	William Gillis.	Blacksmith..	Was striking a piece of steel, missed the same and struck his leg; blood-poisoning afterwards set in.
36	Nickel Plate, Hedley...	Apr. 12	C. J. Swanson.	Mucker.....	Rock dropped off muck-pile on to his leg, causing compound fracture of right leg.
37	Iron Mask, Kamloops .	May 2	G. Duci.....	"	Cut on nose and wrist by falling rocks.
38	Iron Mask, Kamloops..	July 13	C. A. Woods..	Timberman .	Injury to fingers and hand, caused by coming in contact with belt-lacing on circular saw.
39	Iron Mask, Kamloops..	" 21	Valentine Da-[pote	Miner	Was carrying a machine and fell down ore-chute, sustaining broken nose and one broken rib.

SIMILKAMEEN DISTRICT—*Concluded.*

No.	Mine.	Date.	Name.	Occupation.	Details.
40	Iron Mask, Kamloops..	Aug. 7	A. Brandy	Miner	Fell off set of timber on to set below, sustaining a broken rib.
41	Iron Mask, Kamloops..	Sept. 19	Mike Colistio..	"	Slipped while carrying a machine and injured his elbow on side of drift.
42	Iron Mask, Kamloops..	Oct. 12	M. J. Schuffer.	"	Accidentally struck on finger by partner's hammer while setting timber.
43	Iron Mask, Kamloops..	" 23	C. Christinson.	"	Broken bone in left thumb, caused by small piece of rock falling.

REPORT BY JOHN NEWTON AND J. H. MCMILLAN, COAST DISTRICT.

44	Granby, Anyox	Feb. 21	John Bensen ..	Miner	Killed by sliding rock in chute.
45	Britannia.....	May 18	D. Koncar	"	Killed while returning on an unexploded shot.
46	Granby, Anyox.....	" 31	William Hart..	Motorman...	Right thigh crushed in collision between two ore-trains.
47	Granby, Anyox.....	June 7	James McEwen	Miner	Struck by falling rock, causing injuries from which he died two hours later.
48	Granby, Anyox.....	" 7	Robt. H. Jones	"	Same accident as above, causing lacerated leg. Died of heart-failure three hours later.
49	Granby, Anyox.....	" 12	Tony Lanterno.	"	Rock lodged in fleshy part of upper left arm, caused by striking a primer in the rock-pile.
50	Granby, Anyox.....	" 12	Joe Dighera...	"	Same accident as above; probable loss of sight of both eyes; cut head and face.
51	Granby, Anyox.....	July 15	A. Wilkinson..	Labourer....	Fractured ribs, caused from slipping on a log while carrying a keg of bolts.
52	Granby, Anyox.....	" 14	A. Dubinski...	Miner	Struck by flying rocks from shot, causing injuries to eyes, cuts on head and face.
53	Granby, Anyox.....	" 15	Ernest Larson.	"	Struck by flying rock from shot, causing internal injuries, ribs broken; died four hours later.
54	Granby, Anyox.....	" 15	Gust Swanberg	Blaster	Broken big toe on right foot, caused by jumping off a plank on to a detonator, which exploded.
55	Marble Bay, Vananda..	" 25	J. C. Tait.....	Shiftboss....	Dislocated right knee, caused when cage collided with the chairs at 1,100-foot station.
56	Granby, Anyox.....	" 30	Gust Hill	Chuteman's [helper	Electrocuted by striking trolly-wire with a steel bar he had over his shoulder; fatal.
57	Silver Queen and Ruby [Silver, Atlin	" 30	Edward Brann.	Miner	Asphyxiated in gases while returning too soon after blasting; fatal.

COAST DISTRICT—*Concluded.*

No.	Mine.	Date.	Name.	Occupation.	Details.
58	Silver Queen and Ruby [Silver, Atlin	July 30	Henry Oleson..	Miner	Asphyxiated in gases while returning too soon after blasting; fatal.
59	Britannia	Aug. 17	Axel Johnson .	"	Face, neck, chest, right arm and hand badly peppered with rock, probable loss of sight of both eyes, caused by explosion of powder while cleaning out a missed hole.
60	Britannia.....	Sept. 23	Jos. Thompson	"	Both legs fractured by falling rock from roof.
61	Granby, Anyox.....	Nov. 7	F. McKenzie.	Brakeman...	Crushed and lacerated toes of left foot while kicking a coupling together between two cars.
62	Britannia	" 9	L. Pidutti.....	Nipper.....	Instantly killed by being struck by 12-inch air-pipe which parted at a receiver.
63	Britannia	" 9	R. Basso Bert..	Mucker.....	Same accident as above; fatal.
64	Britannia.....	" 9	S. Morris.....	"	Left knee dislocated. Same accident as above.
65	Granby, Anyox.....	" 12	M. Moline	Miner	Rock dropped from back, causing fracture of left thigh, and lacerated neck and head.
66	Granby, Anyox.....	" 12	P. Martino....	"	Laceration of head and face. Same accident as above.
67	Britannia	Dec. 8	E. Austin.....	"	Instantly killed while returning on unexploded shot.
68	Britannia	" 8	J. Penilla.....	Mucker.....	Same accident as above; fatal.

TABULATED LIST OF ACCIDENTS IN METALLIFEROUS MINES, 1916.

	Cause of Accident.	Extent of Injury.			Total.
		Fatal.	Serious.	Slight.	
A	Blasting	5	1	1	7
B	Defective powder	..	..	..	..
C	Drilling into old holes containing powder	..	2	1	3
D	Powder in muck	..	1	1	2
E	Shafts and cages, accidents connected with	1	..	1	2
F	Falling down shafts, stopes or winzes	..	..	5	5
G	Falling down chutes	..	..	..	..
H	Mine-cars	2	2	3	7
I	Rock falling in stopes, levels, etc	8	7	7	22
J	Rock falling down chutes or openings	1	3	1	5
K	Timbering	..	..	3	3
L	Miscellaneous, underground	1	1	4	6
M	Miscellaneous, surface	2	1	3	6
	Totals	20	18	30	68
	Accidents for each 100,000 tons ore mined	0.627	0.564	0.940	2.131
	Accidents for each 1,000 men employed	3.81	3.43	5.71	12.95

COAL-MINING IN BRITISH COLUMBIA.

BY WM. FLEET ROBERTSON, PROVINCIAL MINERALOGIST.

During the year 1916 there was mined in the various collieries of the Province 2,485,580 tons (2,240 lb.) of coal, an increase from the preceding year of 513,000 tons, equivalent to nearly 26 per cent.

This increase is considerable and occurs both in the Coast District and in the Crowsnest field.

It is accounted for in the former by some improvement in the economic conditions and the increased demand for bunker coal for ocean-going vessels, while there has been an increased demand for coke for the Anyox copper-smelter.

In the latter field, owing to high prices prevailing for metals and the consequent activity of the metal-mines and smelters, the demand for coal and coke from this district far exceeded the output.

The early portion of the year gave promise of a much larger production than that realized. The output was seriously affected in the latter half of the year through labour troubles; also an explosion in No. 3 East mine, Michel Colliery, early in August, which cut off the production of this mine for the remainder of the year; and the "bumps" in No. 1 East mine, at Coal Creek, which seriously curtailed the output of that colliery during November and December. In addition to this, operations were seriously hampered by the scarcity of labour, and despite the active demand for coal and coke the district showed but a very small increase over the previous year's operations.

The following table shows, for the past eight years, the output and the *per capita* production of the various districts:—

OUTPUT AND PER CAPITA PRODUCTION OF VARIOUS DISTRICTS.

Year.	District.	Gross Tons of Coal mined during Year.	Total No. of Employees at Producing Collieries.	Tons of Coal mined per Employee for Year.	Number of Men employed Underground in Producing Collieries.	Tons of Coal mined per Underground Employee for Year.
1908	East Kootenay District	883,205	2,524	350	1,746	506
	Coast District	1,226,182	3,549	345	2,686	456
	Whole Province	2,109,387	6,073	347	4,432	476
1909	East Kootenay District	923,865	2,427	380	1,737	532
	Coast District	1,476,735	3,991	370	2,976	496
	Whole Province	2,400,600	6,418	374	4,713	509
1910	East Kootenay District	1,365,119	3,111	439	2,374	575
	Coast District	1,774,116	4,647	382	3,529	502
	Whole Province	3,139,235	7,758	404	5,903	532
1911	East Kootenay District	442,057	2,197	201	1,585	272
	Coast District	1,855,661	4,676	397	3,627	511
	Whole Province	2,297,718	6,873	334	5,212	440

OUTPUT AND PER CAPITA PRODUCTION OF VARIOUS DISTRICTS—*Concluded.*

Year.	District.	Gross Tons of Coal mined during Year.	Total No. of Employees at Producing Collieries.	Tons of Coal mined per Employee for Year.	Number of Men employed Underground in Producing Collieries.	Tons of Coal mined per Underground Employee for Year.
1912	East Kootenay District	1,261,212	2,410	523	1,780	708
	Coast District	1,764,497	4,720	374	3,495	504
	Whole Province	3,025,709	7,130	424	5,275	574
1913	East Kootenay District	1,331,725	2,666	500	1,965	678
	Coast District	1,239,035	3,777	328	2,865	433
	Whole Province	2,570,760	6,443	399	4,830	532
1914	East Kootenay District	955,183	2,397	399	1,749	547
	Coast District	1,211,245	3,335	363	2,518	481
	Whole Province	2,166,428	5,732	379	4,267	508
1915	East Kootenay District	852,572	1,748	488	1,183	721
	Coast District	1,120,008	3,230	347	2,512	446
	Whole Province	1,972,580	4,978	396	3,695	534
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

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 safeguarding the mine and workmen. In the year 1916 it will be observed that the *per capita* output of the East Kootenay collieries increased considerably, while that of the Coast collieries also shows an increase.

The market of the East Kootenay field is provided primarily by the railways of the south-eastern part of the Province and of the northern parts of the adjoining States of Montana and Washington, approximately four-fifths of the coal, sold as such, being exported to those States, while the remainder went to supply the demands of the south-eastern part of the Province—its domestic needs, its railways, steamboats, mines, and smelters. The competition of fuel-oil has already been referred to.

Coke, a product of the coal-mines, is sold in the same markets, with the difference that the local consumption—chiefly by the smelters of Trail and the Boundary District—took about 85 per cent. of the product, while 15 per cent. was exported to the States mentioned.

As regards the marketing conditions in this field, the East Kootenay collieries are, however, brought into direct competition with the collieries of Alberta, just over the Provincial boundary-line, all these collieries being in the same coalfield, with practically the same grade of coal and working under similar conditions.

This competition has kept the price obtainable for coal at from $2.25 to $2.50 a ton, with little probability of any material increase in price, owing to the facility with which new collieries can be opened up and the very large reserve areas of coal limits in this district; a description of these reserves was given in the Report of this Bureau for the year 1909.

The Coast District may be subdivided into two fields—the Nicola-Princeton field and the Vancouver Island field—in which the markets differ considerably.

In the former field the consumption is chiefly by the local railways, while a small amount finds its way to Vancouver, even under the handicap of what seems to be an excessively high freight charge.

The Vancouver Island coal market is provided by the domestic and manufacturing requirements of the Coast cities, and of the ocean-going steamers calling at these ports.

The demand for coal from the larger coasting steamers and from the railways has in past years diminished, as the Canadian Pacific Railway main line engines are nearly all burning California crude oil, and a large coasting steamer burning coal is now an exception.

Owing to the existing conditions in the Island collieries, prices have been maintained as high or higher than for preceding years; in fact, the high price of coal on the Coast is one of the chief reasons for the marked increase in the use of California oil-fuel. It does not seem at all likely, either, that the present price of coal on the seaboard, of from $4 to $4.50 a ton f.o.b., will decrease for some time.

As in former years, the greater proportion of the coal production was made by three larger companies—the Crow's Nest Pass Coal Company, with two collieries in East Kootenay; and by the Western Fuel Company, of Nanaimo, and the Canadian Collieries (Dunsmuir), Limited (formerly the Wellington Colliery Company), these last two operating on Vancouver Island.

In addition to these large collieries, shipments have been made by the Corbin Coal and Coke Company, in East Kootenay; by the Middlesboro Collieries, the Inland Coal and Coke Company, and the Pacific Coast Coal Syndicate, all of the Nicola Valley; by the Princeton Coal and Land Company, of Princeton; and by the Pacific Coal Mines, Limited, and Vancouver & Nanaimo Coal Mining Company, both operating on Vancouver Island, near Nanaimo.

The details of the shipments made by each of these companies will be found in reports of the Inspectors of the various districts.

During the year 1916 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 87 per cent. was consumed in British Columbia, and the remaining 13 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 1916.

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	858,052		233,456	
" export to United States	837,879		34,377	
" " other countries	6,166			
Total sales		1,702,097		267,833
Lost in washing	197,190			
Used in making coke	401,487			
Used under colliery boilers, etc.	203,085			
Total for colliery use		801,762		
		2,503,859		
Stocks on hand first of year	33,358		2,633	
" last of year	15,079		2,525	
Difference taken from stock during year		18,279		108
Output of collieries for year		2,485,580		267,725

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	178		86		264	
Whites—Miners	1,647				1,647	
Miners' helpers	100				100	
Labourers	777		478		1,255	
Mechanics and skilled labour	527		362		889	
Boys	71		57		128	
Japanese	151				151	
Chinese	239		383		622	
Indians	4				4	
Totals	3,694		1,366		5,060	

COLLIERIES OF THE COAST DISTRICT.

The gross output of the Coast collieries, including the Nicola valley, for the year 1916 was 1,603,310 tons (of 2,240 lb.) of coal actually mined, while some 18,238 tons was taken from "stock," making the actual consumption of coal 1,621,548 tons.

Of this gross consumption 1,239,825 tons was sold as coal, 135,037 tons was consumed by the producing companies as fuel, and 197,190 tons was lost in washing; while 49,496 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.

The following table gives an aggregate summary of the output of the Coast collieries for the year 1916, 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	782,733		26,043	
" export to United States	450,926			
" " other countries	6,166			
Total sales		1,239,825		26,043
Lost in washing	197,190			
Used in making coke	49,496			
Used under colliery boilers, etc.	135,037			
Total for colliery use		381,723		
		1,621,548		
Stocks on hand first of year	33,259		26	
" last of year	15,021		1,587	
Difference {* added to / † taken from} stock during year		†18,238		*1,561
Output of collieries for year		1,603,310		27,604

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	128		63		191	
Whites—Miners	1,029				1,029	
Miners' helpers	100				100	
Labourers	682		107		789	
Mechanics and skilled labour	181		229		410	
Boys	55		35		90	
Japanese	151				151	
Chinese	239		383		622	
Indians	4				4	
Totals	2,569		817		3,386	

The following tables show the output of coal and the disposition made of it in the subdivisions of the Coast District:—

COAL-OUTPUT, ETC., 1916, 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	689,997		26,043	
" export to United States	445,242			
" " other countries	6,166			
Total sales		1,141,405		26,043
Lost in washing	195,225			
Used in making coke	49,496			
" under colliery boilers, etc.	124,878			
Total for colliery use		369,599		
		1,511,004		
Stocks on hand first of year	32,958		26	
" last of year	14,715		1,587	
Difference { * added to / †taken from } stock during year		†18,243		*1,561
Output of collieries for year		1,492,761		27,604

COAL-OUTPUT, ETC., 1915, NICOLA-PRINCETON SUB-DISTRICT.

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	92,736			
" export to United States	5,684			
" " other countries				
Total sales		98,420		
Lost in washing, etc.	1,965			
Used in making coke				
" under colliery boilers, etc	10,159			
Total for colliery use		12,124		
		110,544		
Stocks on hand first of year	301			
" last of year	306			
Difference added to stock during year		5		
Output of collieries for year		110,549		

COLLIERIES OF THE EAST KOOTENAY DISTRICT.

The gross output of the collieries of the East Kootenay District for the year 1916 was 882,270 tons (2,240 lb.) of coal actually mined, while 41 tons was taken from stock, making the actual consumption of coal, 882,311 tons. Of this gross consumption of coal, 462,272 tons was sold as coal, 68,048 tons was consumed as fuel by the producing companies, while 351,991 tons was converted into coke, producing 240,121 tons, while 1,669 tons was taken from stock, making the coke sales for the year 241,790 tons.

The East Kootenay collieries exported to the United States about 84 per cent. of the coal sold and about 15 per cent. of the coke.

The following table gives an aggregate summary of the output of the East Kootenay collieries for the year 1916 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	75,319		207,413	
" export to United States	386,953		34,377	
" " other countries				
Total sales		462,272		241,790
Used in making coke	351,991			
" under colliery boilers, etc	68,048			
Total for colliery use		420,039		
		882,311		
Stocks on hand first of year	99		2,607	
" last of year	58		938	
Difference taken from stock during year		41		1,669
Output of collieries for year		882,270		240,121

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	50		23		73	
Whites—Miners	618				618	
Miners' helpers						
Labourers	95		371		466	
Mechanics and skilled labour	346		133		479	
Boys	16		22		38	
Japanese						
Chinese						
Indians						
Totals	1,125		549		1,674	

INSPECTION OF COAL MINES, 1916.

VANCOUVER ISLAND AND COAST DISTRICT.

This district, comprising, as it does, the coalfields of Vancouver island and the Coast, as well as those of the Nicola and Similkameen valleys, has been subdivided, for inspection purposes, into three Inspection Districts, each under the charge of a District Inspector.

The headquarters of the Inspectors of both the Nanaimo and Comox Inspection Districts is at Nanaimo, which permits of one of the Inspectors being constantly at headquarters while the other is making inspections; it also permits of the interchanging of inspection duties, so that each Inspector knows both districts.

NANAIMO INSPECTION DISTRICT.

JOHN NEWTON, INSPECTOR (OFFICE, NANAIMO).

The collieries operating and producing coal during the year in this Inspection District, including the new mines that have been started, were:—

NANAIMO: The Western Fuel Company—No. 1 shaft, Protection shaft, and No. 4 shaft, Northfield mine, and Reserve Colliery.

EXTENSION: The Canadian Collieries (Dunsmuir), Limited (formerly the Wellington Colliery Company)—Nos. 1, 2, and 3 mines, all worked from what is known as the No. 1 tunnel, and No. 4 mine, worked by a shaft.

Pacific Coast Coal Mines, Limited—Fiddick Colliery, South Wellington, Cranberry District, Nos. 1 and 2 slopes, and the new shafts at the Morden mine.

Vancouver-Nanaimo Coal Mining Company, Limited—New East Wellington Colliery, Mountain District, Nanaimo, No. 1 slope.

COMOX INSPECTION DISTRICT.

HENRY DEVLIN, INSPECTOR (OFFICE, NANAIMO).

The collieries operating and producing coal during the year in this Inspection District, including the new mines that have been started, were:—

CUMBERLAND: The Canadian Collieries (Dunsmuir), Limited—Nos. 4 and 7 slopes, and Nos. 5 and 6 shafts, and two new shafts at No. 8.

Pacific Coast Coal Mines, Limited—Suquash Colliery, Nos. 1 and 2 slopes, and shaft.

NICOLA-PRINCETON INSPECTION DISTRICT.

ROBERT STRACHAN, INSPECTOR (OFFICE, MERRITT).

The collieries operating during the year in this Inspection District, including the new mines that have been started, were:—

NICOLA VALLEY: The Middlesboro Colliery of the Middlesboro Collieries, Limited, Merritt—Nos. 2, 3, 4, 5, 6, and 7 mines.

Inland Coal and Coke Syndicate, Merritt—One shaft and 3 slopes.

Diamond Vale Colliery Company, Merritt—No. 3 mine.

Pacific Coast Colliery Company, Merritt—No. 1 slope and No. 2 shaft, adjoining the Middlesboro Colliery.

PRINCETON: Princeton Coal and Land Company's Princeton Colliery—No. 1 slope.

United Empire Mining Company—One adit-tunnel.

COALMONT: Coalmont Collieries, Limited—Developing only.

MIDWAY: Boundary Mining and Exploration Company—Developing only.

NANAIMO INSPECTION DISTRICT.

REPORT OF JOHN NEWTON, INSPECTOR.

I have the honour to submit my annual report for the year ending December 31st, 1916, on the various coal-mines in my inspectorate, consisting of the Western Fuel Company, Vancouver-Nanaimo Coal Company, Pacific Coast Coal Mines, Nanaimo, and West Wellington Colliery, Nanoose.

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, which is in a central position, is always ready to meet any demands that can be made upon it, with J. D. Stewart in charge.

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.*
John Lawson, Chairman,	San Francisco, Cal.
C. P. Heaton, President,	San Francisco, Cal.
D. C. Norcross, Secretary,	San Francisco, Cal.
Clarence Schmitt, Treasurer,	San Francisco, Cal.
Thomas R. Stockett, General Manager,	Nanaimo, B.C.
John Hunt, Superintendent,	Nanaimo, B.C.
T. R. Jackson, Mine Manager, No. 1 Mine,	Nanaimo, B.C.
Geo. Wilkinson, Mine Manager, Reserve Mine,	Nanaimo, B.C.

The above company has operated the following collieries at Nanaimo during the past year, namely: No. 1 or Esplanade shaft, Nanaimo; Protection Island mine, No. 4 Northfield mine, and the Douglas slope.

This company has a fully equipped rescue-station, with apparatus of both the Draeger and Proto type, in charge of George Yarrow, who is a holder of medallion. Also first-aid classes are held every Sunday morning in the rescue-station, instructed by Drs. Ingham and McIntyre.

The following returns show the combined output of all the company's mines for the past year:—

RETURNS FROM WESTERN FUEL COMPANY'S MINES FOR YEAR 1916.

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	208,464			
" export to United States	277,578			
" " other countries	6,166			
Total sales		492,208		
Used in making coke	*Nil.*			
Used under colliery boilers, etc.	66,329			
Total for colliery use		66,329		
		558,537		
Stocks on hand first of year	11,485			
" last of year	7,558			
Difference taken from stock during year		3,927		
Output of collieries for year		554,610		

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	27		18		45	
Whites—Miners	367				367	
Miners' helpers	21				21	
Labourers	289		21		310	
Mechanics and skilled labour	90		72		162	
Boys	52		22		74	
Japanese						
Chinese—Labourers			130		130	
Indians						
Totals	846		263		1,109	

NANAIMO COLLIERY.

T. R. Jackson, Manager.

No. 1 SHAFT, ESPLANADE.

David Brown, Overman of North Side of Mine; Robert Adam, William Johnson, William Neave, David John, John Wallbank, John Martin McGuckie, John Roderick McKenzie, James McMeekin, James William Jemson, William Brown, James Millie Brown, Thomas Smith, John Sullivan, Edward Warren Courtney, John Thompson, John Rowan, Alexander Rowan, George Jardine, William Holliday, Joshua Norris, Thomas James Wood, John Cobden Hughes, James Dudley, George Bennett Bradshaw, and George Stewart, Firemen and Shotlighters.

Development-work.

The general operations of the mine, as far as development-work is concerned, are identical to my report of 1915. The proposed work of driving a rock tunnel from the No. 1 North level across the measures to tap the Newcastle seam at a point on the heading of No. 3 slope, as mentioned in my last report, has not been put into operation as yet; but I am informed that this work will begin about the first of the year.

The proposed tunnel will be 7 x 12 feet and about 700 feet in length, on a 1-per-cent. grade. When completed it will greatly facilitate the handling of the coal from this section of the mine. A new addition has been added to the stables to accommodate the large demand for horses in the district, owing to the method of handling of the coal in the lower seams.

It is proposed at the beginning of the New Year to begin widening the No. 1 shaft-bottom siding, starting at the head of the Main slope and carried along the Motor level a distance of 500 feet.

A new electric pumping unit is to be installed at the foot of Protection shaft, capable of handling all the drainage from the North side of the mine.

Work has begun to retimber the main South side return airway with 12 x 12 square sets, skin for skin. All the timbers before being set are put through a preparation of cement and hydro-lime to increase the life of them.

On Protection island one new Canadian Rand compressor of 2,500 cubic feet capacity and a pair of new return-tubular boilers 84 x 16 inches, each 140 horse-power, has been installed.

All the remodelling of the engine-rooms and Diagonal siding, which was in operation, mentioned in my last report has been completed.

The present operations of the mine are at a depth from 600 to 1,000 feet below the surface, with a large submarine area. This shaft has three openings—namely, No. 1 hoisting-shaft, Protection and Newcastle shafts. All are connected one with the other by good travelling-roads. The seams worked are the Douglas and Newcastle.

Newcastle Seam, North Side of No. 1 Mine.

The coal produced from the North side of the mine is from the Lower or Newcastle seam, which lies from 60 to 70 feet below the Douglas, and is operated by three different slopes—namely, Nos. 1, 2, and 3—varying from 4,000 to 5,000 feet between each opening, making one continuous working-face.

The seam varies from 3 to 3½ feet in thickness, of a very hard nature, worked on the long-wall system, for which it is well adapted. A band of rock about 6 inches in thickness lies between the coal about 15 inches from the floor, making ideal conditions for machine-mining. The mining-machines used are of the "pick quick" (or bar machine) and the puncher types, to undercut the coal varying from 5 to 6 feet in depth. The whole output from this section of the mine is undercut by these machines, operated by compressed air, with the exception of No. 1 slope, which is hand-mined. Labourers are used to load the coal out on a tonnage basis.

A large staff of officials are employed, such as firemen, shotlighters, and facemen, to protect the lives of the workmen. In addition, notices are posted in all sections of the mine warning workmen against the violation of the general and special rules.

Open lights are used in this part of the mine, with permitted explosives exclusively used for the breaking of coal, which are nearly all fired by electric battery.

The coal is hauled out of the North side to No. 1 hoisting-shaft bottom by electric motors of the trolly type. Six of these motors are used for the purpose; four are Edison, one Westinghouse, and one tandem Jeffery type, doing very efficient work. The four Edison motors have been constantly in use for the last eighteen years, and good for many more to come.

The ventilation of the section is produced by a Guibal force-fan, 9 x 16 feet, and 100 horse-power, rope-driven, making 100 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 situated at Newcastle shaft ready for any emergency.

On my last examination I measured 72,000 cubic feet of air a minute passing into the section, divided into three splits.

No. 1 Slope.

I measured 13,000 cubic feet of air a minute passing into the slope for the use of fifty men and seven horses, or an average of 183 cubic feet of air for each unit employed. No explosive gas found; timbering and roadways good.

No. 2 Slope.

I measured 27,000 cubic feet of air a minute passing into the slope, divided into three splits.

No. 1 Split.—I measured 9,000 cubic feet of air a minute passing into the split for the use of twenty-nine men and four horses, or an average of 219 cubic feet of air for each unit employed.

No. 2 Split.—I measured 2,400 cubic feet of air a minute passing into the split for the use of twenty-eight men and seven horses, or an average of 171 cubic feet of air for each unit employed.

No. 3 Split.—I measured 8,000 cubic feet of air a minute passing into the split for the use of twenty-eight men and five horses, or an average of 185 cubic feet of air for each unit employed. No explosive gas found; timbering and roadways good.

No. 3 Slope.

On my last inspection I measured 15,000 cubic feet of air a minute passing into the slope for the use of fifty-six men and nine horses, or an average of 180 cubic feet of air for each unit employed. No explosive gas found; timbering and roadways good.

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 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.

South Side of No. 1 Mine.

Jacob Stobbart, Overman of South Side; Samuel Kenmore Mottishaw, Richard Battey, John Weeks, Matthew Broderick, Henry Ernest Devlin, Frank Green, Moses Woodburn, James Perry, and Robert Potter, Firemen and Shotlighters.

Douglas Seam.

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, then sealed off. Work begins again a certain distance below these 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.

The ventilation of the section is produced by a 72- x 90-inch double-inlet Sirocco fan, rope-driven, ratio 3½ to 1, running 250 revolutions a minute, producing 195,000 cubic feet of air a minute, with a 4-inch water-gauge, and an engine of 350 horse-power. An emergency Sirocco fan of the same size, in every way modernly equipped, is kept under steam ready for use.

The haulage of this section is done by main-and-tail and endless-rope system, worked with very satisfactory results. The output of the mine is 1,650 tons a day.

In this part of the mine safety-lamps of the Wolf pattern and permitted explosives, fired by electric battery, are exclusively used.

To overcome the many dangers of drivers being caught by cars in the safety-lamp district, the company has installed fifty-two electric head-lamps, eight Westinghouse and forty-four Edison, which are giving good results.

When I made my last inspection I measured 46,800 cubic feet of air a minute passing into the South side of the mine, divided into four splits.

No. 4 South Heading (or No. 1 Split).—I measured 2,300 cubic feet of air a minute passing into the split for the use of nine men and two horses, or an average of 153 cubic feet of air for each unit employed.

Dips off the South-east Heading (No. 2 Split).—I measured 9,300 cubic feet of air a minute passing into the split for the use of thirty-two men and four horses, or an average of 211 cubic feet of air for each unit employed.

South-east Heading (No. 3 Split).—I measured 4,260 cubic feet of air a minute passing into the split for the use of eighteen men and six horses, or an average of 118 cubic feet of air for each unit employed.

No. 6 South Heading (or No. 4 Split).—I measured 8,400 cubic feet of air a minute passing into the split for the use of thirty-eight men and seven horses, or an average of 142 cubic feet of air a minute for each unit employed. No explosive gas found; timbering and roadways good.

On all the different 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 from the No. 1 shaft and Protection Island collieries for the year 1916:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	185,927			
" export to United States	237,211			
" " other countries	5,995			
Total sales		429,133		
Used in making coke				
" under colliery boilers, etc.	44,749			
Total for colliery use		44,749		
		473,882		
Stocks on hand first of year	10,753			
" last of year	4,676			
Difference taken from stock during year		6,077		
Output of colliery for year		467,805		

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	21	.....	11	.....	32	.....
Whites—Miners	288	3.56 - 7.00	.....	.....	288	.....
Miners' helpers	18	3.02 - 3.16	.....	.....	18	.....
Labourers	226	3.02 - 4.02	12	2.75 - 3.25	238	.....
Mechanics and skilled labour	67	3.02 - 4.48	46	3.00 - 4.65	113	.....
Boys	45	1.21 - 2.76	15	0.50 - 1.85	60	.....
Japanese	.....	.....	.....	.....	.....	.....
Chinese	.....	.....	83	1.50 - 1.88	83	.....
Indians	.....	.....	.....	.....	.....	.....
Totals	665	.....	167	.....	832	.....

Description and length of tramway, plant, etc.—Mine operated 297 days.

RESERVE MINE.

Geo. Wilkinson, Manager; J. Dickson, Overman; Edward Wilkinson, James Renny, George Erater, Arthur John Challoner, George Moore, Benjamin Cheetham, George Oswald, Frederick Hilley, Frederick Bell, Samuel Jones, and Howell John, Firemen and Shotlighters.

During 1916 the following underground development-work has been done: The Main levels have been pushed rapidly; the East levels have been extended during the year approximately 2,000 feet and have been in fairly good coal the whole distance.

The West levels have been extended about 1,100 feet during the year, but at the present time are standing. These levels have not shown as good as the East levels, there being less coal and more folding and heavier pitches on this side than on the East.

The North-west slopes were extended about 400 feet during the year, making the distance 1,200 feet. At this point a very heavy pitch was encountered (approximately 75 degrees), making it practically impossible to drive them any farther. A pair of levels were turned off at this point in a westerly direction and driven about 800 feet. From the main West slope a pair of headings have been driven a distance of 600 feet in a south-westerly direction across the pitch for the purpose of taking the large cars up to the raise.

The headings on the East side have been extended 500 feet during the year, opening up some fine coal; the largest percentage of the output from the mine coming from this point. These headings pitched heavily for a distance of 250 feet, then became lighter. Chutes are used upon the steep pitches, then small cars are used on the lighter ones above.

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 the chutes when required into the large 2-ton mine-cars which are used on the main haulage level.

Extensive development and proving of pitches has been done by this method, and at the present time diagonal headings are being driven across the pitch to enable the taking of large cars into the working-face. In addition to the two headings used for chutes, two more are used, one for a travelling-road and the other for timber. All the timber for the upper workings are hauled up by a compressed-air winch, a long flat car being used for hauling them up on a 30-inch gauge track. All the tracks on the upper workings where the small cars are used are 30-inch gauge, and 16-lb. rails are used. On the main haulage-roads where the large cars are used a 42-inch gauge and 30-lb. rails are used.

The small horses used on the headings in the upper workings are stabled in the mine; but the large horses used on the main haulage are sent to the surface.

The seam as far as proved shows a variable thickness, from 1 to 20 feet. In places it is very hard, and in other places soft and slickensided. It is a splendid steam-coal and has a high fuel ratio. The roof is friable and is close timbered throughout the mine.

A good deal of permanent work has been done on the ventilating system. The mine is now divided into 4 splits, two on the West and two on the East side.

Two solid concrete overcasts have been built, one in the solid rock. Permanent stoppings are built up to within two crosscuts of the face of the levels; they are built of 12- x 12-inch timbers and 6 feet in thickness.

Explosive gas is seldom found, then in only minute quantities. Free nitrogen is more prevalent and given off freely, especially on the west side of the mine. An outburst of this occurred on July 26th, 1916, a description of which is appended.

Place of Occurrence.—The place where the blow-out occurred was a heading to the raise of the West level, about 1,600 feet distant from No. 1 shaft-bottom. This heading was up about 70 feet from the level, and the pitch about 45 degrees for about 40 feet, then gradually increased to about 75 degrees at the face. The heading was being driven 9 feet wide, and the coal was about 11 feet in thickness.

Nature of Occurrence.—On July 26th, 1916, the miners at the face noticed a slight splintering of the coal from the face; this gradually became worse and they withdrew to the bottom of the chute. Shortly after the blow-out occurred, filling up the place with coal to within about 20 feet from the bottom.

Large volumes of free nitrogen were given off, fouling a ventilating-current of 14,000 cubic feet a minute, and extinguishing the lights of the safety-lamps.

Fortunately the workmen also had an electric safety-lamp, and with this they were able to get quickly to a place of safety in the fresh-air current.

The mine-manager, Mr. Wilkinson, arrived on the scene about ten minutes after this occurred, and by this time the whole district was fouled, his safety-lamp being extinguished at the junction of the returns of the West level and West slope splits, a distance of 2,000 feet from the place of occurrence.

In testing the mixture with a safety-lamp, not the slightest trace of a gas-cap could be found, the flame just simply turning black and dying out quickly; so quick that it was practically impossible to save the light if the lamp was left in the mixture long enough to notice the effect on the flame.

An analysis is given below of the mixture taken from the place four days later, after it had been partially drained off. When this sample was taken it was impossible to get a flame-cap on the safety-lamp before it was extinguished, but it would not flash in the lamp.

"DEPARTMENT OF MINES, CANADA.

"*Report of Analysis, Mine-air Sample.*

"Operator: Western Fuel Company.
"Mine: Reserve mine, Douglas seam.
"Location sampled: In No. 9 crosscut (in still air), West side No. 2 split.
"Sample taken by: John Newton, Inspector. Date of sampling: July 30th, 1916.
"Sample No.: 33. Sample received at Laboratory: August 11th, 1916. Laboratory No.: 359.
"Chemical analysis—

	Per Cent.
Carbon dioxide	0.3
Oxygen	1.8
Methane	4.5
Carbon monoxide	..
Nitrogen	93.4

"Technical analysis—

Air	8.6
Fire-damp	4.5
Black-damp	86.9

"L. STANSFIELD,
Chief Enigneering Chemist."

Quantity of Coal blown out.—The quantity of coal blown out could not be determined as the condition of the place made it practically unsafe to reopen. A start was made to load out the coal, and 156 tons was loaded out. The progress made was about 20 feet, when the roof started to cave from the face, and the place being on about a 75-degree pitch, conditions became unsafe to do any further work. A battery of strong timber was built across the place at the point where it was abandoned. With the exception of about 5 tons of lumps, the coal was very fine and powdery.

The mine-workings are, practically speaking, damp throughout. A little dust is made at the chutes by the method of handling, but is cleared away as fast as it is made, a man being kept on the chutes solely for that purpose. In addition to the dust being immediately cleared away, water-lines are installed in the chutes, and a stream of water kept running on them, keeping them in a wet condition. Water-lines are also extended to the face, and any portion of the mine that shows a dry condition is watered thoroughly twice every day. Two men are kept constantly for this purpose.

Safety-lamps are used throughout the mine, two kinds being used, Ceag electric and Wolf safety-lamps. All shots are fired by electric battery, permitted explosives only being used—Monobel on the coal and Permitite on the rock. An adequate staff of officials are kept to supervise the work.

The ventilation of the mine is produced by a pair of 90-inch Sirocco fans, connected to a 20 x 30 engine, rope-driven. On this engine is a drum-wheel 17 feet in diameter, and on the fan-shaft a drum-wheel 5 feet in diameter, this running with an engine-speed of 16 revolutions a minute, producing 140,000 cubic feet bf air in the fan-drift. The fan and engine are installed on a concrete foundation standing 80 feet from the fan-shaft, connected by two concrete tunnels, with a total area of 110 square feet.

A second or auxiliary fan has been installed. This fan is a Sirocco capable of producing 100,000 cubic feet of air a minute, with a 1-inch water-gauge. The fan is belt-driven and is geared in a ratio of 2 to 1, and is driven by an engine 12 x 14.

A good substantial stable has also been built on the surface during the year. This building is 50 x 30 feet and will stable twelve horses. The tracks around the yard have been much improved. An adequate train service is maintained to carry the miners from Nanaimo to and from their work, there being four trains a day each way. The coaches being used are regular standard passenger-coaches, steam-heated and electric-lighted.

When I made my last inspection I measured 77,300 cubic feet of air a minute passing into the mine, divided into four splits.

West Side, No. 1 Split.—I measured 12,000 cubic feet of air a minute passing into the split for the use of fourteen men, or an average of 857 cubic feet of air for each unit employed.

No. 2 Split.—I measured 17,700 cubic feet of air a minute passing into the split for the use of seventeen men and one horse, or an average of 885 cubic feet of air for each unit employed.

East Side, No. 1 Split.—I measured 33,600 cubic feet of air a minute passing into the split for the use of fifty-six men and four horses, or an average of 494 cubic feet of air for each unit employed.

No. 2 Split.—I measured 14,000 cubic feet of air a minute passing into the split for the use of forty-three men and two horses, or an average of 285 cubic feet of air for each unit employed. No explosive gas found; timbering and roadways good.

On all the different 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 Reserve Colliery for the year ending December 31st, 1916:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	22,537			
" export to United States	40,367			
" " other countries	171			
Total sales		63,075		
Used in making coke				
" under colliery boilers, etc.	21,580			
Total for colliery use		21,580		
		84,655		
Stocks on hand first of year	732			
" last of year	2,882			
Difference added to stock during year		2,150		
Output of colliery for year		86,805		

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	79	3.46 - 7 00			79	
Miners' helpers	3	3.02 - 3.16			3	
Labourers	63	3.02 - 4 02	9	2.75 - 3.25	72	
Mechanics and skilled labour	23	3.02 - 4.48	26	3.00 - 4.65	49	
Boys	7	1.50 - 2.76	7	0.50 - 1.85	14	
Japanese						
Chinese			47	1.50 - 1.84	47	
Indians						
Totals	181		96		277	

Description and length of tramway, plant, etc.—Mine in operation 297 days.

The Vancouver-Nanaimo Coal Mining Co., Ltd.

Head Office—Vancouver, B.C.

Capital, $1,000,000.

Officers.	*Address.*
H. W. Maynard, President,	774 Hastings Street, Vancouver, B.C.
W. H. Gallagher, Director,	448 Pender Street W., Vancouver, B.C.
W. Warner, Director,	602 Hastings Street W., Vancouver, B.C.
H. B. Howell, Director,	1510 Forbes Avenue, North Vancouver, B.C.
H. N. Freeman, Superintendent,	P.O. Box 834, Nanaimo, B.C.

NEW EAST WELLINGTON COLLIERY.

Henry Nevill Freeman, Manager; W. H. Moore, Overman; Geo. Gray, C. Dickinson, Jos. W. Dykes, Stephen Davis, A. Bryden, J. Saunders, 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.

The coal varies from 2 to 8 feet in thickness, worked on the long-wall and pillar-and-stall systems. The coal is of a very hard nature, but free from impurities, all hand-mined. All the levels have reached the boundary-line, and the pillars have been extracted for a distance of 1,000 feet.

The haulage is carried out by the use of horses and small air-winch. Wolf safety-lamps and permitted explosives, fired by batteries, are used throughout the mine.

The mine has a full complement of Wolf safety-lamps in use; also equipped with two 2-hour Draeger oxygen apparatus, one pulmotor, and four Ceag electric lamps. There are at the present time twelve first-aid and a like number of Draeger men in their employ.

In December a small fire was discovered in No. 5 West level, but was extinguished before much damage was done to the property.

During the year permission was granted by the Mines Department to unwater the Old Jingle Pot mine, which lies a quarter of a mile in a north-westerly direction from the present mine, to ensure the safety of the men by leaving sufficient thickness of coal between the two mines.

The ventilation of the mine is produced by a Browing 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.

The surface plant consists of three return-tubular boilers, 212 horse-power; two Glass Canadian Rand compressors; one Canadian Westinghouse 10-kw. volts generator.

When I made my last inspection I measured 57,000 cubic feet of air a minute passing into the mine, divided into three splits.

No. 1 Split.—I measured 10,000 cubic feet of air a minute passing into the split for the use of twenty-nine men and four horses, or an average of 439 cubic feet of air for each unit employed.

No. 2 Split.—I measured 12,500 cubic feet of air a minute passing into the split for the use of seventeen men and two horses, or an average of 543 cubic feet of air for each unit employed.

No. 3 Split.—I measured 9,900 cubic feet of air a minute passing into the split for the use of twenty-two men and three horses, or an average of 321 cubic feet of air for each unit employed.

Explosive gas was found coming off the caves in No. 4 West heading; timbering and roadways good.

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 from the New East Wellington Colliery for the year ending December 31st, 1916:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	68,072			
" export to United States	935			
" " other countries				
Total sales		69,007		
Unmarketable slack and wastage	4,938			
Used under colliery boilers, etc	6,740			
Total for colliery use		11,678		
		80,685		
Stocks on hand first of year	2,699			
" last of year	457			
Difference taken from stock during year		2,242		
Output of colliery for year		78,443		

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	68	4.80			68	4.80
Miners' helpers	2	3.02			2	3.02
Labourers	33	3.24	6	3.02	39	3.21
Mechanics and skilled labour	4	3.63	13	3.50	17	3.53
Boys	3	1.50			3	1.50
Japanese						
Chinese			16	1.75	16	1.75
Indians						
Totals	114		39		153	

Name of seams or pits—Wellington seam.
Description of seams, tunnels, levels, shafts, etc., and number of same—As per Inspector's report.
Description and length of tramway, plant, etc.—As per Inspector's report.

REPORT BY INSPECTOR NEWTON.

Pacific Coast Coal Mines, Limited.

Head Office—Victoria, B.C.

Capital, $2,000,000.

Officers.	*Address.*
James Carruthers, President,	Montreal, Que.
J. H. Paine, Vice-President,	Victoria, B.C.
Talbot Schmuck, Secretary-Treasurer,	Victoria, B.C.
John H. Tonkin, Managing Director,	Metropolitan Bldg., Victoria, B.C.
Robert Bonar, Mine Manager,	South Wellington, B.C.

Value of plant, $501,805.

This company includes in its holdings the Fiddick Colliery at South Wellington; the Morden Colliery on Section 11, Range 8, Cranberry District, two miles east of South Wellington; and the Suquash Colliery on the east coast of Vancouver island, near Malcolm island. Of these, the Fiddick Colliery was the only one to ship coal during the past year, but at the others equipment and development-work were carried out.

The following are the official returns for the Fiddick Colliery, which are also the full returns for the whole company, for the year ending December 31st, 1916:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	66,121			
" export to United States	41,358			
Total sales		107,479		
Lost in washing	23,241			
Used under colliery boilers, etc.	23,287			
Total		46,528		
		154,007		
Stocks on hand first of year	1,923			
" last of year	1,028			
Difference taken from stock during year		895		
Output of colliery for year		153,112		

NUMBER OF HANDS EMPLOYED, DAILY WAGES PAID, ETC.

CHARACTER OF LABOUR.	UNDERGROUND.		ABOVE GROUND.		TOTALS.	
	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.
		$		$		$
Supervision and clerical assistance	12	4.00	5	4.60	17	4.00 - 4.60
Whites—Miners	105	3.30 - 4.60	.....	.....	105	3.30 - 4.60
Miners' helpers	.....	3.00	.....	.....	.....	.....
Labourers	38	3.00	14	2.85	52	2.85 - 3.00
Mechanics and skilled labour	11	.....	33	3.50	44	3.00 - 3.50
Boys	.....	.....	.....	.....	.....	.....
Japanese	.....	.....	.....	.....	.....	.....
Chinese	.....	.....	66	1.50	66	1.50
Indians	.....	.....	.....	.....	.....	.....
Totals	166	.....	118	.....	284	.....

Name of seams or pits—Workings on the upper Douglas seam.

Description of seams, tunnels, levels, shafts, etc., and number of same—At the South Wellington mine coal is reached by means of Slope No. 1. At the Morden mine coal is reached by means of shafts: Shaft No. 3, 655 feet in depth; Shaft No. 4, 630 feet in depth. No. 3 is 10 x 18 feet in the clear; No. 4 is 10 x 10 feet in the clear.

Description and length of tramway, plant, etc.—At South Wellington mine the plant consists of 4 tubular (return) boilers, 100 horse-power each; one Canadian Rand air-compressor, capacity 500 cubic feet a minute; one Canadian Rand cross-compound air-compressor; two Fairbanks-Morse pumps for supplying water to boilers, 7 x 5 x 12 duplex; one thoroughly equipped machine-shop; double-drum hoisting-engine for hauling coal from slopes, 200 horse-power; one Sheldon fan capable of producing 85,000 feet of air, with 1½-inch water-gauge; one mine-rescue station containing two 2-hour apparatus and one ½-hour apparatus. The underground plant consists of two winches 6½ x 8, two 5 x 7, and one 9 x 11. Pumps, 300-gallon electric turbine-pump; one 600-gallon Cameron piston-pump; two Fairbanks-Morse pumps, duplex, one 5¼ x 3½ x 5 and one 7 x 5 x 7; and three small duplex pumps, one 3 x 2 x 5 and two 4 x 3 x 6; 250 mine-cars and approximately ten miles of narrow-gauge track in mine.

At Morden mine the plant consists of three 150 horse-power return-tubular Goldie & McCulloch 72 x 18-inch boilers, 160 lb. working-pressure; one pair 24 x 36 hoisting-engines equipped with safety overwinding devise, steam-reverse and steam-brake; two 10-foot sheaves with collars and boxes and two self-dumping cages; one Gwynnes 5-inch centrifugal pump direct-connected to 250-volt A.C. motor; two 150-kw. electrical generators connected to two Goldie & McCulloch 13 x 20 x 9 high-speed engines; five electrical motors, 400-volt, 1,200 R.P.M.; one Sheldon ventilating mine-fan direct-connected to a 17- x 20-inch Vulcan Iron Works fan-engine; one Marcus screen 65 feet long, one Marcus screen 63 feet long, both with double decks and doors; one "Weir" feed-pump.

The Pacific Coast Coal Mines is operating the South Wellington and Morden mines. The South Wellington mine is situated on the Fiddick property, and the Morden on Section 11, Range 8, Cranberry District, and about two miles east of the Fiddick property, all of which are working on the Douglas seam.

RESCUE-WORK.

I am pleased to say that during the year the company has kept up the first-aid and Draeger work, especially the first aid. A number of the workmen have obtained certificates of competency in the same.

DEVELOPMENT-WORK.

At the present time a new wharf is under construction at Boat harbour, situated about eight miles from the mines. The new additional wharf, when completed, will be 400 feet long, and boats drawing up to 30 feet of water can be loaded at low tide.

The coal will be taken direct from the cars on bunkers and conveyed on rubber belt, which discharges by means of a tripper to an apron-conveyor, which runs at right angles to the belt.

The apron-conveyor is mounted on a travelling tower, which travels the whole length of the wharf, and can be stopped to load at any point along wharf, making it possible to load a boat without the same being moved. The apron-conveyor can be raised or lowered to suit tides and the various heights of vessels. The machinery is being supplied by Link Belt Company, of Chicago.

An electric plant is being installed to drive the necessary machinery. A 75-horse-power motor will run the belt-conveyor. A 20-horse-power motor is required on travelling tower to operate the apron-conveyor and move the tower along the wharf.

A new three-cell Foust jig-washer has been added to the washing plant during the year, which will wash the fine slack coal exclusively.

During the year the company has done a great amount of renewing, repairing, and altering to its tracks and bridges. It has also bought a three-couple 50-ton locomotive in preparation for a large output.

MORDEN MINE.

Robert Bonar, Manager; William Roper, Overman; Thomas Taylor, John Ovington, John Sutherland, Daniel McMillan, Owen Dabb, Peter Carr, John Donnachie, and Robert Wright, Firemen and Shotlighters.

This mine is penetrated by two shafts—No. 3 shaft 9 x 16 and No. 4 shaft 9 x 12 in the clear, sunk a distance of 600 feet. During the year a new eight-stage electrically driven centrifugal pump has been installed, capable of hoisting 450 gallons of water a minute; also an electric hoist of 120 horse-power.

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 direct through the centre of the company's property.

The mine is being rapidly developed and will shortly be in a position to produce a large output. The coal varies in thickness from 4 to 30 feet, and is worked exclusively by the pillar-and-stall system.

The present output from the mine is about 400 tons a day. It is worked exclusively with safety-lamps of the Wolf pattern; permitted explosives, fired by batteries.

The ventilation of the mine is produced by a Sheldon double-entry fan 7 feet in diameter, making 250 revolutions a minute, with a 3-inch water-gauge. A 12 x 16 engine, made by the Vulcan Iron Works, drives the fan, which is built of reinforced-concrete foundation.

When I made my last inspection I measured 40,000 cubic feet of air a minute passing into the mine for the use of fifty men and four horses, or an average of 645 cubic feet of air for each unit employed. A little explosive gas found in the counter-slope; timbering and roadways good.

SOUTH WELLINGTON.

Arthur Edward Smith, Manager; Joseph Neen, Overman; Thomas Robson and William Brown, Firemen.

The South Wellington No. 1 slope has reached the boundary-line, and is now working back, extracting the pillars. In fact, nearly half of the remaining pillars have been extracted. All pumps and winches have been withdrawn from the mine, allowing the drainage to fill up all the abandoned portions.

The mine is worked exclusively with safety-lamps of the Wolf pattern, with permitted explosives, fired by batteries.

No. 2 slope was abandoned during the year, all available coal being exhausted.

The mine is ventilated by a Sheldon fan, producing 80,000 cubic feet of air a minute, with a 1¼-inch water-gauge.

When I made my last inspection I measured 10,000 cubic feet of air a minute passing into the mine for the use of sixteen men, or an average of 625 cubic feet of air for each unit employed. No explosive gas found; timbering and roadways good.

When I made my inspection of the above mines 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.

NANOOSE COLLIERIES COMPANY.

J. Quinn, Manager; J. Saunders, Fireman.

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 two East levels are in a distance of 150 feet, each in good coal of a very hard nature. The seam varies in thickness from 4 to 6 feet, with a band of rock in the centre varying from 14 to 20 inches. The West side of the mine has not proved as good, the coal being very thin.

A loading-wharf is under construction; when completed it will be 250 feet long.

Machinery installed: One small hoist, engine 10 x 16; Ingersoll Rand compressor, 10 x 12; Sheldon fan, 4 feet in diameter; one locomotive boiler, 30 horse-power.

When I made my last inspection I measured 6,000 cubic feet of air a minute for the use of eight men. No explosive gas found; timbering and roadways good.

The following are the official returns from the Nanoose Collieries Company for the year 1916:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	600			
" export to United States				
" " other countries				
Total sales		600		
Used in making coke				
Used under colliery boilers, etc	30			
Total for colliery use		30		
Stocks on hand first of year				
" last of year				
Difference { added to / taken from } stock during year				
Output of colliery for year		630		

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	2	4.00	1	.....	3	4.00
Whites—Miners and helpers	8	3.65	.....	.....	8	3.65
Miners' helpers	.....	.....	.....	.....	.....	.....
Labourers	2	3.30	2	3.25	4	3.25
Mechanics and skilled labour	.....	.....	5	3.25	5	3.25
Boys	.....	.....	.....	.....	.....	.....
Japanese	.....	.....	.....	.....	.....	.....
Chinese	.....	.....	7	1.60	7	1.60
Indians	.....	.....	.....	.....	.....	.....
Totals	12	.....	15	.....	27	.....

Name of seams or pits—Wellington seam.

Description of seams, tunnels, levels, shafts, etc., and number of same—Vertical shaft, with tunnels driven east from shaft-bottom 150 feet, south 80 feet, west 125 feet; one workable seam.

Description and length of tramway, plant, etc.—One fire-box boiler, 50 horse-power; one single-drum hoist, 10 x 16; one compressor, 10 x 12; one 35,000-foot fan with engine.

REPORT BY INSPECTOR DEVLIN.

Canadian Collieries (Dunsmuir) Limited.

Head Office—Victoria, B.C.

Capital, $15,000,000.

Officers.	*Address.*
Sir William Mackenzie, President,	Toronto, Ont.
Hy. S. Fleming, Chairman, Executive Committee,	New York.
R. P. Ormsby, Secretary,	Toronto, Ont.
A. J. Mitchell, Treasurer,	Toronto, Ont.
J. R. Lockard, General Manager,	Cumberland, B.C.

The Canadian Collieries (Dunsmuir), Limited, during the year 1911 acquired all the holdings of the Wellington Collieries Company, Limited, and during the past four years has been operating the following mines:—

The Extension Colliery, in the Cranberry District (Extension); T. A. Spruston, manager.

The Comox Colliery, in Comox District; R. Henderson, Hugh Sloan, Frank Jaynes, 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 1916.

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	346,740		26,043	
" export to United States	125,371			
" " other countries				
Total sales		472,111		26,043
Lost in washing	167,046			
Used in making coke	49,496			
Used under colliery boilers, etc	28,492			
Total for colliery use		245,034		
		717,145		
Stocks on hand first of year	16,851		26	
" last of year	5,672		1,587	
Difference {† added to / * taken from} stock during year		† 11,179		*1,561
Output of collieries for year		705,966		27,604

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	63		23		86	
Whites—Miners	367				367	
Miners' helpers	9				9	
Labourers	260		40		300	
Mechanics and skilled labour	62		71		133	
Japanese—Miners	54				54	
Labourers	97				97	
Chinese — Miners	145				94	
Labourers	111		164		309	
Totals	1,151		298		1,449	

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, 1916, together with a list of all accidents and colliery returns.

Canadian Collieries (Dunsmuir) Ltd.*

COMOX COLLIERIES.

These mines were formerly operated by the Wellington Colliery Company, but were taken over by the Canadian Collieries (Dunsmuir), Limited, in 1910. The mines are situated in the Comox district, about seventy miles from Nanaimo. A railway about twenty miles in length connects the various mines to a shipping-point at Union Bay, over which the whole output is conveyed.

This company is operating in Cumberland mines known as Nos. 4 and 7 slopes and Nos. 5, 6, and 8 shafts. The new railway has been extended to connect with the various mines in this district, thus doing away with the heavy grade on the old line. These mines, with the exception of Nos. 5 and 8 shafts, have been operated continuously during the year, but with a good deal of broken time during the early months of the year.

The company has a rescue-station at No. 6 mine, 40 x 24 feet, with smoke, dressing, and work rooms, while a room for teaching "first aid" is attached. The equipment of the station consists of four 2-hour sets, 1910 model, helmet-type Draeger apparatus; one recharging oxygen-pump; four oxygen-tanks; four electric safety-lamps (Draeger type). The training at this station has been very slack during the year.

The hydro-electric plant has been in continuous operation throughout the year. Part of the canal supplying water to the power-house was lined with brick to prevent erosion of the sides and bottom, and a new trash-screen was installed. Electric power is now in use for the complete operation of the Comox mines, and has superseded the use of steam entirely, excepting locomotives on the railway.

At Union Bay the coke-ovens have been in continuous operation during the year. New elevators and conveyors have been installed at the coal-washer to facilitate the handling of coal.

A Williams coal-crusher has been installed with a direct-connected motor. A new coal-washing jig has been installed, giving an improved quality of washed coal.

Extensions have been made to the machine-shop buildings, and a larger air-compressor is being installed.

No. 4 MINE.

Robert Henderson, Manager; Charles Parnham, Overman; John Comb, Thomas Mordy, Sidney Horwood, John Furbow, John Bennie, James Reid, Daniel Parks Marsh, John Liddle, William Beveridge, Thomas Eccleston, and Thomas William Honey Pearse, Firebosses.

This mine is situated about two miles from Cumberland and about twenty-one miles from the shipping-point at Union Bay.

The ventilation is produced by a Sullivan reversible fan driven by a 350-horse-power direct-coupled motor running at 245 R.P.M., and capable of delivering 196,000 cubic feet of air a minute, with a 5¾-inch water-gauge.

The plant at this mine has been in continuous operation throughout the year. A new three-stage turbine-pump has been installed underground. The installation of a 50-horse-power electrical hoist at the bottom of No. 1 slope has been completed and in operation during the year.

The underground pumping system put into operation during 1914 has been running without interruption ever since, and at the present writing the mine is free from water, the pumping system handling the water in about eighteen hours a day.

All the motors and electrical equipment used underground at this mine are flame-proof, and all electric lamps are fitted into gas-proof globes. Safety-lamps of the Wolf type are used exclusively in the mine, and all blasting is done with permitted explosives, fired by electric battery.

In this mine there are two 100-horse-power electric hoists, hauling from the bottom of No. 1 and No. 2 slopes to a distance of 7,000 feet from the surface, and a 50-horse-power hoist used for sinking the No. 1 slope. The coal-seam is reached by two slopes, Nos. 1 and 2, a direct haulage system being in use.

* *See also* page 468.

No. 1 Slope.

This slope is down a distance of 7,000 feet, running due north. A Diagonal slope, 4,000 feet from the entrance of the mine, running N. 45° E., is down a distance of 3,400 feet, where levels are turned off east and west—Nos. 15, 16, 17, 18, 19, and 20 on the West side, and Nos. 17, 18, and 19 on the East side.

No. 15 West level and Nos. 17 and 18 East levels are extracting pillars. The other levels are worked on the pillar-and-stall method and are advancing. All the levels are in good coal ranging from 4 to 5½ feet in height, with bands of rock running in the centre from 12 to 15 inches thick and having a fairly good fireclay roof.

No. 1 slope has been driven ahead about 800 feet in faulty ground, with the intention of making a connection with No. 8 shaft, and when this is completed it is proposed to haul all coal from No. 4 mine to No. 8 shaft and use the slopes as return airways.

During my inspection in December I measured 30,275 cubic feet of air a minute passing into No. 1 slope, divided into two splits.

In No. 1 split there was 4,140 cubic feet of air a minute passing for the use of nine men and two mules, or an average of 276 cubic feet of air a minute for each unit employed.

In No. 2 split there was 26,135 cubic feet of air a minute passing for the use of forty-two men and nine mules, or an average of 378 cubic feet of air a minute for each unit employed.

I found a small quantity of explosive gas in face of No. 19 West level and in No. 20 West counter-level; all other places in No. 1 slope free from gas. I found timbering and roadways in fairly good condition.

No. 2 Slope.

This slope branches off No. 1 slope a short distance from the mouth of the tunnel, running N. 45° E., and is down a distance of approximately 9,000 feet, having been driven about 700 feet during the year and forming the deepest workings of the mine.

Levels are turned off this slope east and west—namely, 15, 16, 17, 18, and 19 on the East side, and Nos. 15, 16, 17, 18, 19, and 20 on the West side. No. 15 East level and Nos. 15, 16, and 17 West levels are extracting pillars; Nos. 16 and 17 East levels are being worked on the long-wall system; all other levels are worked on the pillar-and-stall system.

The levels that are advancing are all in good coal ranging from 4 to 6 feet in height, with a band of rock in the centre from 12 to 15 inches thick. The roof is of a friable fireclay and requires careful timbering.

When I made my inspection in December I measured 54,400 cubic feet of air a minute passing into No. 2 slope, divided into two splits.

In the East side split there was 16,000 cubic feet of air a minute passing for the use of thirty-four men and seven mules, or an average of 290 cubic feet of air a minute for each unit employed.

In the West side split there was 24,000 cubic feet of air a minute passing for the use of forty-five men and eight mules, or an average of 333 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. 8 stall, off No. 19 East level, and in face of No. 19 East level; and in No. 3 stall, off No. 19 West level, and in a crosscut off Main slope; also found a ½-inch cap of gas in No. 15 East pillars.

I found timbering and roadways in fair condition. There was 54,400 cubic feet of air a minute passing into No. 2 slope in the main intake; the amount passing into the two splits was 40,000 cubic feet a minute, making a loss in leakage of 14,000 cubic feet a minute through doors, stoppings, etc.

No. 5 MINE.

Hugh Sloan, Manager; John Brown, Fireboss.

This mine has not been in operation during the year. A new five-stage turbine-pump is being installed at the shaft-bottom with a capacity of 360 R.P.M. at 350-foot head, direct-connected to a 75-horse-power motor. This pump is a duplicate of the one already installed, and is supplementary to same.

The Sirocco fan for ventilating this and No. 6 mine has been in continuous service during the year and has proved satisfactory.

This mine has been inspected every month during the year. When I made my last inspection in December I measured 102,000 cubic feet of air a minute passing around the workings. I found no explosive gas in this mine; the timbering and roadways were in fair condition.

No. 6 MINE.

Hugh Sloan, Manager; John Gillespie, Overman; Henry Leighton, John Ernest Spicer, Thomas Richards, Duncan Thomson, James Brown, Thomas Leeman, Frank Bobba, and John George Biggs, Firebosses.

The seam averages 4 feet in thickness, with rock-bands running through it. This mine has been in continuous operation during the year. The workings of this mine consist of long-wall and pillar workings, which are both to the rise and dip.

Sufficient height is obtained for the mules on haulage-roads by brushing up 3 feet of bottom. During the year two single-stage centrifugal pumps have been installed. A 100-horse-power electric hoist has been installed on the West side haulage-road, which feeds the coal to the shaft-bottom, and this hoist is fed by a 50-horse-power electric hoist which runs the coal down from the long-wall sections.

A 50-horse-power hoist has been installed on the East side haulage-road, which lowers the coal to the shaft-bottom from the machine-wall sections on the East side, and also pulls the coal from No. 1 dip.

Three alternating-current Sullivan coal-cutters of the C.E. 7 type are in operation in this mine, which prove a success in regard to operation and production.

The rock tunnel on the north side of the shaft, which has been crossing an upthrow fault, has struck 4 feet of good coal, and a large field of coal will be developed to the dip. Another slope has been started on the West side, where a 50-horse-power hoist has been installed. This mine is ventilated by the Sirocco fan installed at the surface outlet at No. 5 mine.

When I made my last inspection in December I measured 45,675 cubic feet of air a minute passing into the mine, divided into three splits.

In No. 1 split there was 14,250 cubic feet of air a minute passing for the use of forty men and two mules, or an average of 309 cubic feet of air a minute for each unit employed.

In No. 2 split there was 16,425 cubic feet of air a minute passing for the use of sixty men and seven mules, or an average of 202 cubic feet of air a minute for each unit employed.

In No. 3 split there was 15,000 cubic feet of air a minute passing for the use of forty men and five mules, or an average of 272 cubic feet of air a minute for each unit employed.

I found a small quantity of explosive gas in the face of the East level off the rock tunnel, No. 1 dip; the timbering and roadways were in fair condition.

No. 7 MINE.

Frank Jaynes, Manager; John Dando, Overman; James Monks, William James Keenan, Norman Wilson Huby, Frederick Horwood, Robert Walker, James Taylor, and George Rankin, Firebosses.

This mine is situated at the town of Bevan, about five miles from Cumberland and fifteen miles from Union Bay, the shipping-point.

This mine is entered by means of two slopes running N. 35° E. and is down a distance of 7,000 feet. The method of mining is the long-wall system, with the exception of No. 3 West level, which is worked pillar and stall owing to the thin surface covering. The seam varies from 2½ to 3½ feet thick and is of a very hard nature, being well adapted to this method of mining. The slopes have not advanced any during the year.

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 to 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 in thickness.

This mine has been in continuous operation during the year. A new belt was installed on the 500-horse-power Rand compressor. No other additions or improvements were required at this mine.

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 last inspection in December I measured 108,000 cubic feet of air a minute passing into the mine, divided into four splits.

In No. 1 West split there was 15,000 cubic feet of air a minute passing for the use of thirty men and four mules, or an average of 357 cubic feet of air a minute for each unit employed.

In No. 2 West split there was 13,200 cubic feet of air a minute passing for the use of thirty-five men and four mules, or an average of 280 cubic feet of air a minute for each unit employed.

In No. 1 East split there was 23,400 cubic feet of air a minute passing for the use of thirty-eight men and three mules, or an average of 497 cubic feet of air a minute for each unit employed.

In No. 2 East split there was 14,000 cubic feet of air a minute passing for the use of forty men and three mules, or an average of 285 cubic feet of air a minute for each unit employed.

I found a small quantity of explosive gas in No. 4 gateway, off No. 5 slant, No. 9 West level; No. 4 gateway, off No. 6 slant; and No. 1 gateway, off No. 7 slant, No. 9 East level; the timbering and roadways were in fairly good condition.

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 108,000 cubic feet a minute, and the quantity passing into the several splits was 65,600 cubic feet a minute, making a loss in leakage of 42,000 cubic feet a minute through doors, stoppings, and old workings.

No. 8 MINE.

This mine has not been operated during the year; the plant is operated at intervals to keep same in good operating condition. Electrical heaters have been installed in the sub-station and winding-engine rooms during the year.

The following are the official returns from the Comox Collieries for the year ending December 31st, 1916:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	215,127			26,043
" export to United States	64,220			
" " other countries				
Total sales		279,347		
Lost in washing	113,246			
Used in making coke	49,496			
Used under colliery boilers, etc., and employees' use	9,916			
Total for colliery use		172,658		
		452,005		
Stocks on hand first of year	7,339		26	
" last of year	4,348		1,587	
Difference { * added to / † taken from } stock during year		†2,991		*1,561
Output of collieries for year		449,014		27,604

NUMBER OF HANDS EMPLOYED, DAILY WAGES PAID, ETC.

CHARACTER OF LABOUR.	UNDERGROUND.		ABOVE GROUND.		TOTALS.	
	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.
		$		$		
Supervision and clerical assistance	31	3.63 - 9.00	8	3.02 - 7.00	39	
Whites—Miners	122	3 30 - 6.00			122	
Miners' helpers						
Labourers	129	2.50 - 3.63	33	2.50 - 3.50	162	
Mechanics and skilled labour	40	3.30 - 4.00	44	3.30 - 4.00	84	
Boys						
Japanese—Miners	54	3.30 - 4.00			54	
Labourers	97	1.75 - 2.50			97	
Chinese—Miners	94	3 30 - 4.00			97	
Labourers and helpers	140	1.75	102		242	
Indians						
Totals	707		187		894	

Name of seams or pits—Comox mines.

Description of seams, tunnels, levels, shafts, etc., and number of same—Nos. 4, 5, and 6 shafts (No. 4 shaft not operating); 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 man.

This colliery has been working full time throughout the year, with the exception of loss of a few days in April and May.

At Extension a new generating set has been installed at the power-house, consisting of a 150-kw. Westinghouse generator direct-connected to a compound Fleming-Harrisburg engine. A recording temperature and pressure-gauge has also been installed for recording the steam-pressure and temperature of the boiler-feed. A new boiler-feed pump has also been installed. A new 50-horse-power hoist has been installed in No. 3 mine to replace one of an older type.

At the washery at Ladysmith a new unit has been added, and the two old units have been fitted with automatic rock-discharge, and also with automatic positive-pressure feed from the bunkers. A recovery plant for washery-sludge has also been installed.

No 1 or Tunnel Mine, Extension.

William Wilson, Overman; Evan John, James Martin, Mathew Meek, John Greenhorn, David Morris, William Wesnedge, Robert Ewing, David John Gordon, Arthur William Watson, and John Michek, Firebosses.

When I made my inspection in December I measured 33,750 cubic feet of air a minute passing into this mine, divided into two splits.

In the East side split there was 11,960 cubic feet of air a minute passing for the use of thirty-two men and five mules, or an average of 254 cubic feet of air a minute for each unit employed.

In the West side split there was 10,250 cubic feet of air a minute passing for the use of thirty-two men and four mules, or an average of 232 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.

There was 33,750 cubic feet of air a minute passing into mine; the amount passing into the two splits was 22,210 cubic feet, making a loss in leakage of 11,540 cubic feet of air a minute through doors, stoppings, etc.

No 2 MINE, EXTENSION.

Hugh McLean Davidson, Overman; William Clifford, William Cosier, James Strang, Joseph Watson, James Brown, John Joshua Jones, Albert Bradford, and James Pollock Nimmo, Sr., Firebosses.

In No. 2 mine the operations have been very light during the year, and were confined to ground adjacent to the Main slope—namely, Nos. 1, 2, and 2½ levels on the West side, and Nos. 2 and 4 on the East side. Only pillar-extraction is in operation on the West side and in No. 2 level on the East side.

No. 4 East level has been opened out again, and will add materially to the future production of this mine.

When I inspected this mine in December I measured 25,000 cubic feet of air a minute passing into the mine, divided into three splits.

In the West side split there was 9,000 cubic feet of air a minute passing for the use of thirty-four men and six mules, or an average of 173 cubic feet of air a minute for each unit employed.

In No. 2 East split there was 5,600 cubic feet of air a minute passing for the use of twenty-one men and four mules, or an average of 166 cubic feet of air a minute for each unit employed.

In No. 4 East split there was 10,400 cubic feet of air a minute passing for the use of seventeen men and three mules, or an average of 400 cubic feet of air a minute for each unit employed.

I found no explosive gas in this mine; the timbering and roadways were in good condition. Safety-lamps of the Wolf type are used in this mine, and all blasting done with permitted explosives, fired by electric battery.

No. 3 MINE, EXTENSION.

James Strang, Overman; Henry Mitchell, George Smith, James Nelson, Patrick Malone, Daniel Fagan, Daniel Campbell, David Davidson, and James Pollock Nimmo, Jr., Firebosses.

All operations in No. 3 mine are in the Slope district, which consists of pillar-and-stall work and the extraction of pillars. The raise shaft, which was driven from the inside of Bowater's level, was completed in May, 1916, and is being used as a downcast for No. 3 mine, and is a big improvement on the old system of ventilation, as the fresh air is practically delivered at the working-places. The air is split at the shaft-bottom, one split ventilating the workings to the rise and the other split ventilating the workings to the dip.

A new 50-horse-power electric hoist has been installed in No. 3 mine to replace one of an older type.

When I made my last inspection in December I measured 21,720 cubic feet of air a minute passing into the mine, divided into two splits.

In No. 1 split there was 10,920 cubic feet of air a minute passing for the use of forty-five men and five mules, or an average of 182 cubic feet of air a minute for each unit employed.

In No. 2 split there was 10,800 cubic feet of air a minute passing for the use of forty men and four mules, or an average of 192 cubic feet of air a minute for each unit employed.

I found a small quantity of explosive gas in the face of McKendrick's stall, in heading off Bowater's level; all other places in No. 3 mine free from gas; the timbering and roadways were in good condition.

Safety-lamps of the Wolf type are used in this mine, and all blasting done with permitted explosives, fired by electric battery.

No. 4 MINE, EXTENSION.

William James, Manager; Thomas Strang, Overman; John Barclay, John McMurtrie, James Glen, John Wright, and Henry Winstanley, Firebosses.

This mine is situated about one mile south of Extension tunnel, and is worked on the long-wall system, hand-mining being employed.

A generating set has been installed in the power-house, consisting of a 100-kw. Crocker-Wheeler generator direct-connected to an Ideal engine. Two turbine-pumps have been installed at the shaft-bottom and a 50 horse-power electric hoist underground.

A 100-horse-power steam-driven hoist has been installed at the air-shaft, complete with cage and hoisting-gear, for emergency service. This mine has been completely equipped with a system of electric lighting.

The slope sections of this mine have been unwatered after having been flooded since August, 1912, and development-work started again.

On December 5th, 1916, there was some trouble with an inrush of water at No. 4 mine from a break in the roof at the face of No. 21 stall, off No. 3 East level. I made several visits to the mine during the month of December, and found the volume of water getting less at each visit, and on the last visit on December 29th there was only about 50 gallons a minute coming from the break.

There has been a dam constructed from Nos. 20 to 23 stalls where the water broke in, the inner wall of the dam being built of 7- x 7-inch square timber, and the outer wall with 6- x 6-inch square timber, with 1 foot of concrete in between the walls of the dam, and a line of 4- x 6-feet square timber cogs on the outer side of the dam.

There are a 3- and a 6-inch iron pipe through the dam to drain off the water, which are open, and are to remain open until further orders. All operations ceased in this mine until the dam was completed.

When I made my last inspection in December I measured 37,300 cubic feet of air a minute passing into the mine, divided into two splits.

In the East side split there was 18,800 cubic feet of air a minute passing for the use of twenty-five men and three mules, or an average of 552 cubic feet of air a minute for each unit employed.

In the West side there was 18,400 cubic feet of air a minute passing for the use of thirty men and three mules, or an average of 471 cubic feet of air a minute for each unit employed.

I found no explosive gas in this mine; found all places well timbered and the roadways in fair condition.

The company has a rescue-station at Extension of frame construction, 25 x 53 feet, which contains a smoke-room, observation-room, work-room, and dressing-room. The equipment of the station consists of four 2-hour sets, 1910 model, helmet-type Draeger apparatus, one oxygen-pump, four oxygen-tanks, and four electric safety-lamps (Draeger type).

There has been some training done at this station in mine-rescue work during the year, twelve men having obtained Government certificates of competency in mine-rescue work.

The following are the official returns from the Extension Collieries for the year ending December 31st, 1916:—

Sales and Output for Year.	Coal.		Coke.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	131,613			
" export to United States	61,151			
" " other countries				
Total sales		192,764		
Lost in washing	53,800			
Used in making coke				
" under colliery boilers, etc., and employees' use	18,576			
Total for colliery use		72,376		
		265,140		
Stocks on hand first of year	9,512			
" last of year	1,324			
Difference taken from stock during year		8,188		
Output of collieries for year		256,952		

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		15		47	
Whites—Miners	245				245	
Miners' helpers	9				9	
Labourers	131		7		138	
Mechanics and skilled labour	22		27		49	
Boys						
Japanese						
Chinese—Labourers	5		62		67	
Indians						
Totals	444		111		555	

Name of seams or pits—Wellington: Mines Nos. 1, 2, 3, and 4.
Description of seams, tunnels, levels, shafts, etc., and number of same—One tunnel connecting Nos. 1, 2, and 3. No. 4 shaft situated one mile south of Main tunnel.

NICOLA-PRINCETON INSPECTION DISTRICT.

REPORT OF ROBERT STRACHAN, INSPECTOR.

I have the honour to submit my annual report as Inspector of Coal-mines for the Nicola-Princeton Inspection District for the year 1916:—

The companies operating in this district during the year were the Middlesboro Collieries, Limited; the Inland Coal and Coke Company, Limited; the Pacific Coast Coal Syndicate; the Merritt Collieries, Limited (formerly the Diamond Vale Colliery Company); and the Princeton Coal and Land Company, Limited.

No active operations were undertaken at the Coalmont Colliery, the United Empire, or the Boundary Mining and Exploration Company's property, Midway, at any time during the year.

Attached is a list of the accidents reported during the year, also a list of the prosecutions for contraventions of the "Coal-mines Regulation Act."

The accident list amounts to thirteen, and it is very gratifying to be able for the third year in succession to report that none of these proved fatal.

Of the accidents reported, six occurred in the mines of the Inland Coal and Coke Company, Limited, five in the Middlesboro Colliery, and two in the Princeton Coal and Land Company's mine at Princeton. Of these, twelve occurred inside the mine and one outside; five were serious enough to keep the workmen off work for some time; the other eight were slight. Seven were due to haulage; one to fall of rock; one to fall of coal; two cut themselves while carelessly handling axes; one slipped and fell while coming out of a chute; and the other bruised his hand against a post while throwing a piece of rock into the gob.

While it is very satisfactory to be able to congratulate the workmen and officials at the collieries on their freedom from fatal accidents, I think that a little more care and forethought would tend to reduce even this number of non-fatal accidents.

For infractions of the "Coal-mines Regulation Act" five workmen were prosecuted, with results as shown in the attached list. While searches were made regularly during the year for articles contrary to section 91, Rule 9, of the Act, only these five were detected, and it is noticeable that these occurred in the later part when a considerable amount of outside labour came into the district, due to the increased demand for coal.

During the year "inspections on behalf of the workmen," as provided for by section 91, Rule 37, has been made at all the larger mines. At these inspections conditions have generally been found very favourable, and no complaints have been made as to the existence or apprehended existence of danger.

No trouble has been experienced during the year with gob-fires; the area sealed off due to this cause at the No. 3 mine of the Inland Coal and Coke Company, Limited, still remains unopened. In the Princeton mine all workings not in course of development or for ventilation and travelling-roads were sealed off, and this seems to be an effective preventive of gob-fires.

MINE-RESCUE WORK.

In this work during the year eleven workmen qualified for certificates and passed a satisfactory examination, making a total of fifty certificates which have been granted in this district. Of these, twenty-two have left or enlisted for overseas service, leaving twenty-eight still available. Of these, fifteen are at the Middlesboro Colliery, nine at the Inland Coal and Coke Company's mine, three at the Diamond Vale mine, and one at Princeton. In addition to those who have passed during the year, the majority of the holders of certificates have maintained their efficiency. A class of eight has been started at Princeton, and I expect will be able to pass a satisfactory examination at an early date.

In first aid to the injured, a class of eight under the instructions of Dr. Tuthill qualified early in the year at Merritt, and another class of twelve are taking instructions under Dr. McCaffray at Princeton.

The equipment of self-contained breathing apparatus, which is all of the Draeger type, is practically the same as reported last year.

Middlesboro Colliery.—Two of the No. 2 type, 1912; one pulmotor; one recharging-pump; 550 cubic feet of oxygen; 111 2-hour potash cartridges; five 1-hour and forty-three ½-hour potash cartridges; electric lamps; and testing apparatus for the machines.

Inland Coal and Coke Co., Ltd.—Two of the No. 2 type, 1912; two of the ½-hour type; one pulmotor; thirty 2-hour, thirty 1-hour, and four ½-hour potash cartridges; 180 cubic feet of oxygen; electric lamps; and testing apparatus for the Draegers.

Princeton Coal and Land Co., Ltd.—One of the 2-hour type, one of the ½-hour; one pulmotor; one recharging-pump; 100 cubic feet of oxygen; six 2-hour and eight ½-hour potash cartridges; electric hand-lamps; and testing apparatus for the Draegers.

Merritt Collieries.—Two of the ½-hour type, with two spare oxygen cylinders for same; six potash cartridges of the ½-hour type. I expect this equipment will be increased at an early date by two of the 2-hour type apparatus and a further supply of oxygen.

The apparatus belonging to the Department is still stationed at the mine-rescue training-station of the Middlesboro Colliery.

Due to the machine at Princeton having to be sent away for repairs, I have had one sent there until such time as theirs is returned, and the pump is stationed at Coal Hill. The Department apparatus at Middlesboro has been maintained in very good condition, and during the year has been improved by being changed from the negative to the positive type, with by-pass valves, and a new pulmotor, "B" type, has been added to the equipment. The rescue-station at the Middlesboro mine is the only properly equipped and maintained station in this district, and has been used for the training of all the workmen who have qualified in this work, and a great deal of credit is due the Middlesboro officials for keen interest taken in maintaining the station for the general use of the district, also their attention to the apparatus belonging to the Department of Mines.

During the year every mine has been inspected as required by the "Coal-mines Regulation Act," and every accident has been investigated as soon as notice was received of the same and a report made thereon.

Samples of mine-air have been taken from all the main airways twice during the year, and once from the splits, and forwarded to the Department of Mines, Ottawa, for analysis; a table showing these is attached.

The production of coal has made a slight increase during the year, and this has been especially noticeable during the last few months, with a better and steadier demand for the same.

I have attended the examination for coal-miners' certificates held in Merritt regularly during the year, during which twenty-two certificates were granted; no examinations were held in Princeton owing to lack of candidates. I also acted as examiner at the request of the Board of Examiners at the examination held for first-, second-, and third-class certificates under the Act held in Merritt during the month of May.

In office-work 338 letters were received, 497 communications sent out, and the distance travelled on duty was 4,234 miles.

I again wish to thank the workmen and officials of the various collieries for their cordial co-operation and assistance in carrying out my duties during the year, and trust for a continuance of the same during 1917. It is only by a prompt and ready compliance on the part of the workmen and a strict enforcement on the part of the officials of the rules and regulations that we can hope to maintain our freedom from fatal and to reduce the number of non-fatal accidents.

The following is a brief description of the collieries operated during the year 1916, accompanied by the official returns as required by section 58 of the "Coal-mines Regulation Act."

Middlesboro Collieries, Ltd.

Head Office—Vancouver, B.C.

Capital, $1,107,700.

Officers.	*Address.*
E. W. Hamber, President,	Vancouver, B.C.
G. S. Raphael, Vice-President,	Barnet, B.C.
Thomas Sanderson, Managing Director and Secretary,	Vancouver, B.C.
Robert Fairfoull, Mine Manager,	Middlesboro, B.C.

Value of plant, $250,000.

MIDDLESBORO COLLIERY.

Robert Fairfoull, Manager.

The Middlesboro Colliery, 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.

During the year no active operations were undertaken at the No. 2 mine, all the coal produced being taken from the Nos. 4, 4 East, and 7 mines. All the mines worked are situated in the Lower or Coal Gully series.

No. 4 MINE.

Tom Brace, Overman; Wm. Hallinan, Alex. Ewart, and Mat McKibben, Firebosses.

The No. 4 mine, which includes Nos. 4 and 6 seams, is reached by a crosscut tunnel, cutting Nos. 4, 5, and 6 seams. Owing to the falling-off in the demand for coal, mining has been confined to the No. 4 seam.

This seam is about 19 feet thick, the bottom portion of which only is worked; it pitches to the south at an angle of 25 degrees. The method of work is pillar and stall, pillars 30 x 60 feet, stalls 10 feet wide. During the past year most of the coal has been obtained by the extraction of pillars.

The coal is mined by hand and very little shooting is required; the haulage is by compressed-air hoists, and then from top of slope by horse to the tipple.

The ventilation is provided by a Sheldon fan 8½ feet in diameter, driven by a steam-engine of the same make. The fan is built so that it can be used either as an exhaust or positive type, and is capable of producing 90,000 cubic feet of air, with a 4-inch water-gauge.

I have regularly examined this mine during the year, and generally found the conditions very good; there was always a good current of air circulating around the faces, and the doors, brattices, and stoppings were in good condition.

During none of these inspections was I able to detect explosive gas with the use of the ordinary safety-lamp, and the roadways were kept fairly damp and free from dust.

The rules covering the "Systematic Method of Timbering" were very well complied with by the workmen, and a plentiful supply of timber seemed to be provided for their use.

At my last inspection of this mine I found 58,500 cubic feet of air provided for the use of twenty-one men and four horses, while the speed of the fan was 132 revolutions a minute, and the water-gauge showed 0.7 inch. Barometer, 28 inches; thermometer, 38 degrees.

No. 4 East Mine.

Tom Brace, Overman; James Fairfoull, Fireboss.

This mine, which is situated a short distance to the east of the entrance to No. 4, is also operated on the No. 4 seam of coal.

The main slope is now down a distance of 1,300 feet, dipping at about 15 degrees to the east; the method of work is pillar and stall, pillars being left 30 x 60 feet, stall driven 10 feet wide.

The haulage is by compressed-air-driven hoist situated outside the mine, the cars being brought to the landings by horse.

Ventilation is produced by a small quick-running fan, driven by a Sheldon type engine, and is capable of producing 40,000 cubic feet of air when required.

At the time of my last inspection it was producing 23,760 cubic feet a minute for the use of thirteen men and one horse, the fan running at a speed of 118 revolutions a minute. Water-gauge, 0.25 inch; barometer, 28 inches; thermometer, 38 degrees.

During the year I have regularly examined this mine, and only once, in the month of July, did I detect explosive gas; this was due to a cave which had deranged the brattice. I have always found, with the above exception, a good current of air circulating around the faces, and the doors, brattices, and stoppings in good condition.

The roadways are very damp and free from dust, well timbered, and the "Systematic Order" *re* timbering seems to be very well carried out.

I have generally found the mining conditions very good, and a good supply of mine timber convenient for the workmen.

No. 7 Mine.

Jno. McDonald, Overman; James Blair, R. S. Brown, Lewis Clarke, Thos. Rowbotton, and Geo. Walker, Firebosses.

This mine is situated in the Coal Gully, and about 300 feet higher up than either Nos. 4 or 4 East. The Main slope is now down a distance of 2,000 feet, dipping at any angle of 25 degrees to the south, and is driven in the coal-seam. The seam is 15 feet thick, of which the top 8 feet only is being extracted in the opening-up.

The method of work is the same as in the other mines—namely, pillar and stall, the pillars being left 50 x 50 feet, and stalls driven 10 feet wide. So far the work has consisted of simply blocking out pillars.

The ventilation is produced by a small fan of the Guibal type, 52 inches in diameter, driven by a 8- x 10-inch Goldie-McCulloch engine.

At my last inspection I found 52,500 cubic feet of air being produced a minute for the use of thirty-one men and one horse, the fan running at 220 revolutions a minute. Water-gauge, 0.3 inch; barometer, 27.5 inches; thermometer, 31 degrees.

During my inspections I have generally found this mine in very good condition, and only on one occasion did I find a slight cap of explosive gas. All the stoppings, doors, and brattices were in good condition, and the air-current kept well up to the working-face.

The "Systematic Order" *re* timbering is very well complied with by the workmen, and a plentiful supply of timber is kept handy. All the roads and airways are secure, and roads are fairly well damp and free from dust.

The haulage is by horse from the face to the slope, then by hoist to the outside, from where the cars are lowered to the tipple by a gravity-tram.

With the exception of the rope-rider on the No. 7 mine slope, safety-lamps only are used in all the mines of the Middlesboro Colliery. These safety-lamps are all of the Wolf type, with internal igniters; they are cleaned and tested in a gaseous mixture in the lamp-room near the tipple before being given out to the workmen, and are again examined by the fireboss before entering the mine.

The coal is all mined by hand, and only those explosives appearing on the permitted list are used for blasting. Electric detonators are used exclusively in firing shots, and only competent persons appointed for the purpose are allowed to use the igniter or battery.

All the coal from the various mines are brought to a common tipple in cars having a capacity of 1.5 tons. They are then dumped by a Phillips crossover dump, a switchback and car-haul bringing the empties back so that they can be arranged into trips for whatever place required.

The coal passes to a shaking screen, which allows all under 2½ inches to pass into a hopper, from where it is either fed to a Stewart washer or in the cold weather sorted dry and arranged into three grades, each being picked and then taken to a separate bin by conveyors. The lump passes over a picking-table 42 feet long, during which the rock or waste is picked out before being loaded into the railway-cars.

To facilitate the loading of box cars a Christy box-car loader is used. At the tipple the main power plant is situated, consisting of four return-tubular boilers, each 150 horse-power; a Canadian Rand cross-compound air-compressor with a capacity of 2,000 cubic feet of free air a minute; a 27½-kw. generator for lighting purposes; and the necessary feed-pumps for the boiler, fire-protection, and household purposes.

There is also a well-equipped machine-shop, carpenter and car-repair shops, where all the mine-cars are built, mine-rescue training-station, and during the year new offices for the management have been built owing to the old ones having been burned down.

Copies of the "Coal-mines Regulation Act," special rules, plans of the mines showing roads, etc., and rules covering the "Systematic Timbering orders are all posted at each of the mines.

The following are the official returns of the Middlesboro Colliery for the year ending 1916:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	44,850			
" export to United States				
" " other countries				
Total sales		44,850		
Used in making coke				
Used under colliery boilers, etc.	4,134			
Total for colliery use		4,134		
Stocks on hand first of year	271			
" last of year	292			
Difference added to stock during year		21		
Output of colliery for year		49,005		

NUMBER OF HANDS EMPLOYED, DAILY WAGES PAID, ETC.

CHARACTER OF LABOUR.	UNDERGROUND.		ABOVE GROUND.		TOTALS.	
	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.
		$		$		
Supervision and clerical assistance	8	4.00	4	3.50 - 5.00	12	
Whites—Miners	35	3.50 - 6.00			35	
Miners' helpers	15	3.00			15	
Labourers	35	3.00 - 4.00	12	2.75 - 3.50	47	
Mechanics & skilled labour			13	3.00 - 4.25	13	
Boys			10	1.50 - 2.50	10	
Japanese						
Chinese						
Indians						
Totals	93		39		132	

Name of seams or pits—Nos. 2 and 3 seams, one mine; Nos. 4 and 6 seams, one mine; No. 4 East operating in No. 4 seam; No. 7 mine operating in No. 4 seam; No. 8 mine.

Description of seams, tunnels, levels, shafts, etc., and number of same—Nos. 2 and 3 seams: No coal was mined from these seams during the past year. No. 4 seam: Coal is being mined from this seam in Nos. 4, 4 East, and 7 mines. No. 6 seam: No coal has been mined from this seam during the past year, and no work done other than repairs. Nos. 4 and 6 mines: These are operated by a tunnel, part of which is in No. 5 seam, the strata being then crosscut by a tunnel from No. 5 to No. 4, then from No. 4 to No. 6 seams. No. 4 East: This is a slope driven in No. 4 seam, and has reached a point 1,100 feet from the surafce. No. 8 mine: No coal was taken from this mine during the past year. No. 7 mine: This is a slope operating in No. 4 seam, and is now down a distance from the surface of 2,000 feet.

Description and length of tramway, plant, etc.—The main power plant consists of four return-tubular boilers, each 150 horse-power; one Canadian Rand cross-compound air-compressor with a capacity of 2,000 cubic feet a minute. No new equipment has been added to the plant during the past year.

Inland Coal and Coke Company, Ltd.

(FORMERLY THE COAL HILL SYNDICATE.)

Head Office—Merritt, B.C.

Capital $1,500,000.

Officers.	*Address.*
Geo. I. Wilson, President,	530 Seymour Street, Vancouver, B.C.
W. L. Nichol, Vice-President,	530 Seymour Street, Vancouver, B.C.
T. W. Berridge, Secretary-Treasurer,	530 Seymour Street, Vancouver, B.C.
Joseph Graham, Vice-Pres. and Gen. Man.,	Merritt, B.C.
Andrew Bryden, Mine Manager,	Merritt, B.C.

Value of plant, $90,000.

COAL HILL COLLIERY.

The property of this company is situated south-west of the Middlesboro Colliery, and at an elevation of 500 feet higher up.

No. 3 MINE.

Andrew McKendrick, Assistant Manager and Overman; Geo. Hudson, 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, and at my last inspection was producing 20,000 cubic feet of air a minute for the use of sixty-two men and one horse. Speed of fan, 300 revolutions a minute; water-gauge, 0.75 inch; barometer, 27.2 inches; thermometer, 4 degrees. The split ventilating the No. 5 seam showed 7,200 cubic feet of air a minute for the use of thirty men.

During my inspections I have generally found the conditions in the mine fairly good, and have not during any of these found explosive gas present in any of the places or airways. There was generally a good current of air circulating around the faces, and the doors, stoppings, and brattices have been maintained in good condition.

The order *re* the "Systematic Timbering" has been very well complied with by the workmen in both seams, and a good supply of timber has been provided.

All the roads and airways have been maintained in fairly good condition, and the roads are free from dust and fairly damp. The stoppings around the sealed-off fire area have been maintained in good condition during the year, and no attempt has been made to reopen this.

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 a 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 team 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.

As required by the Act, mine-rescue apparatus, as already described, is maintained at the mine, although so far no proper mine-rescue training-station has been provided. this work

generally being done at the station of the Middlesboro Colliery. Copies of the "Coal-mines Regulation Act," special rules, plans of the seams showing the roadways and means of egress, and orders *re* the "Systematic Timbering" are kept posted at the mine entrance.

The following are the official returns of the Inland Coal and Coke Company, Limited, for the year ending 1916:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	29,715			
" export to United States				
" " other countries				
Total sales		29,715		
Used in making coke				
" under colliery boilers, etc.	1,580			
Total for colliery use		1,580		
Stocks on hand first of year				
" last of year				
Difference added to stock during year				
Output of colliery for year		31,295		

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	30	3.50			30	3.50
Miners' helpers	22	3.00			22	3.00
Labourers	20	3.00	8	3.00	28	3.00
Mechanics and skilled labour	1	5.00	6	3.50	7	3.71
Boys						
Japanese						
Chinese						
Indians	4	3.00			4	3.00
Totals	82		16		98	

Name of seams or pits—Inland Coal and Coke Company.

Description of seams, tunnels, levels, shafts, etc., and number of same—Nos. 1, 2, 3, 4, and 5 seams. No. 1, 3 feet thick; No. 2, 6 feet; No. 3, 9 feet; No. 4, probably 7 feet, not yet sufficiently developed to be assured; No. 5 seam, 5 feet thick. Nos. 3 and 5 seams are being worked as one mine, both being operated from the same opening and by the same ventilation appliance. These seams are connected by a tunnel through the strata at No. 3 level.

Description and length of tramway, plant, etc.—From the mine to the incline, 1,100 feet; length of incline, 1,760 feet. Two return-tubular boilers, 40 horse-power each; two Beattie upright boilers of 12 horse-power; main hoist, Ottumwa, single-drum geared, 10 x 12; Beattie hoist, double-drum, 8 x 10; Beattie hoist, double-drum, 7 x 9; two Cameron pumps, 4 x 3 x 5; two duplex pumps, 3½ x 3 x 4; one Marsh pump, 6 x 2 x 7.

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.
T. W. Berridge, Secretary-Treasurer,	Vancouver, B.C.
Joseph Graham, General Manager,	Merritt, B.C.
Andrew Bryden, Mine Manager,	Merritt, B.C.
Wm. Hoggan, Overman and Fireboss,	Merritt, B.C.

This property is situated nearly west from the Middlesboro Colliery, and includes that area of land lying between Middlesboro and the Coldwater river.

Two shafts and a slope have been sunk on the property, but all the work during the 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.

The 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 have been employed during the year, and the progress made was necessarily slow.

I have regularly examined this mine, and only on one occasion during the year did I find explosive gas present, and this was in a long crosscut being driven to connect two places. With this exception, I have generally found a good current of air being circulated around the faces, and the doors, brattices, and stoppages in good condition.

A small fan is provided for ventilation purposes, but frequently, during the winter especially, natural ventilation is such as to produce more air than is required to keep the mine free from gas.

At my last inspection I found 9,600 cubic feet being produced thus for the use of four men. Barometer, 27.4 inches; thermometer, 24 degrees.

Haulage is by a 7- x 10-inch double-drum hoist, steam-driven, situated on the surface, and provision is provided for loading coal on the Inland Coal and Coke Company's track.

Open lights are used generally, although during the time trouble was being experienced with gas safety-lamps were in use.

The roads are well timbered and the "Systematic Order" *re* timbering is strictly adhered to. The power plant, in addition to the hoist, consists of two 10-horse-power boilers and two Fairbanks duplex pumps.

Copies of the "Coal-mines Regulation Act," plan of mine, and copies of the "Systematic Timbering Order" are kept posted at the mine.

The following are the official returns of the Pacific Coast Coal Syndicate's colliery for the year 1916:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	213			
" export to United States				
" " other countries				
Total sales		213		
Used in making coke				
Used under colliery boilers, etc.	240			
Total for colliery use		240		
Stocks on hand first of year				
" last of year				
Difference { added to / taken from } stock during year				
Output of colliery for year		453		

NUMBER OF HANDS EMPLOYED, DAILY WAGES PAID, ETC.

CHARACTER OF LABOUR.	UNDERGROUND.		ABOVE GROUND.		TOTALS.	
	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage
		$		$		
Supervision and clerical assistance	1	5.00			1	
Whites—Miners	2	3.50			2	
Miners' helpers	1	3.00			1	
Labourers						
Mechanics and skilled labour			1	3.50	1	
Boys						
Japanese						
Chinese						
Indians						
Totals	4		1		5	

Name of seams or pits—Pacific Coal Syndicate (formerly the Pacific Coast Colliery).

Description of seams, tunnels, levels, shafts, etc., and number of same—Nos. 1, 2, and 3 seams. No. 1 seam, according to the drill, is 7 feet thick; No. 2 seam is over 20 feet in places; No. 3 is a smaller seam, perhaps 5 feet thick, but of a very superior blacksmith quality. During the past year work has been confined to No. 1 slope entirely, which is down 630 feet from the surface.

Description and length of tramway, plant, etc.—The only tramway is 400 feet from top of slope to tipple. The No. 2 hoist is an Albion Iron Works engine, 7 x 9; No. 1 hoist is a single Joshua Henry engine, San Francisco, Cal., 8 x 10; two upright boilers, 12 horse-power each; one Cameron pump, 4 x 3 x 6.

DIAMOND VALE COLLIERY.

OPERATED BY THE MERRITT COLLIERIES, LTD. (UNDER LEASE FROM THE DIAMOND VALE COLLIERIES, LTD.).

W. H. Wall, Manager; L. E. Warburton, Assistant Manager and Overman; James McGrath, Fireboss.

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.

Operations, which were suspended on this property in May, 1913, were resumed in the beginning of December, 1916. Owing to the long period of idleness a considerable time will elapse before it can begin to produce coal on a large scale, and most of the work has been to repair roadways and pump out the water which had accumulated.

The No. 3 slope, where work has been recommenced, is down for a distance of 600 feet on the coal-seam, dipping at an angle of 25 degrees to the south. Two levels have been driven to the east and one to the west. The levels on the East side are driven in about 850 feet, that on the West about 550 feet. The coal-seam is about 5 feet thick, with two bands of sandstone running through it.

The method of work is double-stall, stalls being driven up full pitch about 25 feet wide, leaving a pillar about 20 feet thick.

The ventilation is produced by a fan of the Guibal type, and at my inspection in December was producing 9,000 cubic feet of air a minute for the use of five men. Speed of fan, 50 revolutions a minute; barometer, 27.4 inches; thermometer, 25 degrees. This fan is capable of producing between 20,000 and 30,000 cubic feet a minute.

As I have already mentioned, the work at present is repairing the roads and airways preparatory to shipping coal.

Safety-lamps only are in use, and are cleaned and tested in the lamp-room near the mine entrance, and then re-examined before being taken into the mine. The power plant consists of one 30-horse-power and one 10-horse-power boiler, while another is expected at an early date. A 8- x 12-inch hoist is used for haulage, while an 8- x 10-inch engine drives the fan, which is 8 feet in diameter.

Rules covering the "Systematic Timbering" are being prepared, and copies of the "Coal-mines Regulation Act," special rules, and plan of the mine are posted at the entrance.

The following are the official returns of the Merritt Collieries Company, Limited, for the year ending 1916:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	308			
" export to United States				
" " other countries				
Total sales		308		
Used in making coke				
Used under colliery boilers, etc.	30			
Total for colliery use		30		
Stocks on hand first of year				
" last of year				
Difference { added to / taken from } stock during year				
Output of colliery for year		338		

NUMBER OF HANDS EMPLOYED, DAILY WAGES PAID, ETC.

CHARACTER OF LABOUR.	UNDERGROUND.		ABOVE GROUND.		TOTALS.	
	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.	No. employed.	Average Daily Wage.
		$		$		$
Supervision and clerical assistance	3	4.75	1	5.00	4	4.80
Whites—Miners	25	3.50	.....	.....	25	3.50
Miners' helpers	8	3.00	.....	.....	8	3.00
Labourers	5	3.00	.....	.....	5	3.00
Mechanics and skilled labour	.....	.....	7	3.75	7	3.75
Boys	.....	.....	1	2.00	1	2.00
Japanese	.....	.....	.....	.....	.....	.....
Chinese	.....	.....	.....	.....	.....	.....
Indians	.....	.....	.....	.....	.....	.....
Total	41	.....	9	.....	50	.....

Name of seams or pits—No. 2 seam, Slope No. 3.
Description of seams, tunnels, levels, shafts, etc., and number of same—Slope.
Description and length of tramway, plant, etc.—Tramway, none. Boiler plant, hoisting-engine, and fan for ventilating, and tipple.

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; Allan Ford, Overman; Thos. Bullen, 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 1,800 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.

I have inspected this mine regularly during the year, and only on one occasion—namely, in December—did I find a cap of explosive gas. This was coming off from a small feeder and was being carried away by the ventilation. A good current of air is circulated around the working-places, and measured at my last inspection 35,200 cubic feet a minute for the use of twenty-four men; the fan was running at a speed of 124 revolutions a minute, and the water-gauge showed 0.25 inch. Barometer, 28.1 inches; thermometer, 25 degrees.

The roads and airways were in fairly good condition, and the working-places were all well timbered, as provided for by the special rule on timbering. There seemed to be plenty of timber available for the workmen, and the roads are fairly free from dust.

The coal is mined by coal-cutting machines of the post type, so that a minimum of explosives is required to bring it down, and produces a maximum of round or lump coal for the market.

For blasting purposes only the explosives as shown on the permitted list are used, and all shots are fired with electric detonator and battery in the charge of competent persons appointed for the purpose.

During the year no fresh trouble has been experienced with gob-fires, and energetic steps have been taken to control those already sealed off. The new district being opened is divided into panel systems, which will have the advantage of being able to isolate any cases of fire which should develop in the future.

Safety-lamps of the Wolf type only are used, and are cleaned and examined at the lamp-room, and re-examined by the fire-bosses before being taken underground.

Another opening has been made from the inside workings to the surface, which allows of the workmen to go inby without travelling on the slope.

The surface plant is practically the same as described last year, and consists of a screening plant capable of handling 500 tons a day. The mine-cars, which are built at the mine, have a capacity of 1.5 tons, and are hauled up the Main slope in trips of six by a 50-horse-power steam-engine to the tipple, which is 250 feet long. Here the cars, after being weighed, are dumped by a rotary dump into a reciprocating feeder, which regulated the supply of coal to the shaking screens, where three different sizes of coal are made—"lump," "egg," and "nut." These are taken to separate bunkers by conveyor-belts, and during the journey all the rock is picked out. The bunkers have a joint capacity of 240 tons, and a box-car loader of the Victor type is provided for loading box cars.

The power plant consists of two Goldie-McCulloch boilers, each 75 horse-power, and a 50-horse-power boiler of the Gray type. A Rand compressor with a capacity of 750 cubic feet free air capacity provided air for the mining-machines, hoists, and pumps. A 60-kw. three-phase alternator, driven by a Goldie-McCulloch steam-engine, supplies light for the mine and the town of Princeton. Three separate engines are used for driving the screens and conveyor-belts on the tipple, each being of 30-horse-power capacity.

A well-equipped machine-shop, car-repair and carpenter shop, store-room, wash-house, and offices are maintained, and a 30,000-gallon water-tank is provided for fire-protection and other purposes.

Copies of the "Coal-mines Regulation Act," special rules, "Systematic Timbering" order, and a plan of the mine are kept posted at the mine entrance.

The following are the official returns of the Princeton Coal and Land Company for the year 1916:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	17,650			
" export to United States	5,684			
" " other countries				
Total sales		23,334		
Waste	1,965			
Used in making coke				
Used under colliery boilers, etc.	4,175			
Total for colliery use		6,140		
		29,474		
Stocks on hand first of year	30			
" last of year	14			
Difference taken from stock during year		16		
Output of colliery for year		29,458		

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	3	4.50	5	4.50	8	4.50
Whites—Miners	22	5.00			22	5.00
Miners' helpers	22	3.00 - 3.30			22	3.00 - 3.30
Labourers			4	3.00	4	3.00
Mechanics and skilled labour	13	3.50	8	3.50 - 4.00	21	3.50 - 4.00
Boys			2	1.50	2	1.50
Japanese						
Chinese						
Indians						
Totals	60		19		79	

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 1,050 feet, driven on full pitch of the seam, with main and counter levels on strike of the seam, and 500 and 1,000 feet respectively both east and west. There is an air-shaft down to the seam and has a depth of 60 feet. Nos. 2 and 3 levels are in 1,200 feet; No. 4 East counter, 1,000 feet. The coal is mined by machines, of which six are used.

Description and length of tramway, plant, etc.—The plant consists of tipple having a length of 250 feet, with rotary dump, reciprocating feeder, shaking screens, picking-belts, and bunkers having a capacity of 240 tons, conveyor-belts, and Victor box-car loader; two 75-horse-power and one 50-horse-power boilers; machine-shop containing lathe, shaper, pipe-threader, bolt-cutters, hack-saws; blacksmith and carpenter shops with steam-hammer and all necessary equipment.

Coalmont Collieries.

(FORMERLY COLUMBIA COAL AND COKE COMPANY, LTD.)

Officers.	*Address.*
Arthur McEvoy, President,	811 Rogers Bldg., Vancouver, B.C.
A. N. Canting, Vice-President and General Manager,	Coalmont, B.C.
A. H. Douglas, Secretary,	Dom. Trust Bldg., Vancouver, B.C.
A. Ford, Acting-Superintendent,	Coalmont, B.C.

(Not incorporated.)

This property was acquired late in 1913 by A. McEvoy, and is now operated by him under the name of the "A. McEvoy, Trustee Operators Coalmont Collieries," with the head office at Vancouver.

This property is situated in the Similkameen Mining Division between the fork of the Tulameen river and Granite creek. As has been mentioned in previous reports, all the operations were discontinued on the Tulameen side, or Fraser gulch, and in 1914 work was confined to the outcrops on the North fork of Granite creek.

This property was not operated during any part of year 1916.

United Empire Mining Co.

Capital, $500,000.

Officers.	*Address.*
W. C. McDougall, President,	Princeton, B.C.
M. H. Whitehouse, Vice-President,	Princeton, B.C.
E. G. Marston, Secretary-Treasurer,	Princeton, B.C.
W. G. Simpson, Mine Manager,	Princeton, B.C.

Value of plant, $1,000.

UNITED EMPIRE COLLIERY, PRINCETON, B.C.

The United Empire Mining Co.'s property is situated on Hunter creek, about a mile and a half from Princeton. The main tunnel is driven through the slide-rock to a point 900 feet inside, where it strikes the coal, and then continues on the coal for a distance of almost 500 feet.

This property was not operated during any part of years 1915 or 1916.

Boundary Mining and Exploration Company, Limited.

Capital, $1,000,000.

Officers.	*Address.*
A. E. Watts, President,	Wattsburg, B.C.
A. Carney, Vice-President,	Kaslo, B.C.
S. J. Miller, Vice-President,	Grand Forks, B.C.
E. R. J. Forster, Secretary-Treasurer,	Grand Forks, B.C.

MIDWAY COLLIERY.

Ed. Bridge, Manager.

This company's property is situated in the Greenwood Mining Division on the banks of the Kettle river, two miles and a half west of Midway.

This property was not operated during any part of years 1915 or 1916.

EAST KOOTENAY DISTRICT.

Until within the year 1908 there was only one company actually producing coal in the East Kootenay District—that is, the Crow's Nest Pass Coal Company, although this company operated three separate collieries; but during that year two new companies began to produce—namely, the Hosmer Mines, Limited, at Hosmer, and the Corbin Coal and Coke Company, at Corbin. These new companies began to ship coal towards the latter part of 1908, and, as they have extensive and fully equipped collieries, have now become important factors in the production of the district.

The Hosmer Mines continued operations until about the middle of the year 1914, when all operations were suspended.

The district is divided into two separate Inspection Districts. The Southern East Kootenay District, which was during the year 1916 under Inspector T. H. Williams, with headquarters at Fernie, includes the Coal Creek Collieries and the Carbonado Collieries of the Crow's Nest Pass Coal Company, although this latter colliery has not been worked this past year.

The Northern East Kootenay District, under Inspector George O'Brien, with headquarters also at Fernie, includes the Michel Collieries of the Crow's Nest Pass Coal Company and the Corbin Colliery of the Corbin Coal and Coke Company.

The headquarters of both inspectorates is in the Government rescue-station at Fernie.

SOUTHERN EAST KOOTENAY INSPECTION DISTRICT.

REPORT OF T. H. WILLIAMS, INSPECTOR.

I have the honour to submit the annual report of the inspection of the mines in the Southern East Kootenay District for the year 1916.

The only mines producing coal in this Inspection District are those of the Crow's Nest Pass Coal Company's Coal Creek Colliery.

Crow's Nest Pass Coal Company, Ltd.

Capital, $3,500,000.

Officers.	*Address.*
Elias Rogers, President,	Toronto, Ont.
E. C. Whitney, Vice-President,	Ottawa, Ont.
R. M. Young, Secretary,	Fernie, B.C.
Elias Rogers, Treasurer,	Toronto, Ont.
W. R. Wilson, General Manager,	Fernie, B.C.
Bernard Caufield, Colliery Manager, Coal Creek Collieries,	Fernie, B.C.
Thomas Russell, Colliery Manager, Michel Collieries,	Michel, B.C.

The above company is now operating the following extensive collieries on the western slope of the Rocky mountains in the East Kootenay District, namely:—

COAL CREEK COLLIERY, situated on Coal creek, about five miles from the town of Fernie, on a branch railway to the mines, connected at Fernie with the tracks of the Canadian Pacific Railway and also those of the Great Northern Railway.

CARBONADO COLLIERY, situated on Morrissey creek and connected by a branch railway with the Canadian Pacific Railway and the Great Northern Railway at Morrissey. The colliery is about fourteen miles from Fernie by rail in a south-easterly direction. This colliery has been shut down since 1909.

MICHEL COLLIERY, situated on both sides of Michel creek, on the line of the Canadian Pacific Railway, being twenty-three miles in a north-easterly direction from Fernie. This last colliery is in the Northern Inspection District.

The total gross combined output of all the company's collieries for the past year was 813,250 tons. Of this, 351,991 tons was used in the manufacture of coke, yielding 240,121 tons, and as 1,669 tons of coke was taken from stock, the amount of the coke sold was 241,790 tons, of which 207,413 tons was sold for consumption in Canada, and 34,377 tons was exported to the United States. The coal exported to the United States amounted to 328,135 tons, while 69,835 tons was sold for consumption in Canada.

The amount and disposition of this combined output of the company's collieries is more fully shown in the following table:—

COMBINED RETURNS FROM CROW'S NEST PASS COAL CO.'S MINES FOR YEAR 1916.

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	69,835		207,413	
" export to United States	328,135		34,377	
" " other countries				
Total sales		397,970		241,790
Used in making coke	351,991			
" under colliery boilers, etc.	63,330			
Total for colliery use		415,321		
		813,291		
Stocks on hand first of year	99		2,607	
" last of year	58		938	
Difference taken from stock during year		41		1,669
Output of collieries for year		813,250		240,121

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		17		65	
Whites—Miners	594				594	
Miners' helpers						
Labourers	95		324		419	
Mechanics and skilled labour	343		126		469	
Boys	16		21		37	
Japanese						
Chinese						
Indians						
Totals	1,096		488		1,584	

COAL CREEK COLLIERY.

Bernard Caufield, Manager.

This colliery is on Coal creek, five miles from Fernie, transportation being afforded by a branch line which makes connection with both the Canadian Pacific and the Great Northern Railways at Fernie.

The improved conditions noted in the coal trade during the latter part of the year 1915 has continued throughout this year, the mines working steadily, except for a short stoppage on two occasions, which was the result of a demand on the part of the employees for a "war bonus" and an increase in wages to offset the increase which has taken place in the cost of living.

I regret to report an increase in the number of accidents when compared with the previous year. Thirteen were reported, five of which proved fatal. Of the remaining eight, five were seriously injured and three slightly. Two of the fatalities were caused by falls of roof, two by haulage, and one by a "bump." Two of the non-fatal accidents were caused by falls of roof and side, five by haulage, and one was of a miscellaneous nature.

The mines in operation during the year were as follows: No. 1 North, No. 9, and B North on the north side of the valley, and No. 1 South, No. 1 East, No. 2, and No. 3 on the south side.

The coal from all these mines is conveyed to a central tipple of steel construction, 840 feet in length, extending across the valley. It is equipped with two revolving dumps, screens, and two picking-tables, all of which are worked by electric power. Underneath the tipple are two box-car loaders operated by hydraulic pistons.

No addition has been made to the boiler and power-house plant, a description of which was given in my last year's report.

All the coal is produced without the use of explosives or coal-cutting machines, and safety-lamps are used exclusively in all the mines. The following amount of explosives was used in rock-work at this colliery during the year: Polar Permitite, 3,469 lb.; Monobel, 27 lb.; estimated number of shots fired, 3,288.

In compliance with section 106 of the "Coal-mines Regulation Act," there is installed the following equipment for mine-rescue work: Four 2-hour and six ½-hour sets of Draeger apparatus; two pulmotors; five Ceag electric lamps; eight tanks of oxygen; 100 2-hour cartridges and thirty-six ½-hour ones. This equipment is under the charge of R. Johnstone, the colliery electrician, and is always kept in good condition. All officials who are physically fit have been trained in the use of the above apparatus.

Very little has been done in connection with first-aid and mine-rescue work during the year, six persons only having taken a course of instruction in the latter. This course was taken at the Government Mine-rescue Station, Fernie, the instructor being C. O'Brien.

No. 1 North Mine.

R. Adamson, Overman; T. Tully, E. Rutledge, and M. Turnbull, Firebosses.

This mine is situated on the north side of the valley at an elevation of 300 feet above the tipple. The work done during the year has been principally development-work and the making of a new return airway between New No. 1 incline and Old No. 3 incline. At the time of my last inspection in December I found it clear of explosive gas, well timbered, and in a general good condition. I measured 18,000 cubic feet of air a minute for the use of twenty men and three horses. This was produced by a Keith fan installed at the latter part of the year and which only commenced running about the end of December. It is a double-inlet reversible fan, 7 feet in diameter and 6 feet wide, and is rated to give 200,000 cubic feet of air a minute when running at a speed of 257 revolutions a minute against a water-gauge of 3 inches.

To obtain these results a 140-horse-power motor is required to drive it, but at the present time it is being driven by a 30-horse-power motor. The quantity of air mentioned was obtained in the last break-through between Nos. 2 and 3 levels. The amount obtained in the fan-drift was 29,600 cubic feet a minute. Speed of fan, 150 revolutions a minute; water-gauge, 1 inch.

No. 9 Mine.

W. Commons, Overman; R. J. Brown and J. Maltman, Firebosses.

This mine, which is on the same elevation as the tipple, did not produce any coal during the year, the operations being confined to the repairing and brushing of the Main level and general repairs to the main return. The work which is being done on the Main level is of a permanent nature, and when completed will provide a first-class haulage-road for a considerable time. I measured 15,500 cubic feet of air a minute for four men and one horse. Speed of fan, 44 revolutions a minute; water-gauge, 1 inch.

B North Mine.

W. Commons, Overman; J. Worthington, J. White, and E. Jones, Firebosses.

This mine is situated about 1,800 feet north-east of the tipple, and is opened by two 8- x 10-foot tunnels which struck the coal at a distance of 150 feet from the surface. The seam is about 10 feet in thickness, but only about 5 feet of the upper portion is being worked, the method of working being pillar and stall.

At the time of my last inspection I found it clear of gas, well timbered, and in a general good condition. I have only found explosive gas on two occasions during the year, and in each instance the quantity was very small. I measured 34,000 cubic feet of air a minute for the use of fifty-five men and seven horses. This quantity is divided into two splits, as follows: Incline district, which also includes the bottom of the slope, 24,000 cubic feet a minute for the use of fifty-five men and seven horses; Right side of slope above No. 7 Right, in which there are no places working at the present time, 8,000 cubic feet a minute. The ventilation is produced by a 3- x 10-foot double-inlet, two-compartment, reversible Brazil fan, belt-connected to a 30-horse-power Westinghouse motor. Speed of fan, 150 R.P.M.; water-gauge, 1 inch.

No. 1 South Mine.

Adam G. Watson, Overman; W. Stockwell, W. Joyce, and J. Strachan, Firebosses.

This mine is situated 2,500 feet south-west of the tipple and at an elevation of 200 feet above it. It is opened by an adit-tunnel driven on the strike of the seam, inclines being turned off to the full rise, and level rooms driven from these inclines. Both horse and mechanical haulage is employed to haul the coal to the surface, where it is lowered to the tipple elevation by a gravity-plane, compressed-air locomotives being used to convey it from the bottom of the plane to the tipple. At the time of my last inspection I found it clear of explosive gas and in a fair condition. I measured 21,000 cubic feet of air a minute for the use of sixty men and

ten horses. This is produced by a 3- x 10-foot double-inlet, reversible fan, belt-connected to a 30-horse-power, General Electric motor. Speed of fan, 160 R.P.M.; water-gauge, 1.4 inches.

The foundation is being laid for the installation of a Keith fan at this mine, and if weather conditions are favourable it should be in operation in the month of February. This is an 8- x 3½-foot fan with a capacity of 110,000 cubic feet a minute against a water-gauge of 2.5 inches when running at a speed of 195 R.P.M.

No. 1 East Mine.

David Martin, Overman; J. Caufield, T. Wilson, J. Bell, H. Dunlap, H. Lanfear, and J. Duncan, Firebosses.

This mine is on the south side of the valley, 800 feet east of the tipple and at an elevation of 90 feet above it. It is opened by a rock tunnel which struck the coal at a distance of 215 feet from the surface. Up to the beginning of November this mine was the largest producing mine operated by the company, and its workings had become extensive.

On the afternoon of the 7th and the early morning of the 8th of this month a series of "bumps" occurred, the effect of which destroyed about two-thirds of the working-places. One of these occurred about 2 o'clock on the morning of the 8th, and it caused considerable anxiety, as two firebosses and a number of workmen were missing for some time; the falls of roof which had taken place preventing them from making their escape, and also preventing rescue parties from reaching them. After about three hours the entombed men, with one exception, managed to make their escape uninjured, and it was the opinion of these men that the missing man was under a cave, and preparations were made to try and recover him when another severe "bump" took place, and it was with the greatest difficulty that those who were in the mine made their escape.

As the mine continued "bumping," the work of trying to recover the body of the entombed man had to be abandoned for some time, it being finally got on December 23rd.

This mine is one of the newest opened by the company, and is above No. 2 mine, some of the workings of which were affected by "bumps" several years ago, the cause of which was attributed by some to the insufficient size of the pillars; and in laying out the workings of No. 1 East mine, plans were made and followed which provided much more substantial pillars than was the case in No. 2 mine. These pillars were of such dimensions that the extraction of the seam in the rooms and levels only amounted to about 25 per cent., thus leaving 75 per cent. of the coal to support the overburden, which at this place is very heavy. It was thought that the size and uniformity of the pillars which were left would render it immune from "bumps," and that there would not be a recurrence of these phenomena as experienced in No. 2 mine, but unfortunately such has not proven to be the case.

At the time of my last inspection of the Diagonal district, which is the only part of the mine being worked, I found it clear of explosive gas and in a fairly good condition. I measured 28,000 cubic feet of air a minute for the use of fifty men and six horses. The quantity of air in the main return was 160,000 cubic feet a minute; water-gauge, 3.8 inches. The ventilation is produced by a double-inlet, reversible, belt-driven Wilson fan, rated capacity 200,000 cubic feet a minute when running at a speed of 180 revolutions a minute. It is steam-driven by a 125-horse-power Tangye engine.

Considerable work was done on the Main level in brushing and retimbering it with the object of extending the endless-rope haulage a distance of 1,500 feet, but an extensive cave has taken place along this portion of the level which has practically destroyed the whole of the work done.

No. 2 Mine.

William Lancaster, Overman; F. Lander, J. Bushell, and C. McNay, Firebosses.

This mine is situated on the south side of the valley, on the same elevation as the tipple and in direct line with it. The work done during the year has been principally development-work, only eight places being worked.

At the time of my last inspection in December I found a little explosive gas in one place. The ventilation and general conditions were fairly good. I measured 18,000 cubic feet of air a minute for the use of forty men and five horses. Speed of fan, 130 R.P.M.; water-gauge, 2.9 inches. The ventilation is produced by a double-inlet, reversible Wilson fan, direct-connected.

No. 3 MINE.

John Biggs, Overman; W. R. Puckey, J. McCourt, and J. Thompson, Firebosses.

This mine is working the No. 2 seam, and is opened by a slope 2,250 feet long, driven on the full pitch of the seam, which is about 10 degrees. The method of working is room and pillar, levels being 12 feet wide and rooms 18 feet wide. The rooms are driven in sets of three, with a 60-foot pillar between each room and a 150-foot pillar between each set.

At the time of my last inspection in December I found it clear of explosive gas and in a fairly good condition. I measured 35,000 cubic feet of air a minute for the use of forty-five men and five horses. This quantity was divided into two splits, as follows: Slope split, 4,000 cubic feet a minute for five men and one horse; South level split, 28,000 cubic feet a minute for forty men and six horses. Speed of fan, 130 R.P.M.; water-gauge, 3.5 inches.

I took fifty-nine samples of air in the various mines of the colliery during the year, which were sent to the Mines Branch, Department of Mines, Ottawa, for analysis. The returns from these show that considerable quantities of gas is being given off in some of the mines.

Appended is a list of accidents and prosecutions for the year.

The following are the official returns from the Coal Creek Collieries for the year ending December 31st, 1916:—

SALES AND OUTPUT FOR YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	56,243		126,002	
" export to United States	273,744		3,089	
" " other countries				
Total sales		329,987		129,091
Used in making coke	194,655			
Used under colliery boilers, etc.	44,515			
Total for colliery use		239,170		
		569,157		
Stocks on hand first of year	53		1,607	
" last of year	27		536	
Difference taken from stock during year		26		1,071
Output of collieries for year		569,131		128,020

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	28		10		38	
Whites—Miners	405				405	
Miners' helpers						
Labourers	67		178		245	
Mechanics and skilled labour	219		83		302	
Boys	14		14		28	
Japanese						
Chinese						
Indians						
Totals	733		285		1,018	

The following shows the number of days the Coal Creek Collieries worked each month during 1916:—

January	20½	August	18
February	17½	September	24
March	22½	October	24
April	20½	November	20½
May	21½	December	17½
June	22½		
July	19½	Total	248½

Name of seams or pits—No. 1 North, No. 1, South, and No. 1 East, same seam; No. B; No. 2, No. 3, and No. 9, same seam.

NORTHERN EAST KOOTENAY INSPECTION DISTRICT.

REPORT OF GEORGE O'BRIEN, INSPECTOR.

I have the honour to submit the annual report as Inspector of Coal-mines for the Northern East Kootenay Inspection District for the year 1916.

The collieries at present being operated are as follows: Michel Colliery, by the Crow's Nest Pass Coal Company, Limited, and Corbin Colliery, by the Corbin Coal and Coke Company, Limited. The Hosmer Colliery, formerly operated by the Natural Resources Department of the Canadian Pacific Railway Company, did not operate during the year.

There was one fatal accident and ten non-fatal accidents reported during the year. The fatal accident, which caused the loss of twelve lives, was the result of an explosion in the No. 8 East mine, Michel Colliery, on August 8th, 1916, the cause of which has not yet been determined. Of the ten non-fatal accidents, seven were caused by mine-cars and haulage, one by a fall of coal, one struck by a falling timber, and one on the surface. The above accidents are classified as follows: Fatal, 12; serious, 4; slight, 6.

Had it not been for the unfortunate and deplorable disaster of August 8th, 1916, the accident rate for the district would have been much lower than it has been for a number of years, and I take this opportunity of thanking the officials and employees for their hearty co-operation and attempts to reduce all classes of accidents to a minimum. I sincerely hope and trust that the campaign now being conducted with a view to "safety first" will be carried on relentlessly by officials and employees, and that the efforts of all in this respect will be rewarded by a low accident rate.

Crow's Nest Pass Coal Company.*

MICHEL COLLIERY.

Thomas Russell, Colliery Manager.

This colliery, operated by the Crow's Nest Pass Coal Company, Limited, is situated on both sides of Michel creek, and 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.

These mines worked fairly steadily during the year, though there were two short suspensions of operations during the year owing to local disputes. The No. 3 East mine of this colliery has not produced any coal for the last five months of the year.

* See also page 493.

OLD NO. 3 MINE.

James Touhey, Overman; Robert L. Spruston, Jonathan Henney, Andrew Frew, Walter Almond, and James Mercer, Firebosses.

This mine is opened by a rock tunnel from the surface and cuts Nos. 5, 4, and 3 seams respectively. No. 3 seam, which is 970 feet from the tunnel-mouth, is the only seam from which coal was produced during this year. The method of working is pillar and stall; the entries are driven 10 feet wide and the rooms from 14 to 16 feet wide. The pillars average about 60 feet square, though occasionally much larger pillars are left in for the purpose of supplementing the smaller pillars.

Upon my last inspection on December 20th, 1916, I found this mine clear of explosive gas, well timbered, and the conditions generally good. I measured 85,000 cubic feet of air a minute for the use of sixty men and seven horses, or 1,050 cubic feet a unit. This quantity is divided into three splits, as follows: No. 2 Slope split, 32,400 cubic feet a minute for thirty men and four horses; No. 3 Slope split, 25,200 cubic feet a minute for thirty men and three horses; West Incline split, 6,000 cubic feet a minute. The latter split is not working owing to a shortage of labour. The fan-engine was running 144 R.P.M. Fan ratio, 5½ to 7; water-gauge, 2.4 inches.

The coal in the East side of the mine is all pick-mined and is produced without the use of explosives. The coal in the West side of the mine is also pick-mined, but a little blasting is done, the shots being fired by competent shotfirers with electric batteries. Monobel powder and No. 6 electric detonators are used for blasting the coal. Safety-lamps of the Wolf type are used exclusively in this mine.

I took twenty samples of mine-air from this mine during the year, the analysis of which proved that considerable quantities of methane was given off for each ton of coal mined.

Owing to the friability of the coal in this mine, especially in the East side of the mine, considerable quantities of coal-dust is made. To combat this dust a sprinkling system is partly installed and in operation. There is also a staff of men regularly employed on week-ends and holidays to load up the accumulations of dust that gather during the week and send it out of the mine. No blasting operations are permitted in any place in the mine where it is dry or dusty.

NO. 3 EAST MINE.

Thomas Cunliffe, Overman; Ed. Heyes, Joseph Mason, and Benjamin Ball, Firebosses.

This mine is situated about 3,000 feet south-east of the tipple and is opened by a tunnel in the coal. About 400 feet from the tunnel-mouth the Main slope is sunk for a distance of 2,400 feet on the full dip of the seam. Levels are driven east and west about every 200 feet on the strike of the seam. The method of working is pillar and stall. The entries are driven about 10 feet wide and the rooms from 14 to 16 feet wide. The pillars in this mine average about 60 feet square, though occasionally much larger pillars are left in.

This mine has not produced any coal since the deplorable disaster of August 8th, 1916, the mine being badly wrecked by the explosion, about 75 per cent. of the roadways being caved. Since the date of the explosion the work of recovering the mine has been vigorously prosecuted. This was very difficult and dangerous work, and great credit is due the officials and workmen in charge of the recovery-work, in that not one single accident occurred during the time between the date of the explosion and the end of the year.

Upon my last inspection on December 21st, 1916, I found all accessible places in the mine clear of explosive gas and well timbered. I measured 94,500 cubic feet of air a minute entering the mine for the use of forty men and two horses, all of whom were employed on repair-work. The fan-engine was running 112 R.P.M. The fan-speed was the same as the engine. Water-gauge, 2 inches.

There were formerly four splits in this mine, but at present there are only two, as the overcasts that were destroyed by the explosion are not yet completed.

The coal in this mine was all pick-mined, but a little blasting was done. The shots were fired by competent shotlighters with electric batteries. Monobel powder with No. 6 electric detonators are used for blasting the coal. Safety-lamps of the Wolf type are exclusively used in this mine.

I took fourteen samples of air from this mine during the year, the analysis of which proved that considerable quantities of methane was given off for each ton of coal mined.

NEW NO. 8 MINE.

Wm. Whitehouse, Overman; Matthew Littler, Thomas Baybutt, John Newman, Firebosses; John W. Montgomery and Fred. Hutchinson, Shotlighters.

This mine is situated on the north side of Michel creek at an elevation of 535 feet above the tipple, and is opened by a tunnel driven at right angles to the strike of the seam for a distance of about 400 feet, where it intersects the seam. At this point levels are driven east and west, from which three pairs of inclines are driven on the full pitch of the seam. The method of working is pillar and stall, the pillars being on an average about 60 feet square. The entries and inclines are driven 10 feet wide and the rooms 14 to 16 feet wide. After the boundary-line has been reached the pillars are drawn.

Upon my last inspection of December 21st, 1916, I found this mine clear of explosive gas, well timbered, and conditions generally good. I measured 37,800 cubic feet of air a minute entering the mine for the use of sixty-six men and eleven horses, which is equal to 382 cubic feet a unit. This quantity was divided into two splits, as follows: East side split, 23,100 cubic feet a minute for fifty-four men and ten horses; West side split, 13,000 cubic feet a minute for twelve men and one horse. The fan-engine was running 125 R.P.M. Fan ratio, 2½ to 4; water-gauge, 0.5 inches.

The coal in this mine is all pick-mined, but considerable blasting is done. The shots are fired by competent shotfirers with electric batteries. Monobel powder with No. 6 electric detonators are used for blasting the coal. Safety-lamps of the Wolf type are used exclusively in this mine.

I took six samples of air from this mine during the year, the analysis of which proved that very small quantities of methane was given off for each ton of coal mined.

There were 17,606 shots fired and 13,818 lb. of powder used in this colliery during the year.

A detailed description of the power plant and equipment, also of the ventilation machinery at each mine, was given in my annual report for 1915.

The general and special rules are posted at each mine, also up-to-date copies of the mine-plans.

RESCUE-WORK.

Most of the officials of the colliery have taken a course in mine-rescue work, but I regret to say that the periodical training is not kept up to the standard it should be. It has long been known that the highest efficiency cannot be obtained if the training for this hazardous work is in any way neglected, and I take this opportunity of expressing to those interested the absolute necessity of having periodical training for mine-rescue work.

During the year five certificates of competency in mine-rescue work were granted to five employees of this colliery. The mine-rescue equipment at this colliery is the same as last year, no additions having been made during 1916.

FIRST AID.

During the year there were four candidates up for examination for "medallion," four for "voucher," and eight for "first year," all of whom were successful in passing the examination. Under the circumstances this is a very creditable showing for Michel, as very few English-speaking employees are left, owing to the large number that left here and are now on military service in some part of the Empire.

The following are the official returns from the Michel Colliery for the year ending December 31st, 1916:—

SALE AND OUTPUT FOR THE YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	13,592		81,411	
" export to United States	54,391		31,288	
" " other countries				
Total sales		67,983		112,699
Used in making coke	157,336			
Used under colliery boilers, etc.	18,815			
Total for colliery use		176,151		
		244,134		
Stocks on hand first of year	46		1,000	
" last of year	31		402	
Difference taken from stock during year		15		598
Output of colliery for year		244,119		112,101

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		7		27	
Whites—Miners	189				189	
Miners' helpers						
Labourers	28		146		174	
Mechanics and skilled labour	124		43		167	
Boys	2		7		9	
Japanese						
Chinese						
Indians						
Totals	363		203		566	

The following shows the number of days Michel Colliery worked each month during 1916:—

January	18	August	14
February	22	September	24½
March	26	October	24½
April	22½	November	21½
May	25	December	22½
June	24		
July	24½	Total	269

Name of seams or pits—New No. 3 (top section of No. 3 seam); Old No. 3 (lower section of No. 3 seam); New No. 8 (Old No. 8 seam continued); No. 8 North (not operated during 1916).

Corbin Coal and Coke Company, Limited.

Head Office—Spokane, Wash.

Capital, $10,000,000.

Officers.	*Address.*
D. C. Corbin, President,	Spokane, Wash.
E. J. Roberts, Vice-President,	New York, N.Y.
A. M. Allen, Secretary-Treasurer,	Spokane, Wash.
R. S. Ord, General Manager,	Spokane, Wash.
Chas. Graham, Mine Manager.	Corbin, B.C.

Value of plant, $330,000.

CORBIN COLLIERY.

Charles Graham, Manager.

This colliery, which comprises Nos. 1, 3, and 4 mines, is situated on the East branch of the South fork of Michel creek, about fourteen miles from McGillivray Junction, on the Crowsnest branch of the Canadian Pacific Railway, and is connected to it by the Eastern British Columbia Railway.

The whole of the coal produced during the year was from No. 3 and No. 4 mines, No. 1 mine still being sealed on account of the fire mentioned in my 1913 report.

The underground workings known as No. 4 mine was shut down for four months, or from April to August. A few men were employed at repair-work during this period, but no coal was produced. This mine has worked steadily since August. At No. 3 mine, or "Big Showing," as it is locally known, a large amount of work was done during the year.

There were no fatal accidents reported from this colliery during the year. This is the fourth year in succession in which this colliery has been free from fatal accidents, and is a very creditable record. One slight accident was reported during the year.

No. 3 or "Big Showing" Mine.

This is an open pit or surface operation, and is about 1,200 feet higher than the Corbin townsite, or about 6,200 feet above sea-level. It is reached by a standard-gauge switchback railway eight miles in length, owned and operated by the Coal Company. Shay locomotives are used for hauling the railroad-cars, as the grades are very heavy in places.

The seam at this point is several hundred feet thick and is standing practically vertical. There is comparatively little cover on the seam, and this is removed in benches by steam-shovels. It is sometimes necessary to blast the overburden, and this is done by driving several "coyote" holes in the side of the hill. These holes are then chambered at the back end and loaded with a heavy charge of black powder, as much as 3,000 lb. being in one hole. After blasting, the work of removing the debris is completed by the steam-shovels, leaving a clean face of coal. The coal is then loaded direct into railroad-cars by the steam-shovels.

No. 4 Mine.

Wm. Walker, Overman; Robert Brown and George Elmes, Firebosses.

This mine is situated between No. 1 mine and the tipple, and is working a part of what is known as the Prime seam. The seam at this point stands nearly vertical, and in places is several hundred feet thick between walls. The method of working is pillar and stall. All places are driven 9 feet wide and 10 feet high, water-level course. The levels are driven from the surface at a vertical elevation of 50 feet, and directly, or nearly so, over each other. Where the seam widens out it is sometimes possible to have four places going abreast, with a 50-foot pillar between each. The levels are connected at intervals of about 200 feet with 5- x 5-foot vertical raises. No pillars have been drawn in this mine.

Upon my last inspection on December 14th, 1916, I found this mine clear of gas, well timbered, and in a good condition. The mine is naturally wet and there is no accumulation of coal-dust. The ventilation for the different levels was as follows: 400 level, 9,000 cubic feet of air a minute for the use of seven men and one horse, or 900 cubic feet a unit; 500 and 600 levels, 11,000 cubic feet of air a minute for the use of eighteen men and two horses, or 458 cubic feet a unit. A general description of the ventilating machinery was given in my annual report for 1915.

The coal in this mine is all pick-mined, but a little blasting is done, the shots being fired by competent shotfirers with electric batteries. Monobel powder with No. 6 electric detonators is used for blasting the coal. Safety-lamps of the Wolf type are exclusively used in this mine.

The general and special rules and up-to-date copies of the mine-plans are posted at the mine.

There were 27,532 lb. of powder used and 4,332 shots fired at this colliery during the year. Most of the powder was used at the "Big Showing" in removing the overburden, as mentioned elsewhere in this report, and which accounts for the difference between the quantity of powder used and the number of shots fired.

The rescue equipment at this colliery is the same as last year, no additions having been made. No classes in "first aid" were held during the year.

ADDITIONS TO PLANT AND EQUIPMENT.

The following additions were made to the plant and equipment during the year: One Bucyrus steam-shovel, Class 45 C, equipped with a 1¾-yard dipper; eight 20-yard capacity steel air dump-cars for handling dirt in lieu of the home-made wooden dump-cars formerly used at the "Big Showing."

In order to be able to screen the coal loaded by the steam-shovels at the "Big Showing," a transfer plant has been installed. A standard-gauge railway-track, 2,000 feet in length was constructed and connected to the existing track, and extends to a point underneath the approach to the Marcus screen at No. 4 mine. A hopper was built underneath this track having a 60-ton capacity, and the coal from the railroad-track is dumped into this hopper. An apron-conveyor 4 feet wide and 172 feet long conveys the coal from the hopper up a grade of 11° 20′, and discharges it on the Marcus screen. This conveyor is operated by the same engine that operates the Marcus screen.

Three turntables for use at the ends of the various legs of the switchback railway to the "Big Showing" are being installed. This will overcome the necessity of returning to the Wye at Corbin when it becomes necessary to turn any of the rolling-stock, which is very often the case. *It will be a big advantage when using the rotary snow-plough during the winter season.*

A machine-shop has been erected at the roundhouse, and is equipped with a 24-inch lathe, a 20-inch shaper, a 23-inch drill, power hack-saw, emery-grinders, and pipe threading and cutting machine. All machinery is operated by a 15-horse-power induction-motor. A boiler has also been installed at the roundhouse and a heating system put in.

FIRE IN OLD NO. 1 MINE.

On November 19th, 1916, fire broke through the cement seal in Old No. 1 mine, in the part known as A level. This fire commenced in February, 1913, and the mine has been sealed up since that date. During all this time no evidence could be obtained whether the fire still existed or not, as, of course, only the exterior of the stoppings could be examined. In October, 1916, an attempt was made to find out if the fire still existed by penetrating the cement stopping on A level. This was accomplished, and it was learned that the fire was still burning. The stopping was immediately sealed but, despite this, the fire worked its way back the level and came through the stopping a month later. The fire was evidently getting a supply of oxygen through the stopping. A new seal was then constructed about 150 feet outside the old one in the rock tunnel, and so far it appears to be air-tight.

In conclusion, I am pleased to state that I have not received any complaints from the workmen as to dangerous conditions existing in any of the mines in my district.

The following are the official returns from the Corbin Colliery for the year 1916:—

SALE AND OUTPUT FOR THE YEAR.	COAL.		COKE.	
(Tons of 2,240 lb.)	Tons.	Tons.	Tons.	Tons.
Sold for consumption in Canada	5,484			
" export to United States	58,818			
" " other countries				
Total sales		64,302		
Used in making coke				
Used under colliery boilers, etc.	4,718			
Total for colliery use		4,718		
Stocks on hand first of year				
" last of year				
Difference { added to / taken from } stock during year				
Output of colliery for year		69,020		

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		6		8	
Whites—Miners	24				24	
Miners' helpers						
Labourers			47		47	
Mechanics and skilled labour	3		7		10	
Boys			1		1	
Japanese						
Chinese						
Indians						
Totals	29		61		90	

Name of seams or pits—No. 3 or "Big Showing"; No. 4 mine.

Description of seams, tunnels, levels, shafts, etc., and number of same—No. 3: Open work, stripping, and loading by steam-shovel. No. 4: Nothing to add to previous description.

Description and length of tramway, plant, etc.—A transfer conveyor has been installed at tipple to allow of the coal brought down from the "Big Showing" in railway-cars being dumped and transferred to Marcus screen for picking. Other additions to plant are machine-shop equipment and 45-ton Bucyrus steam-shovel.

SUMMARY—TABLE SHOWING ACCIDENTS OCCURRING IN B.C. COLLIERIES IN TEN YEARS—1907 TO 1916.

For the year	1907.				1908.				1909.				1910.				1911.				1912.				1913.				1914.				1915.				1916.				Total for 10 years.			
Outp't of coal—tons	2,219,608				2,109,387				2,400,600				3,139,235				2,193,062				3,025,709				2,570,760				1,810,967				1,972,580				2,485,580				23,927,486			
No. pers'ns employ'd	6,059				6,095				6,418				7,758				6,873				7,130				6,671				5,732				4,991				5,060				62,787			
Nature of Injury. / Cause of Accident.	Fatal.	Serious.	Slight.	Total.	Fatal.	Serious.	Slight.	Total.	Fatal.	Serious.	Slight.	Total.	Fatal.	Serious.	Slight.	Total.	Fatal.	Serious.	Slight.	Total.	Fatal.	Serious.	Slight.	Total.	Fatal.	Serious.	Slight.	Total.	Fatal.	Serious.	Slight.	Total.	Fatal.	Serious.	Slight.	Total.	Fatal.	Serious.	Slight.	Total.	Fatal.	Serious.	Slight.	Total.
Gas explosions.....	1	1	18	20	1	..	8	9	32	..	7	39	..	..	6	6	..	..	10	10	7	2	3	12	..	..	13	13	..	1	2	3	23	2	8	33	12	..	..	12	76	6	75	157
Falls of coal.....	8	15	7	30	3	6	10	19	7	7	4	18	5	16	5	26	3	5	6	14	4	7	9	20	6	4	2	12	2	6	..	8	1	3	3	7	3	5	2	10	42	74	48	164
" rock	2	7	8	17	5	10	7	22	6	13	9	28	8	15	12	35	..	5	24	29	5	9	10	24	11	9	3	23	2	14	..	16	4	7	4	15	7	6	7	20	50	95	84	229
Mine cars and horses	8	22	15	45	1	19	15	35	6	17	24	47	11	49	23	83	5	7	18	30	5	10	10	25	4	28	9	41	5	18	2	25	3	21	2	26	5	15	7	27	53	206	125	384
Powder, &c., expl'n	1	2	4	7	..	2	4	6	1	1	3	5	1	1	3	5	..	1	2	3	2	1	..	3	..	2	..	2	2	3	..	5	..	..	1	1	..	..	1	1	7	13	18	38
Hoisting, ropes, &c.	..	..	3	3	1	4	..	5	..	.	3	3	..	2	4	6	..	1	1	2	3	7	6	16	1	2	..	3	2	1	1	4	1	4	4	9	..	5	4	9	8	26	26	60
Mine timber.....	..	4	1	5	1	3	..	4	..	2	3	5	1	4	2	7	..	..	5	5	1	2	2	5	3	6	1	10	..	2	2	4	..	..	..	..	..	2	2	4	6	25	18	49
Underground—Miscellaneous	1	1	4	6	4	2	5	11	2	2	2	6	1	4	4	9	4	..	5	9	..	4	4	8	..	..	6	6	3	..	..	3	19	1	3	23	1	3	5	9	35	17	38	90
On surface—Miscellaneous	10	9	2	21	2	4	3	9	3	5	4	12	1	4	7	12	4	4	11	19	1	2	3	6	2	6	1	9	1	8	1	10	1	3	1	5	..	..	1	1	25	45	34	104
	31	61	62	154	18	50	52	120	57	47	59	163	28	95	66	189	16	23	82	121	28	44	47	119	27	57	35	119	17	53	8	78	52	41	26	119	28	36	29	93	302	507	466	1275

ACCIDENTS IN BRITISH COLUMBIA COLLIERIES DURING 1916.

Causes of Accident and Nature of Injury.	Name of Colliery.																																		Total for 1916.			
	W.F.Co. Nanaimo.			C.C. Extension.			C.C. Comox.			P.C.C. Co. S. Wellington			V.N.C. Co. E. Wellington.			I. C. & C. Co. Coal Hill.			M.C. Co. Middlesboro.			P.C. & L. Co. Princeton.			C.N.P. C.Co. Coal Creek.			C.N.P. C.Co. Michel.			C.C. & C. Co. Corbin.			Other Collieries.						
	Fatal.	Serious.	Slight.	Fatal.	Serious.	Slight.	Fatal.	Serious.	Slight.	Fatal.	Serious.	Slight.	Fatal.	Serious.	Slight.	Fatal.	Serious.	Slight.	Fatal.	Serious.	Slight.	Fatal.	Serious.	Slight.	Fatal.	Serious.	Slight.	Fatal.	Serious.	Slight.	Fatal.	Serious.	Slight.	Fatal.	Serious.	Slight.	Fatal.	Serious.	Slight.	Total.
Gas—Explosion of																																						12
Fatal																												12							12			
Serious																																						
Slight																																						
Falls of Coal																																						10
Fatal	1						1			1															2										3			
Serious		1			2																					1										5		
Slight									1									1																			2	
Falls of Rock or Roof																																						20
Fatal	2						3																		2										7			
Serious		4			1																					1										6		
Slight			2						2						1			1			1																7		
Mine Cars and Horses																																						27
Fatal							2			1																									5			
Serious		1			5			1								2										2			4							15		
Slight						1			1								1			1			1						1			1					7		
Shots or Powder																																						1
Fatal																																						
Serious																																						
Slight						1																															1	
Ropes, Hoisting or Haulage																																						9
Fatal																																						
Serious					1			1						1												2										5		
Slight															1			1			1								1							4		
Post or Timber																																						4
Fatal																																						
Serious		1																										1							2		
Slight																					1															2		
Miscellaneous—Underground																																						9
Fatal																										1									1			
Serious		1			1			1																												3		
Slight			1						1												1			1			1										5	
Miscellaneous—Surface																																						1
Fatal																																						
Serious																																						
Slight																											1										1	
Total	3	8	3		10	2	6	3	5	2				1	2		2	4			5			2	5	6	2	12	6	3			1				28	36	29	93
Number of men employed	1,109			555			894			284			153			98			132			79			1,018			566			90			82			5,060		

ANALYSIS OF ACCIDENTS DURING YEAR 1916.

	No. of Accidents per 1,000 Men employed.				Tons of Coal mined per Accident.			
	Fatal.	Serious.	Slight.	Total.	Fatal.	Serious.	Slight.	Total.
East Kootenay District	10.15	7.16	3.58	20.90	51,898	73,522	147,046	25,207
Coast District	3.24	7.08	6.70	17.12	146,755	66,804	69,709	27,640
Total for Province	5.53	7.11	5.73	18.37	88,770	69,044	85,709	26,727

PER CAPITA PRODUCTION OF COLLIERIES.

	Gross Tons of Coal mined in 1916.	Total Number of Men employed by Producing Collieries.	Tons of Coal mined per Man employed at Collieries.	Number of Men employed Underground in Producing Collieries.	Tons of Coal mined per Man employed Underground.
East Kootenay District	882,270	1,674	527	1,125	784
Coast District	1,603,310	3,386	473	2,569	624
Total for Province	2,485,580	5,060	491	3,694	673

DETAILED STATEMENT OF ACCIDENTS IN B.C. COLLIERIES DURING 1916.

COAST COLLIERIES.

REPORTED BY HENRY DEVLIN AND JOHN NEWTON, INSPECTORS.

No.	Colliery.	Date.	Name.	Occupation.	Details.
1	Comox No. 4.... (C.C.)	Jan. 7	Young Sune	Miner	Fractured skull, ribs, and lacerated wounds on face, caused by fall of top coal; fatal.
2	Extension No. 4.. (C.C.)	" 10	Attilio Coren....	Pusher.....	Was riding in empty mine-car when same ran off the track, causing him to fall out, dislocating and fracturing right wrist
3	Extension No. 1..	" 22	Enoch Diman.....	Loader..	Head cut, bruised back and shoulders, caused by fall of top coal.
4	East Wellington. (V.-N.C.C.)	" 24	Hugh Murdock....	Rope-rider	Skull fractured, left leg broken, and scalp-wound, caused by being thrown against a timber when trip stopped suddenly.
5	Extension No. 2.. (C.C.)	" 28	George Bourdis...	Pusher.....	Fractured right collar-bone while riding on top of a loaded car.
6	South Wellington (P.C.C.M.)	" 30	Horace Barber.....	Labourer.....	Died on January 30th, 1916, from injuries sustained on June 10th, 1915; fell in front of cars and was run over, causing severe internal injuries.
7	Nanaimo.. ..... (W.F.C.)	Feb. 5	James Doran	Loader.....	Rock fell from roof, breaking five ribs and causing cuts on chin and left eye.
8	Comox No. 6.... (C.C.)	" 11	Axel Nigren.....	Rockman	Bruise on side and back; superficial wound on cheek, caused by fall of roof.
9	Extension No. 1.. (C.C.)	" 23	Henry Wells.....	Driver.....	Was crushed between car and side, causing fractured pelvis.
10	Nanaimo.. .... (W.F.C.)	" 26	Hugh Bennett.....	Miner	Fractured skull, caused by fall of top coal; fatal.
11	Nanaimo ..... (W.F.C.)	March 8	Jas. H. Robertson..	"	Fractured right leg, caused by fall of top coal.
12	Comox No. 4.... (C.C.)	" 17	Ezra Coleman.....	Driver.....	Fractured right arm, caused by a kick from mule.
13	Extension No. 1.. (C.C.)	" 17	Robert Rafter.....	"	Trip on which he was driving was met by a runaway trip; in the collision Rafter received dislocated upper arm and broken collar-bone.
14	Morden.... .... (P.C.C.M.)	" 21	John W. Millburn..	Miner	Fall of top coal, causing fracture of all ribs below second; internal hæmorrhage, probably ruptured spleen; died one hour after accident.
15	Comox No. 7.... (C.C.)	April 5	Mike Krall.....	"	Bruised and sprained leg, hip, and loin, caused by fall of top coal.

COAST COLLIERIES—*Continued.*

No.	Colliery.	Date.	Name.	Occupation.	Details.
16	Extension No. 2.. (C.C.)	April 28	Mike Varanich....	Loader.....	Fractured skull and lacerated scalp, caused by fall of top coal.
17	Comox No. 4.... (C.C.)	May 2	Mah Sam.....	Miner	Struck by falling slip of rock, causing fracture of the base of skull, broken neck, etc.; fatal.
18	Nanaimo.. .... (W.F.C.)	" 4	William Thompson	Miner	Fractured right arm and bruised shoulder, caused by fall of rock.
19	Reserve ..... (W.F.C.)	" 6	J. A. Challoner....	Fireboss	Sprained leg, caused by fall of rock.
20	Comox No. 7.... (C.C.)	" 9	H. Oyama.....	Pusher.....	Was riding between cars and got crushed between a stringer and coal on car, causing fracture of collar-bone, severe bruise of face and head, etc.
21	Nanaimo ..... (W.F.C.)	" 11	Emilo Costa.....	Brusher	Right arm broken near wrist by fall of false roof.
22	Reserve..... (W.F.C.)	" 11	Mike Duggan.....	Miner	Struck by piece of falling lagging, causing badly bruised thighs and lower part of body.
23	Extension No. 3. (C.C.)	" 17	Joseph Smith.....	Miner	Fracture of leg and sprained right ankle, caused by falling on floor of his working-place.
24	Comox No. 4.... (C.C.)	" 22	Daniel Marsh.....	Fireboss	Crushed between a loaded car and stringer, causing comminuted fracture of ribs on right side.
25	Nanaimo ..... (W.F.C.)	June 2	George Langham...	Miner's helper.	Broken left wrist by fall of coal.
26	Extension No. 1.. (C.C.)	" 8	Alex. Robertson...	Driver.....	Right leg broken by being struck with car-bumper.
27	Extension No. 1.. (C.C.)	" 24	John Davidson	Shiftboss	Crushed between bridge-stick and car, causing broken ribs and bruised back and chest.
28	Comox No. 7.... (C.C.)	" 25	William M. Jones..	Boss driver....	Broken neck, right arm severed from body, supposed to have been caught between top of cars and roof; fatal.
29	Nanaimo ..... (W.F.C.)	" 28	Joseph Sandland...	Miner	Fractured base of skull, caused by falling rock; died in hospital one day later.
30	East Wellington. (V.-N.C.M.C.)	July 19	John McArthur ...	Miner	One finger broken and badly lacerated and two other fingers broken between rope and brake-stick.
31	East Wellington. (V.-N.C.M.C.)	" 28	Robt. McLennan ..	Trackman	Bruised side, caused from being crushed between car and timber.
32	Extension No. 3.. (C.C.)	Aug. 2	Matt Alton	Miner	Top rock rolled off face, striking his leg, breaking it.
33	Comox No. 7.... (C.C.)	" 3	Mah Wing Ging...	Miner's helper.	Compound comminuted fracture of skull, left arm, both legs, and left thigh, caused by fall of rock; fatal.
34	Comox No. 7.... (C.C.)	" 3	N. Koga.... . ..	Miner	Bruised back, hip, and legs. Same accident as above.
35	Comox No. 4.... (C.C.)	" 21	Hin Wang	Miner	Fractured ribs, internal injuries with hæmorrhage, caused by fall of rock; fatal.

COAST COLLIERIES—*Concluded.*

No.	Colliery.	Date.	Name.	Occupation.	Details.
36	Nanaimo..... (W.F.C.)	Sept. 9	George Kabcuoff.	Brusher	Lit a small pocket of gas with open light, causing severe burns on back, arms, hands, neck, and face.
37	Nanaimo..... (W.F.C.)	" 9	Steve Tysclauri....	"	Slight burn on neck and hands. Same accident as above.
38	Comox No. 6.... (C.C.)	" 11	Lung Kee.....	Driver.....	Comminuted fracture left thigh, internal abdominal injuries, caused by falling rock from cave; fatal.
39	Nanaimo.. ..... (W.F.C.)	" 19	William Bamford..	Winch-boy....	Was crushed between car and stop-block, causing compound fracture of left arm and lacerated middle finger of left hand.
40	Extension No. 4. (C.C.)	" 21	Thomas Strang....	Overman	Slight burn on right ribs, caused by explosion of detonator in his pocket.
41	Reserve ..... (W.F.C.)	Oct. 3	William Brough...	Miner	Struck by falling rock off slip causing broken leg and bruises on head and shoulders.
41½	Extension No. 2. (C.C.)	Dec. 11	Edwin Robinson...	Labourer.....	Right leg broken between car and stop-block.
42	Nanaimo..... (W.F.C.)	Nov. 25	Pietro Forner	Brusher	Left lung crushed by fall of rock; fatal.
43	Comox No. 6.... (C.C.)	Dec. 22	G. Martinello.....	Miner	Slipped and fell on brushing, causing neuritis of left leg.
44	Comox No. 6.. (C.C.)	" 23	Wong	Pusher.....	Superficial burns of hands, wrist, and nose, caused by igniting small pocket of gas.

NICOLA COLLIERIES.

REPORTED BY ROBERT STRACHAN, INSPECTOR.

45	Inland C. & C. Co.	Jan. 31	George Jacques....	Rope-rider....	Slipped on ice and struck a water-car, breaking two ribs and dislocating collar-bone.
46	Inland C. & C. Co.	April 6	Wm. McCreight...	Miner	Bruised on left side from being crushed between car and prop.
47	Inland C. & C. Co.	" 15	Wm. Young.....	"	Bruised and cut right foot by fall of rock.
48	Inland C. & C. Co.	July 13	H. Campbell	"	Struck by falling coal in chute, breaking two ribs on right side.
49	Middlesboro..... (M.C.L.)	" 18	Arch. Cunningham.	Rope-rider....	Severe cuts on right leg, caused by stepping and falling on frog, and leg going under car and against car-wheel.
50	Princeton..... (P.C. & L.C.)	Aug. 7	John Dangelo	Assistant rope-[rider	Cut on foot and shoulder by being struck by oncoming cars.
51	Inland C. & C. Co.	" 21	Ed Staton.....	Shotlighter....	Serious scalp-wound, caused while getting out of way of a runaway trip.
52	Princeton..... (P.C. & L.C.)	" 26	Martin Landgrew..	Timberman ...	Cut on foot, caused by axe slipping off post.

NICOLA COLLIERIES—*Concluded.*

No.	Colliery.	Date.	Name.	Occupation.	Details.
53	Middlesboro..... (M.C.C.)	Oct. 8	Walter Nelson	Hoistman.....	Three small cuts on head and bruised back, caused by trip running back on landing.
54	Inland C. & C. Co.	" 14	Frank Konic	Rope-rider....	Sprained wrist, caused by trip stopping suddenly and jamming his wrist between car and timber.
55	Middlesboro..... (M.C.C.)	Nov. 14	David C. Grieve...	Miner	Fell over a piece of coal, breaking one rib on right side.
56	Middlesboro..... (M.C.C.)	" 21	William Travan...	"	Was shaping a cap-piece when axe deflected, severing tendons of index finger, right hand.
57	Middlesboro..... (M.C.C.)	Dec. 9	Gus. Klemola	"	Bruised thumb on right hand, caused by coming in contact with breaker-post while throwing rock into a cog.

EAST KOOTENAY COLLIERIES.

REPORTED BY T. H. WILLIAMS AND GEORGE O'BRIEN, INSPECTORS.

58	Corbin..... (C.C. & C.C.)	Jan. 14	Nick Reppa.....	Driver...	Slightly squeezed around hips, caused by being crushed between car and a post.
59	Coal Creek..... (C.N.P.C.C.)	Feb. 28	Mike Sikora.....	Miner	Buried under a cave of rock; fatal.
60	Coal Creek..... (C.N.P.C.C.)	" 28	Pietro Bortalliotti..	"	Bruised hip and back, cut on head, and shock. Same accident as above.
61	Coal Creek..... (C.N.P.C.C.)	Mar. 10	Daniel Alton	Rope-splicer...	Fracture of small bone of foot, caused by heavy steel rail falling on same.
62	Michel..... (C.N.P.C.C.)	" 30	S. Pavco	Timberman....	Ruptured internal ligament of left knee-joint, caused by timber falling on it.
63	Coal Creek..... (C.N.P.C.C.)	April 5	Albert Bozek.....	Driver.....	Crushed between horse and car, break- both bones of right leg.
64	Michel..... (C.N.P.C.C.)	" 5	J. Sitar.....	Miner	Amputated end of finger between bumper of dump-car and rail.
65	Coal Creek..... (C.N.P.C.C.)	" 18	Alfred Crompton ..	Gripper.....	Runaway car struck his leg, breaking both bones.
66	Michel..... (C.N.P.C.C.)	May 23	J. Lestinsky	Driver.....	Was using a short stick to couple two cars and had little finger amputated while doing same.
67	Coal Creek..... (C.N.P.C.C.)	" 26	William Watkins .	Fireboss	Buried under a cave of roof; fatal.
68	Coal Creek..... (C.N.P.C.C.)	" 26	Benjamin Brown...	Bell-boy	Compound fracture of right forearm, dislocated left shoulder, severely lacerated right hand, caused by being run over by mine-car.
69	Michel..... (C.N.P.C.C.)	" 30	T. Sitvak.....	Driver.....	Was riding on front of car when horse started to run away; in trying to stop horse he slipped off car, breaking right thigh and left leg.
70	Coal Creek..... (C.N.P.C.C.)	July 22	Steve Andruchuk..	"	Crushed between runaway cars and timbers; fatal.

EAST KOOTENAY COLLIERIES—*Concluded.*

No.	Colliery.	Date.	Name.	Occupation.	Details.
71	Michel	Aug. 8	Thomas Phillips ...	Fireboss	Killed in mine explosion.
72	"	" 8	Peter Hrbka	Timberman ...	" "
73	"	" 8	Joe Mekus	Labourer.....	" "
74	"	" 8	George Kometz....	Miner	" "
75	"	" 8	David Davies.....	"	" "
76	"	" 8	H. Evans.....	Labourer.....	" "
77	"	" 8	Andro Ficon.....	"	" "
78	"	" 8	Sam Dmytriv.....	Rope-rider	" "
79	"	" 8	Oscar de Volder ...	Miner	" "
80	"	" 8	Thomas Hampton..	"	" "
81	"	" 8	Daniel Hall	Hoistman	" "
82	"	" 8	Mike Marmol.....	Bratticeman...	" "
83	Coal Creek..... (C.N.P.C.C.)	" 10	Elia Rezko.....	Labourer.....	Right knee-cap broken by being crushed between the bumpers of two cars.
84	Michel..... (C.N.P.C.C.)	Sept. 9	J. Dobija.....	Miner	Piece of coal came away from between two slips and struck his left leg, breaking it.
85	Michel..... (C.N.P.C.C.)	Oct. 11	M. Gricorica	Rope-rider	Right arm broken by being crushed between top of timber on mine-car and roof.
86	Coal Creek..... (C.N.P.C.C.)	Nov. 8	John Goniak	Timberman's [helper	Imprisoned between two caves, caused by "bump" and causing asphyxiation ; fatal.
87	Coal Creek..... (C.N.P.C.C.)	" 15	Genaro Riccuiti....	Driver.....	Crushed between two cars while uncoupling same, fracturing ribs on right side.
88	Michel.. ..... (C.N.P.C.C.)	" 15	J. Beeby.....	Pipe-fitter.....	Little finger on left hand amputated in gear-wheels of machine while threading pipe.
89	Michel..... (C.N.P.C.C.)	Dec. 11	W. Kyryluk.....	Driver.....	Crushed between car and post, causing a pelvic fracture.
90	Coal Creek..... (C.N.P.C.C.)	" 18	Gen Carolei..	Miner	Struck by runaway car from a "McGinty"; fatal.
91	Coal Creek .... (C.N.P.C.C.)	" 21	P. Vanderberghe ..	Timberman's [helper	Both bones of left leg fractured by fall of top coal.
92	Michel..... (C.N.P.C.C.)	" 28	L. Kovach	Miner	Car of coal ran over the end of track and struck his leg, breaking same.

PROSECUTIONS UNDER "COAL-MINES REGULATION ACT."

As is incumbent upon the Inspector, he has been obliged to lay information before the local Magistrates in a large number of cases for infractions, by the workmen in the mines, of the general and special rules, which are provided solely for their own protection. These regulations are for the general safety of all the underground employees, and the carelessness of one man endangers all his fellow workmen, whose lives are practically in the hands of such foolishly careless or criminal person.

The following prosecutions have been brought during the year for the offences noted; the judgments given by the Magistrate being shown:—

Date.	Name.	Occupation.	Mine.	Offence charged.	Judgment.
Jan. 29	Nakamura T. Fuchimo	Miner	Comox	Wilfully damaging a safety-lamp	Two months' hard labour.
Feb. 14	Thos. Connor	"	Coal Creek	Damaging a safety-lamp	Case dismissed.
" 21	T. Budge	Shotlighter	E. Welling'tn	Not having their safety-lamps a certain distance from swing of pick	Fined $10 and costs.
" 21	E. Edwards	Miner	"	Same offence	Fined $10 and costs.
" 21	W. Frear	"	"	Same offence	Fined $10 and costs.
" 21	T. Kitchen	"	"	Same offence	Fined $10 and costs.
" 21	L. Mottishaw	"	"	Same offence	Fined $10 and costs.
" 24	K. Kusumose	"	Comox	Damaging safety-lamp	Fined $10 and costs.
" 27	B. Kitamura	"	"	Same offence	Fined $10 and costs.
March 9	G. Fabbro	"	Michel	Failure to sprag undermined coal	Fined $10 and costs.
" 9	L. Raffin	"	"	Same offence	Fined $10 and costs.
" 9	J. Gall	"	"	Same offence	Fined $10 and costs.
" 29	John Joseph	"	Comox	Charging a shot-hole before the fireboss examined the shot	Fined $10 and costs.
" 30	John Joseph	"	"	For unramming and withdrawing the explosive from the hole	Sixty days' hard labour.
May 19	Martin Beguin	"	Coal Creek	For damaging a safety-lamp	Fined $5 and costs.
" 19	Mike Kosiw	Timberman	"	Same offence	Ordered to pay costs of Court.
July 2	V. Constanzo	Miner	"	Riding on a trip of cars underground	Suspended sentence.
" 2	J. Gigliotti	"	"	Same offence	Suspended sentence.
Aug. 14	A. Destabelle	"	"	Failure to sprag undermined coal	Fined $10 and costs.

PROSECUTIONS—*Concluded.*

Date.	Name.	Occupation.	Mine.	Offence charged.	Judgment.
Aug. 14	A. Kubineez...	Miner	Coal Creek..	Failure to sprag undermined coal	Fined $10 and costs.
" 28	N. Gurlock....	Driver	Nanaimo (Reserve)	Having tobacco and matches in his possession while in mine	Fined $10 and costs.
Sept. 11	J. M. Brown..	Fireboss	Nanaimo....	Failure to examine a working-place within 3 hours before men proceeded to work therein	Fined $5 and costs.
" 21	Mike Jakobic..	Miner	Coal Creek..	Damaging a safety-lamp.....	Fined $10 and costs.
Oct. 2	William James	Manager....	Extension...	Permitting unlocked safety-lamps in mine	Fined $10 and costs.
" 6	D. Graves.....	.....	Coal Creek..	Having matches in his possession while in mine	Fined $5 and costs.
" 6	S. Morris.....	.....	" ..	Same offence.....	Fined $5 and costs.
" 6	J. Ferarelli...	.....	" ..	Same offence.....	Fined $5 and costs.
" 6	V. Bagioli.....	....	" ..	Same offence.....	Fined $5 and costs.
" 12	L. Lapsansky..	Miner	Extension...	For smoking in a safety-lamp district	Fined $10 and costs.
Nov. 21	Young On.....	"	Comox	Having a cigarette and matches in his possession in a safety-lamp mine	Fined $10 and costs.
Dec. 1	Angelo Brindisi	"	Extension...	Same offence.....	Fined $10 and costs.
" 4	T. McKeating..	"	Middlesboro	Having pipe and matches in his possession while in mine	Fined $10 and costs.
" 4	Louis Angelo..	"	"	Same offence.....	Fined $10 and costs.
" 4	John Little....	Labourer....	"	Same offence.....	Fined $10 and costs.
" 4	A. McDonald..	"	"	Same offence.....	Fined $10 and costs.
" 22	Mike Savich...	"	Princeton....	Same offence.....	Fined $5 and costs.

METALLIFEROUS MINES SHIPPING IN 1916.

CASSIAR.

ATLIN MINING DIVISION.

Mine or Group.	Locality.	Owner or Agent.	Address.	Character of Ore.
Engineer	Windy Arm	J. Alexander	Carcross	Gold.
Harper	"	J. L. Harper	"	Gold, silver, lead.
Rufner	Atlin	J. W. Rufner	Atlin	Gold.

SKEENA.

SKEENA MINING DIVISION.

Babington & Jones	Skeena	H. P. Babington	Prince Rupert	Copper.
Esperanza	Alice Arm	Pedro Salinas	Alice Arm	Gold, silver.
Frisco	Skeena	Wm. Tuttle	Prince Rupert	Silver, copper.
Granby Group	Anyox	Granby Cons. M. S. & P. Co.	Anyox	Copper, gold.

PORTLAND CANAL MINING DIVISION.

Falconer	Portland Canal	F. W. Falconer	Stewart	Silver, lead.
Grey Copper	"	C. E. Clarke	Victoria	"

QUEEN CHARLOTTE MINING DIVISION.

Dorathkalon	Jedway	A. H. Knowlton	Vancouver	Gold, silver, copper.
Ikeda Mines	Ikeda bay	A. Ikeda	Ikeda	Copper, gold.
Tasu	Tasu harbour	T. E. Young	Victoria	Gold, silver, copper.
Wireless	Jedway	P. C. Daykin	Jedway	"

OMINECA MINING DIVISION.

American Boy	Nine-mile mountain	Harris Mines, Ltd.	Hazelton	Gold, silver, lead.
Diamond Group	Hardscrabble creek	Stanley Ross	Pitman	Copper.
Larkworthy	Hazelton	W. J. Larkworthy	New Hazelton	Silver, copper.
Price	Legate Creek	J. J. Price	Pacific	Silver, copper, lead.
Rocher Déboulé	Rocher Déboulé mt.	Rocher Déboulé Mining Co.	Tramville	Copper, silver, gold.
Silver Bell	Nine-mile mountain	Geo. T. Stewart	Hazelton	Silver, lead.
Silver Cup	Hazelton	Silver Cup Mines	Prince Rupert	"
Silver Standard	Glen mountain	Silver Standard Mining Co.	Vancouver	"

EAST KOOTENAY.

FORT STEELE MINING DIVISION.

Burton	Elko	A. F. Caldwell	Elko	Copper.
Park Group	Marysville	W. A. Chisholm	Marysville	Silver, lead.
Quantrel	Kimberley	E. E. Jones	Kimberley	"
St. Eugene	Moyie	Consolidated M. & S. Co.	Marysville	"
Sullivan	Kimberley	"	"	"

EAST KOOTENAY—*Concluded.*

WINDERMERE-GOLDEN MINING DIVISION.

Mine or Group.	Locality.	Owner or Agent.	Address.	Character of Ore.
Copper Butte				Silver, copper.
Couverapee	Field.	Manager	Field	Silver, lead.
Giant	Carbon Landing	Golden Giant Mines	Golden	"
Hidden Treasure				Silver, copper.
Isaac	Isaac creek	H. E. Forster	Wilmer	Silver, lead.
Lead Queen	Wilmer	J. MacLeod	"	"
Monarch	Field.	Minerals Recovery Co.	Field	Silver, lead, zinc.
Nip and Tuck	McDonald creek	Wm. Haupt	Wilmer	Silver, lead.
Paradise	Toby creek	R. R. Bruce	"	"
Silver Belt	Windermere	F. Stockdale	Invermere	"

WEST KOOTENAY.

AINSWORTH MINING DIVISION.

Bell	Retallack	C. F. Caldwell	Kaslo	Zinc.
Bluebell	Riondel	New Canadian Metal Co.	Riondel	Silver, lead.
Comfort	Ainsworth			"
Cork Province	Zwicky	Cork Province Mines, Ltd.	Kaslo	"
Crescent	Ainsworth	T. Williams	Ainsworth	"
Early Bird	"			"
Florence	"	Florence Silver Mining Co.	Ainsworth	"
Gallagher	"	A. D. Wheeler	"	Silver.
Grant & General	Woodberry creek	G. F. Olson	"	Silver, lead.
Highland	Ainsworth	Consolidated M. & S. Co.	"	"
Maestro	"	"	"	"
Martin	"	I. A. Carter	Zwicky	"
Nicollet	"			"
No. 1	South fork, Kaslo creek.	Consolidated M. & S. Co.	Ainsworth	"
Panama	Bear lake	H. Giegerich	Kaslo	Silver.
Retallack	Retallack	W. H. Burgess	"	Silver, lead, zinc.
Revenue	South fork, Kaslo creek.	L. McLean	"	Silver, lead.
Utica	Kaslo	Utica Mines, Ltd	"	Silver, lead, zinc.

SLOCAN MINING DIVISION.

Alps-Alturas	Carpenter creek	W. A. McMillan	Vancouver	Antimony.
Apex	New Denver	A. J. Becker	New Denver	Gold, silver, lead.
Black Grouse	Carpenter creek	J. D. Ryan	Three Forks	Silver.
Comstock	Slocan			Silver, lead.
Elkhorn	Sandon	G. T. Gormley	Sandon	"
Galena M. & S. Co.	Silverton	Galena M. & M. Co.	Silverton	"
Hewitt	"	Silverton Mines, Ltd.	"	Silver, lead, zinc.
Idaho-Alamo	New Denver	Thos. Avison	New Denver	Silver, lead.
Ivanhoe	Sandon	Minnesota Silver Co.	Sandon	"
Jo-Jo				
Lucky Jim	Zincton	Lucky Jim Zinc Mines, Ltd.	Kaslo	Zinc.
Lucky Thought	Silverton	Consolidated M. & S. Co.	Trail	Silver, lead.
Majestic-Unexpected	Slocan	F. H. Bourne	Revelstoke	"
Mollie Hughes	New Denver	H. Cleves	New Denver	Gold, silver.
Noonday	Sandon	Bruce White	Sandon	Silver, lead.
Number One	"	J. M. Harris	"	"
Payne	"	Slocan Payne Mines, Ltd.	"	"
Queen Bess	Slocan	Clarence Cunningham	"	"
Rambler-Cariboo	Three Forks	Rambler Cariboo Mines, Ltd.	Three Forks	"
Reco	Sandon	Reco M. & M. Co., Ltd.	Sandon	Silver, lead, zinc.
Richmond-Eureka	"	Consolidated M. & S. Co.	Trail	Silver, lead.
Ruth	"	The Ruth Mines, Ltd.	Kaslo	"
Silver King				
Slocan Star	Sandon	Slocan Star Mines, Ltd.	Sandon	Silver, lead, zinc.
Sovereign	"	Clarence Cunningham	"	Silver, lead.
Standard	Silverton	Standard & Silver Lead Mining Co.	Silverton	Silver, lead, zinc.
Surprise	Sandon	J. P. McFadden	Sandon	"
Wonderful	"			Silver, lead.
Yakima				"

SLOCAN CITY MINING DIVISION.

Black Prince	Springer creek	J. T. Tipping	Slocan	Silver, lead.
Enterprise	Ten-mile creek	S. S. Fowler	Riondel	"
Meteor	Toby creek	G. H. Aylard	Victoria	Gold, silver.
Ottawa	New Denver	Consolidated M. & S. Co.	Trail	Silver.

WEST KOOTENAY—*Concluded.*

NELSON MINING DIVISION.

Mine or Group.	Locality.	Owner or Agent.	Address.	Character of Ore.
California	Toad mountain	W. Moore	Nelson	Gold, silver.
Emerald	Salmo	Iron Mountain, Ltd.	Salmo	Silver, lead.
Euerka.	Eagle creek	Eureka Copper Mines	Nelson	Silver, copper.
Granite	Nelson	Crilly, Wilson, *et al.*	"	Gold.
H.B.	Salmo	Hudson Bay Zinc Co.	Salmo	Silver, lead, zinc.
Hobson	Ymir	Hobson Silver Lead Co., Ltd.	Ymir	Gold, silver.
Molly Gibson	Nelson	Consolidated M. & S. Co.	Trail	Silver, lead.
Perrier	"	C. C. Crossley	Nelson	Gold, silver, lead.
Rio Tinto	"			Silver, copper.
Spokane	Canyon creek	Canyon Creek Mining Syndicate.	Nelson	Gold, silver, lead.
Queen	Sheep creek	Queen Mines, Inc.	Sheep Creek	Gold, silver.
Queen Victoria	Nelson	B.C. Copper Co.	Greenwood	Gold, silver, copper.
Queen Victoria Frac.	"			Silver, copper.

TRAIL CREEK MINING DIVISION.

Centre Star-War Eagle	Rossland	Consolidated M. & S. Co.	Rossland	Gold, silver, copper.
Le Roi	"	"	"	"
Le Roi No. 2	"	Le Roi No. 2, Ltd.	"	"
Velvet	"	Velvet-Portland Mines	"	"

REVELSTOKE MINING DIVISION.

Lanark	Laurie	Lanark Mining Co.	Illecillewaet	Silver, lead.

TROUT LAKE MINING DIVISION.

Ferguson-Silver Cup	Ferguson	Ferguson Mines, Ltd.	Kaslo	Silver, lead.

LARDEAU MINING DIVISION.

Harrigan Mobbs	Lardeau			Silver, lead.
Old Gold	"	Judge Miller	Bellingham, Wash.	"
Triune	"	Mr. Battey	Minneapolis	"

ARROW LAKE MINING DIVISION.

Millie Mack	Burton	H. E. Forster	Wilmer	Gold, silver, lead.

BOUNDARY.

GRAND FORKS MINING DIVISION.

Bell	Wallace mountain	Robt. Perry	Beaverdell	Silver, lead.
Bounty Fract.	"	Andrew Matasky	"	Silver.
Humming Bird	Granby river			
Little Bertha	"	Fred Knight	Spokane	
Pathfinder	North fork, Kettle river.	Pathfinder Mine Co., Ltd.	Grand Forks	Gold, silver, copper.
Seattle	Granby river.			"
Union	Franklin Camp	Lewis Johnson	Grand Forks	Gold, silver.

BOUNDARY—*Concluded.*

GREENWOOD MINING DIVISION.

Mine or Group.	Locality.	Owner or Agent.	Address.	Character of Ore.
B.C	Eholt	B.C. Copper Co.	Greenwood	Silver, copper.
Big Copper	Greenwood	John Moran	"	"
Dayton	Dayton Camp	W. Eyounkin	Bridesville	Gold, silver, copper.
Emma	Denoro	Consolidated M. & S. Co.	Trail	"
Granby Consolidated	Phoenix	Granby Cons. M. S. & P. Co	Vancouver	"
Idaho	"	B.C. Copper Co.	Greenwood	
International				
Jewel Denero	Greenwood	Jewel Denero Mines, Ltd.	Greenwood	Gold, silver.
Kokomo	Beaverdell	G. M. Barrett	Beaverdell	Silver, lead.
Maple Leaf	Franklin Camp	Maple Leaf Mines, Ltd.	Grand Forks	Gold, silver, copper.
Mother Lode	Greenwood	B.C. Copper Co.	Greenwood	"
Orinoco				
Oro Denoro	Denoro	B.C. Copper Co.	Greenwood	Gold, silver, copper.
Rawhide	Phoenix	New Dominion Copper Co.	"	"
Sally & Rob Roy	Beaverdell	Van. & Boundary Ck. D. & M. Co.	Beaverdell	Silver, lead.
Sappho				Silver, copper.
Sunset	Greenwood	New Dominion Copper Co.	Greenwood	Gold, silver, copper.
Totumpo	Wallace mountain			Silver, copper.
Viking				"

OSOYOOS MINING DIVISION.

Dividend-Lakeview	Osoyoos	J. L. Greatsinger	Brooklyn, N.Y.	Gold, silver, copper.
Dolphin	Keremeos	C. & W. Jordan	Keremeos Centre	Silver, copper.
Horn Silver	Similkameen	E. W. Condit	Similkameen	Gold, silver.
Nickel Plate	Hedley	Hedley Gold Mining Co.	Hedley	Gold.

SIMILKAMEEN, NICOLA, AND VERNON MINING DIVISIONS.

Aberdeen	Nicola	Aberdeen Mines Syndicate	Merritt	Silver, copper.
Baker-Sterns	Merritt	Baker-Sterns Co.	"	Copper.
Golden Sovereign	Nicola	R. J. Armstrong.	"	"
Johnson	Merritt	E. C. Johnson	"	"
Joshua	Nicola	Thos. Hunter	Nicola	Gold, silver, copper.
Little Sioux	Similkameen	G. R. B. Elliott		Copper.
St. George and St. Lawrence	Bear creek	Similkameen Mining Co.	Tulameen	Gold, silver, copper.
Totem Pole	Thynne creek	Lucky Tod Mining Co.	Merritt	Silver, copper.

YALE, ASHCROFT, AND KAMLOOPS MINING DIVISIONS.

Antimony Group	Yale	W. S. Clark	Keefers	Antimony.
Chataway Group	Ashcroft	F. Keffer	Spokane	Copper.
Emancipation	Yale	C. H. Lighthall	Hope	Gold.
Evening Star	Kamloops	A. S. McArthur	Kamloops	Silver, copper.
Foghorn	"	Geo. Fennell	Chu Chua	Silver, lead.
Iron Mask	"	Kamloops Copper Co., Ltd.	Kamloops	Gold, silver, copper.
Silver Daisy	Yale	J. A. Russell	Vancouver	Gold, silver, lead.
Snowstorm	Ashcroft	Stuart Henderson	Victoria	Silver, copper.
Wand Pass	Kamloops	Oscar Hargon	Chu Chua	Gold, silver, copper.

LILLOOET MINING DIVISION.

Coronation	Lillooet	F. H. Forbes	Victoria	Gold.
Lorne	"	A. F. Noel	Lillooet	"
Pioneer	"	A. Ferguson	Vancouver	"
Wayside	"	D. C. Paxton	Lillooet	"

SOUTH COAST.

VANCOUVER MINING DIVISION.

Britannia	Howe Sound	Britannia Mining & Smelting Co.	Britannia Beach	Gold, silver, copper.
West	Vancouver	G. G. West	Vancouver	Gold, silver.

SOUTH COAST—*Concluded.*

NANAIMO MINING DIVISION.

Mine or Group.	Locality.	Owner or Agent.	Address.	Character of Ore.
Copper Queen	Texada Island	Geo. Buster	Vananda	Gold, silver, copper.
Little Billie	"	Little Billie Mining Co.	"	"
Le Roi	"	Texada Mines, Ltd.	"	Copper.
Lucky Jim	Valdes Island	Valdes Gold & Copper Co	Vancouver	Gold, silver, copper.
Lasqueti	Lasqueti Island	F. A. Schaeffer		Gold, copper.
Marble Bay	Texada Island	Tacoma Steel Co.	Tacoma	Gold, silver, copper.
Martin Lee & Marlatt	"			Gold, copper.
Planta	"	W. S. Planta	Nanaimo	Gold, silver, copper.
Shushartie	Shushartie Bay	H. Skinner	Shushartie	Gold.

NEW WESTMINSTER MINING DIVISION.

Viking	Pitt Lake			Silver, copper.

VICTORIA MINING DIVISION.

Viva	Cowichan	Joe Gallo	Cowichan	Silver, copper.
Willow Grouse	Sooke	R. G. Mellin	Sooke	Copper.

ALBERNI AND CLAYOQUOT MINING DIVISIONS.

Indian Chief	Clayoquot	Tidewater Copper Co.	Sidney Inlet	Gold, silver, copper.
Monitor	Alberni Canal	Jas. B. Skene	Port Alberni	Copper.
Sunshine	"	J. B. Woodworth	Vancouver	Silver, copper.

LIST OF CROWN-GRANTED MINERAL CLAIMS.

CROWN GRANTS ISSUED IN 1916.

CASSIAR.

Claim.	Division.	Grantee.	Lot No.	Acres.	Date.
Abdies	Omineca	Creighton Ross Palmer	9062 G. 1	26.99	July 22
Albion	Skeena	William Thomas Kergin	3189	32.18	Sept. 25
Ayrshire	Portland Canal	The Pacific Coast Exploration Co., Ltd	3232	43.07	Sept. 12
Aria	Skeena	The Granby Consolidated Mining, Smelting, and Power Co., Ltd	1986	35.53	Jan. 12
Bandolier	Portland Canal	John Wardlaw Stewart, Watson D. Noble, and Alexander Rutherford	3199	51.65	June 26
B and M	Omineca	Henry Bretzins and Alfred H. Morten	6313 R. 5	47.00	Nov. 20
Balsam	Skeena	The Granby Consolidated Mining, Smelting, and Power Co., Ltd	768	26.98	July 18
Balsam	"	The Granby Consolidated Mining, Smelting, and Power Co., Ltd	2221	42.91	Sept. 9
Barber	Atlin	Thomas Vaughan	1173	50.89	Sept. 19
Basin	Skeena	George Ratcliffe Naden	3190	51.65	July 7
Bertha	"	James Falkner	2237 R. 4	42.49	Sept. 22
Big Canyon No. 2 Extension	Atlin	Thomas Vaughan and John Molloy	1171	48.14	Sept. 19
Big Canyon Extension	"	Thomas Vaughan and John Molloy	1170	39.00	Sept. 19
Big Missouri	Portland Canal	Daniel Lindeborg and Hiram Stevenson	3217	45.97	Oct. 25
Black Knight	"	William Thomas Kergin, John Edmund Stark, and George Rudge	3637	49.4	Feb. 15
Black Knight No. 1	"	William Thomas Kergin, John Edmund Stark, and George Rudge	3656	51.65	Feb. 15
Bunny Boy	Omineca	Creighton Ross Palmer	9061 G. 1	49.62	July 22
Black Bear	Portland Canal	George Matheson, George Rudge, and James A. Robertson, administrator of the estate of Donald A. Robertson, deceased, intestate	1553	51.65	Oct. 3
Black Bear	Skeena	Olier Besner	3338	37.6	Oct. 7
Boulder	"	Myron Knox Rodgers	2338	36.15	Mar. 23
Buena Vista	Portland Canal	Andrew Lindeborg	3207	51.65	Oct. 25
Cato	Atlin	Albert Sam Chisel	383	51.65	Jan. 13
Cedar	Skeena	The Granby Consolidated Mining, Smelting, and Power Co., Ltd	764	51.65	July 18
Cobalt Fraction Fractional	Portland Canal	The Pacific Coast Exploration Co., Ltd	3236	36.8	Sept. 15
Commodore	Skeena	The Granby Consolidated Mining, Smelting, and Power Co., Ltd	3588	47.89	Sept. 11
Crystal	"	Ditto	1972A	51.65	Jan. 11
Cyprus	"	"	765	42.75	July 18
Dauntless	Portland Canal	Daniel Lindeborg	3219	37.29	Oct. 25
Darwin Fraction Fractional	Skeena	The Granby Consolidated Mining, Smelting, and Power Co., Ltd	1141	17.6	Sept. 29
Debenture	Omineca	Henry Bretzins and Alfred H. Morten	6310 R. 5	43.39	Nov. 20
Dolly Fraction Fractional	Skeena	The Granby Consolidated Mining, Smelting, and Power Co., Ltd	1513	1.34	Oct. 28
Dolly Varden	"	Charles Swanson	3194	41.88	July 15
Dolly Varden No. 1	"	Ernest Carlsen	3192	29.32	July 25
Dolly Varden No. 2	"	Karl Ludwig Eik	3193	32.04	July 25
Dolly Varden No. 4	"	Ole Evindsen	3195	27.24	July 15
Dolly Varden No. 5	"	Charles Swanson	3196	36.08	July 15
Dolly Varden No. 7	"	Ole Pearson	3198	9.33	July 25
Dolly Varden No. 6	"	Karl Ludwig Eik	3197	35.95	July 25
Edith M	Portland Canal	The Pacific Coast Exploration Co., Ltd	3235	51.65	Sept. 13
Elk	Skeena	Olier Besner	3339	45.62	Oct. 7
Emperor	Atlin	John Ludwig Carlson	109	30.43	Mar. 22
Epluribus	Portland Canal	Duncan Cameron Barbrick, administrator of the estate of James Proudfoot, deceased, intestate	3213	51.06	Nov. 7
Evans	"	The Pacific Coast Exploration Co., Ltd	3231	42.08	Sept. 13
Even Star, The	Atlin	Annie James	1261	41.49	Nov. 8
French	Skeena	James Falkner	2233 R. 4	37.74	Sept. 21
Galena	Omineca	Henry Bretzins and Alfred H. Morten	6311	38.35	Nov. 20
Glengarry No. 1	Skeena	James Falkner	2238	17.62	Feb. 22
Glengarry No. 2	"	James Falkner	2239	33.31	Sept. 22
Glenora	Portland Canal	The Pacific Coast Exploration Co., Ltd	3234	28.73	Sept. 13
Golden Crown	"	Hiram Stevenson	3210	51.65	Oct. 25
Graham	Skeena	James Falkner	2234	33.08	Sept. 21
Granby	Portland Canal	The Pacific Coast Exploration Co., Ltd	3239	51.65	Sept. 15
Gray Eagle	"	The Granby Consolidated Mining, Smelting, and Power Co., Ltd	2025	41.69	Mar. 23

CASSIAR—*Continued.*

Claim.	Division.	Grantee.	Lot No.	Acres.	Date.
Great Ohio	Omineca	Raleigh P. Trimble	702	33.59	May 2
Harvey	Portland Canal	Ella H. Humble	527	46.58	May 1
Hemlock Fraction Fractional	Skeena	The Granby Consolidated Mining, Smelting, and Power Co., Ltd.	1511	2.68	Sept. 7
Henrietta	Omineca	Raleigh P. Trimble	707	48.42	May 3
Hooter	Skeena	The Granby Consolidated Mining, Smelting, and Power Co., Ltd.	2224	48.06	Sept. 9
Hope Fractional, The	Atlin	Horace McNaughton Fraser	962	37.24	Dec. 4
Humbolt	Skeena	Olier Besner	3336	38.03	Oct. 7
Hurrah	Atlin	Eva Lambert	1175	43.59	Sept. 19
Independence	Skeena	The Granby Consolidated Mining, Smelting, and Power Co., Ltd.	1514	46.12	Oct. 28
Iron Cap	"	The Granby Consolidated Mining, Smelting, and Power Co., Ltd.	1508	26.46	Oct. 2
Jain	Portland Canal	Duncan Cameron Barbrick, administrator of the estate of Chas. Proudfoot, deceased, intestate	3209	29.87	Nov. 7
Kansas	"	Daniel Lindeborg and Hiram Stevenson	3218	48.31	Oct. 25
Kaien Frac. Fractional	Skeena	The Granby Consolidated Mining, Smelting, and Power Co., Ltd.	2231	11.53	Sept. 12
Kitsequekla	Omineca	Raleigh P. Trimble	703	31.66	May 3
Knob Hill	Portland Canal	Andrew Lindeborg	3220	51.65	Oct. 25
Lakanian Fraction Fractional	Skeena	The Granby Consolidated Mining, Smelting, and Power Co., Ltd.	1512	42.64	Sept. 8
Lake	"	Ditto	1139	50.84	Sept. 29
Last Laugh	Portland Canal	"	2021	45.52	Mar. 22
Last Laugh No. 2 Fraction Fractional	"	"	1990	36.08	Mar. 22
Last Laugh No. 3 Fraction Fractional	"	"	2023	9.36	Mar. 23
Laura	"	Hiram Stevenson	3214	41.61	Oct. 25
Limestone	Skeena	The Granby Consolidated Mining, Smelting, and Power Co., Ltd.	945	51.51	Oct. 2
Lone Maid	"	Graham Chambers and William Henry Cooper	3191	51.65	April 4
Lone Wolf Fraction Fractional	"	The Granby Consolidated Mining, Smelting, and Power Co., Ltd.	1527	12.78	Oct. 30
Lost Chord Fract. Fractional	"	Ditto	1140	14.71	Sept. 29
Low Pass	"	"	1515	51.65	Oct. 30
Lucky Stricke Fractional	Atlin	Simon Jacob Weitzman	377	22.4	Mar. 22
Malcolm	Skeena	James Falkner	2235 R. 4	29.53	Sept. 22
Mallard	"	The Granby Consolidated Mining, Smelting, and Power Co., Ltd.	2225	38.43	Sept. 12
Maple Leaf	Omineca	Raleigh P. Trimble	705	38.65	May 3
May Day	Skeena	The Granby Consolidated Mining, Smelting, and Power Co., Ltd.	1677	51.59	Jan. 10
May Flower Fract.	"	Ditto	2219	38.65	Jan. 12
May Pole	"	"	1676	45.38	Jan. 10
Merry Widow	Portland Canal	William Spurck	3202	23.87	May 16
Missing Link	Skeena	The Granby Consolidated Mining, Smelting, and Power Co., Ltd.	1138	43.92	Sept. 29
Mogul	Omineca	Henry Bretzins and Alfred H. Morten	6312 R. 5	27.66	Nov. 20
Monarch	Skeena	The Granby Consolidated Mining, Smelting, and Power Co., Ltd.	1526	49.54	Oct. 30
Monkey Fraction Fractional	"	The Granby Consolidated Mining, Smelting, and Power Co., Ltd.	1142	1.07	Sept. 29
Moose	"	Olier Besner	3337	37.98	Oct. 7
Mountain	"	James Falkner	2232 R. 4	51.65	Sept. 21
Nabob Frac. Fractional	"	The Granby Consolidated Mining, Smelting, and Power Co., Ltd.	3589	42.08	Sept. 12
Nellie	Atlin	Thomas Vaughan	1172	51.61	Sept. 19
Never Sweat	Portland Canal	The Granby Consolidated Mining, Smelting, and Power Co., Ltd.	2024	48.09	Mar. 22
No. 1	Skeena	Ditto	1123	49.55	Sept. 8
No. 2	"	"	1124	47.98	Sept. 8
No. 2 Fraction Fractional	"	"	1133	1.51	Sept. 8
No. 3	"	"	1125	47.47	Sept. 28
No. 4	"	"	1126	47.59	Sept. 28
No. 4 Fract. Fractional	"	"	1134	42.19	Sept. 28
No. 5	"	"	1127	51.65	Sept. 29
No. 6	"	"	1128	51.50	Sept. 28
No. 6 Fraction Fractional	"	"	1136	26.18	Sept. 28
No. 7	"	"	1129	25.96	Sept. 29
No. 8	"	"	1130	18.39	Sept. 28
No. 9	"	"	1131	21.26	Oct. 28
No. 10	"	"	1132	42.43	Oct. 28
Omar Khayyam	Omineca	Creighton Ross Palmer	9059 G. 1	31.05	July 22
Oneda	Portland Canal	The Pacific Coast Exploration Co., Ltd	3233	45.6	Sept. 13
Ottawa	Skeena	The Granby Consolidated Mining, Smelting, and Power Co., Ltd.	1509	42.66	Sept. 28
Phyllis Fract. Fractional	"	The Granby Consolidated Mining, Smelting, and Power Co., Ltd.	1510	1.47	Sept. 28
Pilot	Omineca	Raleigh P. Trimble	704	37.43	May 3

CASSIAR—*Concluded.*

Claim.	Division.	Grantee.	Lot No.	Acres.	Date.
Point	Portland Canal.	The Granby Consolidated Mining, Smelting, and Power Co., Ltd.	2022	39.36	May 19
Princess	Omineca.	Raleigh P. Trimble	706	41.45	May 3
Province	Portland Canal.	Daniel Lindeborg	3208	50.94	Oct. 25
Quartz No. 1 Frac. Fractional	Skeena	The Granby Consolidated Mining, Smelting, and Power Co., Ltd.	3587	14.32	Feb. 9
Quartz No. 1	"	Ditto	1535	41.77	Jan. 31
Quartz No. 2	"	"	1536	27.96	Jan. 31
Quartz No. 3	"	"	1678	37.34	Feb. 1
Quartz No. 4	"	"	1679	50.89	Feb. 1
Quartz No. 5	"	"	1680	32.40	Feb. 1
Quartz No. 6	"	"	1681	51.4	Feb. 4
Quartz No. 7	"	"	1682	51.4	Feb. 4
Quartz No. 8	"	"	1683	51.4	Feb. 7
Quartz No. 9	"	"	1684	33.18	Feb. 7
Quartz No. 10	"	"	1685	30.37	Feb. 7
Quartz No. 11	"	"	1686	50.47	Feb. 7
Quartz No. 12	"	"	1687	49.52	Feb. 7
Quartz No. 13	"	"	1688	50.90	Feb. 7
Quartz No. 14	"	"	1689	50.09	Feb. 8
Quartz No. 15	"	"	1690	50.99	Feb. 8
Quartz No. 16	"	"	1691	50.99	Feb. 8
Quartz No. 17	"	"	1692	51.16	Feb. 8
Quartz No. 18	"	"	1693	51.65	Feb. 8
Quartz No. 19	"	"	1694	51.65	Feb. 8
Quartz No. 20	"	"	1695	51.65	Dec. 11
Quartz No. 21	"	"	1696	42.56	Dec. 11
Quartz No. 22	"	"	1697	51.62	Feb. 14
Quartz No. 23	"	"	1698	51.14	Feb. 8
Quartz No. 24	"	"	1699	49.07	Feb. 8
Quartz No. 25B	"	"	1700	50.21	Feb. 14
Quartz No. 26B	"	"	3583	49.70	Dec. 4
Quartz No. 27B	"	"	3584	34.56	Dec. 4
Quartz No. 28B	"	"	3585	51.65	Dec. 4
Quartz No. 29	"	"	3586	18.46	Dec. 4
Quince	"	"	1984	43.80	Jan. 11
Railroad	Portland Canal.	The Pacific Coast Exploration Co., Ltd	3237	51.65	Sept. 15
Rambler	"	Daniel Lindeborg	3206	49.96	Oct. 25
Rangoon	"	Robert Musket Stewart, Watson Dores Noble, and Alexander Rutherford	3200	51.65	July 7
Regina	Skeena	The Granby Consolidated Mining, Smelting, and Power Co., Ltd.	1985	44.05	Jan. 12
Rex	"	The Granby Consolidated Mining, Smelting, and Power Co., Ltd.	1983	44.44	Jan. 11
Rivermouth Fraction Fractional	"	Ole Evindsen	3643	5.82	April 14
Rosalie	Portland Canal.	William Spurck	3201	51.65	May 16
Ruby Fraction	Skeena	The Granby Consolidated Mining, Smelting, and Power Co., Ltd.	1973	16.22	Jan. 11
Saphire	Omineca.	Creighton Ross Palmer	9058 G. 1	38.86	July 22
Scotch Hill	"	Raleigh P. Trimble	708	32.39	May 3
Silver Bow	Skeena	Thomas McRostie and James Lucius Hatch	3189	51.21	July 7
Spruce	"	The Granby Consolidated Mining, Smelting, and Power Co., Ltd.	767	51.63	July 18
Sunbeam	"	William Thomas Kergin	3187	50.98	Sept. 25
Sunset	"	The Granby Consolidated Mining, Smelting, and Power Co., Ltd.	2228	47.80	Jan. 12
Sunset	Omineca.	Thomas Scotch Gilmour	5817 R. 5	42.90	May 22
Terminus	Portland Canal.	Daniel Lindeborg	3221	51.64	Oct. 25
The Tom	Atlin	Thomas Vaughan	1174	51.48	Sept. 27
Thelma	Portland Canal.	George Matheson, George Rudge, and James A. Robertson, administrator of the estate of Donald A. Robertson, deceased, intestate	1552	36.44	Oct. 3
Three in One	Omineca.	James D. A. McIntyre	9060 G. 1	23.54	July 24
Tiger	Portland Canal.	George Matheson, George Rudge, and James A. Robertson, administrator of the estate of Donald A. Robertson, deceased, intestate	1554	28.5	Oct. 3
Tip Top	"	Hiram Stevenson	3205	49.08	Oct. 25
Totem	Skeena	The Granby Consolidated Mining, Smelting, and Power Co., Ltd.	1516	51.65	Oct. 30
Triangle Fractional Fractional	Portland Canal.	The Granby Consolidated Mining, Smelting, and Power Co., Ltd.	3334	0.88	April 4
Winer	"	Duncan Cameron Barbrick, administrator of the estate of James Proudfoot, deceased, intestate	3212	51.25	Nov. 7

LILLOOET.

Clifton	Lillooet.	Andrew Ferguson and Adolphus Williams	3048 G. 1	51.65	Oct. 7
East Pacific	"	Andrew Ferguson and Adolphus Williams	3047 G. 1	51.30	Oct. 7

EAST KOOTENAY.

Claim.	Division.	Grantee.	Lot No.	Acres.	Date.
Alta Fraction Fractional	Fort Steele	The Consolidated Mining and Smelting Co. of Canada, Ltd.	12001 G. 1	46.79	Dec. 4
Badger	"	The Consolidated Mining and Smelting Co. of Canada, Ltd.	12008	50.11	Nov. 15
Calamity Jane	Windermere	Earle Jennings Scovil	3791 G. 1	42.7	Nov. 16
Comet	Fort Steele	Elgin E. Jones	12261 G. 1	45.50	Nov. 9
Constance	Golden	James Francis Melville Moodie	135 G. 1	19.42	Dec. 6
Deer Fraction Fractional	Fort Steele	The Consolidated Mining and Smelting Co. of Canada, Ltd.	12000 G. 1	45.34	Dec. 4
Delos	Windermere	Earl Jennings Scovil	3790 G. 1	47.50	Nov. 16
Ethel Fraction Fractional	Fort Steele	The Consolidated Mining and Smelting Co. of Canada, Ltd.	12011 G. 1	30.99	Dec. 4
Fox	"	The Consolidated Mining and Smelting Co. of Canada, Ltd.	2233 R. 4	37.74	Sept. 21
Mary G	Windermere	Francis Clarence Stockdale	4008 G. 1	50.68	Nov. 16
Trojan	"	William Roaf Grubbe	3792 G. 1	40.90	Nov. 16

WEST KOOTENAY.

Alexander Hill Fractional	Trail Creek	Le Roi No. 2, Ltd.	11484 G. 1	1.51	July 10
Alturas	Nelson	David Griffith Williams and Frank Leslie Murdoff	9915 G. 1	51.63	May 4
Bruce Fract	"	Robert Scott Lennie	10802 G. 1	1.48	Sept. 6
Blue Bird	"	David Griffith Williams and Frank Leslie Murdoff	10032 G. 1	46.29	May 6
Beaver	"	" "	9920 G. 1	51.61	May 5
Caledonian Fraction Fractional	"	" "	9908 G. 1	14.5	May 4
Captain Scott Fractional	Trail Creek	Le Roi No. 2, Ltd.	12173 G. 1	0.1	July 10
Cook Fractional	Nelson	The Nugget Gold Mines Co. (N.P.L.)	10024 G. 1	3.25	Sept. 6
Crescent	Lardeau	William M. Lawrence	6472 G. 1	51.65	Nov. 15
Daisy	Nelson	David Griffith Williams and Frank Leslie Murdoff	9919 G. 1	35.69	May 5
Daisy Fractional	"	David Griffith Williams and Frank Leslie Murdoff	9922 G. 1	2.79	May 5
Dodger	"	Iron Mountain, Ltd. (N.P.L.)	12083 G. 1	42.28	Feb. 17
Empire	"	Iron Mountain, Ltd. (N.P.L.)	12086 G. 1	33.54	Jan. 24
Empire Fractional	Lardeau	George S. Adams	6474 G. 1	18.58	Nov. 15
Etter	Slocan City	Toller Mally Huff, David Ezra Wick, and Jackson Radcliffe.	11729 G. 1	48.18	Sept. 7
Fort George	"	Toller Mally Huff, David Ezra Wick, and Jackson Radcliffe.	12080 G. 1	33.29	Sept. 7
Golden Belle	Nelson	David Griffith Williams and Frank Leslie Murdoff	9917 G. 1	47.77	May 5
Golden Belle Fractional	"	" "	9907 G. 1	28.90	May 8
Golden Eagle	Nelson	" "	9926 G. 1	15.79	May 5
Graphic	Slocan	John Henry Thompson, Edward Frederick Burns, and Martin Welsh	12114 G. 1	22.30	Sept. 22
Happy Jean	Nelson	David Griffith Williams and Frank Leslie Murdoff	9911 G. 1	29.34	May 4
Hillside	"	David Griffith Williams and Frank Leslie Murdoff	9909 G. 1	31.04	May 4
Invincible	"	Iron Mountain, Ltd. (N.P.L.)	12084 G. 1	38.00	Jan. 24
Job Trotter	"	" "	12085 G. 1	36.15	Jan. 24
Last Chance	"	" "	12116 G. 1	49.48	Jan. 24
Lodestone	"	David Griffith Williams and Frank Leslie Murdoff	9916	29.83	May 4
Lone Star	"	The Nugget Gold Mines, Ltd. (N.P.L.)	10023	32.60	Sept. 7
Madison Extension	Slocan	Albert Simons	5192 G. 1	48.86	Dec. 29
Maggie Ainsworth	Ainsworth	Henry Newconen	2718 G. 1	51.65	Dec. 6
Mammoth	Lardeau	George S. Adams	6473 G. 1	51.65	Nov. 15
Mark Tapley	Nelson	Iron Mountain, Ltd. (N.P.L.)	12117 G. 1	46.28	Jan. 22
Margaret	"	David Griffith Williams and Frank Leslie Murdoff	9913 G. 1	22.4	May 4
Martha Rose Fraction	Trail Creek	The Consolidated Mining and Smelting Co. of Canada, Ltd.	11473 G. 1	0.16	Feb. 11
Minora	Nelson	The Nugget Gold Mines, Ltd. (N.P.L.)	12073 G. 1	5.25	Sept. 6
Northern Light	Slocan City	William Lawless Cotterell	11130 G. 1	39.13	Oct. 24
One Eye See	Trail Creek	Alwilda Simpson	3390	25.88	Nov. 2
Overlooked Fraction	"	The Consolidated Mining and Smelting Co. of Canada, Ltd.	12171 G. 1	0.13	Feb. 11
Patritia Fractional	"	The Consolidated Mining and Smelting Co. of Canada, Ltd.	11472 G. 1	0.09	Feb. 11
Pickwick	Nelson	Iron Mountain, Ltd. (N.P.L.)	12087 G. 1	45.68	Jan. 24
Retter	*Slocan City*	*Toller Mally Huff, David Ezra Wick, and Jackson Radcliffe.*	11728 G. 1	30.70	Sept. 7
Riverside	Nelson	David Griffith Williams and Frank Leslie Murdoff	9906 G. 1	36.66	May 6
Riverside Fractional	"	David Griffith Williams and Frank Leslie Murdoff	9925 G. 1	49.78	May 5
Royal Canadian	"	Iron Mountain, Ltd. (N.P.L.)	12115 G. 1	39.47	Jan. 22
Searchlight	"	The Nugget Gold Mines, Ltd. (N.P.L.)	12074 G. 1	27.14	Sept. 6
Sirdar	Lardeau	William M. Lawrence	6471 G. 1	51.65	Nov. 15
Snowdrift	Nelson	David Griffith Williams and Frank Leslie Murdoff	9927 G. 1	37.72	May 5
Starlight	"	David Griffith Williams and Frank Leslie Murdoff	9912 G. 1	48.39	May 4
Starlight Fract. Fractional	"	The Consolidated Mining and Smelting Co. of Canada, Ltd.	12274 G. 1	46.0	Oct. 17
St. Patrick Fractional	Trail Creek	The Consolidated Mining and Smelting Co. of Canada, Ltd.	11474 G. 1	0.37	Feb. 11
Success	*Nelson*	*Harry E. Douglas*	*10009 G. 1*	51.65	Sept. 27
Sunshine Fractional	"	David Griffith Williams and Frank Leslie Murdoff	9918 G. 1	5.61	May 5
Trophy Fractional	Trail Creek	The Consolidated Mining and Smelting Co. of Canada, Ltd.	11487 G. 1	0.28	Feb. 11
Twilight Fractional	Nelson	David Griffith Williams and Frank Leslie Murdoff	9910 G. 1	33.75	May 4
Virginia Fraction	Trail Creek	The Consolidated Mining and Smelting Co. of Canada, Ltd.	11477 G. 1	0.32	Feb. 11

BOUNDARY.

Claim.	Division.	Grantee.	Lot No.	Acres.	Date.
Agricola	Osoyoos	Henry A. Guess	2027 S.	51.65	Feb. 22
Automatic Frac. Fractional	Similkameen.	Emil F. Voigt	1775 S.	45.20	Sept. 19
Banker	Osoyoos	Henry A. Guess	2031 S.	48.33	Feb. 22
Cecil Fractional	Kamloops.	The Hardie Cinnabar Mines, Ltd	953 G. 1	32.24	Feb. 15
Chelmsford	"	" "	956 G. 1	40.98	Feb. 15
Christobel	"	" "	1733 G. 1	51.65	Feb. 15
Federal	Osoyoos	Henry A. Guess	2030 S.	47.18	Feb. 22
Forlorn	Kamloops.	Owen Salusbury Batchelor	3016 G. 1	41.18	Feb. 26
Gouldie	Similkameen.	Peter Hoogenboezem and A. Vanderspek	708 G. 1	50.9	Mar. 18
Grey Gables	Osoyoos	Henry A. Guess	2026 S.	51.57	Feb. 22
Holdfast	Similkameen.	Douglas M. French and David O. Day	3537	32.64	April 14
Idaho	Grand Forks.	Patrick Maginnis, Lewis Johnson, and Donald McCallum, official administrator, administrator of the estate of Michael McDonnell, deceased, intestate	1679 S.	33.49	Aug. 16
Isobel Fractional	Kamloops.	The Hardie Cinnabar Mines, Ltd	951 G. 1	51.18	Feb. 15
Knob Hill	Similkameen.	Peter Hoogenboezem and Arie Vanderspek	709 G. 1	49.87	Mar. 18
Lymington Fractional	Kamloops.	The Hardie Cinnabar Mines, Ltd	1736 G. 1	25.76	Feb. 15
Marcia	"	The Hardie Cinnabar Mines, Ltd	1734 G. 1	33.75	Feb. 15
Midnight Fraction Fractional	Osoyoos	William E. Waugh	2208 S.	41.50	Dec. 16
Mother Lode	Kamloops.	Melissa Arnald	3906 G. 1	51.65	June 6
Nelson Fractional	Similkameen.	Emil F. Voigt	1778 S.	31.40	Sept. 19
New No. 37 Fract. Fractional	"	"	1776 S.	2.83	Sept. 25
New 62A	"	"	1595 S.	39.6	Sept. 25
New 63A	"	"	1596 S.	23.7	Sept. 25
New Wolf Fractional	"	"	1777 S.	43.20	Sept. 25
No. 2	"	"	1773 S.	51.30	Sept. 19
No. 11	Greenwood	Wellesly Fraser, Laura G. Fraser, and Elizabeth S. Carew	1485 S.	51.62	Aug. 16
No. 15 Fractional	Similkameen.	Emil F. Voigt	1598 S.	50.1	Sept. 25
Oakville	Osoyoos	Henry A. Guess	2029 S.	50.53	Feb. 22
O. K. Fractional	Greenwood	Robert Forshaw	1427 S.	14.65	Oct. 10
Oregon	Osoyoos	Lytton W. Shatford, Francis H. French, Howard A. Turner, and Thomas D. Pickard	703 S.	48.73	May 29
Paper Dollar Fract	Grand Forks.	Patrick Maginnis, Lewis Johnson, and Donald McCallum, official administrator, administrator of the estate of Michael McDonnell, deceased, intestate	1677 S.	49.53	Sept. 7
Savage	Osoyoos	Lytton W. Shatford, Francis H. French, Howard A. Turner, and Thomas D. Pickard	704 S.	36.23	May 29
Spotted Lake	"	Frank Calvert	1998 S.	51.65	April 4
Spotted Lake No. 3	"	Frank Calvert	1998 S.	51.65	April 4
St. Bernard	"	Lytton W. Shatford, Francis H. French, Howard A. Turner, and Thomas D. Pickard	705 S.	25.79	May 29
Trachyte	Similkameen.	Peter Hoogenboezem and Arie Vanderspek	2016 S.	50.10	Mar. 18
Tres Hermanos	Osoyoos	Henry A. Guess	2028 S.	35.84	Feb. 22
United	Similkameen.	Emil F. Voigt	1599 S.	51.10	Sept. 19
Verde No. 3	"	Emil F. Voigt	1600 S.	51.65	Sept. 19
Wentworth Fractional	Kamloops.	The Hardie Cinnabar Mines, Ltd	957 G. 1	51.01	Feb. 15
Winchester	Osoyoos	Lytton W. Shatford, Francis H. French, Howard A. Turner, and Thomas D. Pickard	705 S.	42.33	May 29

VANCOUVER ISLAND AND COAST.

Chieftan	Clayoquot	Rose Angeles Dawley	1491	47.90	May 16
Cliff Fractional	Vancouver.	Britannia Mining and Smelting Co., Ltd	2903 G. 1	51.62	June 5
C. M. Annex	"	Britannia Mining and Smelting Co., Ltd	4227 G. 1	49.18	June 5
Deer Trail	Quatsino	San Juan Mining and Manufacturing Co., Ltd.	989	16.38	April 16
Hippo	Vancouver.	Britannia Mining and Smelting Co., Ltd	4141 G. 1	51.65	Jan. 20
Iron Mountain	Clayoquot	Rose Angeles Dawley	1490	45.61	May 16
Lion	Vancouver.	Britannia Mining and Smelting Co., Ltd	4145 G. 1	51.65	Jan. 21
Morris	Quatsino	San Juan Mining and Manufacturing Co., Ltd.	988	34.53	April 15
Mocassin Fractional	Vancouver.	Britannia Mining and Smelting Co., Ltd	3721 G. 1	5.4	Jan. 19
Midas Fractional	Nanaimo	Dorsey E. McLaughlin	301A	32.56	Feb. 15
Mamie	Clayoquot	Clarence Dawley and Anthony Watson	1486	49.15	May 16
Maggie	"	Clarence Dawley and Anthony Watson	1487	45.87	May 16
Magnet	Nanaimo	Polly Fox and Edna J. Pritchard (wife of Arthur T. Pritchard)	886	51.65	Aug. 18
No. 11 Fractional	Vancouver.	Britannia Mining and Smelting Co., Ltd	3948 G. 1	50.84	Jan. 19
No. 27	"	" "	3999 G. 1	45.54	Jan. 18
No. 28 Fractional	"	" "	4000 G. 1	43.38	Jan. 19
No. 34 Fractional	"	" "	4007 G. 1	51.65	Jan. 20
No. 35 Fractional	"	" "	2919 G. 1	47.30	Nov. 17
No. 36	"	" "	2920 G. 1	51.65	Jan. 18
No. 38 M.C.	"	" "	2922 G. 1	51.65	Jan. 19
No. 39 M.C.	"	" "	4006 G. 1	51.65	Jan. 20
No. 43	"	" "	4001 G. 1	51.65	Feb. 10
No. 44	"	" "	4003 G. 1	51.65	Jan. 20
No. 45 M.C.	"	" "	4004 G. 1	25.00	Jan. 20
No. 51	"	" "	2923 G. 1	47.03	Nov. 17
No. 52	"	" "	2924 G. 1	51.21	Jan. 19
No. 53	"	" "	4008 G. 1	51.59	Dec. 27
No. 54	"	" "	4010 G. 1	51.59	Dec. 27
No. 84	"	" "	3953 G. 1	51.65	Dec. 27

VANCOUVER ISLAND AND COAST—*Concluded.*

Claim.	Division.	Grantee.	Lot No.	Acres.	Date.
No. 111	Vancouver	Britannia Mining and Smelting Co., Ltd	4249 G. 1	51.65	June 5
No. 112	"	" "	4248 G. 1	51.65	June 5
No. 114	"	" "	4247 G. 1	37.14	June 5
No. 115 Fractional	"	" "	4246 G. 1	51.30	June 5
No. 132 Fractional	"	" "	4244 G. 1	48.41	Sept. 27
No. 133 Fractional	"	" "	4245 G. 1	44.34	Sept. 27
Pounder	Victoria	Lars Nicholas Anderson	787	44.76	Mar. 2
Princess Fractional	Vancouver	Britannia Mining and Smelting Co., Ltd	3950 G. 1	49.14	Jan. 19
Rhino Fractional	"	Britannia Mining and Smelting Co., Ltd	4142 G. 1	51.61	Jan. 21
Rose	Clayoquot	Clarence Dawley and Anthony Watson	1489	44.12	May 16
Sadie	"	Clarence Dawley and Anthony Watson	1488	21.25	May 16
Saturn Fractional	Vancouver	Britannia Mining and Smelting Co., Ltd	4151	51.34	Jan. 21
Snow Storm	Quatsino	San Juan Mining and Manufacturing Co., Ltd	987	40.26	April 15
Tex Fractional	Vancouver	Britannia Mining and Smelting Co., Ltd	4225 G. 1	39.16	Jan. 21
37 Fractional	"	Britannia Mining and Smelting Co., Ltd	2921 G. 1	51.28	Jan. 18

DEPARTMENT OF MINES.

VICTORIA, B.C.

HON. WM. SLOAN	*Minister of Mines.*
R. F. TOLMIE	*Deputy Minister of Mines.*
WM. FLEET ROBERTSON	*Provincial Mineralogist and Assayer.*
D. E. WHITTAKER	*Provincial Analyst and Assistant Assayer.*
JOHN D. GALLOWAY	*Assistant Provincial Mineralogist.*
GEORGE WILKINSON	*Chief Inspector of Mines, Victoria.*
HENRY DEVLIN	*District* ,, *Nanaimo.*
JOHN NEWTON	,, ,, ,,
GEO. O'BRIEN	,, ,, *Fernie.*
THOMAS H. WILLIAMS	,, ,, ,,
ROBERT STRACHAN	,, ,, *Merritt.*
JAMES MCGREGOR	,, ,, *Nelson.*
J. H. MCMILLAN	,, ,, *Prince Rupert.*
H. H. JOHNSTONE	*Temporary District Inspector of Mines, Nelson.*

GOLD COMMISSIONERS AND MINING RECORDERS.

Mining Divisions.	Location of Office.	Gold Commissioner.	Mining Recorder.	Sub-Recorder.
Atlin Mining Division	Atlin	J. A. Fraser	W. G. Paxton	
Sub-office	Discovery			R. Webster.
"	Telegraph Creek			H. W. Dodd.
"	Haines (U.S.)		(Com. for taking Affidavits)	Risdon M. Odell.
Stikine Mining Division	Telegraph Creek	H. W. Dodd	H. W. Dodd	
Sub-office	Boundary	"	"	William Strong.
Liard Mining Division	Telegraph Creek	"	"	
Sub-office	Porter			Chas. H. Smith.
"	McDame Creek			Amos Everson.
Skeena Mining Division	Prince Rupert	J. H. McMullin	J. H. McMullin	
Sub-office	Alice Arm			Telka Carney.
"	Kitimat			Geo. L. Anderson.
"	Port Simpson			J. R. C. Deane.
"	Essington			A. Forsythe.
"	Copper City			P. R. Skinner.
"	Terrace			C. E. Doolittle.
"	Stewart (Portland Canal)			P. S. Jack.
"	Anyox			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			C. E. Doolittle.

GOLD COMMISSIONERS AND MINING RECORDERS—*Continued.*

Mining Divisions.	Location of Office.	Gold Commissioner.	Mining Recorder.	Sub-Recorder.
Omineca M.D.—*Con.*				
Sub-office	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			Geo. Milburn.
"	Fort George			T. W. Herne.
"	McBride			F. F. O'Halloran.
Quesnel Mining Division.	150-Mile House	C. W. Grain	Arthur Sampson	
Sub-office	Quesnel	(at Barkerville)		George Milburn.
"	Quesnel Forks			Grant Grinder.
"	Barkerville			C. W. Grain.
Clinton Mining Division.	Clinton	E. C. Lunn	E. C. Lunn	
Lillooet "	Lillooet	John Dunlop	John Dunlop	
Kamloops Mining Division	Kamloops	E. Fisher	L. S. Brown	
Sub-office	Chu Chua			George Fennell.
"	Vavenby			Hyde Finley.
Ashcroft Mining Division.	Ashcroft	E. Fisher (at Kam.)	H. P. Christie	
Sub-office	Lytton			Thos. Somerville.
Nicola Mining Division	Nicola	E. Fisher (at Kam.)	W. N. Rolfe	
Yale "	Yale	" "	L. A. Dodd	
Sub-office	Hope			George Blue.
Similkameen Mining Div.	Princeton	Hugh Hunter	Hugh Hunter	
Sub-office	Hedley			F. M. Gillespie.
Vernon Mining Division.	Vernon	L. Norris	H. F. Wilmot	
Greenwood Mining Div.	Greenwood	W. R. Dewdney	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	W. W. Bradley	John Bulman	
Windermere "	Wilmer		E. M. Sandilands	
Fort Steele Mining Div.	Cranbrook	N. S. A. Wallinger.	H. S. Clark	
Sub-office	Steele			Joseph Walsh.
"	Fernie			Ronald Hewat.
"	Moyie			John P. Farrell.
"	Marysville			Alfred Dryden.
Ainsworth Mining Div.	Kaslo	R. J. Stenson	A. McQueen	Wm. J. Green.
Sub-office	Howser			W. Simpson.
"	Trout Lake			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.....	....	.....	W. Forrester.
"	Ymir.....	....	.....	Geo. S. Coleman.
"	Sheep Creek	.....	....	James Thompson.
"	Salmo	....	....	G. A. Kennington.
Arrow Lake Min. Division	Nakusp.....	John Cartmel.....	Walter Scott	
Sub-office	Vernon.....	(at Nelson)	....	H. F. Wilmot.
Revelstoke Mining Div...	Revelstoke.....	Robt. Gordon	R. S. Squarebriggs.	Newton R. Brown.
Lardeau Mining Division.	Beaton	" (at Revelstoke)	William A. Strutt.	Mrs. A. H. Strutt.
Trail Creek Mining Div...	Rossland	H. R. Townsend...	M. S. Morrell.....	
Nanaimo Mining Division	Nanaimo	S. McB. Smith....	S. McB. Smith....	
Sub-office	Ladysmith.....	.....	.....	John Stewart.
"	Alert Bay	.....	....	Ernest H. Robinson
"	Vananda	....	.....	Leonard Raper.
"	Rock Bay.....	....	.....	W. H. Lines.
"	Granite Bay.....	... .	.....	Henry Twidle.
"	Heriot Bay	....	.....	R. J. Walker.
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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LIST OF ILLUSTRATIONS.

VICTORIA, B.C.:
Printed by WILLIAM H. CULLIN, Printer to the King's Most Excellent Majesty.
1917.

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Series.

British Columbia. *Bureau of Mines.*

Annual Report of the Minister of Mines for the year ending 31st December, 1916, being an account of mining operations for gold, coal, etc., in the Province. William Fleet Robertson, Provincial Mineralogist. 547 pp., plates, maps, 1916.
Victoria, Government Printing Office, 1917.

Author.

Robertson, William Fleet. *(Provincial Mineralogist.)*

Annual Report of the Minister of Mines of British Columbia for the year ending 31st December, 1916, being an account of mining operations for gold, coal, etc., in the Province. (British Columbia, Bureau of Mines.) 547 pp., plates, maps, 1916.
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