GEOLOGICAL SURVEY DEPARTMENT.
ALFRED R. C. SELWYN, C.M.G., LL.D., F.R.S., DIRECTOR.

DIVISION OF

MINERAL STATISTICS AND MINES

ANNUAL REPORT

FOR

1890.

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IN CHARGE.

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PUBLISHED BY AUTHORITY OF PARLIAMENT

OTTAWA:
PRINTED BY S. E. DAWSON, PRINTER TO THE QUEEN'S MOST EXCELLENT MAJESTY.
1891.

NOTE

Except for the figures of imports, which refer to the fiscal year, beginning 1st July, the year used throughout this report is the calendar year, and the ton, that of 2,000 pounds, unless otherwise stated.

The figures given throughout the report referring to exports and imports are compiled from data obtained from the books of the Customs Department, and will occasionally show discrepancies, which, however, there are no means of correcting.

The exports and imports, under the heading of each province, do not necessarily represent the production and consumption of the province *e. g.*, material produced in Ontario is often shipped from Montreal and entered there for export, so falling under the heading, Quebec.

The values of the metallic minerals produced, as per returns to this Department, are calculated on the basis of their metallic contents at the average market price of the metal for 1890. Spot values have been adopted for the figures of production of the non-metallic minerals.

N.E.S.=Not elsewhere specified.

ERRATUM.

Page 3, 2nd line from bottom, for "Exports and Imports," *read* Imports.

ERRATUM.

P. 141 S, line 9 from top.—*After* Where no allowance is made by the buyers *insert* for the copper.

To Alfred R. C. Selwyn, C. M. G., F. R. S., &c.,
Director and Deputy Head,
Geological Survey Department of Canada.

Sir,—I beg herewith to hand you the annual report of the Division of Mineral Statistics and Mines for the year 1890.

Difficulty continues to be experienced in securing the information promptly enough to issue the report earlier, although, as formerly, a preliminary summary statement of the mineral production of the country was issued early in April. In this, the quantities of which no returns had been received, were estimated as nearly as possible. These have been revised since the complete returns became available.

It is hoped, however, that as the mining public become more familiar with the object the Department seeks to attain and its usefulness, and also acquire a better understanding of the confidential treatment of the information given, that a more willing response will be forthcoming from all, and that even those few who now delay the work by not replying to the circulars sent out may be persuaded to act more promptly.

With regard to the general information on mining matters contained in the report, it is hoped it may be found more complete than heretofore.

The plan of reproducing suitable matter from the reports of the provincial mining bureaus has been adopted. This information has been incorporated with our own material, and will thus receive a wider circulation and will tend to make the report a more complete review of the progress of mining and allied industries in the Dominion.

To facilitate the work of compilation the fiscal year has been adopted, instead of the calendar year as heretofore, for the figures of exports and imports. Greater uniformity has been attained by stating the values of the metallic products in terms of the metals contained in

the ores, etc., at the average market price of each for the year, thus following the usual practice as well for these as for the non-metallic products, which, as formerly, are given at their spot value.

Apart from the compilation of the annual report the other functions of the division have been performed, as far as the present means at command would permit.

Numerous enquiries have been received and answered, respecting the mining and mineral resources of the country, often involving considerable research to give the details asked for.

The Directory of Mineral Occurrences has also received further attention, and is now almost complete. The system of signs already used by the Survey for representing mineral occurrences on the maps has been elaborated and extended, so that the distribution of the mineral resources of the country can be shown graphically, and thus afford information on this important subject in a concise form.

The arrangements made with the British Columbia Government,* whereby the aid of their local commissioners has been secured, should insure prompt receipt of information relating to mineral discovery and mining progress in the different districts of that province. It is hoped that it may be found possible to complete arrangements already partly made covering other portions of the Dominion. These would include a correspondent in each mining centre, thus attaining the same result as in British Columbia. Corroborative investigation by an officer of this bureau, where required, would then afford full and reliable information.

In conclusion it is desired to gratefully acknowledge the aid received from various sources. Thanks are due to all—a number too numerous to mention here—who, by answering our circulars or letters, have provided much valuable material for the compilation of the report.

Special mention must again be made of the services rendered by my colleague, Mr. H. P. Brumell, assistant to the Division, for his very important and efficient aid in every branch of the work. Apart from his duties in the compilation of the figures he has been a large contributor to the report; the following articles being specially due to him, viz.:—Abrasive Materials, Petroleum, Natural Gas, Mineral Pigments, Salt, Structural Materials, Gypsum and Manganese.

*Summary Report Geological Survey Department, 1890, p. 11.

Our acknowledgments are also due to the Provincial Departments of Mines of Nova Scotia and British Columbia, and to the Dominion Customs Department for aid received.

I have the honour to be, Sir,

Your obedient servant,

ELFRIC DREW INGALL.

Division of Mineral Statistics and Mines,
July 10th, 1891.

SUMMARY OF THE MINERAL PRODUCTION OF CANADA IN 1889 AND 1890.

Product.		1889.		1890.	
		Quantity.	Value.	Quantity.	Value.
Metallic.					
Copper (fine, contained in ore)	Lbs.	6,809,752	$ 885,424	6,013,671	$ 902,050
Gold	Ozs.	72,328	1,295,159	64,046	1.149,776
Iron ore	Tons.	84,181	151,640	76,511	155,380
do pig	"	.....	(b)	.....	(b)
Lead (fine, contained in ore, &c.)	Lbs.	165,100	6,604	113,000	5,085
Nickel (fine, contained in ore, &c.)	"	(a)	(a)	1,435,742	33,232
Platinum	Ozs.	1,000	3,500	.....	4,500
Silver (fine, contained in ore, &c.)	"	383,318	343,848	400,687	420,662
Total, Metallic		.....	2,686,175	.....	3,570,685
Non-metallic.					
Antimony ore	Tons.	55	1,100	26½	625
Arsenic	"	.....	.....	25	1,500
Asbestus	"	6,113	426,554	9,860	1,260,240
Coal	"	2,719,478	5,584,182	3,117,661	6,496,110
Coke	"	54,539	155,043	56,450	166,298
Felspar	"	.....	.....	700	3,500
Fertilizers	"	775	26,606	1,203	31,889
Fire-clay	"	400	4,800	.....	.....
Glass and glassware	.....	.....	150,000	.....	537,130
Graphite	Tons.	242	3,160	175	5,200
Grindstones	"	3,404	30,863	4,884	42,340
Gypsum	"	213,273	205,108	226,509	194,033
Limestone for flux	"	22,122	21,909	18,478	18,361
Manganese ore	"	1,455	32,737	1,328	32,550
Mica	Lbs.	36,529	28,718	770,959	68,074
Mineral pigments—					
Baryta	Tons.	794	15,280	1,842	7,543
Ochres	"			275	5,125
Mineral water	Galls.	424,600	37,360	561,165	66,031
Moulding sand	Tons.	170	850	320	1,410
Petroleum	Brls.	639,991	612,101	765,029	902,734
Phosphate	Tons.	30,988	316,662	31,753	361,045
Precious stones	.....	.....	.....	.....	700
Pyrites	Tons.	72,225	307,292	49,227	123,068
Quartz	"	.....	.....	200	1,000
Salt	"	32,832	129,547	43,754	198,897
Soapstone	"	195	1,170	917	1,239
Structural materials and clay products—					
*Bricks	M	200,561	1,273,884	211,727	1,266,982
*Building stone	C. yds.	341,337	913,691	382,563	964,783
Cement	Brls.	90,474	69,790	102,216	92,405
Flagstones	Sq. ft.	14,000	1,400	17,865	1,643
Granite	Tons.	10,197	79,624	13,307	65,985
*Lime	Bush.	2,948,249	362,848	2,501,079	412,308
Marble	Tons.	980	980	780	10,776
Miscellaneous clay prod'ts	.....	.....	239,385	.....	.....
Pottery	.....	.....	.....	.....	195,242
Carried forward	.....	.....	11,032,644	.....	13,536,766

SUMMARY OF THE MINERAL PRODUCTION OF CANADA IN 1889 AND 1890—*Concluded.*

Product.	1889.		1890.	
	Quantity.	Value.	Quantity.	Value.
Brought forward		$11,032,644		$13,536,766
Non-metallic—Concluded.				
Roofing cement Tons.			1,171	6,502
Sand and gravels (exports) "	283,044	52,647	342,158	65,518
Sewer pipes				348,000
Slate Tons.	6,935	119,160	6,368	100,250
Terra-cotta				90,000
*Tiles M	10,526	134,265	10,521	140,877
Sulphuric acid Lbs.	10,998,713	152,592	11,118,779	145,235
Whiting Brls.			500	500
Total Non-metallic		$ 11,491,308		$ 14,433,648
do Metallic		2,686,175		3,570,685
Estimated value of mineral products not returned (principally structural material)		992,838		995,667
Total		$ 15,170,321		$ 19,000,000
Items left out, 1890—Iron, steel, charcoal and pig iron		(*b*) 4,329,679		

* Incomplete.

(*a*) Owing to the returns of nickel for 1889 being confidential the value had to be included in the last item of the table, viz., estimated values.

(*b*) Statistics of the production of iron, steel and charcoal were not collected for 1890. The pig iron produced was all included under the head of iron ore.

Exports.

Mineral and Mineral Products, Mined or Manufactured in Canada, during 1890.

Product.	Value.	Product.	Value.
Acid, sulphuric	$ 4,393	Mica, crude and cut	$ 19,171
Asbestus, first-class	453,704	do ground	3,297
do second-class	58,973	Nickel	89,568
do third-class	15,853	Oil, crude and refined	18,154
Barytes	1,960	Ore, antimony	1,000
Brick	3,762	do iron	40,690
Coal	2,436,906	do manganese	36,831
Coke	21	do silver	204,142
Copper	398,497	Phosphate	499,369
Fertilizers	5,778	Plumbago	1,529
Gold	706,792	Salt	1,667
Glass and glassware	12,015	Sand and gravel	65,518
Grindstones	18,564	Slate	153
Gypsum, crude	192,254	Stone, unwrought	43,611
do ground	105	do wrought	21,725
Iron and steel, about	275,000	Other articles	7,735
Lime and cement	168,804	Total	5,807,541

Exports.

Products of the Mine during the Fiscal Year, 1890.

Exported to	Value.	Exported to	Value.
United States	$ 3,963,257	Brazil	$ 2,205
Great Britain	630,815	France	1,132
Newfoundland	167,075	Belgium	900
St. Pierre	19,905	Spain	500
Germany	17,067	Danish West Indies	300
British West Indies	12,170	Norway and Sweden	197
Spanish do	11,994		
Sandwich Islands	10,312	Total	4,855,757
Hong Kong	7,254		
Japan	7,200	1889	4,419,170
British Guiana	3,474		
		1888	4,110,937

Imports.

Minerals and Mineral Products, Fiscal Year, 1890.

Product.	Value.	Product.	Value.
Alum and aluminous cake	$ 28,758	Grindstones	$ 20,569
Antimony	17,439	Gypsum	4,064
Arsenic	4,474	Iron and steel	8,473,741
Asbestus and manufactures	13,250	Lead and manufactures of	368,180
Ashes, pot, pearl and soda	2,138	Lime	5,360
Asphaltum	68,454	Litharge	31,401
Baryta	978	Lithographic stone	4,071
Borax	24,845	Manganese oxide	3,192
Brass and manufactures of	554,545	Marble	99,353
Bricks	12,500	Mercury	7,677
do bath	2,225	Mineral water	40,802
do and tiles, fire	96,537	Nickel	75
Buhrstone	2,506	Ochres	14,066
Building stone	132,155	Paraffine wax	15,844
Cement	14,491	Petroleum and manufactures of	515,852
do Portland	313,572	Plaster of Paris	6,004
Chalk	7,221	Platinum	5,215
Clays—		Potash salts	10,787
China	28,167	Precious stones	119,824
Fire	21,366	Salt	309,840
All other, N.E.S	11,044	Sand and gravel	36,768
Coal, anthracite	4,595,727	Silex	2,617
do bituminous	3,528,959	Slate	22,871
do dust, &c	29,818	Soda salts	327,961
do tar and pitch	19,345	Stone or granite, N.E.S	84,396
Coke	133,344	Spelter	71,122
Copper and manufactures of	484,189	Sulphur	44,276
Copperas	4,001	Sulphuric acid	2,927
Earthenware	695,206	Tiles, sewer pipes, &c	77,434
Emery and pumice	19,925	Tin and manufactures of	1,289,756
Fertilizers	46,637	Whiting	27,471
Flagstones	48,995	Yellow metal	98,472
Fullers' earth	1,060	Zinc and manufactures of	99,002
Glass and glassware	1,230,585		
Graphite and manufactures of	36,881	Total	24,472,327

ABRASIVE MATERIALS.

Notwithstanding the many extensive deposits of tripoli, buhrstone, and rocks suitable for the manufacture of whetstones, nothing has been done during the past year in the production of abrasive materials beyond the manufacture of grindstones and a small quantity of scythe-stones at several of the grindstone quarries.

Tripoli.—This material which occurs in the Dominion, generally in lake bottoms, is found in great quantity in New Brunswick and Nova Scotia. In the former province the localities best known are Pollet River Lake, Mechanic's Settlement and Fitzgerald Lake, in King's Co., and Pleasant Lake, St. John Co. New Brunswick.

Of the material from the former locality, an analysis was made in 1879 by Mr. G. C. Hoffmann, Chemist to the Survey, with the following result:—

Silica	80·487
Alumina	3·146
Ferric oxide	0·951
Lime	0·342
Magnesia	0·283
Carbonic acid	0·011
Phosphoric acid	?
Potash and soda	?
Water combined and hygroscopic and organic matter	13·321
	98·541

In the lakes above-mentioned the material is said to be in very considerable quantity, the deposit at Fitzgerald Lake being, throughout the area of the lake, over 10 feet in thickness.

Small quantities have at various times been shipped from these deposits, though in no instance has the shipment exceeded a few tons for experimental purposes. None was shipped from this province during 1890.

In Nova Scotia, the list of lakes already known to afford tripoli is too great to publish here, being scattered over Pictou, Colchester, Cumberland, King's, Halifax, Victoria and Cape Breton counties. Little work has been performed, though, it is believed, small lots of a few tons have been shipped. None was raised during 1890. Nova Scotia.

The following table shows the imports of material classified by the Customs Department as "silex," presumably tripoli, or manufactures of the same:—

ABRASIVE MATERIALS.

TABLE 1.

IMPORTS OF "SILEX."

Fiscal Year.	Cwts.	Value.
1880	5,252	$2,290
1881	3,251	1,659
1882	3,283	1,678
1883	3,543	2,058
1884	3,259	1,709
1885	3,527	1,443
1886	2,520	1,313
1887	14,533	5,073
1888	4,808	2,385
1889	5,130	1,211
1890	1,768	2,617

Pumice Stone.—This material has not as yet been found in Canada. The imports will be found included with those of Emery in table 2.

Emery.—Corundum has not as yet been found in any quantity in Canada, thus making it impossible that there should be any production of emery. The Dominion, however, contains very extensive garnet deposits, which may at any time be worked and produce large quantities of a material which is to a certain extent used as a substitute for emery, though having a less degree of hardness.

The imports of emery, in addition to pumice stone are given in the following table:—

ABRASIVE MATERIALS.

TABLE 2.

IMPORTS OF PUMICE STONE AND EMERY.

Fiscal Year.	Value.
1880	$ 7,854
1881	11,179
1882	15,762
1883	17,823
1884	16,518
1885	14,450
1886	14,458
1887	15,617
1888	18,564
1889	16,888
1890	19,925

As the value of emery wheels is not altogether dependent on the quantity of contained emery, it has been thought better not to include the imports of this manufacture in the preceding table.

Buhrstones.—In the descriptive catalogue of a collection of minerals sent to Philadelphia in 1876, the following description of an area of rocks suitable for buhrstones is given :—

"This buhrstone constitutes a series of veins, cutting an intrusive mass of syenite, which occupies an area of thirty-six square miles, among the Laurentian rocks of Grenville, Chatham and Wentworth. The veins consist of yellowish-brown or flesh-red cellular chert; the colours, in some cases, running in bands parallel to one another and sometimes being rather confusedly mingled, giving the aspect of a breccia. The cells are unequally distributed, some parts being nearly destitute of them, while in others they are very abundant, and of various sizes, from that of a pin's head to an inch in diameter."

This deposit for other than the purpose of obtaining specimens has not yet been opened, nor have any buhrstones been as yet made from Canadian material. The imports are given in the following table :—

ABRASIVE MATERIALS.

TABLE 3.

IMPORTS OF BUHRSTONES.

Fiscal Year.	Value.
1880	$12,049
1881	6,337
1882	15,143
1883	13,242
1884	5,365
1885	4,517
1886	4,062
1887	3,545
1888	4,753
1889	5,465
1890	2,506

Grindstones.—Throughout the area covered by the Carboniferous and Permian rocks in Eastern New Brunswick and Nova Scotia are extensive areas of sandstone, eminently suitable for the manufacture of grindstones. The industry is carried on in the district surrounding Shepody and Cumberland Bay, at the North-East end of the Bay of Fundy; at Newcastle, Northumberland county; and along the south shore of the Baie des Chaleurs from Janeville to Grand Anse, in Gloucester county, New Brunswick; and throughout Pictou and Cumberland counties, Nova Scotia.

Although there are a considerable number of operators, the production is but small, as outside of the Baie des Chaleurs quarries the output is in small quantities from building stone quarries.

Probably the best stone for the manufacture of grindstones is that on the south side of the Baie des Chaleurs, where the industry has been carried on since 1830, and possibly before.

The stone from this district is obtained from beds averaging about six feet in thickness, interstratified with heavy deposits of blue and red shale, pyro-schists and fire clay.

The exposure on the coast at Clifton shows the following section:—

Clay (surface), 10′.
Blue shale, 25′.
Sandstone, 8′ (used in the manufacture of grindstones).
Bituminous shale, 8′.
Fire clay, 6′.
Shale, red (in base of quarry).

Dip very slight, to south-east; strike, north-east.

This section will be approximately repeated along the coast (both east and west), the various beds of sandstone being almost invariably between the blue and the bituminous shales.

The thickness of the beds enables very large stones to be obtained from this district; shipments of stones weighing up to 3 tons being frequently made. The largest stone shipped weighed 7,840 lbs.

As a rule the stone is shipped from Northern New Brunswick in the finished condition, small quantities only of rough hewn ("scabbled") stone being sent away, whereas from Nova Scotia the greater quantity is sent to Boston and other points in the Eastern States in the latter condition to be further manufactured.

The production in New Brunswick during 1890 was, according to returns received at this office, 4,034 tons, valued at $33,804.

For Nova Scotia no returns of production were received. Assuming, however, that the quantity exported was equivalent to that produced, there is for that province a production of 850 tons, valued at $8,536, making a total production of 4,884 tons, valued at $42,340. No grindstones are produced outside of these two provinces.

These figures show a very material increase over those for the year previous, the increase being 1,480 tons, valued at $11,477. The amounts produced during the previous four years were:—

1886	4,000	tons, valued at	$46,545
1887	5,292	" "	64,008
1888	5,764	" "	51,129
1889	3,404	" "	30,863

A considerable proportion of the production of Canadian grindstones finds a market in Boston, where they are sold at an average price of $25 per ton, and enter into direct competition with the Ohio stones, which sell at from $10 to $12 per ton.

The exports by provinces for the last hree years are shown in table 4, while in table 5 are shown the total exports since 1884.

ABRASIVE MATERIALS.

TABLE 4.

EXPORTS OF GRINDSTONES.

Provinces.	1888.	1889.	1890.
Ontario	$ 252		
Quebec		$ 1,387	$ 12
Nova Scotia	11,430	7,150	8,536
New Brunswick	16,494	21,437	10,016
Manitoba		8	
Totals	$28,176	$29,982	$18,564

ABRASIVE MATERIALS.

TABLE 5.

EXPORTS OF GRINDSTONES.

Year.	Value.
1884	$28,186
1885	22,606
1886	24,185
1887	28,769
1888	28,176
1889	29,982
1890	18,564

The imports for the past eleven years are given in the following table which explains itself:—

ABRASIVE MATERIALS.

TABLE 6.

IMPORTS OF GRINDSTONES.

Fiscal Year.	Tons.	Value.
1880	1,044	$11,714
1881	1,359	16,895
1882	2,098	30,654
1883	2,108	31,456
1884	2,074	30,471
1885	1,148	16,065
1886	964	12,803
1887	1,309	14,815
1888	1,721	18,263
1889	2,116	25,564
1890	1,567	20,569

Hone and Whetstones.—A small quantity of scythe stones is made at Clifton and Stonehaven, Northumberland Co., New Brunswick, the value of which is included in that given for grindstones. No hone or whetstones (so-called) were produced during the year, nor has there been any production for several years.

FOSSIL RESIN ("AMBER").

A discovery of considerable importance was reported upon by Mr. J. B. Tyrrell, who, during his summer's work in Northwestern Manitoba, visited an extensive deposit of so-called amber on the west shore of Cedar Lake. This lake is on the Saskatchewan River, of which it is in reality a part, and near its mouth where it empties into Lake Winnipeg, and is distant from the city of Winnipeg about 300 miles.

Mr. Tyrrell in his summary report to the Director of the Survey writes as follows:—

"It occurs mixed with sand and many fragments of partly decayed wood, on a low beach behind a gradually shelving shore and along the face of a deep, wet, spruce swamp. The pieces were for the most part smaller than a pea, but could be readily seen glittering among the sand and vegetable débris. Some pieces were found as large as a robin's egg, and Mr. King informed me that he had collected pieces very much larger. It has evidently been washed up on the shore by the waves, but its exact age has not yet been positively determined.

"The first place at which it was seen was in a small bay behind a limestone point projecting towards the north, but the most extensive

deposit is more than a mile south of this point, where a rounded beach stretches across the margin of a low swamp. This beach is about a mile in length, and from eighty to one hundred and twenty feet in breadth. The "amber" is found most plentifully along its ridge, where it constitutes between five and ten per cent. by volume of the sand and vegetable débris, and holes dug to a depth of two feet show no diminution in its quantity. Towards the edge of the lake, however, the sand is freer, both from fragments of wood and "amber." It is difficult to make an accurate estimate of the quantity of "amber" on this mile of beach, but it may confidently be said to be found throughout the distance in a band thirty feet wide, with a minimum depth of two feet. This band has thus a total bulk of 316,800 cubic feet. A number of specimens collected from various parts of it showed an average of a little over ten per cent. of "amber," which, in natural fragments, weighed forty-six pounds to the cubic foot. The amount of "amber" on this strip of beach would, therefore, be about 31,680 cubic feet, or 1,457,280 pounds. At a minimum value of 25 cents a pound, this would represent a total of $364,320. This estimate refers merely to the material that is now washed up on the ridge of the beach, without considering the source from which it is originally derived."

In Canada* "amber" has been found frequently in the coals and lignites of the North-West, and also occurs at many points in the United States, notably in the Cretaceous and Tertiary beds of New Jersey and Massachusetts. These deposits, however, have not as yet been operated commercially, specimens only having been extracted.

No statistics regarding the market for this substance in Canada are available.

The following table of imports into the United States up to 1885† will prove of interest as illustrating a possible outside market for this substance:

Fiscal Years.	Value.
1869	$ 427
1870	1,433
1871	180
1872	2,426
1873	1,534
1874	1,448
1875	7,169
1876	15,502
1877	17,307
1878	13,215
1879	17,821
1880	36,860
1881	42,400
1882	72,479
1883	40,166
1884	56,301
1885	21,722

* Annual Reports Geological Survey of Canada for the following years:—1873-74, p. 55; 1876-77, pp. 471-3; vol. IV, p. 46T.

† Bulletins U.S. Geological Survey:—Mineral Resources of the United States, by David T. Day, 1886, p. 605.

ANTIMONY.

The only producing antimony deposit in Canada during the past year was that at Rawdon Mines, Hants county, Nova Scotia, though it cannot be said that the mine was actually in operation, as the shipments consisted of material cobbed from the dumps and consigned to Liverpool, England.

Extensive deposits occur in New Brunswick, at Prince William, and at South Ham, Quebec, neither of which properties have, however, been operated for several years.

The production during the past year amounted to 26½ tons, valued at $625, a decrease since the previous year of 28½ tons and $475.

The annual production for the past four years is:—

1887	584	tons, valued at	$10,860
1888	345	do	3,696
1889	55	do	1,100
1890	26½	do	625

Lessened demand by the American companies taking the output of these mines is said to be the cause of the annual decrease in production shown above.

The exports of antimony ore for the past eleven years are as given below:

ANTIMONY.

TABLE 1.

EXPORTS.

YEAR.	Tons.	Value.	YEAR.	Tons.	Value.
1880	40	$ 1,948	1886	665	$ 31,490
1881	34	3,308	1887	229	9,720
1882	323	11,673	1888	352½	6,894
1883	165	4,200	1889	30	695
1884	483	17,875	1890	38	1,000
1885	758	36,250			

The imports of antimony (other than ore, which is not imported) for the corresponding number of years are as follows :—

ANTIMONY.

TABLE 2.

IMPORTS.

Fiscal Year.	Pounds.	Value.
1880	42,247	$ 5,903
1881	.....	7,060
1882	183,597	15,044
1883	105,346	10,355
1884	445,600	15,564
1885	82,012	8,182
1886	89,787	6,951
1887	87,827	7,122
1888	120,125	12,242
1889	119,034	11,206
1890	117,066	17,439

ARSENIC.

The production of arsenic for 1890 has been small. It is all from Deloro, Ontario, and was obtained by resublimating the crude arsenic derived from the condensation chambers at the works of the Canadian Consolidated Gold Mining Company, and at the Malone Mines. These mines, now closed for some years, were formerly worked for gold, the concentrates being said to contain about 25 per cent. of oxide of arsenic. The present production of arsenic is limited to the quantity of crude material obtained as above stated, and also by the small demand. Altogether some 650 tons of refined arsenic have been shipped from the Madoc region since the commencement of operations there. It is to be regretted that more is not being produced, as the Canadian material has been proven to be of very superior quality, owing to its entire freedom from impurities, whereas English and other arsenic frequently contains small amounts of zinc, tin or lead.

An analysis of a carload shipped from Madoc in 1887, gave, according to P. de P. Rickets, Columbia College:

As $_2O_3$ (arsenious oxide)	99·84
Impurities	0·16
	100·00

Two others by Baker Edwards, of Montreal, gave :—

As $_2O_3$ refined	97·5
As $_2O_3$ crude	92·8

The markets of the United States and Canada require about 6,000 tons per annum, nearly all of which is now supplied from England, though there is every probability that in the near future Canada will furnish a large proportion from the practically inexhaustible source of supply in Hastings county.

The amount produced during 1890 was 25 tons, valued at $1,500, or $60 per ton in New York.

The production for the past five years has been:—

	Tons.	Value.	
1886	120	$5,460	At the Mine.
1887	30	1,200	do
1888	30	1,200	do
1889	Nil.	Nil.	do
1890	25	1,500	do

According to the report on the Mineral Resources of the United States, 1885, there were during that year 440 tons of crude and refined arsenic shipped from the Consolidated Company's mine to the United States.

The table of imports is given below.

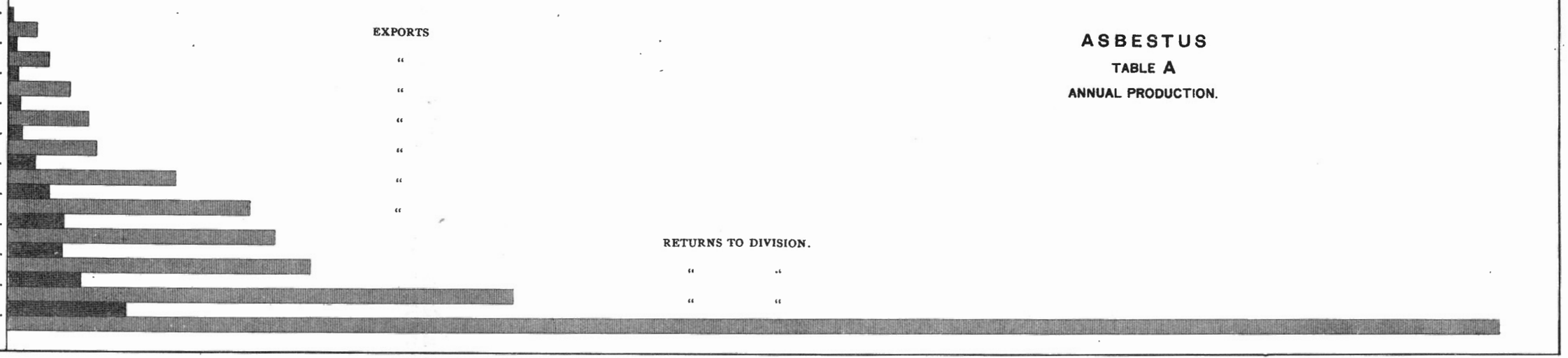
ARSENIC.

TABLE 1.

IMPORTS.

FISCAL YEAR.	Pounds.	Value.
1880	18,197	$ 576
1881	31,417	1,070
1882	138,920	3,962
1883	51,953	1,812
1884	19,337	773
1885	49,080	1,566
1886	30,181	961
1887	32,436	1,116
1888	27,510	1,016
1889	69,269	2,434
1890	138,509	4,474

Year	Tons	Value
	380	$.....
1880	.....	24,700
.....	540	.....
1881	.....	35,100
.....	810	.....
1882	.....	52,650
.....	955	.....
1883	.....	68,750
.....	1,141	.....
1884	.....	75,097
.....	2,440	.....
1885	.....	142,441
.....	3,458	.....
1886	.....	206,251
.....	4,619	.....
1887	.....	226,976
.....	4,404	.....
1888	.....	255,007
.....	6,113	.....
1889	.....	426,554
.....	9,860	.....
1890	.....	1,260,240



ASBESTUS

TABLE A

ANNUAL PRODUCTION.

ASBESTUS.

Production.

The production of this mineral during 1890 shows an encouraging increase of over 60 per cent in the amount and about 200 per cent. in the total value, being for 1890, 9,860 tons, with a value of $1,260,240 as computed from returns received as compared with a production for last year of 6,113 tons, with a value of $426,554. (*See* Graphic Table A.)

This result has been brought about by improvements in plant, methods of extraction and especially by the stimulating effect of a considerable increase in prices, the value of a ton of the different grades ranging as follows:—"Thirds," $20 to $50; "seconds," $75 to $100; "firsts," $125 to $150, whilst extra quality of "firsts" ranged as high as $250; the margin of price for the same quality being due to the great difference often existing between the equivalent grades from different mines.

Operations.

The operations for the extraction of this mineral are almost altogether confined to the districts of Thetford, Black Lake and Coleraine in the County of Megantic, P.Q., which are traversed by the Quebec Central Railway, although there are one or two detached mines outside of this in the same general district of the Eastern Townships. The deposits are all found in the areas of serpentine which are associated with the Cambrian rocks of the district.

Dr. R. W. Ells has made a special study of the asbestus deposits, during several years spent in making investigations for the Survey, the results of which may be found in the Annual Reports of the Survey. The mode of occurrence of these deposits cannot be better given than by quoting his description of them, in a paper read before the American Institute of Mining Engineers, at its meeting at Ottawa, October, 1889, where he describes as follows:—

R. W. Ells on "Asbestus Mines."

"The asbestus industry, although of comparatively recent date, has, since its inception in 1878, rapidly increased in importance, and bids fair to speedily become the leading mining industry of the province. While the occurrence of fibrous serpentine or chrysotile in the Townships has been known for many years, and has been mentioned in the earlier reports of the Geological Survey, its true economic importance remained unrecognized, and it was not until the opening of the Quebec Central Railway across the serpentine belt of Thetford and Coleraine that any importance was attached to this peculiar mineral. Although occurring to some extent with the serpentines of the Laurentian district, north of the Ottawa River, its development in this direction has not as yet been sufficiently studied to warrant a clear expression of opinion as to the actual value of these areas, and the production of asbestus or chrysotile

is as yet entirely confined in Canada to the Eastern Townships, and to the serpentine rocks which are at present regarded as forming a part of the volcanic belt of the lower Cambrian system of Quebec.

"This mineral differs entirely from the actinolite of central Ontario, and the asbestos of the Townships also presents several points of difference when contrasted with that from the Laurentian district. This is seen in the greater softness, silkiness and tenacity of the fibre of much of the former, a property which gives it great value for spinning and for its working into the finer variety of textures to which it is now so extensively applied.

"The stratified rocks associated with the serpentines of the Townships in which the workable asbestos occurs are generally slates of various colours, black, gray, green and purple, with occasionally conglomerate and sandstones, which are often hard and highly quartzose. These are frequently associated with diorites, which often form large mountain masses as at Orford, Ham, Broughton and other points, and which in texture are generally fine-grained, both massive and concretionary, and in colour, range through shades of green to brown.

Distribution. "In the Province of Quebec the serpentine extends for many miles, in a series of interrupted outcrops from the boundary of Vermont, nearly to the extremity of the Gaspé peninsula. At several places, notably in Thetford and Coleraine, and in the Shickshock mountain-range of Gaspé it presents a large development. It is sometimes found in bands of a few yards in breadth, apparently interstratified with the slates and sandstones, and sometimes with diorites, in conjunction with which it forms knoll-like hills or elongated ridges of considerable extent. In many places a gradual transition from the diorites to the serpentines can be observed, and it seems very conclusively settled, both from observation in the field on a large scale and from analyses in the laboratory of the Survey, that much of the serpentine is an alteration-product from dioritic rocks, rich in olivine or some allied mineral. While generally massive, the rock has at times a slaty structure, and in many localities the mass is much shattered and broken. More especially is this latter feature noticeable in quarries or areas where dykes of diorite, but more generally of a whitish granite or granulite, cut the serpentine. This latter rock, which has generally a grayish or grayish-white colour, consists for the most part of orthoclase felspar and quartz, but at times contains an admixture of mica, classing with a true granite. Whatever may be the age of these whitish dykes, which frequently become masses of considerable extent, they certainly are newer than the serpentines which they traverse, as is evidenced clearly by the alteration and shattering of the

mass traversed, along the contact. The view is held by many of those engaged in mining asbestus, that the presence of these smaller dykes exercises a favourable influence on the production and character of the veins, in the same way as the action of diorite dykes upon copper or other metalliferous strata on the production of ore-deposits.

"Among the principal areas of serpentine which are found at so many widely scattered points, the most easterly yet known is at a point called Mount Serpentine, about 10 miles up the Dartmouth River from its outlet in Gaspé basin. The serpentine is here associated with limestone and surrounded by strata of Devonian age. Small veins of asbestus are found in the rock, but not yet in quantity sufficient to be economically valuable. West of this the next observed is the great mass of Mount Albert, whence it extends west in a great ridge for some miles. This mass is known to contain veins of chromic-iron, and traces of asbestus have also been observed, but the area has never yet been carefully explored with a view to ascertain the presence of the mineral in quantity, owing largely to the present difficulty of access.

"In Cranbourne and Ware, to the north of the Chaudière River and in the vicinity of that stream between the villages of St. Joseph and St. Francis several small knolls are seen, in all of which small and irregular veins are visible, but apparently not in quantity sufficient to render them economically important, at least in so far as yet examined. Further to the southwest, in Broughton, Thetford, Coleraine, Wolfestown and Ham, a very great development of these rocks is observed, forming at times mountain-masses from 600 to 900 feet above the surrounding country level, and presenting very peculiar and boldly marked features in the landscape by their rugged outlines and curiously weathered surfaces. The large areas of this division terminate southward at a point termed Ham Mountain, a very prominent peak of diorite which marks the extremity of the ridge. In this great area, which we may style the central area, asbestus can be found at many points in small quantity but at a comparatively few does it occur in quantity and quality sufficient to warrant the expenditure of much capital in its extraction.

"The third area, regarding that of the Shickshocks as the first, begins near the village of Danville, and may be styled the southwestern area. Thence it extends through Melbourne, Brompton, Orford, Bolton and Potton, in a series of disconnected hills, to the American boundary, beyond which the continuation of the serpentines can be traced into Vermont. In these areas, with the exception of the peculiar isolated knoll near Danville, the asbestus has, as yet, been observed in small quantity only, and generally of inferior quality. Large areas of

soapstone are found at points throughout the area, and the associated diorites have a large development. It must, however, be said of this section, that considerable areas, whose outcrops can be seen along the roads which traverse the district, are concealed by a dense forest growth, and the true value of such portions must, for some considerable time, be largely conjectural. In fact, until the forest and soil are completely removed by the action of forest fires, as was the case at Black Lake and Thetford, the search for asbestus is likely to prove difficult and unsatisfactory. It is, however, very evident from the studies already made on this interesting group of rocks in Canada, that all serpentines are not equally productive—a fact very evident even in the heart of the great mining centres themselves, where large areas of the belt are made up of what is known as barren serpentine. As a general rule, however, the rock likely to prove asbestus-producing can be determined by certain peculiarities of texture, colour or weathering.

"At the Thetford mines, and in that portion of Coleraine lying to the northeast of Black Lake, certain conditions favourable to the production of asbestus appear to have prevailed, and have led to the formation of numerous veins, often of large size, which, in places, interlace the rock in all directions. These veins range in size from small threads to a width of 3 to 4 inches, and in rare cases even reach a thickness of over 6 inches. The quality of the fibre, however, varies even in these localities, and while much of it is soft, fine and silky, other portions are characterized by a harshness or stiffness which detracts greatly from its commercial value.

"Several theories have been put forth as to the origin of the asbestus veins. From a careful study of many places throughout the belt, it would seem that the theory of segregation applies equally to these as to quartz veins or other mineral lodes. The fibre of the veins, unless distorted by pressure, is always found at right angles to the sides of the fissure, and frequently in veins of what are regarded as of large size, say from two and a-half to four inches, the continuity of the fibre is broken by a dividing zone or comb, if one may use the expression, of grains of magnetic or chromic-iron. In certain cases, also, the mass of the serpentine appears to lose colour near the veins or in immediate contact with them, but this feature is not always observed.

"The fissures or veins are not always regular or persistent for any very great extent. A small vein at the surface, of half an inch in thickness, may quickly enlarge to one of three inches or more, and, continuing, may die out entirely, while others come in on either side. They have much the aspect of the gash veins in slaty rocks, though there are

many instances are seen where the fibre maintains a tolerably uniform size for considerable distances.

"The containing rocks show the presence of numerous faults, as in other mineral localities, but possibly in the serpentine these are often more plainly marked. These faults throw the veins from side to side, and frequently are of sufficient extent to cut off entirely the working face of a highly productive area, the rock on the other side of the fissure being often entirely barren. The sides of the fault, in such cases, show extensive slickensides, and frequently have great sheets of coarse or woody-fibred, or imperfect asbestus, along the planes of fracture. Occasionally pockets or small veins of chromic iron are found in close proximity to the asbestus.

"Much of the asbestus found at the surface, or in the upper workings, is discoloured. This is generally the case where the rock is shattered by the action of the intrusive dykes, or from some other cause, and the colouring is doubtless due to infiltration of water along the lines of jointing or fracture, becoming less as the rock grows more solid. The quality of the fibre in such cases improves as the mine becomes deeper. A somewhat similar remark may be made as to the quality of the fibre at the surface as compared with that from a lower level, but proceeding from a different cause. Owing to the destruction of the forest over the serpentine-knolls by extensive fires or by the action of the weather, the asbestus veins, which are exposed at the surface, have frequently a certain amount of harshness, which entirely disappears as the vein is opened. This peculiarity is probably due to the action of the fire, by which a certain proportion of the contained water of the mineral is dissipated; and in this connection, also, a very interesting study is afforded by the comparison of the output at the Thetford mines with that from certain areas in the Black Lake District. At the former, the fibre is remarkable for its soft, silky character, and the percentage of harsh fibre is comparatively small. The same is true of certain of the Black Lake mines, but at others, though many veins of good size are also found, a very much larger proportion of the fibre is harsh or brittle. The cause of this difference has long been a subject of speculation to those more immediately interested in the subject, some attributing it to a difference in level of the two localities—a theory, however, which can scarcely be maintained in view of the fact that much of the output from the Black Lake mines, from the higher levels, is of the best quality.

"The presence, however, of large masses of the intrusive granulite near Black Lake, as contrasted with its almost entire absence at Thetford, where it is found generally in small dykes, leads to the inference that to

this intrusion of heated matter may be largely due the lack of softness and silkiness in much of the Black Lake output. The presence of such great masses would have a tendency to dissipate a certain proportion of the contained water from the chrysotile, which is really a hydrous silicate of magnesia, in the same way as the action of the forest fires, though on a much more extended scale. The same effect can be produced by placing a piece of the mineral in the fire or on a sufficiently heated surface, when in a short time it will be found to have lost its softness to a large extent and become harsh and brittle.

"The extraction of asbestus in the present stage of the industry may rather be termed quarrying than mining proper, the workings so far being all open cuts. The rock is blasted out, broken up, carried to the dumps and subsequently cobbed by hand, the latter being generally done by boys. The smaller veins, of a-fourth to a-half inch, are frequently left in the rock of the dump, as not in the present state of the industry repaying the cost of extraction. There is no doubt that with suitable machinery for crushing and cobbing the greater part of most or all of the dumps, which have already reached a large size, would easily pay for working over, while the removal of the dumps themselves, from the fac- of their covering much valuable ground, will very shortly become a net cessity.

Thetford. "The workings at Thetford are at present confined principally to four companies, viz.: King Bros., The Bell Company, Irving, Johnston & Co. and Ross, Ward & Co. These are all situated on a small knoll of serpentine which rises to a height of 80 to 90 feet above the adjacent track of the Quebec Central Railway which traverses the properties. The output from all these mines is practically the same in quality and length of fibre, though in the quarry of Irving, Johnston & Co., veins of extra width, nearly six and a half inches, have been found. This extra length of fibre does not, however, possess any special advantage, since it is generally broken by grains or partings of iron, and for practical purposes good clear fibre of two to three inches, or even less, is quite as valuable as any. In addition to the properties at this place above mentioned, new workings have lately been commenced by Mr. A. H. Murphy, now of Montreal, and by Luck & Mitchell, of Sherbrooke, both of which promise well. These are to the west of the railway, and at a lower level, and some extra work may be involved in the removal of a considerable covering of drift in places. The ground between the railway and the Thetford River, which here marks the western limit of the serpentine, has also been lately proved to some extent, and portions of it found to contain asbestus in satisfactory quantity, but the greater facilities for working the upper levels are such as to give them the preference for the present.

"At Black Lake, four miles south of Thetford mines, four companies are also located. These are the Anglo-Canadian, the Frechette-Dauville, the Scottish-Canadian, and the American Abestus Company, or Wertheim's, at all of which a large amount of work has been done. They are all at higher levels than the mines at Thetford, and the output, as already stated, is not, as a whole, equal in quality comparing the percentage of firsts produced. This will be seen from a statement of the relative percentages of the two districts, though this is again to a certain extent affected by the difference in grading practised by the several companies. Thus from the Thetford area the percentage of firsts ranges from 50 to 70; seconds, from 7 to 30; thirds, from 20 to 40. From the Black Lake district the percentages are: firsts, 10 to 50; seconds, 25 to 20; thirds, 20 to 60. Black Lake.

"Taking the scale of prices and the percentage of the higher grades, it is seen that at the present time, commercially speaking, the properties of Thetford are entitled to the first place. This is to some extent explained by the fact that a considerable proportion of the Black Lake output is off-colour, the areas worked lying partly below the crest of the main serpentine ridge and having a considerable covering of drift. At Thetford, owing to elevation of the knoll on which most of the mines are located, the loose or shattered rock, if it ever existed there, has been largely removed by glacial action, the surface of the rock being frequently polished and striated. It has always been expected that the Black Lake output would increase in value when the shattered surface rock was removed, and this expectation has, to a certain extent, been realized in so far as the workings have proceeded, the rock gradually becoming more solid at greater depths, and the colour and quality of the fibre improving. New workings along the face of the ridge at this place have also disclosed the presence of large veins of excellent material, and greatly superior to that from the lower works, yielding a large percentage of first quality. Here the action of the intrusive granulites has not been felt apparently to any considerable extent, and the conditions in this respect more closely resemble those prevailing at Thetford.

"In estimating the values of asbestus properties, the question of the relative percentages of output should be carefully considered, since, while the number of tons produced by two areas might be approximately equal, and to the uninitiated the properties in consequence be nearly equal in value, the one from the large amount of firsts would be capable of paying very handsome dividends, while the other would require great economy of management and yield far less satisfactory returns.

Danville.

"In addition to the areas just described, several others are worthy of notice. The knoll of serpentine near Danville, of small extent, has been worked for some years by Mr. Jeffrey, of Richmond, with good results. The veins at this place are not large, seldom reaching two inches in width, but the quality of much of the fibre is excellent, and, though small, a considerable number of them produce a good amount of abestus. The proportion of firsts from this mine is at present about 20 per cent., and of seconds 60 per cent., the remainder, of course, being thirds, thus approximating more closely the output of the mines at Black Lake.

"A more curious deposit however, is that known as the Broughton mine. The asbestus here is apparently confined to a single vein, having a hanging wall, in places, of soapstone. This vein was remarkable for its large size when first worked, being at times nearly or quite a foot thick, as well as for the great silkiness and softness of fibre. It had more the aspect of a well-defined vein, and has been worked for a distance of several hundreds of yards, and to a depth of about 70 feet. In the lower workings, however it decreased rapidly in size, and at last split up into minute strings, rendering it worthless. Another peculiar feature observed at one of the mines near Coleraine station is the presence of mica, or a similar mineral, associated with the asbestus veins, or in close proximity to them, and occurring in irregular fissures in the rock, of several inches in width. The rock is much shattered, and the mica is not, in so far as yet observed, found in any of the other mines in this section of the country.

"In many places the serpentine is intimately associated with masses of soapstone. In such cases, while occasional small and irregular veins of asbestus may be seen, in none of those examined has the quantity, with the exception of the vein at Broughton, just described, been found to be of much economic importance."

Methods of working.

The methods of working in the district are very simple, consisting in the opening up of large open pits or quarries from which the rock after a certain amount of selection in the pit is hoisted to surface, those portions containing the asbestus being further broken up and going, finally, to the cobbing sheds. Here, after the water has been driven off by heating on a sheet-iron drying table a force of boys select out the asbestus, further cleaning away the rock and classifying the product according to the length of the fibre into "firsts," "seconds" and "thirds." The grading adopted by the different firms varies very much both according to the length and quality of fibre each obtains. One of the leading firms, however, gives the following definition:—Firsts, over ½ inch; Seconds, ½ inch and under; Thirds, short fibre obtained by screening the refuse and re-picking it to free it from rock as far as possible.

There has been a tendency lately to recognize the necessity of adopting machinery in the treatment of the material especially of that carrying the shorter fibre, and the American Asbestus Company have installed a very complete works for the preparation of their product. Here the material as it comes from the quarry is placed in a very ingenious car with shelves, which is run on a track into a drying oven; the remainder of the process consisting of breaking the dried asbestus rock by means of stone breakers and grading through a system of sieves.

The mining is now mostly done by means of steam or compressed air drills, steam and horse derricks being used for hoisting.

Thetford.

At Thetford, the main workings are on a knoll on the east side of the railroad and here, within a radius of some ten chains, or so, are crowded over 20 pits often where belonging to different companies, with only thin walls of rock between. The waste rock has accumulated in large dumps around the pits and now that the more accessible ground begins to be worked out it is found necessary to remove it to get at the portions thus covered. In order to accomplish this steps are being taken by some of the companies to crush and work over these dumps, thus securing a large amount of asbestus that they contain and removing the waste to barren ground further from the workings.

None of the pits have attained any great depth as yet, the deepest probably measuring not more than 200 feet.

Recently, in several places, unexpected but encouraging results have followed on breaking through the large walls or faces of rock visible in the different pits which were believed for a long time to form the limit of the productive rock. This belief proved to be ill-founded and similarly in removing, to ensure safety, large portions of rock also believed to be barren good asbestus has been found in several cases.

Formerly, operations were mostly confined to the high ground, on the east of the railroad, at Thetford and Black Lake; but recently work has been begun at various points on the lower ground, on the other side with fair results, although, as far as the works have gone, the average of the fibre has been shorter than in the older working.

The chief mine, outside of these districts is situated near Danville, and continues to be worked by Mr. Jeffrey. A little activity is also evident in other portions of the district of which Dr. Ells who visited the localities, speaks as follows:—

Brompton Lake.

"*The Brompton Lake mine, which is the most southerly worked to any extent, has been open to a very considerable depth, and a large

* Summary Report of the Geol. Surv. Dep., 1890.

amount of money has been spent; but the prospects for workable veins in the lower workings are no better than at the surface, and no returns have yet been made. About Orford Pond, on the south side of Orford Mountain, and near Long Lake, at the northern extremity of the same ridge, excavations have been made in thin and irregular seams a fourth of an inch, and in the road west from Knowlton Landing to Bolton Pass, in the serpentine band to the east of the Missisquoi River, some exploratory work has been done without finding asbestus of any economic value, and, in so far as yet ascertained, this portion of the province does not present favourable indications for profitable asbestus mining."

Operators

The names of the chief companies operating and producing in the Quebec district, who give employment to about 1,000 men, are as follows:—

Messrs. King Bros.,	Thetford.
The Bell Asbestus Co.,	
Messrs. Ward, Ross & Co.,	
The Beaver Asbestus Co.,	
The Thetford Asbestus Mining Co.,	
Andrew S. Johnson & Co.	
Messrs. King, Bros.,	Black Lake and Coleraine.
The American Asbestus Co.,	
Messrs. Irwin, Hopper & Co.,	
The United Asbestus Co.,	
Messrs. Steele & Co.,	
The Laurier Mining Co.,	
The Murphy Mining Co.,	
Dr. Jas. Reed,	
The Megantic Mining Co.,	
The Jeffrey Asbestus Mine.	Danville.

The Scottish Canadian Asbestus Company of Black Lake, being still in liquidation, remained idle during the year, but hope to start again shortly.

A little prospecting for this mineral was carried on near St. Francis, Beauce, on the 1st range, S.W., near the Bras River, but, so far, no longer fibre than about $\frac{1}{2}$ inch had been obtained. Prospecting operations in Pontiac county, on the north shore of the Ottawa River, in the vicinity of Calumet Island, are also reported, but with what result was not definitely ascertained.

Ottawa County.

The most interesting feature, outside of the progress in the main districts, is to be found in the work prosecuted with a view to testing deposits in the Laurentian rocks of Ottawa county. Some little work was done on the property of Mr. W. A. Allan, on lots 15 and 16, range V, Portland West. Here, numberless small seams of the mineral are

found in the top of a ridge of serpentinized limestone. Only a small force, however, was at work, and enough had not been done to give a clear idea of the nature of the deposit.

A more extended effort is in progress in the Templeton district on lot 11, range VIII of that township. The mine is situated on a low flat ridge of limestone which has been cleared off by bush fires, so that the rocks can be easily examined. A most interesting structure here presents itself, a peculiar process of alteration having gone on, resulting in a reticulation of serpentine bands or seams throughout the limestone, cores of the latter being surrounded by the former. These cores seem to be clearly cut off from the enclosing serpentine ring, and when small can be lifted out leaving like the kernel of a nut a smooth cavity. The seams of asbestus generally follow the course of the serpentine band around the cores, although little cross seams occasionally traverse the band from side to side. A number of these serpentine bands of very varying sizes joining each other at intervals form the reticulation spoken of. The cores of limestone seem to be much more compact and harder than the general mass of the limestone around. Templeton.

The work at this mine consists of a shaft or pit somewhat curved, as might be expected, sunk on one branch of a loop of serpentine of larger dimensions than the rest. This has been followed to a depth of 50 feet without showing any signs of giving out. The serpentine band at this spot with its accompanying asbestus veins has on surface been traced all round the central core, the outcrop of which is the shape of a flat ellipse, its larger diameter measuring about 50 feet. Operation in Templeton.

The large proportion of the fibre, so far, is quite short, but of good quality; whilst a small quantity of "firsts," measuring up to two inches long and very clean and good, was also obtained. The accompanying serpentine shows very beautiful tints, delicate shades of green and amber prevailing. It is clear and semi-translucent, resembling wax. In cobbing, it breaks away easily and cleanly from the fibre, which is generally very clean and free from imbedded rocky impurities.

Only a small force was at work during 1890, as commencement was only made in the beginning of August, but already a boiler has been erected on the spot supplying steam to a machine drill.

The progress of these developments will be watched with great interest as being made to test not only a new district, but also a formation quite different from that of the now well proved areas of Thetford and Black Lake. There we are dealing with asbestus deposits developed in relatively extensive areas of serpentine, which would seem to have been subjected to extensive fracturing forces, the complicated set of fissures

thus formed allowing free scope for the percolation of waters and providing spaces for the deposition of serpentinous material in the fibrous form.

In the Laurentian districts so far examined the process of formation seems much more obscure. The serpentinous matter is small in proportion to the predominating limestone rock, and would seem to be due rather to a quiet replacement of the carbonate of lime along certain lines by the serpentine, and there seems to be no evidence of any extensive movement or fracturing.

It seems, however, quite possible that at places this alteration process will have gone on far enough to produce very considerable bodies of the serpentine, wherein the veins of asbestus may be found to be both more plentiful and yield a larger proportion of longer fibre.

Exports

The exports and imports are given in Tables Nos. 1 and 2 below:—

ASBESTUS.

TABLE 1.

EXPORTS.

Quality.	1887. (a)		1888.		1889.		1890.	
	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.
1st class.....	1,761	$130,707	3,625	$262,552	4,579	$319,461	5,453	$453,704
2nd do	566½	23,296	110	5,306	593	27,308	1,172	58,973
3rd do	184	4,826	201	9,884	416	13,375	373	15,853
Totals....	2,511½	$158,829	3,936	$277,742	5,588	$360,144	6,998	$528,530

(a) Second half of year only.

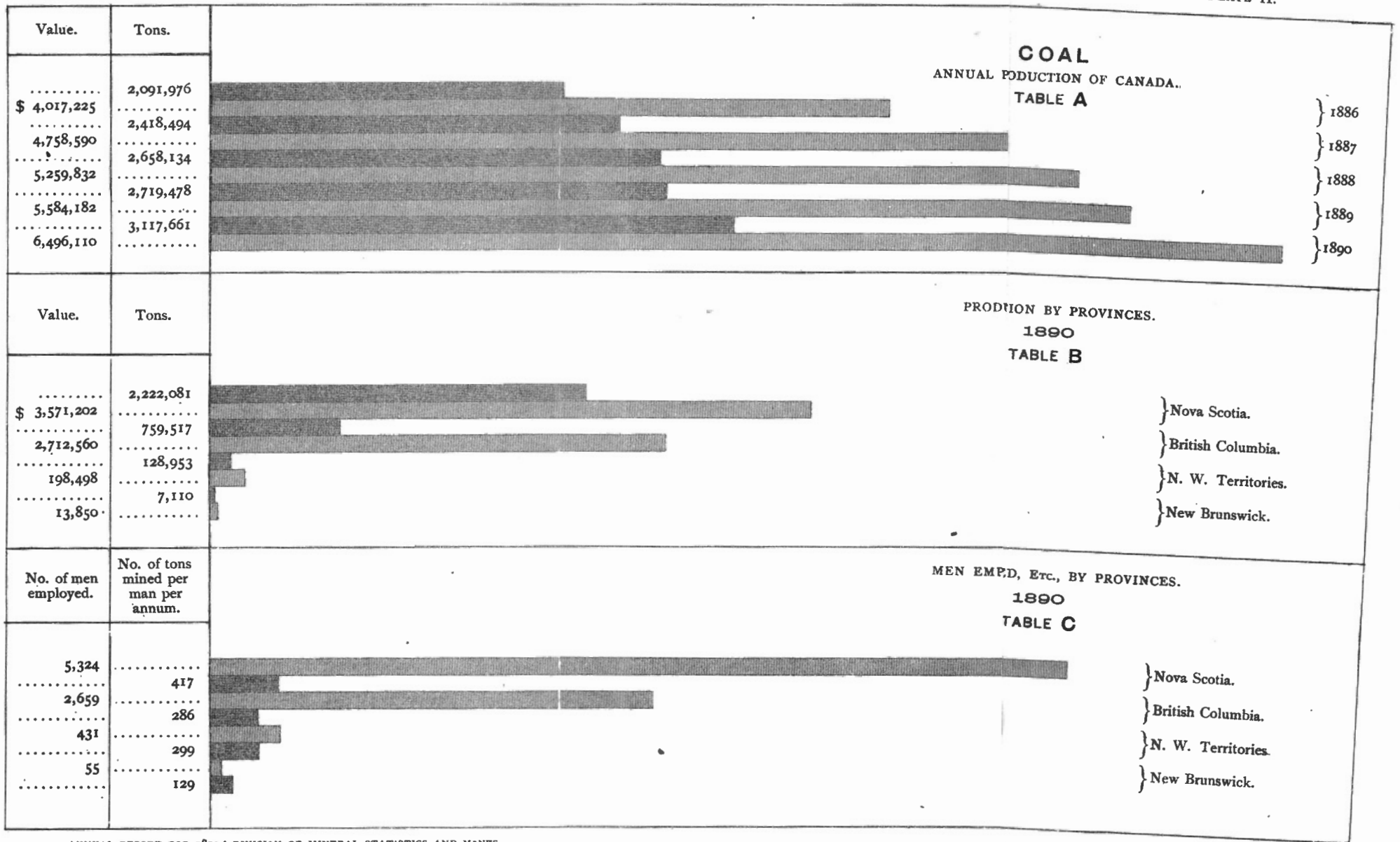
ASBESTUS.

TABLE 2.

Imports

IMPORTS.

Fiscal Year.	Value.
1885.....	$ 674
1886.....	6,831
1887.....	7,836
1888.....	8,793
1889	9,943
1890..	13,250


Value.
Tons.
COAL
ANNUAL PODUCTION OF CANADA.
TABLE A
..... 2,091,976
$ 4,017,225 .....
..... 2,418,494
4,758,590 .....
..... 2,658,134
5,259,832 .....
..... 2,719,478
5,584,182 .....
..... 3,117,661
6,496,110 .....
1886
1887
1888
1889
1890
Value.
Tons.
PRODUCTION BY PROVINCES.
1890
TABLE B
..... 2,222,081
$ 3,571,202 .....
..... 759,517
2,712,560 .....
..... 128,953
198,498 .....
..... 7,110
13,850 .....
Nova Scotia.
British Columbia.
N. W. Territories.
New Brunswick.
No. of men employed.
No. of tons mined per man per annum.
MEN EMP'D, ETC., BY PROVINCES.
1890
TABLE C
5,324 .....
..... 417
2,659 .....
..... 286
431 .....
..... 299
55 .....
..... 129
Nova Scotia.
British Columbia.
N. W. Territories.
New Brunswick.

COAL

TABLE D

NOVA SCOTIA
ANNUAL PRODUCTION.

Year	Tons
1870	700,861
1871	754,031
1872	984,664
1873	1,117,643
1874	977,446
1875	848,395
1876	794,803
1877	848,395
1878	863,081
1879	882,863
1880	1,156,635
1881	1,259,182
1882	1,529,708
1883	1,593,259
1884	1,556,010
1885	1,514,470
1886	1,682,924
1887	1,871,338
1888	1,989,263
1889	1,967,032
1890	2,222,081

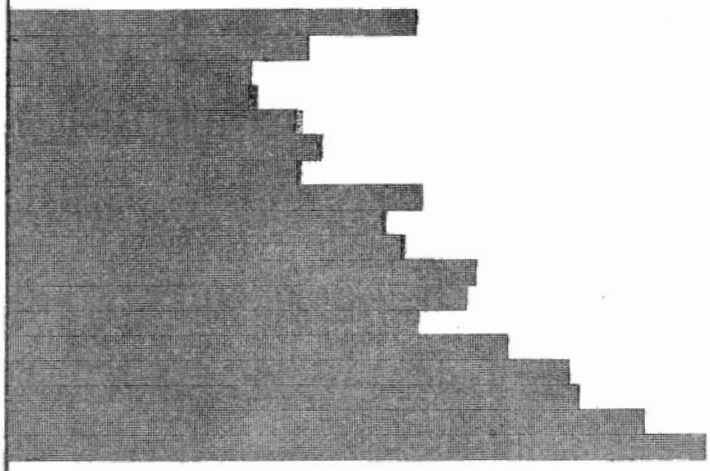
COAL

TABLE E

BRITISH COLUMBIA
ANNUAL PRODUCTION.

Year	Tons
1874	81,574
1875	110,145
1876	131,192
1877	154,052
1878	170,846
1879	241,301
1880	267,595
1881	228,357
1882	282,139
1883	213,299
1884	394,070
1885	365,596
1886	326,636
1887	413,360
1888	548,017
1889	649,409
1890	759,517

Year	Tons
1873	420,683
1874	310,988
1875	250,348
1876	248,638
1877	301,317
1878	327,959
1879	306,648
1880	432,188
1881	395,382
1882	412,682
1883	486,811
1884	474,405
1885	427,937
1886	520,703
1887	580,965
1888	588,627
1889	665,315
1890	724,486



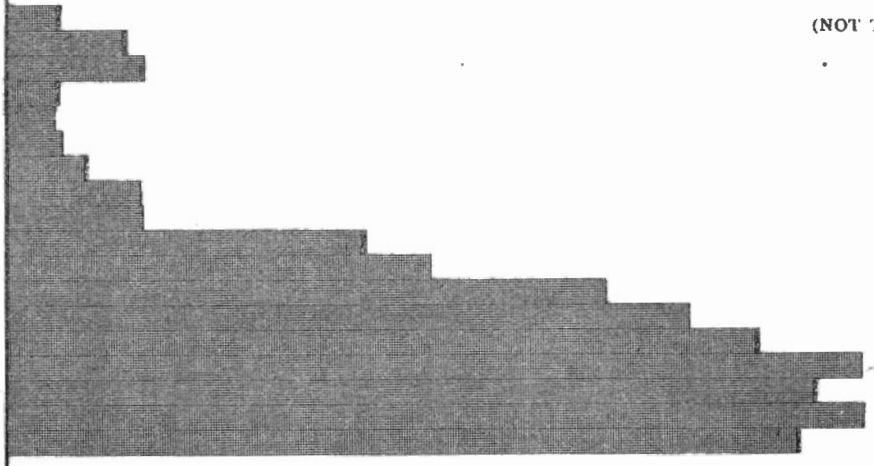
COAL

EXPORTS

(PRODUCE OF CANADA)

TABLE F

Year	Tons
1873	5,403
1874	12,859
1875	14,026
1876	4,995
1877	4,829
1878	5,468
1879	8,468
1880	14,217
1881	14,245
1882	37,576
1883	44,388
1884	62,665
1885	71,003
1886	78,443
1887	89,098
1888	84,316
1889	89,294
1890	82,534



COAL

EXPORTS

(NOT THE PRODUCE OF CANADA)

TABLE G

COAL.

Production.

Operations were carried on during 1890 in Nova Scotia, British Columbia, the North-West Territories and New Brunswick and altogether 3,117,661 tons of coal were raised, value at the pit's mouth, $6,496,110. This shows an increase in quantity over 1889 of 398,183 tons, and in value of $911,928. Comparison with years prior to 1890 is given in the accompanying graphic table A. The production by provinces is also graphically illustrated, and is given in table B, while table C shows the average number of men employed as well as the number of tons mined per man per annum.

The production of Nova Scotia and British Columbia is given in graphic tables D and E, respectively, while that of New Brunswick and the North-West Territories is given for the past four years in table 1, following:

COAL.

TABLE 1.

PRODUCTION IN NEW BRUNSWICK AND NORTH-WEST TERRITORIES.

Year.	New Brunswick.		North-West Territories.	
	Tons.	Value.	Tons.	Value.
1887.....	10,040	$ 23,607	74,152	$ 157,577
1888	5,730	11,050	115,124	183,354
1889.... . ..	5,673	11,133	97,364	179,640
1890.....	7,110	13,850	128,953	198,498

Exports.

The statistics of exports are given in the following tables 2, 3 and 4, and graphic tables F and G, which explain themselves:—

COAL.

TABLE 2.

EXPORTS: THE PRODUCE OF CANADA.

Province.	1889.		1890.	
	Tons.	Value.	Tons.	Value.
Ontario.....	55	$ 193	368	$ 559
Quebec...	7,249	17,848	12,599	32,233
Nova Scotia....	186,608	396,830	202,387	426,070
New Brunswick.....	710	1,728	37	161
Prince Edward Island.....	9	32	142	478
Manitoba..... ..	1	11	71	214
British Columbia.....	470,683	1,918,263	508,882	1,977,191
Totals..... . .	665,315	$2,334,905	724,486	$2,436,906

COAL.

TABLE 3.

Exports.

EXPORTS: NOT THE PRODUCE OF CANADA.

Province.	1889.		1890.	
	Tons.	Value.	Tons.	Value.
Ontario	72,008	$173,382	63,251	$150,258
Quebec	12,625	31,181	13,185	31,042
Nova Scotia	4,483	10,154	5,784	15,055
New Brunswick	178	500	136	395
Manitoba			178	801
Totals	89,294	$215,217	82,534	$197,551

Table 4 gives the exports annually since 1874 from Nova Scotia and British Columbia:—

COAL.

TABLE 4.

Exports: Nova Scotia and British Columbia.

EXPORTS: NOVA SCOTIA AND BRITISH COLUMBIA.

Year.	Nova Scotia.		British Columbia.	
	Tons.	Value.	Tons.	Value.
1874	252,124	$647,539	51,001	$278,180
1875	179,626	404,351	65,842	356,018
1876	126,520	263,543	116,910	627,754
1877	173,389	352,453	118,252	590,263
1878	154,114	293,795	165,734	698,870
1879	113,742	203,407	186,094	608,845
1880	199,552	344,148	219,878	775,008
1881	193,081	311,721	187,791	622,965
1882	216,954	390,121	179,552	628,437
1883	192,795	336,088	271,214	946,271
1884	222,709	430,330	245,478	901,440
1885	176,287	349,650	250,191	1,000,764
1886	240,459	441,693	274,466	960,649
1887	207,941	390,738	356,657	1,262,552
1888	165,863	330,115	405,071	1,605,650
1889	186,608	396,830	470,683	1,918,263
1890	202,387	426,070	508,882	1,977,191

The following tables 5, 6 and 7 show the amounts of coal annually imported into the Dominion since 1880 :—

COAL.

TABLE 5.

IMPORTS OF BITUMINOUS COAL.

Imports Bituminous Coal.

Fiscal Year.	Tons.	Value.
1880	457,049	$1,220,761
1881	587,024	1,741,568
1882	636,374	1,992,081
1883	911,629	2,996,198
1884	1,118,615	3,613,470
1885	1,011,875	3,197,539
1886	930,949	2,591,554
1887	1,149,792	3,126,225
1888	1,231,234	3,451,661
1889	1,248,540	3,255,171
1890	1,409,282	3,528,959

COAL.

TABLE 6.

IMPORTS OF ANTHRACITE COAL.

Imports Anthracite.

Fiscal Year.	Tons.	Value.
1880	516,729	$1,509,960
1881	572,092	2,325,937
1882	638,273	2,666,356
1883	754,891	3,344,936
1884	868,000	3,831,283
1885	910,324	3,909,844
1886	995,425	4,028,050
1887	1,100,165	4,423,062
1888	2,138,627	5,291,875
1889	1,291,705	5,199,481
1890	1,201,335	4,595,727

Coal.

Table 7.

Imports Coal Dust.

* Imports of Coal Dust.

Fiscal Year.	Tons.	Value.
1880	3,565	$ 8,877
1881	337	666
1882	471	900
1883	8,154	10,082
1884	12,782	14,600
1885	20,185	20,412
1886	36,230	36,996
1887	31,401	33,178
1888	28,808	34,730
1889	39,980	47,139
1890	53,104	29,818

* This table includes coal dust and all coal other than that specified as anthracite or bituminous.

Market in Canada.

Assuming that the imports, as given for the fiscal year, are equivalent to those for the calendar year, there is shown to have been a market for coal in Canada during 1890 equal to 4,974,362 tons as follows:—

	Tons.
Production	3,117,661
Imports	2,663,721
	5,781,382
Less—Exports	807,020
	4,974,362

Nova Scotia operators.

Nova Scotia—There were nineteen collieries producing, during 1890, as follows:—

Collieries.	Lessees.
Chignecto	Cumberland Coal Mining Co.
Joggins	Joggins Coal Mining Association.
Salt Springs	
Springhill	Cumberland Railway and Coal Co.
Acadia	Acadia Coal Co.
Black Diamond	
East River	B. G. Gray.
Intercolonial	
Holmes	
Bridgeport	General Mining Association.
Caledonia	Caledonia Coal and Railway Co.
Francklyn	
Glace Bay	Glace Bay Mining Co.
Gowrie	Archibald Blowers.
International	International Coal Co.
Ontario	Halifax Coal and Iron Co.
Reserve	Sydney and Louisburg Coal and R.R. Co.
Sydney	General Mining Association.
Victoria	

The production of each of these is given in the following table which is, as are all those relating to Nova Scotia, taken from the report of the Inspector of Mines for that Province.

COAL.

TABLE 8.

NOVA SCOTIA.

PRODUCTION BY COLLIERIES, 1890.

Colliery.	Tons.	Colliery.	Tons.
Chignecto	11,336	Francklyn	810
Joggins	68,181	Glace Bay	124,848
Salt Springs	157	Gowrie	158,031
Springhill	469,293	International	160,262
Acadia	307,924	Ontario	10,135
Black Diamond	37,270	Reserve	174,615
East River	1,523	Sydney	203,359
Intercolonial	120,668	Victoria	101,841
Holmes	65,303		
Bridgeport	31,610	Total	2,222,081
Caledonia	174,915		

In the following tables certain statistical information is given relating to the coal trade of Nova Scotia, which will explain itself:—

COAL.

TABLE 9.

NOVA SCOTIA.

PRODUCTION, SALES AND COLLIERY CONSUMPTION.

Period.	Production.	Sales.	Colliery Consumption.
	Tons.	Tons.	Tons.
1890—First quarter ... tons	364,428	239,264	37,357
" Second " "	587,806	528,966	53,669
" Third " "	647,488	677,441	47,167
" Fourth " "	622,359	554,773	42,396
" Totals "	2,222,081	2,000,444	180,589
1889 " "	1,967,032	1,741,720	177,106
1888 " "	1,989,263	1,765,895	176,336
1887 " "	1,871,338	1,702,046	156,550
1886 " "	1,682,924	1,538,504	159,512
1885 " "	1,514,470	1,405,051	142,939

COAL.

TABLE 10.

NOVA SCOTIA.

COAL TRADE BY COUNTIES, 1890.

YEAR 1890.	CUMBERLAND.		PICTOU.		CAPE BRETON.		TOTAL.	
	Raised.	Sold.	Raised.	Sold.	Raised.	Sold.	Raised.	Sold.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
First quarter	151,886	137,850	113,275	94,499	99,267	6,915	364,428	239,264
Second "	139,132	122,443	131,437	114,349	317,237	292,174	587,806	528,966
Third "	74,319	67,703	150,200	147,032	422,969	462,706	647,488	677,441
Fourth "	183,629	163,245	137,788	126,290	300,942	265,238	622,359	554,773
Totals...	548,966	491,241	532,700	482,170	1,140,415	1,027,033	2,222,081	2,000,444
1889...	549,294	469,983	483,145	429,500	934,593	842,237	1,967,032	1,741,720

COAL.

TABLE 11.

NOVA SCOTIA.

DISTRIBUTION OF COAL SOLD.

Market.	1889.	1890.
	Tons.	Tons.
Nova Scotia :—		
Transported by land.....	351,995	390,322
" sea..... ...	264,481	283,869
Total..... ...	616,476	674,191
New Brunswick.....	218,595	251,749
Newfoundland.	98,048	107,557
Prince Edward Island.....	61,533	62,544
Quebec	707,612	842,163
West Indies.	4,461	5,284
United States.....	33,584	56,956
Other countries....	1,411	....
Total..... ..	1,741,720	2,000,444

Nova Scotia developments.

Regarding operations in the province, the following notes are taken from the report of the Inspector of Mines above referred to:—

" *Pictou County.*—At the Intercolonial Colliery extensive workings were pushed into the Holmes area, and the coal found to be of good quality. Preparations are being made at this mine for erecting a powerful hoisting engine to draw coal direct from the dip workings, and to do away with the intermediate engine. Further work in the second seam

leads to the hope that next season it will furnish a large supply of coal of good quality. The manufacture of coke has been commenced here and the results are pronounced satisfactory. Nova Scotia developments.

"At the Black Diamond Colliery the extraction of pillars has been continued.

"At the collieries of the Acadia Coal Company a new hoisting engine has been procured for the Acadia Slope. The work of reopening the Ford pit has been steadily carried out. The old workings have been isolated, and the levels, etc., are being driven in the bottom coal, leaving a cover of twelve feet of coal between them and the old workings in the upper portion of the seam.

"*Cape Breton County.*—Some prospecting was done in the rear of Big Pond, East Bay, Cape Breton County. The following analysis of coal was made for the Rev. M. A. McPherson:—

FAST COKING.

Volatile matter	41·79
Fixed carbon	44·98
Ash	13·23
	100·00
Coke, per cent	58·21

"It yields a firm co-herent coke. The gases evolved during coking burnt with a yellow smoky flame. Colour of ash, purplish brown. G. C. Hoffman (Geo. Sur., Canada).

"*Other Counties.*—Discoveries of coal were reported from Parrsboro', Cumberland County, and from Middleton, Annapolis county.

The following information also taken from the report of the Inspector of Mines for Nova Scotia, is by Mr. Wm. Madden, Deputy Inspector for the counties of Pictou and Cumberland, and relates to mines in those counties:—

"*Pictou County.—International Coal Mining Company, Westville.*—During the year an attempt was made to connect the workings of No. 4 slope with the workings of slopes Nos. 1 and 2 for the purpose of hoisting the coal to surface at one outlet. The water, however, became so heavy that the sinking and other necessary operations in this line had to be discontinued and the connection has not been made. In No. 4 they continued drawing pillars until June, when work was stopped, and the men were transferred to No. 1 slope, which was then worked double shift.

"In March, the levels going south in No. 1 slope were driven to the limits of the area on that side, and beyond the barrier, into the adjoining area. In October, they started drawing the pillars near the line. About

Nova Scotia developments.

the same time operations were resumed in the Scott pit, with the idea of testing the coal, which is the second seam in this district, that is, it immediately underlies the seam or vein on which slopes Nos. 1 and 2 and 4 are driven, a vertical distance of about 300 feet separating them, It has been a general idea that this second seam or vein, to the dip, would improve in quality, and the management has fully determined to satisfy themselves upon this point. In this year much labour and care has been bestowed upon the air-ways in the old slopes (Nos. 1 and 2), by in many places repairing and enlarging them ; the results have been satisfactory. It has been decided to make further extensive improvements, by erecting larger and more powerful winding engines on the bank, enabling them to hoist not less than from twelve to fifteen boxes from a depth of from 4,000 to 5,000 feet, instead of only seven boxes, as heretofore, thus permitting them to do away with the underground engine at the 1,700 feet level. The old slopes have been timbered, and rails laid to the 3,300 feet level, in preparation for the changes.

"*Acadia Mines, Westville.*—Work has been very steady at this mine for the past year, pillar working in the 3,100 ft. lift forming the principal feature. It is now nearly finished, and has been very successfully prosecuted, a large percentage of coal having been obtained. In the next lift 3,560 feet, the levels on the north side have been driven 2,000 feet, and are now stopped. On the south side the levels have been driven some 2,500 feet and are still working.

"*Vale Colliery, Acadia.*—McBean Seam.—At this mine, which unfortunately about a year ago caught fire, the coverings of the Travelling slope and East intake were removed on the 22nd March, and left open for a few days, when, the temperature beginning to rise rapidly, it was deemed best to close them up again. It has remained in this situation since that time.

"Six Feet Seam.—Work has not been very actively prosecuted here. In August, in the west side, 3rd Balance, 1,000 ft. lift, they began drawing the pillars. The levels going east and west on this lift were stopped. In the lower lift the levels on both sides are being driven.

"*McGregor Pit, Stellarton.*—At this pit they have been opening up the lower lifts ; the coal is strong and gives off considerable gas, so that it was found necessary to prohibit the use of powder on the lower lift, south side. This made a very difficult job of driving the balance. They have, however, succeeded and started eleven bords on south side balance. The balance west side of south slant is up and bords started off; the air being increased by getting those places through, so that powder is now again used in the lower shift, south side. The balance on south

side north slant is also driven up, and air likewise increased largely. The pillars along the crop have been very successfully won. A new place has been driven to the surface with the view at some future day to utilize it for a hoisting slope, doing away with the shaft and underground engines. Nova Scotia developments.

"*Douglas Slope.*—No. 2.—This slope has been cleaned up and timbered. On 1st September the mine bords and levels going east and west were started to work. The drift which, about six months ago, was driven with the aim of catching the Cage-pit seam, has been excavated through rock and stone, etc., a distance of 250 feet, at which point the cage-pit seam was struck, thus winning a large field of coal for this slope to handle. Boreholes to tap the drift connecting the cage-pit and Foord pit were put through, and the water of 3rd seam is now running to the Foord pit.

"*Black Diamond Mine, Westville.*—This mine has been kept pretty steadily at work during the year, pillar working forming the principal feature. They began some 1,500 feet down the slope drawing the pillars that had been left to support the travelling and main slopes, and are succeeding in getting some very fine clean coal.

"*Lawson Mine.*—A small amount of work has been done here during the year. The ventilation (natural) during July and August gave some trouble. Their pump is not of sufficient capacity, and, in consequence, the water gave them difficulty. Some prospecting was done in the month of October. Twenty-five men were employed in December.

"*Minudie.*—Ten or twelve men worked here for the first three months of the year, taking out some very good coal, supplying local demands; it then remained idle from March to November, when work was again begun, and at my visit in December, twelve men were employed.

"*Chignecto.*—This mine worked on in the usual way until July, when most of the men were dismissed. Some 19 or 20 were, however, retained prospecting until late in the fall, when Mr. Frank Burrows, underground manager, took these men and began taking out coal along the crop-out on the eastern side of their works, and as it can be got water dry, the idea is to keep these men employed for the winter months in readiness for prospecting next spring.

"*Scotia* —Alexander Dewar began taking coal out of what was formerly known as the Scotia area, and on my visit in December he had 3 or 4 men employed."

From the statement of Mr. P. Neville, Deputy Inspector for Cape Breton Island, the following notes have been taken, which will illustrate the year's operations in that part of the province :—

Nova Scotia developments.

"*Gowrie Mines.*—Work has been carried on its usual way, levels extended on both sides of the low lift and rooms broken off. On No. 1 lift west side, the levels have been driven about 99 feet parallel to the stone troubles; it is found, as they advance, that the coal is dipping slightly to the south-west, so that the course of the levels are now going more northerly, gaining more grip on the seam. The management say it is their intention this winter to drive through and come out on the opposite side of the basin.

"*Ontario Mines.*—During last winter pumps were placed below No. 1 level for the purpose of drying the dip workings. The water was lowered by the 10th of June a distance of 200 feet to No. 2 level, and up to the last of September it was lowered to No. 3 level, a distance in all of 460 feet. From that date the pumps seemed to be getting out of order and the water raising. Finally work ceased on the 31st of October and pumps and pipes removed to the surface. The coal mined here during the season was taken from No. 2 section, north side between No. 1 and No. 2 levels. A few pillars have been drawn up and split in No. 3, north side; also six rooms were worked at the face of the solid coal, below No. 1 level, south side.

"*Caledonia Mines.*—Work has been brisk at this mine during the last season. The main deeps have been driven down 300 feet; No. 2 levels, above this, have been extended on the west and east sides, and rooms broke off and worked. A slant road has been driven from this east level coming out at the east side of the pit, for the purpose of drawing coal from that section. A small section of pillars have been drawn and split in the east side rise workings. A new double engine has been imported and placed on surface east of the hoisting shaft for the purpose of drawing the coal from the deeps. Also, preparations are being made to put a double furnace where the single one is now.

"*Little Glace Bay.*—The operations at this colliery during the year has chiefly been the extension of rooms already gained and worked off the levels. The rooms south of the 1,800 feet headway have been worked, and some of them drawn up to the Harbour pit workings.

"*International Mines.*—The pit bottom has been re-timbered; the back deeps have been driven, connecting No. 9 landing; laid and worked No. 8 and 9 landings. No. 6 section has been driven seawards to the barrier and stopped; south side drove and laid angle deeps, from pit bottom level to No. 1 landing on incline deep.

"*Reserve Mines.*—During last winter the east slope was driven down and a new lift of 600 feet gained, and levels turned off east and west. The west levels were driven three chains, and the east eight; back deeps

were also driven and rooms broke off and worked parallel to the level. A new travelling road has been made up the back deep on east side. The barrier between No. 2, east side level, and No. 6, west side, has been pierced for the purpose of letting off the water from that section, which had been filled for a number of years. This done, it was found that the pump on the east side was not equal to the task, and a new pump has been placed at the bottom of the west slope to dry No. 6. Nova Scotia developments.

"*The Emery Mine*, which had been idle for a number of years, and full of water, has this year been pumped out, and a pump placed below the bottom of the pit, by which the water is pumped up the shaft to the surface. This shaft has been repaired, and slides and cages put in. The coal is raised to bank in half-ton boxes. A bank-frame and engine-house have been erected, and an engine and boiler placed therein; also, a branch railway of 400 yards has been built, connecting with the Reserve road. The levels in the west side of the pit have been driven about 700 feet, and headways driven towards the rise; rooms broke off and worked; these rooms are eighteen feet wide; pillars eighteen feet thick; cross-cuts twelve feet, and sixty feet apart. On the east side, the old levels and rooms have been extended, and a pair of dip-slants is being driven, in order to gain a lift of 600 feet.

"*Old Bridgeport.*—Levels and rooms have been extended on the south side of the pit. No mining has been done during the year north of the furnace headway. The band of the shale, spoken of in last year's report, was found to be quite thin in the levels or low rooms, and consequently it was taken down with the top coal, which made the seam about nine feet thick. However, as the levels advanced it was found again to thicken, and the management thought it more profitable to timber and keep it up than take it down. A section of pillars have been drawn from south of mine headway.

"*Gardner Mines.*—This property has been acquired by Messrs. Burchell Brothers. This property has been closed down since 1879, previous to which it was worked by the Gardner Coal Company. It was thoroughly equipped with the best machinery, some of which are still in excellent condition. Work commenced there in the latter part of the summer, getting everything in order to be ready for shipping at the opening of navigation next spring. Engine houses and miners' cottages are being erected.

"*Victoria Mines.*—Work has been carried on at this mine in its usual steady way during the year. The east dips have been extended and a lift of 600 feet gained; this lift being free from water is completely dry; levels have been turned off east and west, and driven 150 yards. A

Nova Scotia.

balance was driven upon the east side and rooms broke off. The levels on No. 2 lift are still being extended in driving up the balance.

"*Sydney Mines.*—I am glad to state that a great improvement have been made in this pit during the year for the safety of men's lives. New travelling ways have been made on the south side, a distance of 1,700 yards. On engine and incline planes, where the roadway was found narrow, additional manholes have been driven between the ones there already, according to law. On the north side bankhead landing, where the road was narrow, the place has been made wider for 300 feet, so that there is now ample room to pass the standing or moving trips. No. 3, or pump deep, has been working since the 27th of May last. This is one of the submerged districts. The deeps have been extended 300 yards in solid coal, and rooms broken off right and left and worked."

The value of Nova Scotia coal has been computed at $1.80 per ton of 2,240 pounds at the pit's mouth, or $1·607 per ton of 2,000 pounds.

New Brunswick.

New Brunswick.—A small quantity of coal was raised in this province during the year, and was the result of the operations of fourteen producers in the neighbourhood of Grand Lake, Queen's and Sunbury counties, from whence it is shipped principally to St. John. The seams are small, and the work of a desultory character, being carried on principally by farmers, who, during the winter months and between the seasons of sowing and harvesting raise small quantities from pits sunk on their properties.

North-West Territories.

North-West Territories.—Returns were received from seven producers, the principal one being the Alberta Railway and Coal Company, operating at Lethbridge, Alberta, the others being in the vicinity of Calgary and Edmonton, where small seams are worked to supply local demands.

Large deposits of coal have been located in the vicinity of Canmore and between that point and Anthracite, and it is confidently expected that the new discoveries, as well as the older workings at Anthracite, will be operated during the present year, as it has been found that the anthracite and semi-anthracite afforded by these deposits are of very superior quality.

Regardingg the deposits at Canmore, Dr. Selwyn, in his summary report for 1890, writes:

"On the 29th of August a short time was spent at Canmore to look at the coal mines newly opened there on the seams on the right bank of the river described, pages B–132 and 133, Annual Report, Geological Survey, Vol. 1, 1885. The three feet seam is now being worked by a slope which starts on a terrace about 200 feet above the river, where a small outcrop

of the measures is exposed dipping 50° to 60° to westward. In a level being driven in to the hill to cross cut the seams, about 100 feet below the slope, the dark shales associated with the coal had been struck at about 30 feet in dipping 30° to north-east, so that there must be either a fault or a steep anticlinal fold along the face of the hill. The coal is much crushed and slickensided. It is apparently a semi-anthracite, like that from Cascade River—see analysis, Part M., Annual Report, Geological Survey, Vol. 1, 1885. There can be little doubt that the Canmore seams are the extension of those of Cascade River and Anthracite on the opposite side of the Bow River valley. The mine is already connected by a branch railway with the station at Canmore; an incline tramway and shipping stages have been constructed at the mine and there is now every convenience for handling a large output."

Dr. Selwyn also visited the Turtle Mountain coal area, of which he writes, in the above referred to report, as follows:—

"In the Turtle Mountain coal field, range 24, township 1, several pits and bore holes have been sunk and in all seams of lignite-coal of workable thickness have been struck. In one pit, now full of water, but said to be 50′ 6″ deep, strata are stated to have been passed through as follows:—

	Feet.	Inches.
Surface	3	0
Dark clay	4	0
Coal	5	6
Clay shale	10	0
Coal	3	6
Sandy brown shale	6	0
Soft whitey brown sandstone	2	0
Sandy clay	6	0
Coal	1	6
Friable whitey brown sandstone	12	0
Bored from bottom of shaft—sandstone	20	0
	73	6

"In another pit, 150 yards south of the one above described and about 15 feet higher, the coal was struck at 40 feet 4′ 6″ thick, then 12 feet sandy shale and thin bands of iron ore; coal 1′ 6″ then bored 25 feet through sandy shale; total 78′ 6″. This is the only pit from which any coal has been raised. An engine with winding gear and shaft house have been erected here and a few tons of coal raised. This section is probably the most reliable, and omitting the upper 5′ 6″ seam of coal given in the first section, which is probably a mistake—the two sections are much alike. The coal or lignite, like that of the Souris at Roche Percée, slacks on exposure and would not bear distant transport. The seams probably underlie the whole of Turtle Mountain, except where deep ravines have been cut out and have been filled in again with the superficial drift

deposits. They will probably be found in places in township 1 from range 19 to 24. They could be mined at small cost, and for use among the settlers in the treeless country to the north and north-west between the Souris River and the Mountain would prove a cheaper and more economical fuel than wood.

"I examined this district in 1883, and in the Summary Report for that year, page 2, it was stated 'the evidence obtained clearly shows that there is every likelihood of workable seams being found here, as on the south flank of the mountains, at the head of Willow Creek in Dakota a seam has already been found showing from 3 to 5 feet of lignite of fair average quality.' The seams now opened are doubtless the extension of those above referred to on Willow Creek, and as soon as railways are constructed to the mines, the lignite could be very advantageously distributed over a wide extent of country in which wood is even now scarce and costly, and yearly becoming more so."

British Columbia.

British Columbia.—The production of coal in British Columbia is that of four collieries, viz.:—

Nanaimo	Colliery,	owned by	The New Westminster Coal Mining and Land Co.
Wellington	"	"	R. Dunsmuir & Sons.
E. Wellington	"	"	East Wellington Coal Co.
Union	"	"	Union Colliery Co.

Statistics regarding their output are given in the following table 12, for comparison with which a similar table, No. 13, published for 1889, is given.

COAL.

TABLE 12.

BRITISH COLUMBIA.

PRODUCTION, SALES, &c., FOR 1890.

Name of Colliery.	Coal raised.	Sold for home consumption.	Sold for exportation.	On hand, 1st Jan., 1889.	On hand, 1st Jan., 1890.	Number of men employed.
	Tons.	Tons.	Tons.	Tons.	Tons.	
Nanaimo.....	436,246	110,141	327,946	10,744	6,802	1,493
Wellington.....	195,436	78,141	119,035	3,416	2,794	646
E. Wellington..	49,954	9,502	39,348	612	1,605	170
Union.	77,881	1,659	82,933	10,431	3,720	350
Totals... .	759,517	199,443	569,262	25,203	14,921	2,659

Coal.

Table 13.

British Columbia.

1889.

Name of Colliery.	Coal raised.	Sold for home consumption.	Sold for exportation.	On hand, Jan. 1st, 1889.	On hand, Jan. 1st, 1890.	Number of men employed.
	Tons.	Tons.	Tons.	Tons.	Tons.	
Nanaimo.....	250,735	44,929	200,800	5,736	10,744	875
Wellington....	306,189	85,707	221,011	4,145	3,416	862
E. Wellington..	57,537	8,552	48,259	112	612	190
Union.	34,948	112	26,645	2,240	10,431	314
Totals	649,409	139,298	491,715	12,233	25,203	2,241

British Columbia developments.

Regarding the operations and development in British Columbia during the year, the following notes are taken from the report of the Minister of Mines of that province:—

Nanaimo Colliery.

"The coal from this colliery was in good demand during the past year.

"*No. 1 Pit, Esplanade, in Nanaimo.*—This mine, forming part of the Nanaimo Colliery, belongs to the New Vancouver Coal Mining and Land Company (Limited). As in the previous year, the workings in this pit have been from what is known as No. 1 and No. 3 North Levels. All the workings from these levels are under the water of the Nanaimo Harbour, and are getting to be very extensive. The No. 1 Level with its windings is in about 2,800 yards from the shaft in a north and westerly direction. In this division of the mine they have taken much coal during the past year, the coal being of a first-class quality, hard, and will average about seven feet thick. They have drifted or run the level in about 800 yards, without a fault or hitch of the smallest kind. Here they have as many employed, considering the distance, as they can take coal away from; and at present they have coal won where they could employ 100 more men than what are now employed in this district of the mine. At the back of the level they are only a few yards from working under Protection Island, under all of which, I have reason to believe, lies this famous and valuable coal. In No. 3 level there has been much prospecting and exploring done. They are now getting out a considerable quantity of good coal, but they do not seem to have got into the extensive field where No. 1 is, although they are working towards it and expect to get in soon.

British Columbia developments.

"*No.* 3 *Pit: (Chase River), Nanaimo Colliery.*—This is mentioned in a previous report as being near to the mouth of Chase River. With the exception of a short stoppage in the early part of the summer this mine has been worked steadily. The coal from here is of a very good quality, and hard. As it is worked on the pillar and stall system and that by a slope, and having got as far as it is intended to go at present, all the mining is at the pillars (coal), which were left behind to support the roof; those pillars being fully one-half of the coal that was in the mine at the start, so that there is yet a large output to be got here.

"*South Field Mine, No.* 1 *and No.* 2.—These mines are now what are known as the South Field mine.

"This mine is worked by a slope from the surface, and is now down about 800 yards, but at present it is not worked in the bottom, and nearly all the coal came out from the south side. It has been the greatest producing mine of the colliery. This coal is of a very good quality, and in some parts is about 18 feet thick, but as in the other mines it had faults now and again to contend with. The coal is mined on the pillar and stall system.

"*No.* 4, *South Field Mine.*—This is the slope mentioned in a former report, and about half a mile from No. 3 pit. It is down about 1,000 yards with a long level to the south side. The company have been to a great expense here, and at times prospects looked favourable, and it was reasonably expected that good coal would be early found here, as they have good coal coming this way from No. 3, and also from bores they put down away to the dip only a few hundred yards ahead; yet, with all those encouragements, the prospects are not looking very favourable; but it is to be hoped that there will before long be a profitable mine here, the location being good, and well situated for other works.

"*No.* 5, *South Field Mine.*—This is a new shaft which the company are putting down to the dip and north of the working of No. 2 slope, after having put down a series of bore holes. The prospects from those holes gave them encouragement to start the above shaft, which is now down 100 feet; and they expect to reach the coal a little over 500 feet from the surface. As the company have got machinery and head gear up, to be used in the sinking, it may be expected that, in the absence of unforeseen accident, the company will get to the coal early in the summer, and this will be quite an acquisition to the proprietors.

"*North Field Mine, Nanaimo Colliery.*—This mine is mentioned in a previous report as being in the northern part of the New Vancouver Coal Company's extensive estate. The mine has been worked contin-

uously during the past year, the coal varying in thickness from three to six feet, and is very hard and of a very good quality. It is in good demand both in the Victoria and California markets, and commands the highest price. British Columbia developments.

"During the past year the company have been sinking another shaft, which is about 70 yards west of the hoisting shaft, and had got down to the coal and connected with the works at the end of December, so that once they get these works arranged this second shaft will be their return or up-cast shaft, and will also form a second connection or outlet with the surface. Little or no gas has ever been seen in this mine."

Wellington Colliery.

"*No.* 3 *Pit, Wellington Colliery.*—This pit, as has been mentioned in a previous report, is in the valley of the Millstone River. The workings are all by way of a slope from the south side of the shaft.

"In this pit much of the work is under the valley, which is sometimes overflowed at very high stages of the river. As well as mining underneath the valley, a great deal of work has been done below the high bluff overlooking the valley. The workings here have only been at pillars (coal), and that under the bluff, as it is not the intention of the manager to take any of the pillars from under the valley, until every other part is worked out; this is done as a safeguard against an inflow of water from the surface. They were working at the pillars up to the 16th May, when there was a strike, and up to the present time there has not been any coal taken out of this mine. Water was being pumped out as usual up to the 26th August, when I was there and went down the mine with Mr. Bryden, the manager. We were satisfied that the gob was heating from the steam and smoke that travelled along the return airway.

"*No.* 5 *Pit, Wellington Colliery.*—This is about the most extensive mine in this colliery. The coal is worked here from the east and west sides, also from an incline on the south, and a slope to the north. As this has been on the pillar and stall system (with the exception of part of the slope that is long wall), there has been much good coal worked here. Now at the south incline and west side, all the mining is at the pillars, which contained about two-thirds of the entire coal; but of course there are many of them by this time taken out. On the east side they are working in the solid coal, and also at the pillars. Down the slope to the north the long wall system works well, but it has to be closely attended to.

British Columbia developments.

"In this slope there is also a considerable amount of work done on the pillar and stall system. Down this slope and also in the east level there is the prospect of having a very extensive mine for many years to come.

"*No. 6 Pit, Wellington Colliery.*—This is the same mine as mentioned in a former report, and about 900 yards east of the No. 4 Pit. Although working, the two shafts are only a short distance from each other; but that small piece is to remain, as it is not the manager's intention to connect those works for some time. This is going to be a very extensive mine, the coal almost lying flat, so that the working is all around the shaft, with a great extent to spread out. The coal is very good and hard, from six to eight feet thick, and worked on the pillar and stall system, which seems to be the best way of mining in this colliery, all things being considered.

"*No. 2 Slope, Wellington Colliery.*—There has been little or no coal mined or work done here during the past year, but the company intend to resume work early in the spring.

East Wellington Colliery.

"This property of the East Wellington Coal Company comprises two shafts, known as No. 1 and No. 2, which are in the valley of the Mill-stream. The shafts are about half a mile apart by a direct course, and are worked as one mine.

"In No. 1 Pit, coal only comes from a few men, and that from the west level, towards the No. 2. The coal is of the usual good quality, and hard, but the company are much troubled with faults of one kind and another. On the east side they are now in a long distance which has proved one continuous fault, with a little black dirt here and there; but as this side is the greater part of their estate, they are determined to find out what is in it, and it is to be hoped that they will yet find a good piece of valuable coal as they have incurred a large outlay. I might say it has been up-hill work all the way.

"*No. 2 Pit, East Wellington Colliery.*—In this pit the company have been working steadily all the year, except for a day now and then. The coal has kept good, and is in good demand in San Francisco, where most of it goes.

Union Colliery, Comox.

"This colliery belongs to the Union Colliery Company. The mines are only a few miles from Comox. This company are working two veins of coal, two mines, known as No. 1 and No. 2 tunnels, or adit levels, going in on the hill side on the south side of the railway, and high above its level. Both of these levels are in about 600 feet, in good hard coal, and from two three feet thick, overlaid by a strong sandstone. The mines here are on the pillar and stall system, and are very safe workings.

British Columbia developments.

"*No.* 1 *Slope, Union Colliery.*—This slope, which is now down about 2,000 feet, has not been extended any distance during the past year, but the levels from it to the north side have been working steadily the most of the year, that is by three levels with the stalls therefrom. The coal has kept good and very hard, and improving a little in thickness, being from three to five feet thick, with a strong roof. There are good indications to show that this seam of coal will improve in thickness, going to the north.

"*No.* 1 *Shaft, Union Colliery.*—This is the shaft mentioned in a former report. There has been much prospecting done here during the past two years, but there has been very little coal taken out. Now it is looking better, and the company have the prospect of yet getting good workable coal, and it is hoped that they will do so after going to so much expense.

"*No.* 2 *Slope, Union Colliery.*—This is a new mine, started during the past summer, and about one mile north of No. 1 slope. Here the coal was easy to get at, and now the company have put a slope down 260 yards. The coal will average six feet thick. This coal is very hard, of good quality, and resembles the Wellington coal, and I may say that it is the most valuable strike of coal that has been made here by this company, and is a good thing for them, also for the settlers of the extensive district of Comox, as well as for the province in general. The company have put down a series of bore-holes away ahead of this slope, which have proved the coal for a long distance.

"*New Vancouver Coal Mining and Land Company, Limited.*—The workings from the No. 1 shaft have now got through under the harbour, with one and three-quarters of a mile to haul the coal, this being about under Protection Island. There was a bore-hole started in this island about three months ago, and pushed with all haste. When at the depth of 588 feet coal was struck, and as it was gone through it proved to be a good workable seam. After going through this, the bore-hole was continued, and at the depth of 650 feet from the surface another seam of coal was struck, which was thought to be a continuation of the first seam of coal that was worked on Newcastle Island, and also in the old No. 3 Pit, Front Street, Nanaimo. As the coal from both those places was of a good quality, there is no reason to think that it is not as good under Protection Island and the waters of Nanaimo Harbour. Near to this bore-hole the company is preparing to sink a shaft, making every preparation to start, so as to lose no time, in order that they may be able to ship coal from this island at as early a date as possible. There is now a wharf built on the island for landing the machinery and materials."

Coke.

Coke. During the year there were produced in Nova Scotia 56,450 tons of oven coke, valued at $166,298, the greater part of which was consumed in the manufacture of iron at Londonderry, N. S. In no other province is oven coke produced, though gas coke is, of course, made in all cities where coal is used in the manufacture of illuminating gas; the coke so obtained being sold locally, whilst no returns of production were collected.

According to direct returns the production during the past year has been,—

1886	35,396	tons	valued at	$101,940
1887	40,428	"	"	135,951
1888	45,373	"	"	134,181
1889	54,539	"	"	155,043

The following table shows the imports of oven coke since 1880:—

COKE.

TABLE I.

IMPORTS OF OVEN COKE.

Fiscal Year.	Tons.	Value
1880	3,837	$19,353
1881	5,492	26,123
1882	8,157	36,670
1883	8,943	38,588
1884	11,207	44,518
1885	11,564	41,391
1886	11,858	39,756
1887	15,110	56,222
1888	25,487	102,334
1889	29,557	91,902
1890	36,564	133,344

Peat.

Peat. In his summary report to the Director of the Geological Survey for 1890, Mr. Robert Chalmers makes the following mention of extensive deposits of peat in that part of New Brunswick in which he was making investigations during the year:—

"Peat is found in extensive bogs along the coast, especially near the Kouchibouguac, the Kouchibouguacis, Aldouane, Richibucto, and in many other places. These bogs are often deep, and produce abundant crops of cranberries. In the interior, large bogs often occur upon the flat, undrained portions of the district, but they are usually shallow, and in many cases support a scrubby growth of hacmatac and black spruce. No use has yet been made of peat in this part of the country."

COPPER.

As in former years the copper product of the year is represented in the shipments of sulphuret ores from the mines of the Eastern Townships of Quebec and those of the copper-nickel ores from Sudbury. Production.

The characteristics of the latter deposits are given later in this report under the head of nickel.

The chief contributors from the Quebec district were the Albert and Crown Mines at Capelton, operated, as formerly, by Messrs. G. H. Nichols & Co., and the Eustis Mining Co., respectively, and the Moulton Hill and Howard Mines, operated by Mr. E. R. Howard. Messrs. G. H. Nichols & Co. have lately started operations at the old Huntingdon Mine, on lot 8, range viii, of Bolton. The others are all situated within a radius of six miles of the town of Sherbrooke, in areas of Pre-Cambrian chloritic, micaceous and talcose schists. The Howard Mine is close to the contact of these, with the Cambrian rocks to the north-west. Quebec.

The workings are on the veins running parallel with the strike of the schists or perhaps rather on belts of the same, impregnated with copper and iron sulphurets. These are of considerable width, in places being said to occasionally attain a thickness of as much as 50 feet in some of the workings of the Capelton Mines, where they have been followed to a depth of over 1,500 feet.

The ores average about four per cent of copper, the percentage of sulphur ranging between 35 and 45 per cent, whilst they also contain a little silver, averaging probably about 4 ounces per ton.

At the Albert Mines Messrs. G. H. Nichols & Co. have very extensive and well equipped works for the utilisation of part of their ore in the manufacture of sulphuric acid, the "fines" being used for this purpose, whilst the higher grade ore is shipped direct to their other works at Laurel Hill, New York, and similarly treated. At the Capelton works, also is a Herreshoff water jacket furnace intended to bring the "cinder" remaining after burning off the sulphur from the ore, to the state of "matte." The great bulk of the ore from the other mines was shipped raw to acid-makers in the United States, although a small proportion was burned and reduced to the state of matte and thus shipped by the Eustis Mining Company.

The amount of copper contained in the mixed silver, lead and copper of the mines of southern British Columbia could not be ascertained as, the official returns give only the total value of the ores for both the copper and silver contents. This, however, does not amount to quite $45,000 and as the greatest value of that lies in the silver, the amount of copper thus overlooked cannot be very considerable. British Columbia.

Nova Scotia. No contribution has been made to the grand total by the province of Nova Scotia this year, the activity in this direction being confined to development work and some little prospecting, of which the Report of the Department of Mines of the province speaks as follows:—

"Some attention has been given to the copper ores of Brierly Brook and Pinkietown, Antigonish county, and a lease has been taken at the former place by Mr. John Grant.

"A good deal of work was performed at the Coxheath Mines, Cape Breton county, and but for the general financial depression, systematic works would have been started last fall. The No. 2 shaft was sunk to the 250 feet level, and a cross cut was driven 134 feet to the north cutting the main, or B. vein, which was found to be 32 feet wide, and to yield a considerable proportion of smelting ore assaying from 10 per cent to 20 per cent copper, with a little silver and gold. On the new vein lying south of the present workings a shaft has been sunk 50 feet in paying ore, and on the surface it has been traced 1,000 feet. No. 1 shaft was unwatered and repaired, and the drill plant prepared, so that a drift would be run into vein B, lying a short distance to the south. The additional drills and compressors alluded to in a previous report have been added to the plant, giving it a strength of ten drills, with two in reserve; and some 3,000 feet of piping has been laid to connect shafts 1 and 3 with the plant at shaft No. 2. On the Argyle area the westward extension of the veins has been further tested, and a point has been selected for a new shaft.

"Mr. J. P. Gragg makes the following return of labour performed during the year 1890:

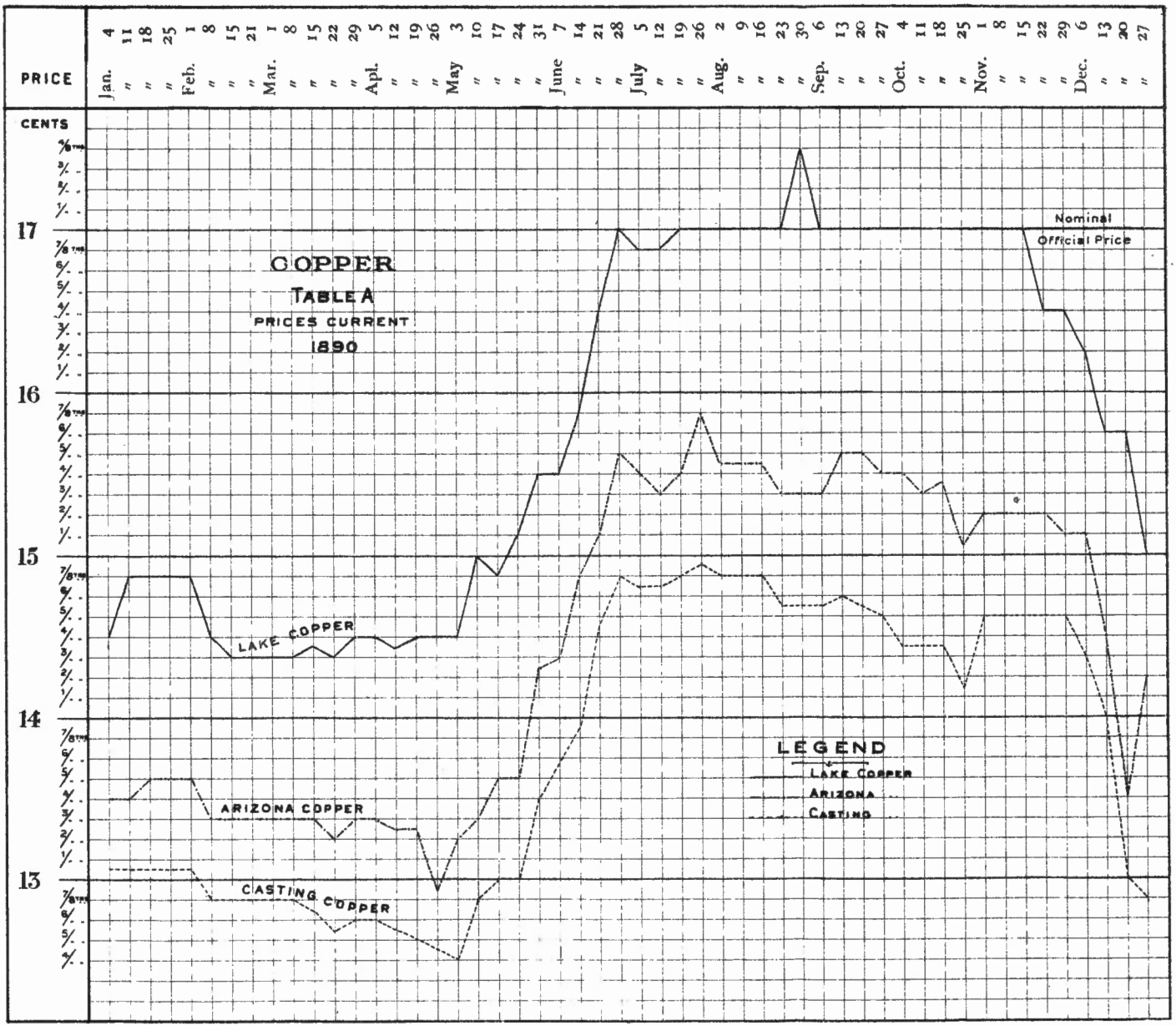
Skilled labour, overground	1,717	days.
Unskilled do	3,380	do
Skilled labour, underground	1,785	do
Unskilled do	1,598	do
Teams and drivers	323	do
Coal teams	360	do

Production. "About 1,000 tons of ore were extracted and banked."

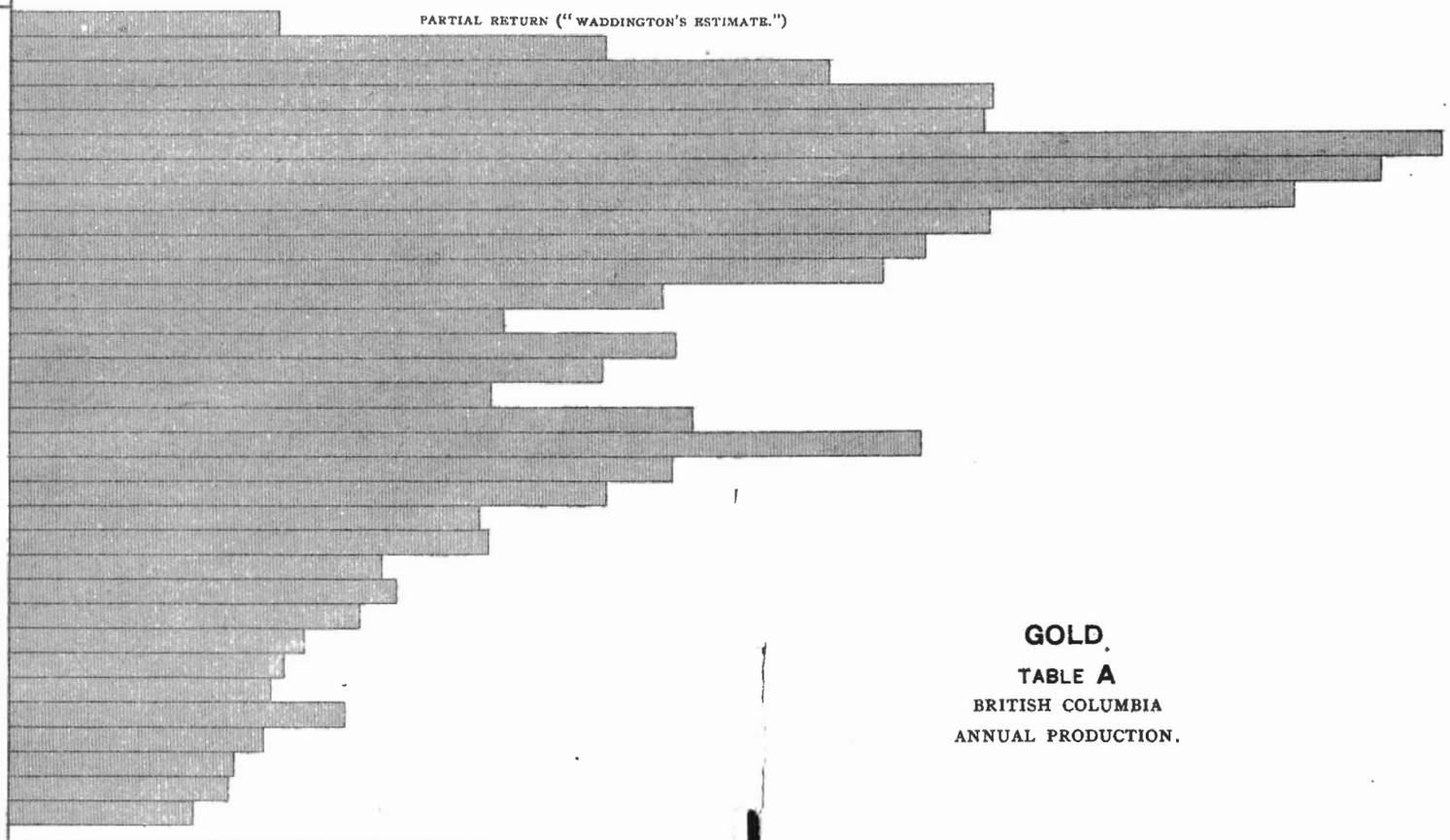
The total amount of copper contained in the ores shipped as before mentioned from the two provinces of Ontario and Quebec was 6,013,671 lbs., which taken at 15 cents, the average market price of the metal for the year, gives a valuation of $902,050.

The production last year was given at 6,809,752 lbs., so that this year shows, on comparison, a falling off of 796,081 lbs.

Prices. Table A shows the fluctuations in the price of the metal for the year as quoted for the three chief brands in the New York market and speaks for itself.


PRICE
CENTS
17
16
15
14
13
Jan. 4 11 18 25
Feb. 1 8 15 21
Mar. 1 8 15 22 29
Apl. 5 12 19 26
May 3 10 17 24 31
June 7 14 21 28
July 5 12 19 26
Aug. 2 9 16 23 30
Sep. 6 13 20 27
Oct. 4 11 18 25
Nov. 1 8 15 22 29
Dec. 6 13 20 27
COPPER
TABLE A
PRICES CURRENT
1890
Nominal
Official Price
LAKE COPPER
ARIZONA COPPER
CASTING COPPER
LEGEND
LAKE COPPER
ARIZONA
CASTING

Year	Value
1858	$705,000
1859	1,615,072
1860	2,228,543
1861	2,666,118
1862	2,656,903
1863	3,913,563
1864	3,735,850
1865	3,491,205
1866	2,662,106
1867	2,480,868
1868	2,372,972
1869	1,774,978
1870	1,336,956
1871	1,799,440
1872	1,610,972
1873	1,305,749
1874	1,844,618
1875	2,474,904
1876	1,786,648
1877	1,608,182
1878	1,275,204
1879	1,290,058
1880	1,013,827
1881	1,046,737
1882	954,085
1883	794,252
1884	736,165
1885	713,738
1886	903,651
1887	693,709
1888	616,731
1889	588,923
1890	494,436



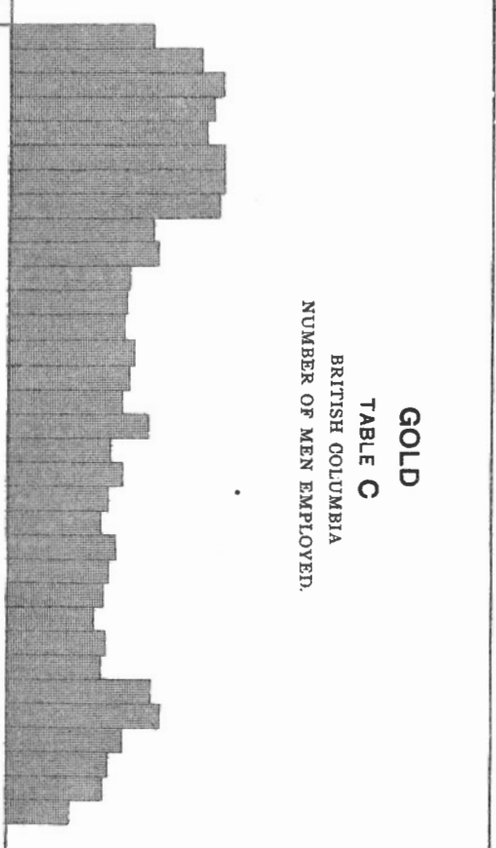
GOLD

TABLE A

BRITISH COLUMBIA

ANNUAL PRODUCTION.

Year	Number
1858	3000
1859	4000
1860	4,400
1861	4,200
1862	4,100
1863	4,400
1864	4,400
1865	4,294
1866	2,982
1867	3,044
1868	2,399
1869	2,369
1870	2,348
1871	2,450
1872	2,400
1873	2,300
1874	2,868
1875	2,024
1876	2,282
1877	1,960
1878	1,883
1879	2,124
1880	1,955
1881	1,898
1882	1,738
1883	1,965
1884	1,858
1885	2,902
1886	3,147
1887	2,342
1888	2,007
1889	1,929
1890	1,342



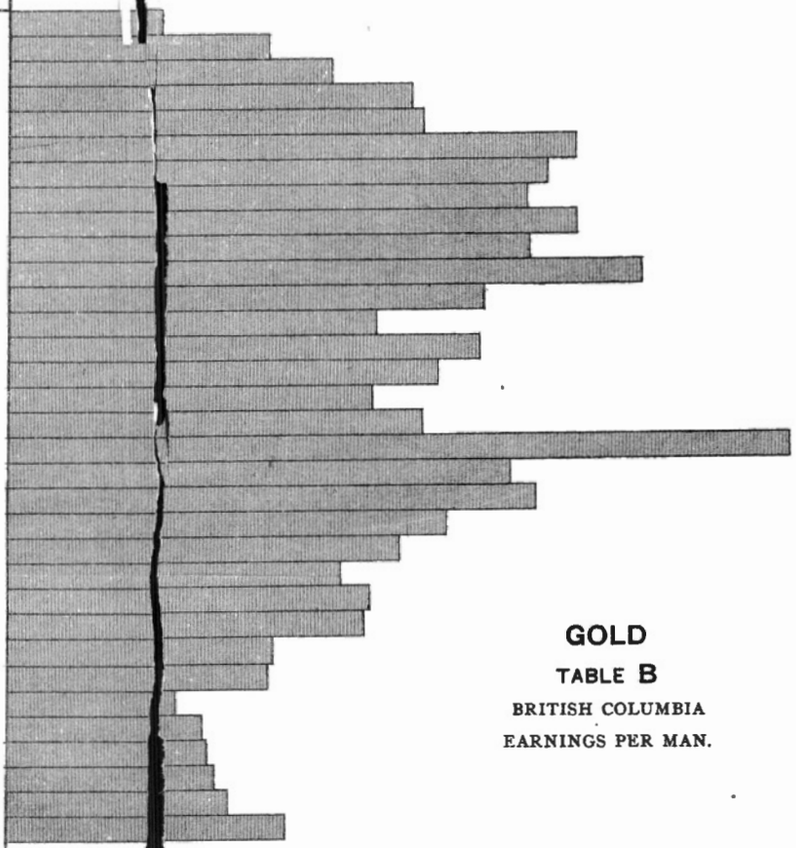
GOLD

TABLE C

BRITISH COLUMBIA

NUMBER OF MEN EMPLOYED.

Year	Value
1858	$235
1859	403
1860	506
1861	634
1862	648
1863	889
1864	849
1865	813
1866	893
1867	814
1868	992
1869	749
1870	569
1871	734
1872	671
1873	567
1874	643
1875	1,223
1876	783
1877	820
1878	677
1879	607
1880	518
1881	551
1882	548
1883	404
1884	396
1885	246
1886	287
1887	296
1888	307
1889	330
1890	423



GOLD

TABLE B

BRITISH COLUMBIA

EARNINGS PER MAN.

The exports and imports are given in Tables 1, 2 and 3.

COPPER.

TABLE 1.

EXPORTS.

Exports.

Year.	Ontario.	Quebec.	Total.
1885		$262,600	$262,600
1886	$16,404	232,855	249,259
1887	3,416	134,550	137,966
1888		257,260	257,260
1889		168,457	168,457
1890	2,219	396,278	398,497

COPPER.

TABLE 2.

IMPORTS: PIGS, OLD AND SCRAP.

Imports.

Fiscal Year.	Pounds.	Value.
1880	31,900	$ 2,130
1881	9,800	1,157
1882	20,200	1,984
1883	124,500	20,273
1884	40,200	3,180
1885	28,600	2,016
1886	82,000	6,969
1887	40,100	2,507
1888	32,300	2,322
1889	32,300	3,288
1890	112,200	11,521

COPPER.

TABLE 3.

IMPORTS: MANUFACTURES.

Fiscal Year.	Value.
1880	$123,061
1881	159,163
1882	220,235
1883	247,141
1884	134,534
1885	181,469
1886	219,420
1887	325,365
1888	303,459
1889	402,216
1890	472,668

Discovery and exploration.

Besides the activity in the chief producing districts already mentioned, a small amount of exploratory work has been done on the areas of Keweenian rocks of the north shore of Lake Superior, the geological parallels of the native copper-bearing formations of the south shore, in which are situated the famous Calumet and Hecla, Tamarack and other similar mines.

Ontario.

This work was prosecuted on the Michipicoten Island and Mamainse areas. At the latter point, the Silver Islet Mining and Land Company had an exploratory party at work further examining the numerous veins and copper-bearing belts proved by former explorations to exist there.

Copper has been known to occur throughout these areas since the earliest times, and numerous attempts have been made to develop them, which, for various reasons, have not met with success. The copper exists in the native form impregnating the beds of trappean rocks and also exists thus in one of the accompanying agglomerate beds on Michipicoten Island. It also occurs native in fissure veins cutting the formation, as well as in the form of various sulphurets in similar veins. The occurrence of argentiferous copper glance is a special feature of this formation, although so far the veins carrying this class of ore have never proved very persistent.

The other areas of these native copper-bearing rocks in Canadian territory are to be found in St. Ignace and other islands in the mouth of Nipigon Bay, L.S., and also the newly-discovered area in the townships of Blake and Crooks, south of Port Arthur, mentioned in last year's report.

Further details relating to the various copper districts of the Dominion will be found in the annual reports of the Geological Survey Department; the British Columbia districts being dealt with by Dr. Dawson in Part R, Annual Report, 1887, and Part B, Annual Report, Vol. IV, 1888-89, whilst the Quebec areas are well described by Dr. Ells in Part K, Annual Report, Vol. IV, and in a report recently issued by Mr. Obalski, the Government Mining Engineer of the province.

GOLD.

Production.

As formerly, British Columbia and Nova Scotia are the main contributors to the total production of this metal, the remainder being furnished by the districts of Beauce in Quebec, the Saskatchewan River washings and an estimated yield from the Yukon district.

The total yield thus obtained amounted to 64,046 ounces, worth $1,149,776, which, compared with last year, shows a falling off of 8,282

ounces and $145,383. This is mainly due to the lesser yield of British Columbia and Nova Scotia, which show deficits, respectively, of $94,487 and $350,039. Regarding the first item it may be said to be due partly to the absence of returns from the Cassiar district and to the continuation of the cause similarly acting for some years, viz., the gradual working out of the placers and the slow development of the quartz-mining industry, which should eventually win back for the province its place as a gold producer.

Nova Scotia.

Of Nova Scotia the report of their Government Department of Mines speaks as follows :—

"The total returns for the year 1890 show that 41,886 tons of quartz were crushed, yielding 24,358 ounces of gold for 160,264 days' labour, compared with 26,155 ounces of gold from 39,160 tons of quartz for 211,548 days' labour. It is to be regretted that there is a falling off in the yield of gold, and no very satisfactory explanation can be offered. It is stated that recently mines have been started on insufficient evidence of permanent values in the veins, and that this past season their producing capabilities have diminished. It will be noticed that more quartz has been crushed, and it is in this direction, that of low grade ore, that the future extension of gold mining in Nova Scotia must be sought for."

The following table gives the yield by provinces :—

GOLD.

TABLE 1.

PRODUCTION BY PROVINCES.

Provinces.	Ounces.	Value.	No. of Men.
Nova Scotia	24,358	$474,990	534
Quebec	75	1,350	25
North-West Territories (including Yukon District)	10,529	179,000	200
British Columbia	29,084	494,436	1,742
	64,046	1,149,776	2,501

The items for Quebec and the North-West Territories are close estimates, the latter including an approximation to the yield of the Yukon Territory in the absence of direct returns.

British Columbia.

Graphic Tables A, B and C, and Table 2, compiled chiefly from data furnished by the report of the Minister of Mines for that province, give

GOLD
TABLE D
NOVA SCOTIA
ANNUAL PRODUCTION

Year	Value
1862	$141,871
1863	272,448
1864	390,349
1865	496,357
1866	491,491
1867	532,563
1868	400,555
1869	348,427
1870	387,392
1871	374,972
1872	255,349
1873	231,122
1874	178,244
1875	218,629
1876	233,585
1877	329,205
1878	245,253
1879	268,328
1880	257,823
1881	209,755
1882	275,090
1883	301,207
1884	313,554
1885	432,971
1886	455,564
1887	413,631
1888	436,939
1889	510,022
1890	474,990

GOLD
TABLE E
NOVA SCOTIA

Year	Quantity
	TONS
1862	6,473
1863	17,000
1864	21,431
1865	24,421
1866	32,157
1867	31,384
1868	32,259
1869	35,144
1870	30,824
1871	30,787
1872	17,089
1873	17,708
1874	13,844
1875	14,810
1876	15,490
1877	17,369
1878	17,989
1879	15,936
1880	13,997
1881	16,556
1882	21,081
1883	25,954
1884	25,186
1885	28,890
1886	29,010
1887	32,280
1888	36,178
1889	39,160
1890	42,749

TONS OF QUARTZ CRUSHED

Year	Value
1862	$21.91
1863	16.02
1864	18.11
1865	20.32
1866	15.28
1867	16.96
1868	12.41
1869	19,91
1870	12.56
1871	12.17
1872	14.81
1873	13.05
1874	12.87
1875	14.89
1876	15.08
1877	19.01
1878	13.63
1879	16.83
1880	18.42
1881	12.66
1882	13.04
1883	11.60
1884	12.44
1885	14.98
1886	15.70
1887	12.81
1888	12.08
1889	13.02
1890	11.11

AVERAGE YIELD OF GOLD PER TON (2000 LBS.) CRUSHED

GOLD
TABLE F
QUEBEC
ANNUAL PRODUCTION.

SECOND HALF OF YEAR ONLY

Year	Value
1877	$12,057
1878	17,937
1879	23,972
1880	33,174
1881	56,661
1882	17,093
1883	17,787
1884	8,720
1885	2,120
1886	3,981
1887	1,604
1888	3,563
1889	1,207
1890	1,350

the details of the industry and also the following figures of the value of gold exported by the banks at Victoria during 1889 :—

Bank of British Columbia.....	$203,111
Messrs. Garesché, Green & Co.....	183,587
Bank of British North America.....	25,331
	$412,029

The total amount of gold produced by the province from 1858 to 1890, inclusive, adds up to $55,192,163.

GOLD.

TABLE 2.

BRITISH COLUMBIA.

YIELD, ETC., BY DISTRICTS.

District.	Divisions.	Whites.	Chinese.	Yield of Gold by Divisions.	Total Yield by Districts.
Cariboo.....	Barkerville.....	74	156	$61,200	
	Lightning Creek.....	27	123	38,000	
	Quesnelle Mouth....	3	107	26,250	
	Keithley Creek.....	40	196	62,800	
		144	582		$188,250
Kootenay....	Western...	443	30	35,000	
	Eastern	8	52	37,400	
		451	82		72,400
Lillooet.....	... .	40	75	71,455	71,455
Yale..... ..	Hope, Yale and Lytton	.....	150	9,000	
	Osoyoos.....	71	29	17,000	
	Similkameen.....	39	79	23,450	
		110	258		49,450
					$381,555
	Total Whites.....	745			
	do Chinese.....	.... . .	997		
	do employed....	1,742			

Nova Scotia. The details of the statistics regarding the gold mining industry in Nova Scotia, as given by the Government reports of that province will be found in the below given tables, D and E and Nos. 3 and 4.

GOLD.

TABLE 3.

NOVA SCOTIA.

DISTRICT DETAILS.

Districts.	Number of Mines.	Days' Labour.	Mills.	Tons of Quartz Crushed	Yield of Gold per Ton.			Total Yield of Gold.		
					Oz.	Dwt.	Gr.	Oz.	Dwt.	Gr.
Brookfield	1	.....	1	2,500	..	13	..	1,643	5	..
Caribou Moose River	3	17,748	5	6,661	..	4	17	1,576	19	8
Fifteen Mile Stream	2	6,089	2	3,017	..	15	6	2,305	2	18
Lake Catcha	1	4,333	1	1,008	..	15	10	779	5	..
Malaga	6	22,569	3	6,633	..	11	19	3,883	12	12
Montagu	3	6,911	3	1,411	1	12	..	2,263	1	..
Oldham	2	8,469	1	1,122	2	9	10	2,774	13	20
Rawdon	1	6,657	2	1,892	1	..	..	1,899	15	..
Renfrew	2	3,778	2	760	..	6	15	253	10	12
Salmon River	1	19,408	1	6,415	..	6	10	2,070	..	..
Stormont	3	9,130	2	1,052	..	11	17	616	15	12
Uniacke	3	14,196	3	2,525	..	12	18	1,612	2	13
Waverley	4	17,679	3	3,509	..	2	18	482	12	..
Whiteburn	1	11,787	2	960	..	17	2	840	3	1
Unproclaimed, etc	5	11,410	5	3,284	..	8	6	1,357	11	9
	38	160,164	..	42,749	..	11	9	24,358	9	9

GOLD.

TABLE 4.

NOVA SCOTIA.

PRODUCTION OF THE DIFFERENT DISTRICTS FROM 1862 TO 1890 INCLUSIVE.

Districts.	Tons of Quartz Crushed.	TOTAL YIELD.				Average yield per ton of 2,000 lbs.
		Ozs.	Dwts.	Grs.	Value at $19.50 per oz	
Caribou and Moose River	43,959	23,818	11	13	$ 464,462	$10 56
Montague	16,192	32,581	11	16	635,341	39 24
Oldham	38,147	41,242	6	3	804,224	21 08
Renfrew	46,071	31,814	13	2	620,385	13 46
Sherbrooke	165,831	119,648	4	2	2,333,140	14 09
Stormont	22,236	23,240	14	5	453,192	20 36
Tangier	29,122	19,126	15	18	372,970	12 80
Uniacke	37,353	21,850	17	4	426,092	11 41
Waverley	93,081	53,873	19	14	1,050,542	11 28
Salmon River	34,575	10,715	4	0	208,947	6 04
Brookfield	5,663	4,858	4	9	94,735	16 73
Whiteburn	4,985	8,385	15	16	163,522	32 60
Lake Catcha	4,027	6,630	16	3	129,300	32 10
Rawdon	10,879	8,718	14	4	170,015	15 63
Wine Harbour	39,975	27,940	17	1	544,845	13 63
Darr's Hill	39,909	18,715	19	19	364,962	9 14
15 Mile Stream	8,501	4,996	11	17	97,434	11 46
Malaga	11,021	7,859	16	1	153,265	13 90
Unproclaimed, etc	51,629	40,528	17	17	709,314	15 01
Totals	703,156	506,548	9	20	9,877,687	14 03

If comparison is made between tables A and D it should be noted that the former would have to be enlarged five times to bring it to the same scale as the latter. The steady falling off of the yield of the placers of British Columbia is clearly brought out in this table and makes an interesting comparison with the fluctuations of the quartz-mining districts of Nova Scotia. Tables D and E also well illustrate the points already alluded to, viz., the falling off of the total yield, notwithstanding the increase of the number of tons of quartz crushed, thus showing that the ore milled was lower grade than usual.

Quebec.

Table F gives the yield of the metal by the Chaudière and Compton districts, Quebec, as far as ascertainable. The mining in these districts has been of late of a very desultory nature, so that it is difficult to get exact figures, but the falling off since its year of greatest prosperity in 1881 is very apparent.

The figures of the exports of the metal as found in the books of the Customs Department will be found in Table 5.

GOLD.

TABLE 5.

EXPORTS.

Exports.

Provinces.	1887.	1888.	1889.	1890.
	$	$	$	$
Ontario	6,650		2,660	
Nova Scotia	321,379	163,412	191,671	304,521
Manitoba		50	261	
British Columbia	592,300	464,696	414,658	402,271
Totals	920,329	628,158	609,250	706,792

There is no reason to believe that any gold ore is imported into the country and in any case its amount could not be ascertained, as the Customs Department makes no distinction between ore and bullion.

The details of the progress of the industry are as follows:—

Nova Scotia.

The gold of the province occurs in the area of Cambrian rocks forming the Atlantic slope of the peninsula of Nova Scotia, and extending from Canso on the north to Yarmouth on the south.

The enclosing rocks consist of compact quartzites and sandstones locally known as "whin," frequently felspathic, but rarely calcareous, associated with argillaceous slates, in some instances magnesian or chloritic. Nova Scotia.

The veins occur along the denuded crests of anticlinal folds of the strata and carry free gold associated with varying amounts of sulphurets, arsenical pyrites, etc.

The ore is stamped and amalgamated in the batteries, the tailings running out over amalgamated copper plates.

The following notes, reprinted from the Report of the Department of Mines of the province for 1890, give the main features of interest in the industry for the year:—

HALIFAX COUNTY.

"*Montagu.*—Operations have progressed in this district during the past year; the quartz averaging about as high as in the year 1889. Returns were received from the Annand, Kaye and Rose mills. The largest yield was 362 ounces from 120 tons crushed in the Annand mill.

"*Caribou.*—The returns show 1,560 ounces from 6,591 tons, against 1,906 ounces from 7,338 tons in 1889. Returns were received from the Lakelode, Dixon, Touquay, Caffrey and the Moose River Gold Mining Company mills. The returns from the Dixon mill show an average of over an ounce. Mr. Touquay crushed a large amount of surface ground and dump stuff.

"*Waverley.*—The Lake View Mining Company, having completed their new mill, commenced crushing in the fall. It is expected that they will handle in this mill a large amount of quartz, as extensive blocks of ore ground have been won. A new company will operate the Gue and Wilson properties. A concentration and clorination plant has been put up here to treat ores, tailings, etc.

"*Lake Catcha.*—The returns from this mine were good for the first part of the year, but there was little done during the fall.

"*Fifteen Mile Stream.*—The operations of the New Egerton Company, under Mr. Jas. A. Fraser, have been successfully carried on during the past year. The Stanley Company also worked steadily. The returns show 3,017 tons crushed, yielding 2,305 ounces, compared with 786 ounces from 1,416 tons in 1889.

"*Salmon River.*—The approaching completion of the new and powerful mill at this mine will enable an increased output to be maintained next year. The returns show 6,415 tons crushed, and a yield of 2,070 ounces, averaging 6 dwts., 10 grns., against 7,633 tons and 2,032 ounces during

Nova Scotia.

the year 1889. The uniformity of the yield of large amounts of quartz in this mine is worthy of notice. Up to date this mine has yielded 35,270 ounces from 79,456 tons of quartz.

"At Killag crushing has commenced, the December returns of the Killag Company being 51 ounces from 45 tons. At other points in Halifax county there is little new to report.

"The Western Gold Mines were visited by Mr. Madden, Deputy Inspector, who reports that they are worked with proper regard to the safety of the men employed. I append a memo. of his visits:—

"The returns show—

	Tons.	Ozs.	dwt.	Grs.
Brookfield	2,500	1,643	5	0
Malaga	6,198	3,809	18	12
Whiteburn	960	840	0	0

GUYSBORO' COUNTY.

"During the past season little has been done at *Goldenville* and *Wine Harbour*. At *Stormont* litigation has impeded mining, and the returns show a falling off. It is anticipated that this difficulty will be surmounted shortly, and it is to be hoped this district, one of the most promising in the province, will be worked to a greater extent than it has for several years.

"*Oldham.*—The returns show 2,774 ounces from 1,122 tons, compared with 2,709 ounces from 1,391 tons in 1889—the returns being from the Oldham Gold Mining Company. A noticeable yield was from June 23rd to June 30th, when 30 tons 8 cwt. yielded 875½ ounces. A new mill is being built by this company, and additions are being made by the Standard Company to their plant.

"*Rawdon.*—At the close of the year the returns showed 1,899 ounces from 1,892 tons of quartz, etc. A large amount of prospecting has been done in this locality, and at the end of the season it was anticipated that several valuable leads would be opened in the spring. Several lots of surface ground and slate were crushed by the Central Rawdon and the Gould-Northup mill, and yielded well. It is believed by some authorities that the surface is rich enough to be systematically treated.

"*Renfrew.*—Work has not been very successful in this district during the year 1890, the returns amounting to only 253 ounces. The Empress Gold Mining Company have restored their plant injured by fire last summer. Work on the free claim was to be closed at the end of the year.

"*Uniacke.*—The principal returns were from South Uniacke. The Withrows continued working, and the new shaft on the Thompson property was sunk, striking the pay ground, which proved to be richer than to the westward. Nova Scotia.

"*Memo. of visits paid by Mr. Madden, Deputy Inspector, to the Queen's County Mines.*

"*Brookfield Mine.*— * * * Thirty-eight men to work. This mine is in excellent order.

"*Malaga Mine.*— * * * North Lead working west; Rabbit Lead is also being worked. The Chester Lead and Mill Lead are idle under repairs. The management is sinking No. 4, west shaft, and when down about 90 feet more, will crosscut the other leads, and will then have two years' work opened in advance. The Nugget and Boulder workings are under repairs.

"*Boston Mining Company.*— * * * About fifty men employed here erecting buildings and machinery. This mine has heretofore not been furnished with pump or engine, but having now obtained them, expect shortly to utilise them to advantage. The mine is in good order.

"*Caledonia Mine.*— * * * Thirty-six men employed. This year have erected a 10 stamp mill. The engine being connected with the bank head of 5 or 6 shafts by a steel wire rope and a cog-and-pinion-wheel at each bank head, connected with hoisting gear, are enabled to hoist or lower from each shaft independently of the other. A diamond drill is at work boring south at a point 100 feet down the shaft testing the property. Two compressed air drills, capable of boring 4′ in 20 minutes, are at work in this mine; they have sufficient power to start three or four more.

"*Parker Douglas Mine.*— * * * Forty men employed. Seven compressed air drills to work. Hoisting engine same system as Caledonia. Six new hoists during the year. New machinery—boilers, 200 h. p.; boiler, 75 h. p., running the drills; a new rotary pump; fifteen new stamps, making twenty in all; new boiler shed; new compressor house, 45′ x 32′; also a large addition to the mine house; new concentrators. This company has prospected 30 leads bearing gold. They have sunk 160′ in one shaft and cross-cut several other leads; laid railroads on their lead and cross-cuts. The quartz is dropped down shoots into boxes, then taken to main shaft, where the boxes are hoisted and then dumped into shoots carrying the quartz to the mill. This is probably the best equipped mine in the province, and it is in good order.

Nova Scotia. "*Newton Mine.*—Queen's Mining Company. * * * Busy erecting new machinery, the buildings for which are nearly completed.

"*West Mine*, so-called.— * * * Sixty men employed, chiefly engaged building. Also adding some new machinery.

"*Royal Gold Mining Company* for want of machinery are not doing very much, but have the necessary plant on the ground, and are hard at work getting into working shape.

* * * The mines are all being thoroughly repaired, and additions in the shape of the most modern machinery and appliances are being made to the plant.

Speaking of his work in Colchester county, Mr. Fletcher, of this Department, reports as follows of a district visited by him :—

"Great excitement was caused last summer by the reported discovery of gold in a whitish-grey flinty conglomerate consisting almost wholly of pebbles and grains of white quartz, beds of which underlie the Carboniferous limestone from the neighbourhood of Brookfield, far up the Stewiacke River on the north side. The region was proclaimed a gold district and rights of search taken out covering many miles. The attention of prospectors was, moreover, directed to all the conglomerates in the province. That the conglomerate of Gay's River is auriferious has long been well known, and Professor Hind has proved the existence of gold, silver and copper in certain beds of that nature near Baddeck. The Brookfield conglomerate was said to have given rich returns by milling, although a somewhat close examination by panning the dirt in the beds of the streams flowing over it failed to indicate the presence of gold in appreciable quantity. Two samples were sent to Mr. Hoffmann, one from the neighbourhood of the barytes mine, the other from the brook three hundred yards above the Glenbervie mills, but neither of them yielded, on assay, a trace of either silver or gold. Tests subsequently made on a large scale at the mill of one of the gold mines emphatically confirmed the accuracy of Mr. Hoffmann's assays."

Interest having been awakened in the gold regions of the southern end of the province, their further examination was decided upon, and Dr. Selwyn visited the district with Professor Bailey, with whom he arranged for the prosecution of the work. Speaking of his visit he says :—

"On the 17th of June I left Ottawa for Shelburne, Nova Scotia, to visit the gold fields first opened in 1886 at and near Caledonia Corner, and to investigate the probability of the same leads continuing southward and westward into the county of Shelburne, and also to ascertain what would be the best plan of operation in commencing a detailed

examination and survey of these western parts of Nova Scotia in connection with the occurrence of gold, in quartz veins or in placer deposits, or in regard to other economic minerals. I had, in 1870, visited and cursorily examined the same part of the Nova Scotia coast, having then made detailed notes on a journey from Digby *viâ* Weymouth, Cape St. Mary and Salmon River to Yarmouth; and thence to Tuskett, Shelburne, Liverpool and Bridgewater to Lunenburg, the Ovens and Chester, returning to Bridgewater and Liverpool *viâ* New Ross and Dalhousie, and from Liverpool to Annapolis *viâ* Caledonia. The present trip has enabled me to do little more than refresh my memory and to confirm the general accuracy of the conclusions then arrived at respecting the distribution of the granitic and gneissic rocks and the gold bearing series, as subsequently delineated on the geological map. Nova Scotia.

"On the 23rd of June a trip was made 28 miles up the river from Shelburne to Indian Fields, where some pits have been sunk searching for gold. The country here is tolerably open, much of it flat and swampy and covered with drift and a fine granitic gravel or sand, with few exposures of the underlying rocks, though doubtless such would be found by following up the beds of all the brooks and small streams in the district. On the 24th of June I examined the route from Shelburne to Lockport, and thence *viâ* Sable River, Port Joli and Granite River to Liverpool. On the 25th I drove from Liverpool to Caledonia, 30 miles inland, and found the rocks to be alternations of the "whin" and black slates of the Atlantic coast Gold Series or Lower Cambrian, as indicated on the published geological map. The gold field of Whiteburn, six miles south-west of Caledonia, was visited on the 26th. It is of limited extent, on an oval shaped anticline outcrop of the lower "whin" rock, surrounded by the upper black slate. The veins are parallel with the stratification. They are not more than from six to nine inches thick, and are therefore costly to work, as about four feet of hard, barren rock has to be mined in driving or sinking on them. Consequently, though the quartz is of more than average richness the profits are not large. The beds dip about 45° to S.E. On the 27th I left Caledonia for Bear River, on the Annapolis Basin. As regards the extension or recurrence of anticlines like those in which the Malaga and Whiteburn leads occur, further to the south-west, no definite statement can be made. That some such areas should be found in the unsettled country where the boundaries of the counties of Digby, Yarmouth, Shelburne, Queen's and Annapolis meet, and especially along the flanks of the central granite mass, the limits of which have not yet been traced, but which certainly occupies a considerable area in this district and which is crossed, with a width of ten or twelve miles, on the road between Maitland and Bear River, is most probable."

Nova Scotia.

Professor Bailey in his preliminary report to the Director, speaks of the district in these words:—

"About the 25th of July I proceeded, in accordance with your instructions, to the Province of Nova Scotia, and entered upon the study of the geology of Queen's and Shelburne counties. Having been desired by you to give my first attention to the coast, operations upon the latter were begun at the town of Liverpool, and were continuously carried on until the entire coast, from Port Medway harbour, forming the eastern boundary of Queen's county, to Pubnico harbour, forming the western limit of Shelburne, had been examined. This work was found to be unexpectedly easy, owing to the circumstance that almost the entire shore is occupied by fishermen, and bordered by roads which give easy access to any desired point. The comparative uniformity of the rock formations, consisting chiefly of fine grained gneisses, quartzites and mica schists, together with irregular masses of granite, further facilitated their study. The general result of these observations was to show that the crystalline rocks in question, which occupy a belt along the coast of from two to fifteen miles in width, are only a more highly altered condition of the gold-bearing slates and sandstones of the interior."

Quebec.

The gold region still remains under a cloud, and nothing has been done outside of a small amount of washing of the alluvial gravels of the tributaries of the Beauce River at and above the town of St. Francis.

There were only four parties working when the district was visited in September. On the Mill stream near the town of St. Francis, Messrs. McArthur & Coupal were at work, having sunk a shaft to bed rock at some little distance from the stream on its west bank. Some work was also done on the gravels of the Cumberland River under the direction of Captain Richards, whilst on the Famine River the St. Onge Bros. were tunnelling in on the level of the river in search of an old channel they believed to exist. Mr. Louis Gendreau was doing a little work, washing with a short sluice the gravels found at the confluence of the River du Loup and the Chaudière. All of these operations have only yielded a little gold, having been carried on only for short periods, and on a small scale. Besides this there have undoubtedly been small quantities washed out of the river bars by individual prospectors, of which it is evidently impossible to get any record. The water was, however, rather high for this latter class of work this season.

Outside of the Beauce district a small amount of work has been done on the streams of Compton county, chiefly in the township of Ditton.

A certain amount of interest is also being taken in the quartz veins of these districts which, there is reason to believe, might in some cases prove to be remunerative if properly examined and worked. Mr.

Obalski, the Provincial Government engineer, who has been studying this question, gives the following account of his investigations in the "Report of the Crown Lands Department of Quebec" for 1890: Quebec

"Quartz has been very little worked, although a good deal of attention has been awakened of late in the possibilities of the quartz mining industry. It has not been within my power in the time at my disposal to thoroughly investigate this area wherein occur so many quartz veins, but I have visited a certain number of them on which I picked some samples weighing from 3 to 5 pounds. Assays of the ore from these veins by Messrs. Ledoux & Co., of New York, show the presence of only a small proportion of gold, not over 30 cts. per ton. I may also state that having had several pieces from a quartz vein at Jersey Point pounded up and washed down in a pan, two fine particles of gold, unquestionably derived from the quartz, were obtained. Gold of similar character is also reported to have been obtained from a vein of the Famine river, in rear of St. George. These are by no means solitary instances of gold derived from the quartz veins in Beauce, many similar cases being reported from different quarters. We have contributed towards forwarding two tons of quartz from the Jersey vein to be tested by Mr. J. Thompson, South Uniacke (N.S.), in his experimental quartz mill, the latter gentleman having kindly volunteered to crush our quartz specimens. It is greatly to be desired that numerous assays from these veins should be made; and should these assays prove satisfactory and fair averages be given, the result would be highly conducive to the rapid development of this important industry.

"The results, as given by Mr. Thompson, are as follows:

"1. On a lot of 3,000 lbs., 5 dwt. and 18 gr. or 3 dwt. 14 gr. = $3.65 per ton of 2,000 lbs.

"2. On a lot of 800 lbs., 2 dwt. 18 gr. or 6 dwt. 21 gr. = $6.85 per ton.

"*Gold in the Laurentides.*—As already stated in previous reports, some prospecting in search of gold has been made throughout the Laurentian formation. In the county of Joliette, two new companies have been organized. One of these, the '*Compagnie minière du district de Joliette,*' operates lot IV, 6 of the gore of Kildare, near St. Alphonse; assays from a rock heavily charged with magnetic pyrites gave traces of the precious metal.

"The other company, styled: '*Compagnie des Mines d'or de Mattawin,*" is operating a mining property at a place called 'La Barrière,' in the unsurveyed portion of the township of Tracy. From the latter property several samples taken by myself on a small vein a few inches wide,

Quebec.

were assayed by Messrs. Ledoux & Co., New York assayers, and while two of the samples gave traces of gold, a third one gave the following result:—

Gold, 1 ounce 83, per ton of 2,000 lbs.
Silver, 2 do 65, do

"From the various statements here presented, unquestionably worthy of interest and further investigation, no hasty conclusion should be drawn, it being very difficult, from the limited amount of work done, to express any decided opinion as to the auriferous character of this area."

Ontario.

A certain amount of exploration and discovery has been carried on in Ontario. In the Madoc district of Hastings county, the Crescent Gold Mining Company started work late in the fall, re-opening the Feigle mine.

On the north shore of Lake Huron discoveries of gold-bearing veins were reported, and some testing work done on the discoveries.

A small amount of similar work has been done at places on the north shore of Lake Superior, between Sault St Marie and Port Arthur.

Reports come to hand also of renewed interest in the Lake of the Woods district, where small gangs of men have been at work testing a number of the veins. Work has been proceeded with on the reduction works, which are in course of erection at Rat Portage, and which it is expected will shortly be completed. This should favourably affect the development of this promising district, so that it is hoped that we may have to report from thence a production of the metal next year.

North-West Territories.

Of the working for gold on the bars of the Saskatchewan River, Mr. Griesbach, Commandant N.-W.M.P. at Fort Saskatchewan, kindly furnishes the following information:—

"Mining on the river has not been carried on this year to the same extent it was last, owing to continued high water preventing the miners from getting at the 'pay dirt.' The amount of gold taken out of the North Saskatchewan River during the season from, say 50 miles above Edmonton and 50 miles below Fort Saskatchewan, is estimated at between $3,000 and $4,000."

British Columbia.

Placer Mining. Outside of the already mentioned falling off of the yield of gold from the alluvion and its causes there is nothing very new to relate.

An interesting discovery of an old river channel in the Cariboo District is described as follows by Mr. Bowron:—

"The Keithley Creek division of the district has proven most prolific, both as regards the season's output, as well as in the importance of its developments, the particulars of which will, no doubt, be fully reported

by Mr. Stephenson; but as a discovery has been made in this division, which, I think, merits more than passing notice, a few words in addition to what may have been said on the subject will not here be out of place. British Columbia.

"The opinion has prevailed for many years among our most experienced miners from California and Australia that, judging from the formation of the country, there existed, and ultimately would be found, in this district immense obliterated river channels traversing the country upon a higher level than the present streams, which, in crossing the former, in many instances, received therefrom their chief supply of the precious metal. The first of such ancient river channels would now appear to have been discovered on the south side of the South Fork of the Quesnelle River. A Chinese company working up Dancing Bill's Creek, three miles above the Forks (*vide* Mr. Bowman's map), when about a thousand feet from the Quesnelle River, and at an altitude of one hundred and twenty-five feet above the stream, came to a pitch-off in the bed-rock which they were unable to follow, owing to the quantity of water encountered. They continued working ahead as near on a level as the grade to the sluices would allow. This occurred some ten or twelve years ago, and they have continued since that time to work into the hill without finding bed-rock. They use hydraulic pressure in working; but as their water supply is limited, and the face of their cut is now nearly two hundred feet in height, they make but small headway, but are known to have been taking out, with six men working, from five to eight thousand dollars annually. The operations of this company having for some years been watched with interest by the white miners in the vicinity, and the developments seeming to confirm their pre-conceived ideas of an immense 'blind' river channel in the hill, Messrs. Barker, Polley, Burrill & Co. sank two shafts half a mile above the Chinese Company, and back some fifteen hundred feet from the river, behind the rim rock which forms the river bank, and although not reaching bed-rock, owing to the quantity of water encountered, they found similar prospects to those obtained in the Chinese claim. Subsequently, Mr. John Hepburn, of Victoria, located ground below the Chinese, and in running in cuts developed similar pay gravel inside the rim rock, which is regarded as settling the question of a paying channel in the hill beyond a doubt. Messrs. Whittier & Pomeroy below, and the Champion Company above, have also located ground until there are nearly six miles of the channel claimed.

"Some are of the opinion that the channel will ultimately be traced to the Horsefly River, some twenty miles distant. However that may be, it is generally conceded that there must be at least ten miles of the old river bed. As to the richness of the pay, and consequent importance

British Columbia.

of the discovery, I can only say it is estimated that the Chinese Company are taking out at least one thousand dollars per lineal foot of the channel so far as they have worked, and as large river channels are usually very regular in the gold deposits, further comments are unnecessary."

Mr. Stephenson, writing from Quesnelle Forks, gives further particulars of the same discovery as follows:—

"The South Fork of Quesnelle River is at present very promising for hydraulic mining. The *Hop E. Tong*, a Chinese company, have for years been working on *Dancing Bill Gulch*, a small stream that empties into the left hand or south side of the South Fork, about three miles above the Forks. The gulch has cut across what is now proved to be an old channel, with a heavy rim rock between it and the present river. This old channel contains an immense deposit of gravel, which pays them well for hydraulic mining. Last year (1889) the *South Fork Hydraulic Mining Company* located and leased a piece of ground next above the Hop E. Tong Company, up the South Fork. They did some prospecting, sinking two shafts but did not get to the bottom of the channel. They got prospects in sinking those shafts that they considered warranted them in bringing water on to the ground. They have been engaged this season in making a trail to the claim, building a house and running ditch lines. They have located a ditch line fifteen and three-quarter miles long, and have commenced cutting a ditch four feet wide on the bottom, two feet deep, and six feet wide on top. This ditch they will push ahead a considerable distance next season, and will also place in position an hydraulic pipe about 450 feet long, suitable to handle the amount of water which the ditch will carry. Next below the Hop E. Tong, and joining their lower line, the *Victoria Hydraulic Mining Company* have located and leased a considerable piece of ground. This company, under the management of Mr. John Hepburn, with a gang of six to eight men, have been engaged in prospecting for the last three months. Mr. Hepburn tells me he has obtained satisfactory prospects for the work done. Then up the river and joining the South Fork Company, there has lately been another location made, and a company is about to be organized to prospect another section of the same channel."

Discoveries of auriferous gravel of more or less importance at various places in the province are alluded to in the above report, but otherwise the operations in alluvial gold are decreasing in importance.

Quartz Mining.—An increase in the interest taken in prospecting for veins continues to be apparent in most of the mining districts.

Speaking of the Cariboo district the report of the Minister of Mines for the province gives the following:—

"Regarding the development in our quartz or mineral claims, although I regret to say that there has not been that enterprise displayed we so much desire, this season has not been entirely fruitless of results. The destruction by fire of the Government Reduction Works last winter had a most depressing effect upon this branch of our mining industry, but, fortunately, these works, although in operation but a few weeks, had proven their capability to successfully treat the character of ore found here, and consequently justified the Government in rebuilding the same upon a somewhat increased capacity, which undertaking has been accomplished most succesfully under Mr. Martin's supervision, and the works are now in operation again. It is a fact worthy of note that the gross product of the district has been increased by about $5,000 produced from the working of quartz. The Black Jack Quartz Mining Co. have, during the season, prosecuted work on their mine; their shaft being now down to a depth of something over 100 feet, and exposing a valuable body of ore. Their small prospecting mill was kept running a good part of the time until stopped by frost. This company has taken another lot of sulphurets to the test works, which is now under treatment. A most satisfactory test of the ore from this mine was made at "The Cassell Gold Extracting Co.'s Works." Glasgow, Scotland. From 360 pounds of ore sent a result of something over $80 per ton was obtained; the ore worked up to 90 per cent. of the assay value. The advantages of this company's method is that no roasting is required, and the company claim that in ordinary cases ore can be treated for one-fourth the cost of working by the chlorinating process, a circumstance which, if substantiated by further working tests, means wealth to this district. British Columbia.

"The Island Mountain Co. completed their ten-stamp mill, to which is attached four concentrators and an improved rock crusher, and the machinery was put into operation about 20th August, and was found to work satisfactorily. Rock crushing commenced on 25th August, and by 25th September several hundreds of tons were put through. Some difficulty was experienced in getting the silver plates to catch the gold, owing to the presence of some foreign substance coating the plates, but after a time this was partially remedied. Some fifteen or twenty tons of sulphurets were saved and brought to the Government Works for treatment. I learned from Mr. May, who put up the Island Mountain Co.'s mill and superintended the working of the ore, that the test made cannot be regarded as a fair result, inasmuch as the ore was taken from the dumps at the various tunnels belonging to the company, and was mostly surface rock, and only trial runs of each kind of rock."

British Columbia.

In the south-eastern part of the province, in the districts of East and West Kootenay and Yale, considerable activity has prevailed in prospecting for and opening up a number of veins. Some of these might be classed as gold veins proper. Most of the veins of this and other mining camps of these districts, however, are better classed as silver and copper deposits, although carrying more or less gold, some assays running very high in that metal. They will therefore be described in the article on silver. Some of the veins of the Toad Mountain camp, however, might properly be classed as gold veins, and of these Dr. Dawson speaks as follows :—

"*With the exception of the Poorman Mine and other adjacent claims on Eagle Creek, near the west end of Toad Mountain, all the metalliferous deposits so far found occur in the stratified rocks. The exceptional veins traverse a hard dark-grey mica-syenite, and differ in character from the other ores containing auriferous iron pyrites in a quartz gangue."

The following information relating to the year's development of these veins is given in the Report of the Government Gold Commission for the district :—

"The Poorman, on Eagle Creek, has been developed by shafts, tunnels and drifts for a depth of 125 feet and about 600 feet along the ledge. Stoping has been done from the 90 foot level. The stamp mill has not been worked during the whole of the summer, owing to the scarcity of water. Abont 1,200 tons of quartz has been crushed, the returns from which can only be conjectured, as the proprietors do not feel disposed to make them public. None of the sulphurets, which are rich, have yet been treated. The last clean-up produced a gold bar worth over $7,000. Two men are engaged in running a tunnel at the upper end of the mine, which will strike the ledge in about 450 feet, and will be extended 400 feet further to reach the ore deposit in the White-Buchanan mine, which runs parallel to the Poorman, and is owned by the same proprietors. To advance the work as rapidly as possible a Burleigh rock drill will be set up and operated on the opening of navigation.

"On Gold Hill, about 1½ miles south of the Poorman, are located the Wild Cat, Catamount and Forest mines. The first mentioned exhibits a large body of ore composed of quartz impregnated with sulphurets. A tunnel is now in a distance of 115 feet. The vein matter assays from $15 to $30, and is of a free milling character. The vein is 10 feet wide, and is in a formation of hornblende granite. One-half of the claim was bonded by H. Keefer, the railway contractor, for 30 days, which he has since obtained by payment of the amount mentioned in the agreement.

* Annual Report Geogloical Survey Dept., Vol. IV, p. 33 B.

"One mile below where the trail crosses Eagle Creek several promising locations exist, the principal of them being the Paradise, Total Wreck, Pioneer, High Ore, and Wizard. The Paradise has a tunnel 30 feet long, exposing a vein three feet wide carrying excellent ore. The Pioneer shows a body of mineral from 2½ to 6 feet wide. The High Ore has a number of open cuts and a prospect shaft, from which several tons of good-looking quartz has been extracted. British Columbia.

"The Royal Canadian has two tunnels, one a distance of 75 feet, the other 65 feet; width of vein from 2½ to 3 feet, existing in a slate country rock. The stated value of the ledge is said to be from $20 to $30 to the ton. Mr. Johnson, of Sydney, Australia, offered $15,000 for one-half the claim, and agreed to erect a plant to cost as much more, provided one ton of average ore would return $20 to the ton, at the sampling works, Revelstoke.

"On Rover Creek some locations have been made, which promise to become of great value. They are known as the Whitewater, Midas, Snow-water and Columbia. The tunnel in the first mentioned is 90 feet long, showing a ledge 6 feet wide, of a free milling nature. It is a contact vein, the hanging wall being granite and the footwall slate. The average of fifteen assays made amounted to $80 in gold. The return from 1½ tons tested at the sampling works was $110 in gold and $9 silver to the ton. Assays of similar richness were obtained from the Snow-water, which is an extension of the former. A trail has been graded a distance of ten miles, and it is the intention of Mr. Davys, who is one of the principal owners, to obtain the two Huntington mills, belonging to the Cottonwood Gold Mining Company, Toad Mountain, and work them to their fullest capacity.

"The output of ore from the gold belt, extending from Eagle to Rover, is estimated at about 1,800 tons, 1,200 tons of which were extracted from the Poorman, and the remainder the result of prospecting work in the various claims referred to. Of course this will be greatly increased when operations are confined to the production of ore only."

From Yale district, Kamloops division, comes the report that only assessment work has been done on the claims of that vicinity, that the Nicola Milling and Mining Company has suspended operations for the present, and that no new discoveries of veins have been made. From another part of the district however the following discovery is reported.

"*Siwash Creek.* Seven miles north-east from Yale, on which about 20 hardy and industrious miners have worked the entire season, many of them performing assessment work only, there has been found rich quartz carrying free gold.

British Columbia.

"The Roddick Company, I may state, have expended nearly $3,000 in opening their claim by driving tunnels and sinking, finding very rich deposits in free milling ore. Test assays have been made in the province and in California that range from $150 to $2,000 per ton in gold."

The mines of the Rock Creek camp received a certain amount of attention, but that district is kept back for want of communications.

"*Cherry Creek.*—Mr. L. W. Riske, in company with Mr. Donald McIntyre, have completed the erection of their quartz mill on the Monashee Mountain, and hope, after getting their ditch constructed, to convey the water a distance of two or two and a half miles to the mill, when they will at once commence crushing the ore, which is pronounced to be very rich."

Further news of this point is given in the following remarks made by Dr. Dawson :—*

"In the course of the preliminary work done on the Shuswap sheet, the Monashee Mine, situated on the watershed between Cherry Creek and Kettle River, and in process of development by Mr. D. McIntyre, was visited. There are at this place several distinct veins of auriferous quartz in which specks of free gold are frequently visible. These veins, in which points of gold are often visible, traverse Monashee Mountain, composed of quartzite, diabase (?) and limestone strata, near to the margin of a wide granitic mass, which lies to the south. Several small tunnels and openings have been made on the veins, and a small mill has been erected with a view to commencing work on the ore in the spring. A number of small specimens selected from the ore at the mouth of the principal working drift at this place, have proved on assay by Mr. Hoffman, to contain, gold 0·583 oz., silver 2·683 oz. to the ton."

GRAPHITE.

Distribution.

The known deposits of this mineral in the country chiefly occur in the Laurentian rocks of the districts of the north shore of the Ottawa River in the Counties of Argenteuil and Ottawa, Province of Quebec, and in similar rocks in Eastern Ontario along the line of the Kingston and Pembroke Railway.

In both districts they mostly occur in the form of irregular veins, strings or beds in the crystalline limestones of the series or in scales disseminated throughout the same whilst a number of interesting minerals form their associates, notably pyroxene, wollastonite, felspar, quartz, sphene, phlogopite, zircon, idocrase, etc.

*Summary Report Geological Survey Department for 1890.

Mining has also been carried on in the Laurentian rocks of the immediate vicinity of St. John, New Brunswick. Here graphite in a finely divided state is disseminated through the rock and at a few points is found in beds of economic importance. They occur in argillites and sub-crystalline limestones and vary from one to four feet in thickness.

Operations.

At the Walker Mine in Buckingham township, Ottawa county, which was working last year, operations were suspended at the end of February, pending negotiations for the more extended capitalization of the mine.

At this place the graphite is found in the gneissic rocks, showing two modes of occurrence. At places on the property it occurs disseminated through the rock, whilst at others the foliated and columnar varieties occur forming a solid filling in veins traversing the formation. The veins are of varying widths, from a few inches up to 2 feet and the surrounding gneiss has a generally rusty and rotten appearance,

Comparison with foreign graphite.

Allusions to the mode of occurrence of the mineral at the various known localities will be found at various places in the Reports of the Geological Survey and analyses and comparisons of its qualities with those of other countries in "Report on Canadian Graphite" by Mr. Hoffmann, Chemist to the Survey; Report of Progress, Geological Survey, pp. 489–512, 1876-77.

In this pamphlet investigation was made of the specific gravity of a number of Canadian specimens, the percentage of ash, and its composition being also determined on all of which points comparison was made with samples of graphite from New York State and from Ceylon. Experiments were also carried out to determine their relative combustibility with a view, amongst other things, to illustrate the fitness of the home product for the manufacture of crucibles.

The results of the investigation show that as regards ash the Canadian graphite gave more than the Ceylon, but much less than the New York. Speaking of the above mentioned experiments and those on the relative combustibility of the different samples examined the report says:—

"From these experiments it will be seen that in respect to incombustibility the Canadian graphite may claim perfect equality with that of Ceylon; and that consequently—apart from any consideration of the proportion and nature of the associated foreign matter—it is in no wise inferior to the latter as a material for the manufacture of crucibles.

"Prepared according to the present process, the 'dressed graphite' (analyses 5 to 14 inc.) obtained from the beds of the disseminated mineral (analyses 1 and 3) is apt to contain more or less carbonate of lime and oxide of iron; it has however been pointed out, experimentally, (analyses 12 and 14) how readily these admit of removal by a very

simple and inexpensive chemical treatment, leaving the graphite with a very small amount of ash, and that of a nature in no wise prejudicial to its application for the purpose here under consideration. That the graphite from this source, in itself compares favourably with that of Ceylon, will be seen from the above table, 1 and 3."

Methods of preparation.

The plumbago obtained at St. John, N.B., only goes through a simple process of hand picking before being shipped, but at the chief mine of the Ottawa county district works have been erected to crush, wash and otherwise prepare the material.

Here, after passing through a Blake crusher, the rock passes through two batteries of Cornish stamps of 10 heads each. From thence it is carried by water to the buddle floor where there are 6 large circular buddles besides two for finishing. These buddles have fine sieves in the outlets and the separation takes place by the settling of the graphite, which is the lighter material, out towards the circumference, whilst the rocky impurities remain near the centre. The waste water from these passes to catch pits where a further amount of the finer graphite is caught. After passing through the buddles the material goes to a drying furnace and the purer portions are further ground and bolted to produce the best grades.

This mill is capable of handling about 40 tons per day of 24 hours.

During the time of the recent operations, which ceased in February last, only the rock containing disseminated graphite was being mined and treated, carrying, it is said, from 25 to 30 per cent of graphite.

At this place the grades made are as follows:—

Grade.	Uses.	Value.
A. 0	Pencil manufacture and electro-typing	50 to 75 cts. per lb.
A. 1, A. 2	do do fine lubricate	
A. 3, A. 4	Lubricate and shot polishing	4 to 25 do
A. 5, A. 6	Crucible manufacture	
S. P.	Slime products for stove polish manufacture	3 to 6 do
F. F.	Foundry facings	1½ cts. per lb.

Latterly a very interesting application has been made by the Ontario Bolt Company of the rock containing the disseminated plumbago in finishing off and facing a certain grade of small and plain castings. They have found it a greatly improved substitute for the grade of plumbago

formerly used for this purpose as when the castings are rotated with it in the "rumblers" the hardness of the rock helps to wear down their roughnesses whilst the plumbago contained in it gives their surface the necessary polish.

The production for the year amounted to 175 tons, valued at $5,200, against 242 tons and $3,160 for last year. This falling off in the amount, but increase in the value, is due to the fact that one of the chief operators whilst working only a short time made sales of a higher grade article. Production.

The exports and imports are given below in Tables 1, 2 and 3. Exports and imports.

GRAPHITE.

TABLE 1.

EXPORTS.

Year.	New Brunswick.		Ontario.	
	Cwts.	Value.	Cwts.	Value.
1886	8,142	$3,586	.....	.....
1887	6,294	3,017	.....	.....
1888	2,700	1,080	.....	.....
1889	660	422	22	$116
1890	400	160	329	1,369

GRAPHITE.

TABLE 3.

IMPORTS OF BLACKLEAD.

Fiscal Year.	Value.
1880	$18,055
1881	26,544
1882	25,132
1883	21,151
1884	24,002
1885	24,487
1886	23,211
1887	25,766
1888	7,824
1889	11,852
1890	10,276

GRAPHITE.

TABLE 2.

IMPORTS OF RAW AND MANUFACTURED PLUMBAGO.

Fiscal Year.	Plumbago.	Manufactures of Plumbago.
1880	$1,677	$2,738
1881	2,479	1,202
1882	1,028	2,181
1883	3,147	2,141
1884	2,891	2,152
1885	3,729	2,805
1886	5,522	1,408
1887	4,020	2,830
1888	3,802	22,604
1889	3,546	21,789
1890	3,441	26,605

GYPSUM.

Distribution. As in previous years the production of gypsum is afforded by the provinces of Ontario, New Brunswick and Nova Scotia.

Ontario. In Ontario work was carried on by the Alabastine Company at Paris and by Messrs. W. Donaldson & Co., of Mount Healy; L. H. Johnson, of Caledonia; Thomas Martindale, of York; and the Grand River Plaster Company of Gypsum Mines.

The deposits which are characteristic of the lower portion of the Onondaga formation occur on the Grand River from the town of Paris to a short distance below Cayuga or to Gypsum Mines, the site of the Merritt mine, operated by the Grand River Plaster Co.

Although the area containing practically workable deposits of gypsum extends for about forty miles, there are considerable stretches along the river where none has been found, as for instance in the neighbourhood of the city of Brantford. The mode of occurrence is very similar to that of the salt beds of Ontario, as it is found in large lenticular interbedded masses of from 3 to 6 feet at the point of greatest thickness and having a total area, of possibly five or ten square miles.

The series of rocks which includes the gypsum lies horizontally and is cut by the valley of the Grand River, thus affording facilities for mining by simply drifting in either from the river bank or from depressions a short distance inland. The work of extraction is continued to the right or left of these drifts, pillars of gypsum being left for the support of the roof, which in many places consists of either a very

friable shaly limestone or of calcareous clay. In many of the abandoned mines, as well as those at present working, the process of extraction has been continued to a distance of 1,500 feet from the mouth of the level. The area mined in each would cover possibly 20 or 25 acres.

No new developments were made in New Brunswick in this industry during the past year; the production, as in previous years, being altogether that of Albert and Victoria counties. In the former county the Albert Manufacturing Company, of Hillsboro', and E. W. Lynds, of Hopewell Hill, were the only producers. In Victoria county Messrs. McQueen and Stewart, of Andover, took out a small quantity. New Brunswick.

That the shipments from Victoria county were somewhat smaller last year than formerly is due to the fact that the Tobique Valley Railway is only as yet in course of construction, and the producers prefer waiting for its completion, that the cost of handling may be greatly lessened, the distance to market being about 25 or 30 miles, and the cost of transport in consequence heavy.

The geological position of all the New Brunswick gypsum deposits is in the lower Carboniferous formation where they occur, forming large interbedded masses in the limestones and shales.

As in previous years the production of Nova Scotia is in a great measure altogether from deposits in the neighbourhood of the Basin of Mines, the quarries being situated at Wentworth Creek, near Windsor, and at Cheverie, Walton, Stewiacke, etc. A considerable amount was also quarried throughout the various counties of Inverness, Victoria and Antigonish. Nova Scotia.

An analysis of gypsum from the Mabou querry was made by Mr. F. J. Shutt of the Experimental Farm, Ottawa, for Col. C. N. Snow, of Pictou, with the following result:—

"Sulphate of lime	97·53
do magnesia	0·92
Carbonate do	0·98
Insoluble rock matter	0·48
Moisture, etc. (undetermined)	0·09
	100·00

"As this sample contains but 2·5 per cent of foreign matter, it must be considered a very pure specimen of commercial gypsum, and one that is well adapted for all the purposes for which this substance is used."

Although occasionally found in large quantities in Manitoba and Athabasca of a quality suitable at least for the manufacture of land plaster, no production is as yet reported from this province. Manitoba.

Of the deposits, Mr. J. B. Tyrrell, in an article entitled "Gypsum deposits in Northern Manitoba," published in the *Canadian Record of Science*, April, 1889, writes :—

"In the north-west corner of township 32, range VIII, west of the principal meridian, is a rounded hill rising thirty-five feet above the plain, its greatest length being about 600 feet, and its greatest breadth 150 feet. Its surface is overgrown with small canoe-birch. Two holes, each about eight feet deep, have been dug by prospectors in this hill. One at the top shows, below a foot of decomposed material, seven feet of hard, compact, white anhydrite or 'bull plaster,' exhibiting a more or less nodular structure, and breaking on the surface into small irregular fragments. Very little bedding can be detected in the mass. The other hole is in the side of the hill fifteen feet lower down, and shows on top two feet and a half of white clay, consisting of decomposed anhydrite, below which is five feet and a half of white nodular anhydrite similar to that in the other hole. This gives a thickness, almost certainly, of twenty-two feet of this rock, and it is not improbable that the hill is composed entirely of it.

"Again, just north of the ninth base line, and two miles east of the township corner, between ranges VIII and IX, is a poplar-covered hill or ridge, thirty feet high. In various places on this hill are exposures of snow-white gypsum, similar to what has been described above, showing in some cases a thickness of ten feet in one section. The most of it is massive or crypto-crystalline, and lies in regular beds which dip slightly towards the west."

Production.

The total quantity produced in the Dominion during 1890 was 226,509 tons, valued at $94,033, the output by provinces being :—

GYPSUM.

TABLE 1.

PRODUCTION BY PROVINCES.

Provinces.	Tons.	Value.
Nova Scotia	181,285	$154,972
New Brunswick	39,024	30,986
Ontario	6,200	8,075
	226,509	$194,033

The production for the past five years has been :—

1886	162,000 tons,	valued at	$178,742
1887	154,008 "	"	157,277
1888	175,887 "	"	179,393
1889	213,273 "	"	205,108
1890	226,509 "	"	194,033

Manufactures.

Of this production the greater part was exported in the crude state, nearly all of the production of Nova Scotia being shipped as such, while in New Brunswick and Ontario small quantities of plaster of Paris were manufactured as well as land plaster, which was sold locally.

The amount of gypsum ground and sold as land plaster was 5,550 tons, valued at $18,114, and of plaster of Paris 19,460 tons, valued at $71,880. In the manufacture of plaster of Paris there is a loss in weight of material of about 20 per cent. Assuming that such be the case there were therefore 24,325 tons of gypsum used in the production of 19,460 tons of plaster of Paris, a total quantity manufactured in Canada of 29,875 tons, or a little more than one-tenth of the total output.

Besides the foregoing, a quantity of "Alabastine" and "Plastico" was made by the Alabastine Company of Paris, Ont., and a considerable quantity of superior quality rock was shipped by the Albert Manufacturing Company of Hillsboro', N.B., to their works at Newark, N.J., for the manufacture of "terra alba."

Exports.

The exports of crude gypsum are given below :—

GYPSUM.

TABLE 2.

EXPORTS OF CRUDE GYPSUM.

YEARS.	ONTARIO.		NOVA SCOTIA.		NEW BRUNSWICK.		TOTAL.	
	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.
1874	.....	.....	67,830	$ 68,164	.....	.....	67,830	$ 68,164
1875	.....	.....	86,065	86,193	5,420	$ 5,420	91,485	91,613
1876	120	$ 180	87,720	87,590	4,925	6,616	92,765	94,386
1877	.....	.....	106,950	93,867	5,030	5,030	111,980	98,897
1878	489	675	88,631	76,695	16,335	16,435	105,455	93,805
1879	579	720	95,623	71,353	8,791	8,791	104,993	80,864
1880	875	1,240	125,685	111,833	10,375	10,987	136,935	124,060
1881	657	1,040	110,303	100,284	10,310	15,025	121,270	116,349
1882	1,249	1,946	133,426	121,070	15,597	24,581	150,272	147,597
1883	462	837	145,448	132,834	20,242	35,557	166,152	169,228
1884	688	1,254	107,653	100,446	21,800	32,751	130,141	134,451
1885	525	787	81,887	77,898	15,140	27,730	97,552	106,415
1886	350	538	118,985	114,116	23,498	40,559	142,833	155,213
1887	225	337	112,557	106,910	19,942	39,295	132,724	146,542
1888	670	910	124,818	120,429	20	50	125,508	121,389
1889	483	692	146,204	142,850	31,495	50,862	178,182	194,404
1890	205	256	145,452	139,707	30,034	52,291	175,691	192,254

Ground gypsum, to the value of $105, was exported from the province of New Brunswick during 1890.

Imports. The imports of gypsum crude, ground, and calcined, or plaster of Paris, are given in the three following tables :—

GYPSUM.

TABLE 3.

IMPORTS OF CRUDE GYPSUM.

Fiscal Year.	Tons.	Value.
1880	1,854	$3,203
1881	1,731	3,442
1882	2,132	3,761
1883	1,384	3,001
1884		3,416
1885	1,353	2,354
1886	1,370	2,429
1887	1,557	2,492
1888	1,236	2,193
1889	1,360	2,472
1890	1,050	1,928

GYPSUM.

TABLE 4.

IMPORTS OF GROUND GYPSUM.

Fiscal Year.	Pounds.	Value.
1880	1,606,578	$ 5,948
1881	1,544,714	4,676
1882	759,460	2,576
1883	1,017,905	2,579
1884	687,432	1,936
1885	461,400	1,177
1886	224,119	675
1887	13,266	73
1888	106,068	558
1889	74,390	372
1890	434,400	2,136

IRON

TABLE A

ANNUAL PRODUCTION OF ORE.

Year	Province	Quantity	Value
		TONS	$
1886	B. C.	3,941	7,882
	ONT.	16,032	32,064
	QUE.	.....	.....
	N. S.	49,735	87,036
1887	B. C.	2,796	6,990
	ONT.	16,598	36,218
	QUE.	13,404	26,808
	N. S.	43,532	76,181
1888	B. C.	8,372	14,950
	ONT.	16,894	37,710
	QUE.	10,710	74,509
	N. S.	42,611	74,500
1889	B. C.	15,487	20,742
	ONT.	.....	.....
	QUE.	14,533	33,091
	N. S.	54,161	97,807
1890	B. C.	.....	.....
	ONT.	5,000	12,500
	QUE.	22,305	41,196
	N. S.	49,206	101,684

GYPSUM.

TABLE 5.

IMPORTS OF PLASTER OF PARIS.

Fiscal Year.	Pounds.	Value.
1880	667,676	$ 2,376
1881	574,006	2,864
1882	751,147	4,184
1883	1,448,650	7,867
1884	782,920	5,226
1885	689,521	4,809
1886	820,273	5,463
1887	594,146	4,342
1888	942,338	6,662
1889	1,173,996	8,513
1890	693,435	6,004

IRON.

Production.

Of iron ore, 76,511 tons were produced in Canada during the year 1890, valued at $155,380, showing, compared with 1889, a decrease in quantity of 7,670 tons and an increase in value of $3,740, the latter being attributable to the fact that the ores of Nova Scotia brought a much higher price this year than last. The decrease in quantity may be largely accounted for by the cessation of operations by the Puget Sound Iron Company, of British Columbia, who were operating in 1889. The production by provinces is shown comparatively with that of previous years in the graphic table A.

Of the annual production of iron ore in Nova Scotia the following table 1 will afford ample explanation :—

IRON.

TABLE 1.

NOVA SCOTIA: ANNUAL PRODUCTION OF ORE.

	Tons.
1876	15,274
1877	16,879
1878	36,600
1879	29,889
1880	51,193
1881	39,843
1882	42,135
1883	52,410
1884	54,885
1885	48,129
1886	44,388
1887	43,532
1888	42,611
1889	54,161
1890	49,206

Imports and exports.

No ore was imported into Canada during the year, the only trade statistics available, therefore, are those of exports which are shown in table 2 as follows :—

IRON.

TABLE 2.

EXPORTS OF ORE.

Province.	1887.		1888.		1889.		1890.	
	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.
Ontario.....	12,244	$38,990	31,161	$36,397	4,108	$10,407	18,601	$38,967
Quebec.....	38	119	10	380	.....	2,700	120	1,640
Nova Scotia.	.....	.....	.....	.....	.....	100	.....	.....
British Columbia.	1,410	3,525	7,300	18,400	13,335	26,680	33	83
Totals.... ...	13,692	42,634		55,177		39,887	18,754	40,690

Developments Nova Scotia,

In Nova Scotia operations were carried on by the Londonderry Iron Company and the New Glasgow Iron, Coal and Railway Company, the latter company as yet only doing development work, while the former are carrying on the business established for many years at Londonderry. Of the iron industry in Nova Scotia Mr. E. Gilpin, jr., Inspector of Mines for that province, writes thus in his report for the year 1890 :—

"Operations have been steadily pursued by the Londonderry Iron Company, both at their mines and their furnaces. Calcining furnaces have been built, and large amounts of spathic ore have been burned. This process greatly increases the percentage of iron in the ore, and makes it more fusible.

"The New Glasgow Iron, Coal and Railway Company have commenced a branch line from Eureka to connect with their furnace at the forks of the East River, and with their mines at Springville. They have continued opening and testing their large and valuable properties.

"Iron ore was mined by this Company at Brookfield. Mr. Leckie, of Londonderry, tested a promising deposit near Pugwash, and discoveries were reported from various localities."

New Brunswick.

No iron ore was mined in New Brunswick during the year. A little work in development was, however, done on a property on the Millstream River, Gloucester county, where according to one of the owners, Mr. John Ellis, of Bathurst, N. B., three cross-cuts had been

made during the year upon a deposit of magnetite. In conversation, Mr. Ellis stated that the vein was 32 feet in width, striking E. and W. and dipping nearly vertically, and had been traced for upwards of one mile and a half. According to an assay by Prof. J. T. Donald, of Montreal, the ore contains,—

Metallic iron	65·85	per cent.
Silica and insoluble matter	8·10	do
Phosphorus	0·01	do
Sulphur	0·17	do

It is understood that a small quantity of ore was taken out in proving the vein, though no shipments have been made.

In the province of Quebec active operations were carried on at the Radnor and Drummondville furnaces and at the Bristol mines on lot 21, range II, Bristol township, county of Pontiac. Quebec.

These furnaces have been in operation for many years and are supplied by bog ore procured in their vicinity; that used at the Radnor furnace being in a large measure dredged from the bottom of Lac à la Tortue. A change in proprietorship is reported from Radnor during the past year, the furnace having passed into the hands of the Canada Iron Furnace Company, Limited, of Montreal, remaining, however, under the superintendence of the late owner, Mr. George McDougall, of Three Rivers. It is the intention of the present owners to increase the capacity of the works by the erection of a new furnace about 45 feet in height, with a 10-feet bosh, having a capacity of about fourteen tons per day, making that of their works about twenty tons per day.

In eastern Ontario but little work was done during the year, the small amount shipped being altogether from the district served by the Kingston and Pembroke Railway Company. Ontario.

In western Ontario, although no active operations were carried on, there have been further discoveries made of very extensive deposits of high grade ore in the regions west and north-west of Port Arthur in Algoma District, the more important being undoubtedly those in the neighbourhood of the Atikokan River, where many square miles of rich iron lands have been taken up and prospected.

Regarding this district, the following extracts from a report addressed to the Deputy Minister of Agriculture for the Province of Ontario, by Mr. W. W. Russell, of Port Arthur, and dated October, 1890, may be taken as a very fair description of the district and its ores:—

"Some five years ago the first discovery of magnetite in this range was made, and a tract taken up by Messrs. Graham & McKellar. The property was shortly afterwards examined by Mr. D. H. Bacon (now

Ontario.

superintendent of the Minnesota Iron Company), and on his report bonded for a long term to a Cleveland party, represented by Major Pickands. No active operations having been begun, the discovery of the iron did not attract general notice in any way, until the finding last fall of another equally extensive and rich deposit, several miles further west on the same range. The result of this was the starting of numerous exploring parties this summer, and the discovery of still other outcrops of the same ore further westward, until now these rich deposits have been traced by outcrops for a length of sixteen miles along the belt.

"Nothing more than a superficial examination of the deposits has been made, in the way of a few surface cross cuts, and an occasional shot to secure unweathered samples; but in many places the ore outcrops boldly, showing a varying width of from ten to fifty feet.

"Before describing these outcrops or surface showings more minutely, I may refer to the geological occurrence of the deposits. They occur as beds in Huronian hornblendic and chloritic schists, which are nearly vertical, having a dip of 86 degrees north, and a strike of N. 75 degrees east. The surface showings indicate that there are several of these beds, the intervening rock having a width of from five to thirty feet. Whether these beds will unite at a depth or maintain their separate identity, is a problem for development work to decide. The Huronian belt has an average width of eight miles, and rests conformably in the folds of the Laurentian rocks, so we may presume its depth (and that of the interbedded magnetite) to be very considerable, practically unlimited.

"The McKellar-Graham property is the most easterly on the range, and its most conspicuous outcrops occur on the summit and both faces of a bluffy ridge running nearly east and west one hundred feet above the level of the Atic Okan River. Mr. D. H. Bacon sampled the surface showing here, taking samples at three inch intervals; and for an aggregate width of eighty feet these samples gave 63½ per cent metallic iron, without more than a trace of titanic acid or phosphorus, and little more than a trace of sulphur. The outcrops here showed three beds of ore.

"Immediately west of the McKellar-Graham property is Sabawe Lake, a sheet of water three miles in length. For some distance west of the lake, in the course of the iron belt, a considerable depth of soil covers everything; this extends to location R400, on which and R401, other outcrops occur very similar to those on the McKellar-Graham property. A similar ridge traverses these locations, and in many places, especially on the southern exposure, which is very steep, large outcrops occur. Having closely examined these and several locations adjoining them on the west, I can speak more definitely of them than of others where my inspection was more cursory; and it may be as well to state

here that the ore throughout this range varies but very slightly in character or grade—it is virtually identical throughout, though in some places where greatly exposed to atmospheric action it is of course leaner. On location R400, where a natural exposure of ore some twenty feet in width occurs, a large number of samples taken at random gave from 66 to 68½ per cent metallic iron. On the location west of this, R401, a surface cross-cut was made this summer which showed 46 feet in width of ore; the full width was not ascertained as the cut was abandoned on account of the depth of overlying soil and large boulders; some of the ore from this cut, when protected by deep soil, gave as high as 71 per cent metallic iron. Ontario.

"A little more than half a mile west of this the ore again outcrops on the south face of a ridge about fifty feet in height, the intervening ground being low; samples from here gave 65 per cent. Half a mile further west a short trench dug in the low ground showed rich ore at a depth of only three feet; no attempt was made to uncover the width of the deposit, the sole object being to locate it. A mile beyond this numerous showings are found along the top and south face of a ridge about 100 feet high; the surface showings here are very extensive, and the ore of the same high grade, 66 to 68 per cent. For nearly three miles beyond this the ground in the line of the deposits is very low, and no attempt to locate the ore by test pits, etc., has been made. As the ground rises, the ore again outcrops and shows at the crossing of the Atic Okan River, which is very rapid at this point.

"To bring the Atic Okan ores to a market, a railway from thirty to fifty miles in length will have to be built from near Carlstadt station on the Canadian Pacific Railway to and along the Atic Okan River. An examination of the route was made by the Canadian Pacific Railway Company last fall, and their engineer reported it a very easy one, estimating the cost of grading at not over $2,000 per mile for four-fifths of the distance, the balance being medium work only, to cost say $10,000 per mile. The company are not disposed to build the road unless a reasonable amount of freight is guaranteed, but are willing to equip and operate the road when built if desired, and to facilitate the successful operation of the mines by cheap freight rates, etc. There is no local traffic for the railway throughout this section, and it is plainly to the interest of the company to promote to the utmost any undertaking that might lead to making this part of the line a remunerative one through local traffic. That they are fully alive to this is very evident in all intercourse on the subject with the chief officials of the company.

"With regard to the market for these ores, and the cost of delivering them thereat: Mining will cost from 75 cents to $1.00 per ton, say $1.00

Ontario.

as an outside estimate. Railroad freight to Port Arthur or Fort William, $1.00 per ton. Lake freight to either of the principal ore ports on Lake Erie, Cleveland or Ashtabula, may be taken as the same as that from Ashland or Two Harbours, the shipping ports of the Gogebic and Vermillion districts. The rate last year and during the present season has been about $1.25 per gross ton, and there is no reason to think this will be exceeded in the future, considering the continual increase in numbers and tonnage of vessels built on the lakes. Shipping charges, insurance, etc., may be taken at 30 cents per ton; duty going into the United States, 75 cents per ton. This will give the total cost delivered at a Lake Erie port of $4.30 per ton. The present value of a high grade Bessemer ore, such as this under consideration, delivered on the docks at Cleveland or Ashtabula is $6.00 per ton, which would leave a net profit of $1.70 per ton.

"The Dominion Government gives a bonus of $2.00 for every ton of pig iron manufactured in Canada, and a portion of the Atic Okan ores might be profitably treated at Port Arthur or Fort William, where other ores for mixing, fluxes and fuel can be brought at low rates. Coal is carried here from Lake Erie ports at from 40 to 50 cents per ton, and coke from 80 cents to $1.00. There is no duty on anthracite coal and coke also is admitted free, if for smelting purposes.

"I append hereto a number of analyses of the Atic Okan ore from different parts of the range.

"ASSAYS OF ATIC OKAN MAGNETITE.

"M'KELLAR-GRAHAM LOCATION.

	Averages by Mr. D. H. Bacon.			Chapman.
	(1)	(2)	(3)	
Silica	6·60	7·30	5·89	2·43
Alumina	1·09	1·80	0·98	0·67
Ferrous ox				23·32
Ferric ox	87·66	86·90	88·36	46·74
Manganese	trace.	trace.	trace.	
*Calcic (? carbonate)	1·28	0·90	1·40	
Magnesia	0·75	0·60	0·75	
Phosphoric acid	0·0079	0·069	0·025	
Titanic acid	none.	none.	none.	none.
Total	94·46	97.57	97·41	
Metallic iron	63·47	62·84	63·97	70·06

"The first three are averages from the three beds sampled by Mr. Bacon, and the last is a single specimen given Prof. Chapman of Toronto.

*The original M. S. is not clear here but the carbonate would evidently be intended.

"AVERAGES TAKEN BY W. W. RUSSELL FROM LOCATIONS R400 AND 401. Ontario.

Assayed by {	Minnesota Iron Co.	F. Hille, Pt. Arthur.	H. M. Currie for Carnegie Bros.
Metallic iron	68·50	65·90	65·702
Silica	2·90	5·80	4·20
Phosphorus	0·015	0·001	0·003
Sulphur	0·052	0·16	Not specified.
Titanic acid	none.	none.	none.

"ASSAYS BY SHARON IRON WORKS, PA., OF SAMPLES FURNISHED BY CAPT. M. N. GARLAND, AS FROM PROPERTY MARKED 'GARLAND LOCATIONS.'

Metallic iron	68·75
Silica	1·41
Phosphorus	0·006
Sulphur	0·185

"ASSAYS OF ATIC OKAN ORE BY GEOLOGICAL SURVEY OF CANADA

G. C. Hoffmann, Assayer.

1. Magnetite from R402:	
Metallic iron	68·579
Titanium	none
2. Magnetite, R400:	
Metallic iron	68·027
Titanium	none
3. Magnetite from R403:	
Metallic iron	64·551
Titanium	none
4. Magnetite from line between Mining Locations 10E and 11E, collected by Smith:	
Metallic iron	65·710
Titanium	none

In British Columbia the mine which was the only producer for some years past did not operate during 1890, so that there is no production to report from this province. The following item regarding a recent discovery is taken from the report of the Minister of Mines for British Columbia:— British Columbia.

"About ten miles east of Lytton, by the side of the Canadian Pacific Railway track, Mr. James Wilson, Superintendent of the C. P. R. telegraphs, is the fortunate owner of an extensive iron deposit, which is represented to me as having indications of becoming a valuable property a few years hence. Already about $1,000 has been expended towards developing this mine by sinking and drifting."

Pig Iron. During 1890 the amount of pig iron produced in Canada from Canadian ores was 21,772 tons, valued at $331,688, showing a decrease, when compared with the year previous, of 4,149 tons and $168,184. Statistics of this industry will be found in the following table where they are shown in comparison with those of the year previous. Pig Iron.

IRON.

TABLE 3.

Pig Iron.

PIG IRON PRODUCTION: CONSUMPTION OF ORE, FUEL, ETC.

Production and Consumption.		1889.		1890.	
		Quantity.	Value.	Quantity.	Value.
Pig Iron made.....	Tons.	25,921	$499,872	21,772	$331,688
Iron Ore consumed.....	"	65,670	126,064	57,304	117,880
Fuel consumed.. Charcoal..	Bush.	755,800	41,568	589,860	29,493
Fuel consumed.. Coke.....	Tons.	33,289	94,791	32,832	97,659
Fuel consumed.. Coal... ..	"	3,044	6,525	1,241	2,638
Flux consumed	"	22,122	21,909	18,478	18,361

The number of furnaces in blast during the year was four, and the entire production was utilized in Canada, as there were no exports reported.

Iron and Steel Manufactures.

Iron and Steel Manufactures. In table 4 will be found statistics regarding exports of iron manufactures produced in Canada, while in tables 5, 6 and 7 will be found the statistics of imports of all iron products other than highly finished iron and steel goods of which the value of the metal alone represents but a small proportion of the whole.

IRON.

TABLE 4.

EXPORTS OF IRON AND STEEL GOODS, THE PRODUCE OF CANADA.

Province.	Scrap Iron.	Iron Stoves.	Iron Castings	Iron, all other and Hardware.	Steel and Manufactures of	1890. Totals.	1889. Totals.
Ontario..... ..	$12,410	$1,517	$5,571	$11,756	$8,404	$39,658	$40,679
Quebec.....	22	665	1,926	38,061	12,853	53,527	66,570
Nova Scotia..... ...	153	753	805	10,974	5,041	17,726	14,914
New Brunswick.	.....	567	.....	8,110	.....	8,677	7,365
Prince Edward Island	.....	12	....	98	.....	110	108
Manitoba.....	.... ..	220	22	332	563	1,137	1,659
British Columbia....	10,040	6	11	1,614	1,218	12,889	13,614
Totals....	22,625	3,740	8,335	70,945	28,079	133,724	144,909

Iron.

Table 5.

Imports: Iron in Slabs, Blooms, Loops and Puddled Bars, etc.

Fiscal Year.	Cwt.	Value.
1880	195,572	$244,601
1881	111,666	111,374
1882	203,888	222,056
1883	258,639	269,818
1884	252,310	264,045
1885	312,329	287,734
1886	273,316	248,461
1887	522,853	421,598
1888	110,279	93,377
1889	80,383	67,181
1890	15,041	15,923

Iron.

Table 6.

Imports of Pig Iron, etc.

Fiscal Year.	Pig Iron, Charcoal.		Pig Iron, all Other.		Pig Iron, Kentledge, &c.		Total.	
	Tons.	Value.	Tons.	Value.	Tons.	Value.	Tons.	Value.
1880	.....	.....	23,159	$371,956	.....	.....	23,159	$371,956
1881	.....	.....	43,630	715,997	.....	.....	43,630	715,997
1882	6,837	$211,791	56,594	811,221	.....	.....	63,431	1,023,012
1883	2,198	58,994	75,295	1,085,755	.....	.....	77,493	1,144,749
1884	2,893	66,602	49,291	653,708	.....	.....	52,184	720,310
1885	1,119	27,333	42,279	545,426	.....	.....	43,398	572,759
1886	3,185	60,086	42,463	528,483	.....	.....	45,648	588,569
1887	3,919	77,420	46,295	554,388	.....	.....	50,214	631,808
1888	.....	.....	.....	.....	48,973	$648,012	48,973	648,012
1889	.....	.....	.....	.....	72,115	864,752	72,115	864,752
1890	.....	.....	.....	.....	87,613	1,148,078	87,613	1,148,078

Iron and Steel Manufactures.

IRON.

TABLE 7.

IMPORTS OF IRON AND STEEL GOODS.*

Fiscal Year.	Value.
1880	$6,620,260
1881	8,484,175
1882	8,578,685
1883	8,613,739
1884	6,143,870
1885	4,606,193
1886	4,698,882
1887	6,084,704
1888	5,147,111
1889	7,108,052
1890	7,260,845

LEAD.

Production. According to returns made to this office there were 113,000 pounds of lead produced during 1890, which at 4½ cents per pound is equivalent to $5,085. This production is altogether that of the provinces of Ontario and Quebec. No operations were undertaken in Nova Scotia and New Brunswick.

Developments Quebec. In Quebec the most important is undoubtedly that known as the Lake Temiscamingue mine on lots 56 to 62, range I of the township of Duhamel, the shaft and workings being on lot 62 near the lake shore. Work was carried on in a desultory way for many years under the management and ownership of Mr. E. V. Wright of Ottawa. During 1890, however, the mine was purchased by American capitalists and active work undertaken, the result being that a shaft already begun was carried to a depth of over 100 feet. From this shaft two drifts were made on the course of the vein, one to the west being 30 feet in length, and known as the 65-foot level, the other in an opposite direction, at about 100 feet from the surface, was carried to a distance of 15 feet, a cross-cut was made at 70 feet which struck the wall on the north-east side at a distance of 20 feet from the shaft. In the 65-foot level a diamond drill test was made to a depth of 75 feet or a total depth of 140 feet from the surface and showed good ore throughout its entire length. On the surface the fissure is plainly shown to be 80 feet in width and has been

*These figures do not include those of hardware, engines, agricultural implements, or other highly finished iron products.

traced for a distance of 1,400 feet in a north-easterly direction. The great drawback to the proper development has always been the distance from railway communication and the difficulties to be contended with as regards shipments. The position of the mine is unfortunate in this respect, its only means of communication being by the waters of the Ottawa River, of which Lake Temiscamingue is a part for a distance of about 100 miles above Mattawa station. The lower 40 miles of this distance is broken in many places by rapids and falls, necessitating frequent transhipment. The first portage is made by means of a narrow gauge railway of eight miles in length, the lower rapids requiring short tramways of from one-half to one mile each. Until the completion of the projected railway from Mattawa station on the Canadian Pacific Railway to Lake Temiscamingue, the cost of laying ore or concentrates on the cars will be in the neighbourhood of $11 per ton. The present owners have a very complete mill and mining plant at the works, consisting of:— Quebec.

1 Blake crusher.
2 pair rolls.
2 revolving screens.
4 jigs.
1 revolving table.
1 Corliss engine.
Ingersoll compressor and drills.

The average of lead in the ore is, according to E. Obalski, Government Mining Engineer for the province of Quebec, 52 per cent with a content of silver equivalent to 26 ounces per ton. Many other occurrences are known throughout the province of Quebec on which however no work was performed during the year.

In Ontario a small amount of development work was done in the neighbourhood of Black Bay, Lake Superior, where several of the old properties as well as some recent discoveries of galena were opened and tested; no shipments were however made. Ontario.

Particulars regarding the lead ores of British Columbia will be found in the article on silver, as the ores of that province are highly argentiferous, and as such have been treated of there. It has been found impossible to obtain the amount of lead ore or lead contents shipped from that province, as the values of all shipments of that metal are included in the total value of the ores for that and the other metals. It is expected that during the present year increased railway and other facilities will be afforded for the shipment of ores and that in consequence there will be a large production of lead to report from that province. British Columbia.

Imports.

The only statistics of the lead trade available are those of the imports, which are given below:—

LEAD.

TABLE 1.

IMPORTS OF LEAD.

FISCAL YEAR	OLD, SCRAP AND PIG.		BARS, BLOCKS, SHEETS.		TOTAL.	
	Cwt.	Value.	Cwt.	Value.	Cwt.	Value.
1880	.....	.....	.....	.....	30,298	$124,117
1881	16,236	$ 56,919	18,222	$70,744	34,458	127,663
1882	36,655	120,870	10,540	35,728	47,195	156,598
1883	48,780	148,759	8,591	28,785	57,371	177,544
1884	39,409	103,413	9,704	28,458	49,113	131,871
1885	36,106	87,038	9,362	24,396	45,468	111,434
1886	39,945	110,947	9,793	28,948	49,738	139,895
1887	61,160	173,477	14,153	41,746	75,313	215,223
1888	68,678	196,845	14,957	45,900	83,635	242,745
1889	74,223	213,132	14,173	43,482	88,396	256,614
1890	101,197	283,096	19,083	59,484	120,280	342,580

LEAD.

TABLE 2.

IMPORTS OF LEAD MANUFACTURES.

Fiscal Year.	Value.
1880	$15,400
1881	22,629
1882	17,282
1883	25,556
1884	31,361
1885	36,340
1886	33,078
1887	19,140
1888	18,816
1889	16,315
1890	25,600

MANGANESE.

Production.

In the lower provinces of Canada are found many extensive deposits of the various ores of manganese, viz.:—Pyrolusite, manganite and wad, which occur, in the case of the crystalline ores, almost without exception, in rocks of Carboniferous age. That the industry has not been neglected may be evidenced by the fact that, since 1868, the exports of high grade ore amount to over 30,000 tons, the greater part of which went to the United States.

The ores are, briefly, as follows:—Pyrolusite, known locally as "grey ore" or "needle manganese," is essentially an anhydrous oxide of manganese having the general formula of MnO_2. Ores.

Manganite, known locally as "blast furnace ore" or "brown ore," is essentially a hydrous sesquioxide of manganese having the general formula Mn_2O_3, H_2O. In appearance it is similar to pyrolusite, except perhaps that it is more generally black, seldom, except in the case of the purer varieties, being greyish black. This ore is readily distinguished from pyrolusite by its streak, which is reddish or brownish black, that of the latter being black to submetallic.

Wad, or bog manganese, is an impure hydrous oxide of manganese occurring generally in bogs or old lake bottoms, in the form of an earthy deposit or in amorphous masses of some size. The composition varies considerably, ranging in content of manganese binoxide from 50 to 75 per cent, with considerable quantities of ferric oxide and small percentages of phosphorus and other impurities.

Throughout the southern part of New Brunswick and in the areas underlain by the Carboniferous limestone are many extensive deposits of manganese which have afforded considerable quantities of high class ore. The most important in this province, owing to its extent and development, is undoubtedly that at Markhamville, where the mines of the Pope Manganese Company are situated. New Brunswick.

Pope Manganese Co.—In the parish of Sussex, Kings Co., and about twelve miles in a direct line south from the town of Sussex, is a small area of Carboniferous limestone, on the north-west side of which are located the mines of the above company. The ore occurs throughout the limestone in the form of beds and pockets, attaining in places large dimensions, as much as 4,000 tons having been produced from one pocket. The discovery of manganese at this point was made in 1862, when it was worked by Mr. Wm. Davidson, of St. John, until 1865, when the property passed into the hands of the Queen Manganese Company, by whom it was operated under the management of Major A. Markham, until the fall of 1889. The Queen Manganese Company then went into liquidation, owing to the failure of the more important members of the company, and the result was the formation in 1890 of the Pope Manganese Company, capital stock $75,000, with the following officers: President, W. C. Pope; treasurer, C. H. Converse; manager and superintendent at mines, A. Markham.

In the extraction of the ore no regular system of mining is attempted nor possible. Owing, however, to the location of the deposits, in a valley cut through the soft limestones, the workings have, until quite recently, taken the form of drifts and open cuts, the hill on the north and west of

New Brunswick.

the property being literally honey-combed with drifts, adits, pits and open cuts. During 1890 Major Markham was making explorations by means of a diamond drill, and had been successful in locating two large ore bodies, both of which were being sunk upon.

Of the ore shipped from this mine two distinct classes are recognized, viz.:—"Blast furnace ore," consisting almost entirely of manganite, and high grade or "grey ore" consisting of pyrolusite.

The following analyses are of "high class manganese ore from Markhamville, New Brunswick," and are taken from "The Mineral Resources of the United States, calendar year 1888," Washington, 1890:—

	No. 1.	No. 2.	No. 3.
Manganese binoxide	98·70	.....	.....
do peroxide	.....	97·25	96·62
Silica	0·55	.....	.....
Iron	0·75	.....	.....
Iron peroxide	.....	0·85	0·78
Barium	Trace.	.....	.....
Baryta and silica	.....	0·95	0·85
Water	.....	Trace.	Trace.
Loss	.....	0·95	1·75

For the treatment of their ore the company have a well-equipped mill, in which the following plant is contained:—1 crusher, 2 Cornish jigs, 1 cyclone pulverizer, 1 Bogardus mill, 1 sizing machine and 1 calcining furnace; while the plant in connecting with the extraction of ore consists of 2 hoisting engines, 2 steam pumps, 2 steam drills, 1 diamond drill, complete, as well as a rotary saw-mill.

Jordan Mountain.—About five miles north of Sussex, and on the western end of Jordan Mountain, is a deposit of manganiferous limestone throughout which is scattered, in a manner similar to that at Markhamville, more or less extensive deposits of pyrolusite and manganite. Since its discovery in 1882, by the present owner, Mr. F. W. Stockton of Sussex, but little has been done, further than a small amount of development work consisting of stripping and an open cut of about eighty feet in length in the bottom of which in August, 1887, was to be seen a lenticular interbedded mass of manganite and pyrolusite. From this open cut about 400 tons of 80 to 85 per cent ore has been extracted.

Brunswick Manganese Company.—The property of this company, consisting of one thousand acres, is situated on a promontory extending into the Bay of Fundy opposite to the village of St. Martin's and known as "Quaco Head." Traversing this high point is a heavy bed of red calcareous shale which is highly charged with manganite, pyrolusite being of much rarer occurrence than in the limestone deposits of the before-mentioned localities. The deposit has been worked in a very desultory manner for many years, energetic operations not having been commenced until the acquisition by the present company, who began

operations by driving a tunnel N. N. W. into the shales which show a bluff face of about 150 feet in height. This tunnel, on 2nd October, 1890, was about sixty feet in length, from which two cross-cuts had been driven at right angles, extending in either direction about twenty feet. In these workings numerous pockets, as well as small scattered masses, of very hard manganite, suitable for blast furnace purposes, had been opened and the ore extracted, though no shipments had been made. New Brunswick.

In connection with the mine a well-equipped mill has been erected, the plant consisting of one cracker, one pair rolls, one revolving screen, two jigs and one 40-horse power engine and boiler. Owing to the position of the mine, every facility is afforded for shipping, the ore being run direct from the mouth of the tunnel and after treatment in the mill loaded into self-dumping cars and run direct to the wharf, where it is possible for vessels to load at almost all seasons.

Assays of the ore by A. M. Cowey, of Cambridge, Mass., are as follows:—

	Compact Variety.	Porous Variety.
Manganese dioxide	71·54	65·00
Insoluble silicates	8·37	6·66
Ferric oxide	2·19	1·75
Phosphorus	0·02	0·04
Calcium	Trace.	Trace.
Metallic manganese	58·20	57·15

A considerable quantity of lime is generally present in the concentrates, which, however, does not interfere with their fitness for use in the manufacture of steel, for which purpose all the ore from this property will be used, a contract having been entered into with the Carnegie Company of Pittsburg.

Gowland Mountain.—A small amount of exploratory work has been done on the north and north-east side of Gowland Mountain, Elgin parish, where the lessees, Messrs. H. A. Whitney, C. J. Butcher *et al*, had, during October, 1890, a small force of men engaged in driving a tunnel and sinking pits, several of which had already been sunk, showing in all of them small quantities of pyrolusite and manganite occurring in a very broken and decomposed granite of pre-Cambrian age. No shipments have as yet been made, nor has there been any material production.

This property is peculiar in affording the only instance in New Brunswick where manganese has been known to occur in appreciable quantity outside of the Carboniferous areas.

New Brunswick.

The following analysis made by Mr. F. D. Adams, assistant chemist to the Geological Survey, is that of a specimen of psilomelane from this property, and was made in 1885 :—

Manganese dioxide, available.....	50·21	per cent.
Ferric oxide..	3·06	do
Insoluble residue	33·78	do

" Agreeably with the results of a qualitative examination, this ore would appear to contain a very appreciable percentage of baryta."

Other localities where manganese, in the form of its crystalline ores, has been noted are, Upham, Waterford, Springfield, Tête-à-Gauche Falls, and many points throughout Albert county. Of one of these, Shepody Mountain, Dr. R. W. Ells, in his report to the Geological Survey for 1884, page 35 E, writes: "The rocks of the mountain" (Shepody Mountain) " rest upon a small outlier of the talco-chloritic schists, which show on the road to the north, leading to Curryville, and are flanked on the east by the grey sandstones of the millstone-grit. On the north-west side a large deposit of manganese was worked for some years, a tunnel being driven into the mountain along the contact with the underlying schists for nearly 1,000 feet, the ore, which consisted of pyrolusite and psilomelane, occurring at the base of the conglomerate in irregular pockets. Operations have been suspended for some years, and the workings have all fallen in. At the mouth of the slope the conglomerates dip N. 15° E. $<$ 15°—20°"

It is understood that negotiations are now pending for the sale of this property by the present owner, Mr. John Murphy.

Crimora Manganese Company.—This company own and are operating a property of 260 acres in extent, known as the Duffy property in Dawson settlement, parish of Hillsboro', Albert county, wherein occur considerable areas of wad. These deposits vary in extent and depth, attaining in some places a thickness of over forty feet, to which depth they have been tested. The ore is covered throughout with peaty matter to the depth of about one foot, beneath which it is found in a good state of purity. The mode of working is very simple, consisting first of cross trenching, by which means the ore is partly drained, after which it is excavated and dried in six pans, each 6 by 50 feet, the result being a dry and almost impalpable powder, which is loaded direct into cars of the Salisbury and Harvey Railway, from the main line of which a spur has been built. It is understood that contracts have been entered into with several steel makers in the United States for a supply of ore from this locality.

A partial analysis of the ore by Mr. W. F. Best, St. John, gave,— New Brunswick.

Manganese binoxide	47·0
Iron oxide	18·0
Vegetable matter	34·0
Loss	1·0
Copper	Trace
Cobalt	Trace
	100·0

Several analyses by John Burwash gave the following percentages of manganese binoxide:—73·6, 35·5, 58·3, 57·6, 70·7, 63·4, and an assay of specimens collected at various points gave an average percentage of 47·4.

Large deposits of wad, pyrolusite and manganite occur throughout the province of Nova Scotia, the harder or crystalline ores occurring, as in New Brunswick, in the greater number of instances in the Carboniferous limestones, whereas wad, the most common of the Nova Scotia ores, exists in the form of surface deposits over widely-scattered areas. Space does not permit of more than a brief mention of the various more important localities, among which may be mentioned that at Teny Cape and the other manganese deposits in the immediate neighbourhood of Minas Basin, Boularderie Island, and throughout the western part of Cape Breton Island. Nova Scotia.

Teny Cape and Minas Basin.—On the south shore of Minas Basin and midway between Noel and Walton is situated the Teny Cape mine, which, since its discovery in 1862, has been operated more or less continuously. The ores, consisting mainly of pyrolusite and manganite, are found in the Carboniferous limestone which is traceable for many miles on the south shore of Minas Basin, the limestone immediately in connection with the ore deposits being highly manganiferous and interstratified with small beds and masses of a manganiferous calc-shale, the whole being usually of a deep red colour. The mode of occurrence is pockety, the ore being found in irregular masses and stringers, which follow the bedding planes and fractures; some of these pockets are of considerable extent, one affording, it is said, upwards of 1,000 tons of high grade ore.

A very considerable proportion of the ore extracted is high grade pyrolusite, selling for from $100 to $125 per ton at the mine, and containing from 85 to 95 per cent of available binoxide.

The following assays taken from an article entitled "Notes on the Manganese ores of Nova Scotia," by E. Gilpin, jr., Proc. Roy. Soc. Can., Vol. II, show the character of the ores obtained from Teny Cape and district.

	Teny Cape (*a*)	Cheverie (*b*)	Douglas
Manganese oxides	85·54	90·15	84·62
Iron peroxide	1·18	2·55	0·60
Baryta	0·89	1·12	0·72
Insoluble matter	3·27	2·80	1·73
Phosphoric acid	0·34	1·03	....
Water	8·54	2·05	5·29
Oxygen	....	....	7·04
	99·76	99·70	100·00

(*a*) Analyst, Dr. Howe.
(*b*) do E. Gilpin, jr.
(*c*) do H. Poole.

Deposits similar to that at Teny Cape have been worked to a smaller extent at Cheverie, Walton, Noel and Shubenacadie, on the south shore of Minas Basin, while on the north shore no important deposits of manganese have been noted, though some of the limonite and other iron ores of the neighbourhood of Londonderry are highly manganiferous; this is also the case with many of the iron ores of both Colchester and Pictou counties.

The following analyses taken also from Mr. Gilpin's article, mentioned above, show the character of some of these ores, the particular cases cited here being of two limonite ores from Springville, Pictou county.

Iron sesquioxide	10·848	48·223
Manganese oxide	62·950	
do peroxide	.....	14·410
Magnesium	1·630	
Lime	7·280	0·015
Alumina	2·880	Trace
Baryta	0·670	
Sulphur	....	0·480
Phosphorus	.....	0·020
Insoluble residue	2·731	25·130
Water of composition	.....	12·530
Moisture	1·450	
	90·439	100·808

Cape Breton.—Among the more important deposits of Cape Breton Island may be mentioned those on Loch Lomond, which have been exploited by the Hon. E. T. Moseley, of Sydney. In the report of the Geological Survey, 1882–84, Mr. Hugh Fletcher writes of the deposits as follows:—"Large deposits of pyrolusite, which promise to be of great importance, have recently been discovered and developed by the Hon. E. T. Moseley, of Sydney, on the south side and near the head of Loch Lomond, in Cape Breton county. The ore is associated with lower Carboniferous rocks and has been worked in two places about three-quarters of a mile apart. At the most easterly of these, in a brook on the farm of Norman Morrison, a tunnel has been driven about thirty feet on a vein about seven inches thick, dipping N. 87° W. $< 25°$ in fine red sandstone overlying reddish and greenish grit, with grains of quartz about the size of wheat and red marly sandstone. The ore is irregularly mixed with red and grey bituminous limestone, red and

greenish shale conglomerate and other rocks blotched with calc-spar. It is in lenticular layers and also intimately mixed with the limestone, being probably of the same nature and origin as the hematite and forming at times a cement for the pebbles of the comglomerate * * * The mines were first worked in 1880. In 1881 about 70 tons, and in the following year 59 tons of excellent ore were shipped to the United States, * * * An analysis of a sample from the Morrison mine afforded Mr. Adams 91·84 per cent of manganese dioxide, only ·12 per cent of ferric oxide and 2·91 per cent of insoluble residue."

Many other deposits, both of crystalline ores and wad, are known to exist throughout the island. One of these on Boularderie Island is said to be quite extensive, and the character of the ore may be judged from the following assays:—

	I.	II.	III.
Manganese peroxide	25·42	11·04	44·33
Iron sesquioxide		12·49	35·50
Insoluble matter		57·76	10·00
Water	33·52		

I and II by G. C. Hoffmann, Chemist Geological Survey. III by E. Gilpin, jr., Trans. Royal Society of Canada, Vol. II, sec. IV.

Quebec.—In many places throughout the province of Quebec are small deposits of manganese, principally in the form of wad. One of these occurs on the St. Louis road, about four miles from Quebec, where it covers an area of about 300 yards square and is about twelve inches in thickness. Similar deposits occur in Stanstead, Bolton, Tring, Aubert Gallion, St. Mary's and other parishes, but nowhere in sufficient quantity for commercial purposes. Quebec.

Of manganese occurring on the Magdalen Islands, Mr. Jas. Richardson, in the report to the Geological Survey, 1879–80, writes :—"Immediately under Demoiselle Hill, on Amherst Island, numerous blocks charged with peroxide of manganese, or pyrolusite, occur among the debris of the fallen cliffs. They are in pieces varying from one pound to ten or fifteen pounds in weight. There can be little doubt that they are derived from a deposit more or less regular in the hill side, but which is now completely concealed by the fallen debris. At a place bearing nearly due west from Cap aux Meules, at the distance of about a mile, and close to the English Mission church, similar pieces to those above-described are very frequently picked up." Assays of this ore, in the same volume, gave :—

Manganese dioxide	45·61 per cent.
Water, hygroscopic	0·10 do

Ontario.—A considerable deposit of manganese is, according to the "Geology of Canada, 1863," reported as occurring on Batchewahnung Ontario.

Bay, Lake Superior. The ore is said to be manganite and to assay 60 per cent of peroxide of manganese. No other occurrences have been reported authentically.

Production. During the year 1890 manganese ore to the extent of 1,328 tons was mined and shipped, the value being, according to direct returns made to this office, $32,550. The price per ton, as shown by the above figures, is about $24.50, which, compared with that of the year previous, shows an increase of $2.00.

The production for the past four years has been,—

1886.....	1,789	tons.....	$41,499
1887.....	1,245	do	43,658
1888	1,801	do	47,944
1889.....	1,455	do	32,737

It was all mined in New Brunswick and Nova Scotia.

According to the reports of the Department of Mines for Nova Scotia, the production of manganese in that province since 1877 has been as follows:—

1877.....	97	tons.	1884.....	302½	tons.
1878.....	127	do	1885.....	353½	do
1879.....	145	do	1886.....(a)	427	do
1880.....	223	do	1887.....	691	do
1881.....	231	do	1888.....	88	do
1882.....	205	do	1889.....	67	do
1883.....	150	do	1890.....	112	do

(a.) 250 tons from Cornwallis should more correctly be classed as an ochre.

Exports. The following tables give the exports of manganese ore since 1868, the greater proportion in latter years going to the United States:—

MANGANESE.

TABLE 1.

EXPORTS OF MANGANESE ORE PRIOR TO 1873.

FISCAL YEARS.	NOVA SCOTIA.		NEW BRUNSWICK.		TOTAL.	
	Tons.	Value.	Tons.	Value.	Tons.	Value.
1868.....	156	$4,700	861	$19,019	1,017	$23,719
1869.....	156	4,695	332	6,174	488	10,869
1870.....	1,256	4,102	146	3,580	1,402	7,682
1871.....	102	1,608	954	8,180	1,056	9,788
1872.....	131	4,005	1,075	24,495	1,206	28,500
1873.....	.....	.....	838	17,171	838	17,171

MANGANESE.

TABLE 2.

EXPORTS OF MANGANESE ORE SINCE 1873.

YEARS.	NOVA SCOTIA.		NEW BRUNSWICK.		TOTAL.	
	Tons.	Value.	Tons.	Value.	Tons.	Value.
1873			1,031	$20,192	1,031	$20,192
1874	6	$ 12	776	16,961	782	16,973
1875		200	194	5,314	203	5,514
1876	21	723	391	7,316	412	8,039
1877	106	3,699	785	12,210	891	15,909
1878	106	4,889	520	5,971	626	10,860
1879	154	7,420	1,732	20,016	1,886	27,436
1880	79	3,090	2,100	31,707	2,179	34,797
1881	200	18,022	1,504	22,532	1,704	40,554
1882	123	11,520	771	14,227	894	25,747
1883	313	8,635	1,013	16,708	1,326	25,343
1884	134	1,054	469	9,035	603	20,089
1885	77	5,054	1,607	29,595	1,684	34,649
1886	(a) 441	854	1,377	27,484	(a)1,818	58,338
1887	578	14,240	837	20,562	1,415	34,802
1888	87	5,759	1,094	16,073	1,181	21,832
1889	59	3,024	1,377	26,326	1,436	29,350
1890	177	2,583	1,729	34,248	1,906	36,831

(a.) 250 tons from Cornwallis included in this quantity more properly come under the heading mineral pigments.

The imports of oxide of manganese (presumably manufactured) into Canada can only be given for the past seven years and are as follows:— Imports.

MANGANESE.

TABLE 3.

IMPORTS: OXIDE OF MANGANESE.

Fiscal Year.	Pounds.	Value.
1884	3,989	$ 258
1885	36,778	1,794
1886	44,967	1,753
1887	59,655	2,933
1888	65,014	3,022
1889	52,241	2,182
1890	67,452	3,192

MICA.

This industry has come to the front lately, on account of the demand for the mineral for electrical purposes.

Mica ; occurrence, etc.

The sources of the mica mined during the year have been the deposits occurring in the Laurentian rocks of the valley of the Gatineau River, Ottawa county, P.Q., and of that section of country in Eastern Ontario tributary to the Kingston and Pembroke Railway,—the former district with headquarters at Ottawa and the latter at the village of Sydenham.

Nearly all the shipments of the year have consisted of the quality known as "amber" or "brown" mica, which is a magnesia mica of the phlogopite species, as distinguished from the "muscovite" or potash mica, which has been commonly used for stove purposes. This latter variety was, until recently, shipped from the Villeneuve mica mine, in the township of the same name, Ottawa county, P.Q., which, however, has ceased operations.

This "amber mica" of the trade occurs chiefly in the crystalline limestone of the Laurentian system, and occasionally also in the pyroxenic belts of the same. It occurs as aggregates of crystals of various sizes, or in veins of more or less regularity, and is generally associated with more or less phosphate, forming a very common associated mineral, in the deposits proper of this substance. Some of the worked deposits, however, yield it free from intermixed substances.

Some of the mines have yielded crystals of considerable size, having been known to produce cut sheets as large as 24 x 14 inches, whilst a crystal lately found in one of the mines in the Gatineau district measured three feet across and over five feet in length.

The potash mica or muscovite occurs generally, as at the Villeneuve mine, in the coarsely crystallized granitic veins and intrusions, of which it forms a constituent, along with the associated felspar and quartz.

On none of the mines have very considerable developments been made, the depth attained not exceeding 168 feet in the deepest of them, which has been worked for some years, whilst the length of the vein explored at that place would be comprised within 210 feet, and the average force of men employed at this mine would not range over 30. Returns were received from eight operators, but the grand total was augmented considerably by the product of desultory mining by small producers, of whose output, however, a close estimate was obtained.

From some of the mines mica is shipped only in the uncut state as selected crystals, whilst others have cutting sheds, and send away their product in this shape, the waste resulting from this process is sold, to be ground and used in the manufacture of lubricants, fireproof roofing, cement, ornamental pigments, etc.

The proportion of this waste to the yield of cut mica is considerable, as it takes from 7 to 10 or even 20 tons of selected crystals to yield 1 ton of clean cut mica.

Owing to the desultory nature of much of the mining done and reti- Production.
cence on the part of some producers, considerable difficulty has been experienced in getting the exact amount and value of the marketed production of this mineral for 1890. Direct returns give 770,959 lbs. of all sorts of mica, valued at $68,074. A firm in the trade gave us $72,000 as their estimate of the value of the whole marketed product of of mica, but consider the total quantity, given above as marketed, as altogether too high.

The above totals, as computed from direct returns, are made up as follows:—

MICA.

TABLE 1.

PRODUCTION.

—	Quantity.	Value.	Average Value.
Electrical mica..	400,559 lbs.	$58,625	About $292.25 per ton.
Stove "	3,400 "	8,500	" 2.50 per lb.
Waste "	367,000 "	949	" 5.00 per ton.
	770,959 lbs.	68,074	

Most of the Canadian mica is marketed in the United States, being Markets and prices.
taken by manufacturers of electrical machinery; a small proportion of this quality being sold for similar purposes in the Dominion itself. Some dealers call for it ready cut, whilst others prefer to get it in the shape of selected crystals and cut for themselves. This causes a great variation in the value of the product as shipped from the mine, and makes it hard to strike an average price, which difficulty is emphasized by the great difference in value between the large and small sizes.

Block mica for electrical purposes sells at different prices per ton, according to the size which each block will cut clear of all cracks and flaws, the prices varying all the way from $25 to $200 per ton according to their excellence in this respect.

The demand for waste and small crystals for the various purposes already mentioned is not nearly equal to the possible supply, as the quality called for is not only produced in large quantities as a waste product in cutting the larger crystals, but could also be afforded by the smaller crystals occurring so plentifully in many cases in some of the phosphate deposits of the same district and obtained in working them.

Mica; uses. For lubricator manufactures it must, of course, be free from grit. Thus, to be worked at a profit, a deposit must yield a good proportion of crystals of sufficient dimensions and clear enough from faults to cut to good sizes.

The darker colour of the magnesia micas (phlogopite and biotite), whilst not affecting them for the electrical trade, renders them less fitted for use in the construction of stoves than the clearer potash mica (muscovite), whilst the frequency with which the latter is stained by deposition of iron oxides between the laminæ and its consequently lowered insulating power militates against its fitness for electrical purposes.

The stove trade also calls in general for larger sizes on the average than the electrical trade, which latter provides the greater part of the consumption.

The 35 per cent. duty imposed on mica entering the United States by the McKinley tariff will, of course, lessen considerably the profits of this industry.

Exports. The value of this mineral exported is given in the books of the Customs Department as follows:—

Mica, crude and cut	$19,171
" ground	3,297
	$22,468

But it is evident that all that was exported was not entered, or was entered at much below its true value.

Imports into U. S. A. The following figures of the imports of mica into the United States illustrate the extent of the chief market for the Canadian production of this mineral. For the calendar year 1890 the total amount from all countries was valued at $220,702. The total for the fiscal year ending 30th June, 1890, was $146,975, made up as under:—

Germany	$ 3,506
England	64,611
Canada	25,105
British East Indies	49,058
Sweden and Norway	4,695
	$146,975

Electrical Trade demands. In answer to enquiries, the Edison General Electric Company of the United States kindly furnish the following information regarding the requirements of the electrical trade with regard to mica:—

"The bulk of mica used by us is Canadian mica, which is known in the market as 'Amber Mica,' being of amber colour and clear. It is

essential that the mica should be smooth, free from wrinkles or crevices, it must split readily, and must be flexible, so much so that a piece of mica ·010″ thick would bend to a curvature of about 3″ diameter without cracking. Mica that has dark spots or coloured spots similar to rainbow colours, or what is known as smoky mica, is not at all suitable for electrical purposes. Mica must also stand a flame of intense heat without crumbling up or showing any disintegration.

"We give you below the principal sizes of mica used by us, and would say that at the present time we have orders out for some of the sizes, ranging from 200 to 600 pounds:

COMMUTATOR MICA.

1½	×	4	inches.
1¼	×	6⅝	"
1⅝	×	4¼	"
1⅜	×	6½	"
1⅜	×	8	"
1¾	×	8	"
2	×	5	"
2½	×	5	"
2	×	7	"
2	×	12	"
2½	×	12	"
4	×	4	"
5	×	8	"

BINDING MICA.

1¼″ wide."

Discovery and development.

Mention is made of mica in the reports on the recently-surveyed townships of Cleland and Gladman, in the report of the Commissioner of Crown Lands for Ontario for 1890. The former township is twelve miles south-east from Sudbury, and the report states "there has been a mining location surveyed in the northern part of the township, where I saw some fine deposits of white mica, which had been stripped and some blasting done." The other township, Gladman, is situated some 20 miles north of Lake Nipissing, and the survey report speaks of "large quartz veins seen all over the township and on the shores of a small lake, in which were found some very fine specimens of white mica." The rock of the vicinity was granitic.

MINERAL PIGMENTS.

Baryta.

Baryta.—Of the many extensive deposits of baryta (sulphate of barium or heavy spar) in Canada, only two were being mined during the past year and the production was small. The most important is undoubtedly that of McKellar's Island in Lake Superior, now operated by

Baryta.

the United States Baryta Company, of Cleveland, Ohio; the other deposit is that of Messrs. A. G. Peuchen & Co., of Toronto, in the township of Hull, Quebec, where the mineral occurs in a strong and well-defined vein of about three feet in width.

The vein at McKellar's Island is perhaps the largest on the continent, and is certainly the most extensive in Canada, attaining a gross thickness of about sixty feet, which, whilst made up in a great measure of calcite and quartz, carries, however, a rib of considerable thickness of clear baryta.

The production for the year amounted to 1,842 tons, valued at $7,543 at the point of production, all of which, with the exception of a small amount used in Toronto, was exported to the United States.

The imports of baryta for the past eleven years are given below:—

MINERAL PIGMENTS.

TABLE 1.

IMPORTS OF BARYTA.

Fiscal Year.	Cwt.	Value.
1880	2,230	$1,525
1881	3,740	1,011
1882	497	303
1883	.....	185
1884	.....	229
1885	7	14
1886	.....	62
1887	379	676
1888	236	214
1889	1,332	987
1890	1,322	978

Ochres.

Ochres.—Ochres were produced during the past year in Ontario and Quebec, in the former province in the townships of Walsingham and Esquesing, and in Quebec in the neighbourhood of Three Rivers. These deposits have all been operated in previous years, so that there is no newly-worked discovery to report.

The so-called paint beds of Campbellville, Halton county, Ontario, are now drawn upon to furnish the colouring material for certain varieties of terra cotta produced by the various terra cotta makers in that neighbourhood.

A new brand of metallic paint has during the past two years sprung into prominence, viz., the "Magnetic Paint" made by the Wm. Johnson Company, of Montreal. This paint is made directly from the ochres of Point du Lac and vicinity, deposits similar to which occur throughout

the province. The paint, as prepared and sold by the above firm, has proved itself to be of excellent quality, affording a very good colour for indoor work and an exceptional paint for outdoor work, such as structural iron work, bridges, &c.

Canadian ochres prepared by this firm are now being sold in England and South America, as well as in large quantities in the United States.

The production of ochres for the past year was 275 tons, valued at $5,125. Compared with last year, this shows a decrease of 519 tons. The production of ochres for the past four years has been as follows:—

1887	385	tons, valued at	$	2,233
1888	397	"	"	7,900
1889	794	"	"	15,280
1890	275	"	"	5,125

The imports for the past eleven years are given below:—

MINERAL PIGMENTS.

TABLE 2.

IMPORTS OF OCHRES.

Fiscal Year.	Pounds.	Value.
1880	571,454	$ 6,544
1881	677,115	8,972
1882	731,526	8,202
1883	898,376	10,375
1884	533,416	6,398
1885	1,119,177	12,782
1886	1,100,243	12,267
1887	1,460,128	17,067
1888	1,725,460	17,664
1889	1,342,783	12,994
1890	1,394,811	14,066

Litharge.—Although considerable quantities of this substance are used annually in Canada, not only for paint, but in the purification of petroleum, no effort has as yet been made to produce it in the country. The only statistics, therefore, available are the imports which are given below:— Litharge.

MINERAL PIGMENTS.

TABLE 3.

IMPORTS OF LITHARGE.

Fiscal Year.	Cwt.	Value.
1880.....	3,041	$14,334
1881.....	6,126	22,129
1882	4,900	16,651
1883	1,532	6,173
1884.....	5,235	18,132
1885..	4,990	16,156
1886....	4,928	16,003
1887.....	6,397	21,865
1888.....	7,010	23,808
1889.....	8,089	31,082
1890.....	9,453	31,401

MINERAL WATER.

Although a comparatively old industry, the production of mineral waters has increased to a very considerable extent during the past few years. That the consumption is yearly becoming much greater is evidenced by the great growth in the quantities imported.

No new features geologically, nor to any great extent geographically, are afforded by the facts relating to the production of mineral waters during the year, the celebrated springs at St. Leon, St. Hyacinthe and Ste. Genevieve in Quebec, and Caledonia and Winchester Springs in Ontario, affording as in former years the greater proportion of the total production.

Nova Scotia.

In Nova Scotia a locality that has been known and resorted to for many years has lately sprung into greater prominence, and now affords a very considerable quantity of a water of rare medicinal properties. The locality referred to is known as Wilmot Spa Springs, in the village of Wilmot, where the water is used to a large extent in the manufacture of soda water, &c.

New Brunswick.

In New Brunswick the spring at Apohaqui has for the first year an output to report. The water is alkaline and is very similar in composition and taste to the celebrated Vichy water. An analysis by W. F. Best, of St. John, gave for 100,000 parts of water,—

	Grains.
Potassium sulphate	·50
do chloride	1·08
Calcium carbonate	1·25
Sodium chloride	76·00
do bicarbonate	201·60
Magnesium	Traces.
Iron	Traces.
Silica	·90
Organic matter	Traces.
Grains	281·33

This water has proved itself an excellent emulsifier of the fatty oils, particularly of cod liver oil, for which purpose it is eminently suitable.

Ontario and Quebec.

Of the springs in Ontario and Quebec little need be said, as outside of that at Brechin, on Lake Simcoe, they are well known, and without an exception report large increases in their production. Regarding Brechin a word may be said here. The spring is situated near the village of Brechin, on Brechin Beach, and at an elevation of about fifty feet above Lake Simcoe. The water known and sold as "Eudo mineral water" gave, on analysis by Mr. Thos. Heys, of Toronto, the following content per imperial gallon:—

	Grains.
Bicarbonate of soda	35·000
Sulphate of potash	3·968
Chloride of sodium	201·096
do of potassium	5·480
do of magnesium	35·344
do of calcium	42·176
Carbonate of iron	2·160
Silica and alumina	1·744
Free ammonia	·120
Organic ammonia	·008
Grains	327·096

	Cubic inches.
Sulphuretted hydrogen	105·20
Carbonic acid gas	5·728

N. W. Territories.

Throughout the North-West Territories so many of the waters are alkaline or saline that special mention of any is not necessary.

British Columbia.

* Returns were received from British Columbia of water afforded by the "Harrison mineral spring," which is now being aerated and bottled and sold extensively throughout the province.

Outside of those waters shipped from their point of production, very considerable quantities are annually used on the spot at the various sanitariums throughout the Dominion, notably that at Banff, N.W.T., Preston, London, Winchester and Caledonia in Ontario, St. Leon in Quebec, and Wilmot, N.S.

Production.

The production for the past year was 561,165 gallons, valued at $66,031, showing an increase over the previous year of 136,565 gallons and $28,671. The quantities produced and shipped for the past three years, according to returns received at this office, have been :—

1888	124,850 gallons	$11,456
1889	424,600 "	37,360
1890	561,165 "	66,031

Exports and Imports.

The quantities exported (if any) are but slight, and are not taken cognizance of as such by the Customs Department. The imports are however given for the past eleven years in the following table :—

MINERAL WATERS.

TABLE 1.

IMPORTS.

Fiscal Year.	Value.
1880	$15,721
1881	17,913
1882	27,909
1883	28,130
1884	27,879
1885	32,674
1886	22,142
1887	33,314
1888	38,046
1889	30,343
1890	40,802

Most of the waters imported are from Europe, small quantities only being from the United States.

* *See* Geological Survey of Canada, Annual Report, Vol. IV, 1888-89, pp. 13 to 16 r.

MISCELLANEOUS.

The production of those substances for which separate articles are not deemed necessary may be found in the following table:— Production.

MISCELLANEOUS.

TABLE 1.

PRODUCTION.

Product.	1889.		1890.	
	Quantity.	Value.	Quantity.	Value.
Felspar..	... .	.....	700 tons	$ 3,500
Glass	....	$150,000	... .	537,130
Moulding sand.	170 tons	850	320 tons	1,410
Platinum	... .	3,500	.....	4,500
Quartz.....	.....	.....	200 tons	1,000
Soapstone.. ..	195 tons	1,170	917 do	1,239
Whiting.	. .....	.....	500 bbls	500

Felspar.—During 1890 the production of felspar amounted to 700 tons, valued at $3,500. Of this the greater part is exported, going to Trenton, N. J., and other china and earthenware producing centres in the United States, a small quantity only being used in domestic factories, notably at St. Johns, Quebec, where it is used in the manufacture of sanitary pottery and china. On account of its superior quality and freedom from impurity the Canadian felspar is particularly valuable and an increased output is confidently looked for. Felspar.

Glass.—As the result of the operations of four producers there was an output in Canada during 1890 of $537,130 worth of glass and glassware. This production consisted entirely of "green" and "flint" glass and a small amount of brown glass bottles, there being no window-glass manufactured in the Dominion. The production for the two previous years, as returned to this office, was in 1888 $375,000 and in 1889 $150,000. Glass.

That nearly all this production is utilized in Canada is established by the fact that the value of the exports amounted to only $12,015 during the year, as follows:—

Ontario.....	$1,374
Quebec.....	9,858
Nova Scotia.....	409
New Brunswick.....	269
Manitoba.....	92
British Columbia	13

The exports for the past four years were:—

1887	$1,030
1888	1,739
1889	6,287
1890	12,015

The following table shows the value of glass imported for the past eleven years:—

MISCELLANEOUS.

TABLE 2.

IMPORTS OF GLASS AND GLASSWARE.

Fiscal Year.	Value.
1880	$ 650,092
1881	889,803
1882	1,184,716
1883	1,176,912
1884	996,483
1885	1,020,882
1886	1,144,222
1887	1,269,288
1888	1,203,537
1889	1,205,090
1890	1,230,585

In the figures given above for the year 1890 is included an importation of window-glass of $311,753.

Moulding sand.

Moulding Sand.—In the report of the Department of Mines, Nova Scotia, for 1890, the production of moulding sand in that province is stated to have been 320 tons from Newport, near Windsor, and from River Hébert. Outside of those for Nova Scotia, no figures were obtained of the production of moulding sand, which, on account of the many foundries using local sands, must be considerable.

Platinum.

Platinum.—As in previous years, the production of platinum is altogether that of British Columbia, where it is found associated with gold in placer deposits, more especially on the Tulameen and Similkameen rivers and tributaries.

According to the report of the Minister of Mines of British Columbia, the production in that province during the year 1890 had a value of $4,500, showing over 1889 an increase of $1,000. The annual production since 1887 has been:

1887	$5,600
1888	6,000
1889	3,500
1890	4,500

The following table gives the imports of this metal in all forms :—

MISCELLANEOUS.

TABLE 3.

IMPORTS OF PLATINUM.

Fiscal Year.	Value.
1883	$ 113
1884	576
1885	792
1886	1,154
1887	1,422
1888	13,475
1889	3,167
1890	5,215

Soapstone.—During 1890 there was a production of soapstone of 917 tons, valued at $1,239, all of which was utilized in the manufacture of roofing cement, for which purpose it is ground and mixed with a certain proportion of mica or actinolite fibre. Soapstone.

Whiting.—The production of this material, as in previous years, is but small, amounting to only 500 barrels, having a spot value of $500. The only works in operation are situated at Marlbank, Ont., where Messrs. W. P. & A. N. Allan manufacture whiting from the marl found at that place. These works were not visited by any of the staff, nor is the method of manufacture known, though it is presumed that it is the same as that adopted in the manufacture elsewhere, viz. :— grinding and lævigation. Whiting.

According to the following table of imports, there was during 1890 a market in Canada for 96,243 cwts. or 28,295 barrels of 340 pounds each, having a value, including freight and charges, of $27,471, or about 97 cents per barrel. As the material produced at Marlbank is sold for $1 per barrel in the face of foreign importations, and as there are in many parts of Canada marl-beds similar to that at Marlbank, it does not seem unreasonable to suppose that ere long the manufacture of whiting will acquire much greater proportions.

MISCELLANEOUS.

TABLE 4.

IMPORTS OF WHITING.

Fiscal Year.	Cwts.	Value.
1880	84,115	$26,092
1881	47,480	16,637
1882	36,270	16,318
1883	76,012	29,334
1884	76,268	28,230
1885	67,441	23,492
1886	65,124	25,533
1887	47,246	15,191
1888	76,619	20,508
1889	84,658	22,735
1890	96,243	27,471

Chalk.

Chalk.—The following table illustrates the imports of chalk and cliff-stone, and represents the consumption of those materials in Canada, as there is no home production, chalk not being known to occur in the Dominion.

MISCELLANEOUS.

TABLE 5.

IMPORTS OF CHALK.

Fiscal Year.	Value.
1880	$2,117
1881	2,768
1882	2,882
1883	5,067
1884	2,589
1885	8,003
1886	6,583
1887	5,635
1888	5,865
1889	5,336
1890	7,221

Mercury.

Mercury.—Although known for many years to occur in British Columbia, no efforts to exploit the known deposits have as yet been made, though it is said that a company of Victoria capitalists has recently been formed for the purpose of developing a deposit lately found on Sechart Channel, Barclay Sound, where ore said to afford 20 lbs. of mercury to the ton is stated to occur in no inconsiderable quantity. The localities in British Columbia where this metal is known to exist, though in small quantity, are, according to Dr. G. M. Dawson, in his

report on "The Mineral Wealth of British Columbia," Geological Survey Report, 1887:—"Ebenezer mine," 3 miles from Golden; on the north side of the Homathco river; near Boston Bar, Fraser river; 12 miles above Kelly's Lake creek, Fraser river; and Silver Peak, near Hope.

As there is no production to report from Canada the only statistics available are those of the imports given below. Imports.

MISCELLANEOUS.

TABLE 6.

IMPORTS OF MERCURY.

Fiscal Year.	Pounds.	Value.
1882.	2,443	$ 965
1883.	7,410	2,991
1884.	5,848	2,441
1885.	14,490	4,781
1886.	13,316	7,142
1887.	18,409	10,618
1888.	27,951	14,943
1889.	22,931	11,844
1890.	15,912	7,677

Tin and Zinc.—The following tables give the imports of these metals, neither of which have as yet been produced in Canada:— Tin and zinc imports.

MISCELLANEOUS.

TABLE 7.

IMPORTS OF TIN AND TINWARE.

Fiscal Year.	Value.
1880.	$ 281,880
1881.	413,924
1882.	790,285
1883.	1,274,150
1884.	1,018,493
1885.	1,060,883
1886.	1,117,368
1887.	1,187,312
1888.	1,164,273
1889.	1,243,794
1890.	1,289,756

MISCELLANEOUS.

TABLE 8.

IMPORTS OF ZINC IN BLOCKS, PIGS AND SHEETS.

Fiscal Year.	Cwts.	Value.
1880	13,805	$67,881
1881	20,920	94,015
1882	15,021	76,631
1883	22,765	94,799
1884	18,945	77,373
1885	20,954	70,598
1886	23,146	85,599
1887	26,142	98,557
1888	16,407	65,827
1889	19,782	83,935
1890	18,236	92,530

MISCELLANEOUS.

TABLE 9.

IMPORTS OF ZINC, MANUFACTURES OF.

Fiscal Year.	Value.
1880	$ 8,327
1881	20,178
1882	15,526
1883	22,599
1884	11,952
1885	9,459
1886	7,345
1887	6,561
1888	7,402
1889	7,233
1890	6,472

MISCELLANEOUS.

TABLE 10.

IMPORTS OF SPELTER.

Fiscal Year.	Cwts.	Value.
1880	1,073	$ 5,310
1881	2,904	12,276
1882	1,654	7,779
1883	1,274	5,196
1884	2,239	10,417
1885	3,325	10,875
1886	5,432	18,238
1887	6,908	25,007
1888	7,772	29,762
1889	8,750	37,403
1890	14,570	71,122

NATURAL GAS.*

Successful operations were carried on in only two counties during the year 1890, namely, those of Essex and Welland, in Ontario, in the former of which and in the neighbourhood of Sherks Station the Provincial Natural Gas and Fuel Company have finished their series of 13 wells, from all of which, with one exception, heavy flows of gas were obtained. Ontario. Provincial Natural Gas and Fuel Co.

This company has now from its producing wells a daily flow of gas equivalent to 30,895,000 cubic feet per day, as follows:—

No.	1	2,050,000
"	2	375,000
"	3	600,000
"	4	2,200,000
"	5	8,500,000
"	6	70,000
"	7	3,000,000
"	8	Abandoned
"	9	3,500,000
"	10	4,500,000
"	11	300,000
"	12	5,500,000
"	13	300,000
		30,895,000

A pipe line connection was being made with the city of Buffalo during the latter part of the year, and it was expected that during the spring of 1891 that city would be largely supplied with gas from this Canadian field. Pipe line to Buffalo.

As an experiment the Provincial Company have sunk a new well, No. 14, to the Trenton limestone, to test the gas-producing properties of that formation. The effort was not, however, crowned with success, as the limestones were found to be quite barren at that point.

This well is useful, however, in defining somewhat accurately the north-east boundary of the gas-bearing area, the location of the well being lot 6, concession XV, township of Bertie. The usual gas-bearing horizon was struck at 762 feet and was found to be quite barren, though small quantities of gas were found in the red sandstone overlying these beds.

Other operators have been busy throughout this county, notably the Messrs. Cronmiller and White, John Reeb, Messrs. Carroll Bros., Edward Near and — Hopkins. The well sunk by Messrs. Cronmiller and White

* A very detailed report on the oil and gas wells of Ontario by Mr. H. P. Brumell is now nearly completed and will shortly be published by the Geological Survey. It will give the fullest information regarding distribution and operations in search of gas in that province.

is on lot 29, concession I, township of Humberstone, and attained a depth of 800 feet, gas to the extent of 6,000 cubic feet only being found at 675 feet.

Mr. John Reeb's well is situated on lot 6, con. I, township of Wainfleet, and was sunk to a depth of 820 feet, wherein, at a depth of 685 feet, gas, having a measured daily flow of 400,000 cubic feet, was obtained.

Messrs. Carroll Bros. drilled on lot 4, con. I, Humberstone township, and obtained gas at 883 feet, the depth of the well being 917 feet and the flow of gas 990,000 cubic feet per day.

The Near and Hopkins wells each afford about 400,000 cubic feet of gas per day, and are on adjoining lots, the former being located on lot 29, con. II, Humberstone township, while the Hopkins well is on lot 28 of the same concession.

In all of the wells drilled in the county of Welland the gas, when obtained, is found in a white friable sandstone, near the summit of the Medina formation, according to the following record, which is that of No. 1 well belonging to the Provincial Company:—

Record of No. 1 well.

Character of Beds.	Thickness.	Formation.
Surface deposits	2 feet.	Drift.
Dark grey limestone	25 "	Corniferous.
Drab and grey dolomites, black shales and gypsum	390 "	Onondaga.
Grey dolomite passing into brown	240 "	Guelph and Niagara.
Black shales	50 "	Niagara.
White crystalline dolomite, grey towards bottom	30 "	Clinton.
Red sandstone	55 "	Medina.
Red shale	10 "	
Blue shale	5 "	
White sandstone	5 "	
Blue shale	20 "	
White sandstone	15 "	Gas horizon.

Lincoln County.

In the adjoining county, Lincoln, no further operations were undertaken, the ill success of efforts of previous years acting as a strong deterrent upon any further expenditure of money.

In Wentworth county, adjoining Lincoln, to the west, this has, however, not been the case, as several attempts to find gas in the neighbourhood were made without success. Wentworth County.

In Perth county a boring was made during the year by the Stratford Natural Gas Company, wherein a depth of 2,386 feet was attained without encountering gas or oil. The Trenton limestone, in which it was expected gas would be obtained, was struck at 2,360 feet, and was found to be "flooded," a heavy salt water seam being opened at 2,384 feet. This was not cased off, and the well at 2,386 feet was abandoned. Perth County.

In Kent county Messrs. Walker & Sons have drilled two wells, without, however, obtaining gas. Kent County.

Of one of these drilled on lot 10, concession XI, township of Oxford, and known as the "Ravey" well, the following record was obtained through the courtesy of the driller, Mr. J. S. Hyland :—

	Feet.
Surface	160
Limestone	81
Shale, white	70
Limestone, grey	90
do pink	154
Sandstone, (?) pure white	30
do grey	45
Limestone, grey	285
Sandstone (?), fine	85
Total depth	1,000

The other sunk on lot 23, con. XIV of the same township, and known as the "Grant" well, was not finished at the time of my visit to the district, being only 500 feet in depth, of which the following was the record :—

	Feet.
Surface	240
Limestone	10
do pink and grey	140
do white	20
Sandstone (?), fine grey	30
do and limestone, grey and white	60

In neither of these two wells was gas obtained, though oil in small quantities was noted at 470 and 410 feet, respectively.

In Kent county, in addition to the work done by Messrs. Walker & Sons, mentioned above, a certain amount of work has been carried on,

notably the well sunk by the Citizens' Gas Company of Blenheim, where in a boring 900 feet deep small flows of gas were obtained at 700 and 800 feet.

Essex County. In Essex county extensive drilling operations were in progress at various points, more especially in the district between Essex Centre, Harrow and Leamington. At Essex Centre the Central Gas and Oil Company of that place have finished a well 1,200 feet in depth without, however, any economic result, as neither gas nor oil were obtained. The Citizens' Gas, Oil and Piping Company, of Kingsville, during the year drilled on the road allowance, west of the well known as "Coste No. 1," where a daily flow of gas amounting to over 7,000,000 cubic feet per day was obtained; this gas is now being utilized in lighting the streets of Kingsville, to which town it has been piped. The drilling of this well was the cause of considerable litigation between the owners and the Ontario Natural Gas and Fuel Company, the owners of "Coste No. 1." The result of the suit was, however, in favour of the former company, the injunction given at the instance of the latter not being sustained.

The Union Gas Company have, it is understood, undertaken operations in the county, in that part between "The Marsh" and Essex Centre, with what result, however, we are unacquainted. Various other operators have been working throughout the county, but owing to lack of time it was found impossible to visit and ascertain the result and extent of their operations.

Outside the foregoing but little work has been done throughout Ontario in the search for gas, though that product is being found, in small quantities as heretofore, in the petroleum wells which are constantly being sunk in Enniskillen township.

Quebec. In the Province of Quebec no active operations were undertaken during 1890, though small finds of gas were reported during the year, notably from the area covered by the drift deposits to the south and south-east of the River St. Lawrence. The gas was in all instances obtained in wells sunk or bored for water, and flowed from the sands and gravel underlying the clay deposits. The flows were small.

Regarding the rest of the Dominion there is nothing of importance to report, nor have any boring operations in search of gas been undertaken.

Available production of Ontario. In January, 1891, there was in Ontario an available daily flow of gas of over 50,000,000 cubic feet, very little of which was at that time being put to practical use.

NICKEL.

The chief producing district of the Dominion, so far of the ores of this metal, has its centre at Sudbury, at the junction of the Canadian Pacific Railway main line and the Algoma branch. Sudbury District.

The discoveries of deposits of nickeliferous pyrrhotite in this district since the inception of prospecting in 1883 have been very numerous. They occur in a belt of country, running about E.N.E. and W.S.W. from Sudbury village, which is about four or five miles wide. It extends from the shores of Wahnapitae Lake, some fifteen miles east of Sudbury, and has been proved nickeliferous as far as Nelson, on the Algoma branch, making a total distance of some fifty miles. Up to the end of the year some twenty well-authenticated deposits had been located, not to mention many others of which little is as yet known.

About thirty miles north-west of Sudbury, on the main line of the Canadian Pacific Railway, is the Straight Lake area, with dimensions about six miles by two. It is in the vicinity of the station of that name, and contains several promising deposits.

Apart from prospecting work, the activity this year has been confined to the operations of the three chief companies, viz.:—The Canadian Copper Company, with headquarters at Cleveland, Ohio, and operating the "Copper Cliff," "Stobie" and "Evans" mines. The Dominion Mineral Company, with headquarters in Montreal, and operating the "Dominion" mine, and Messrs. H. H. Vivian & Co., of Swansea, England, operating the "Murray" mine. Operators.

All these mines are within a radius of about six miles of Sudbury. The "Copper Cliff" and "Evans," on the Algoma branch, and the "Murray" on the main line, west of the villlage, whilst the "Stobie" and "Dominion" find outlet by means of a short branch line. These mines give employment directly to some 780 men.

A description of the mode of occurrence of these deposits and of the processes of extraction adopted cannot be better given than it is in the paper written by Mr. A. E. Barlow and given below. His official connection with the staff of the Geological Survey as well as with the work undertaken by the Department in the study of the district enables him to speak with special authority on its geological features. Further details concerning the geology metallurgical processes, &c., will be found, by reference to the article on nickel in the volume on the Mineral Resources of the United States for 1888, issued by the Geological Survey of that country; to a paper on the Sudbury ore deposits by E.D. Peters, formerly manager for the Canada Copper Co., in vol. XVIII, Trans. American Inst. Mining Engineers; and to a paper by Dr. R. Bell

entitled "The Nickel and Copper Deposits of Sudbury district, Canada." Transactions Geological Society of America, Vol. 2, pp. 125.140.

ON THE NICKEL AND COPPER DEPOSITS OF SUDBURY, ONT.*

By Alfred E. Barlow, M.A., Geological Survey Department.

Geological associations of deposits.

"The presence of large deposits of nickel and copper in the district of Algoma, Ontario, has of late years attracted world wide attention, in the first place on account of their immense and apparently inexhaustible character, but latterly because of the proposed application of nickel in alloy with steel to improve the quality of the latter. The existence of workable deposits of copper in this region was a fact that had long been known, and as far back as 1770 a company had been formed and attempts made to mine this metal, but the difficulty of procuring and maintaining miners at so great a distance from any centre of civilization, the remoteness of any market for the ore, as well as the absence of facilities for transportation, rendered these first attempts abortive. However, in 1846, owing to the activity in prospecting and locating mineral lands on the southern shore of Lake Superior, and a favourable report by Mr. W. E. Logan, then newly appointed Provincial Geologist, some enterprising Canadians banded themselves together into two associations called "The Montreal Mining Company," and the "Upper Canada Mining Company." The former company having purchased, amongst others, what was then known as "The Bruce mines" location, and on account of the richness of the deposit decided to commence active work at this locality, while the Upper Canada Company proceeded to develop and work what was known as the "Wallace mine," at the mouth of the Whitefish River. The Montreal Mining Company continued their operations from 1846 to 1865, when, from a variety of causes, the work proving unremunerative, they sold out the whole of their claim to the "West Canada Mining Company," who had previously leased and worked the western half of the location under the name of the Wellington mine. This company continued working till 1876 when, owing to unsatisfactory results, work was suspended and has not been resumed since. The Wallace mine was chosen on account of its promising character and proximity to civilization, and is chiefly remarkable as having been the first place in Canada in which the presence of nickel had been detected.

Wallace Mine.

"According to Mr. Alex. Murray, of the Geological Survey of Canada, who made an examination of the location in 1848, 'No true vein can be discovered, but the ore occurs at the contact of quartzose and chloritic slates with diorite, as bunches and strings of pyritous matter, inter-

*Read before the Ottawa Field Naturalist Club.

laminated irregularly with the slates, and distributed in specks and patches in the diorite. Abundant evidence of disturbance is displayed in irregularities of dip and intrusion of the diorite. The material collected for assay was chosen as free as possible from copper pyrites, but nearly two-fifths of the specimen consisted of earthy materials, which might readily be separated by dressing.' (See Report Geological Survey of Canada, 1848–49, p. 42—45). Dr. T. Sterry Hunt, in his report on this ore, says that "the specimen is a steel grey arseniuret, the species not determined, with white iron pyrites and probably some arsenical sulphuret of iron.' The mass, weighing 45 oz., was reduced to powder and submitted to analysis, with the following results:— Analyses of ore.

Iron	24·78
Nickel, with trace of cobalt	8·26
Arsenic	3·57
Sulphur	22·63
Copper	·06
Earthy materials	40·01
	99·31

"In the process of washing the ore, the earthy parts being removed by washing, the composition of the ore in 100 parts, as deduced by calculation from the above, would be—

Iron	41·79
Nickel and cobalt	13·93
Arsenic	6·02
Sulphur	38·16
Copper	·10

"From the small proportion of arsenic the nickel must, in part at least, be present in a state of sulphuret, a fact which is, indeed, made evident by the spontaneous oxidation of the ore. The nickel from this source contained about three parts in a thousand of cobalt. In conclusion, he remarks that in the same bands of rocks we may detect the presence of nickel and cobalt, a prophecy which has since been amply verified.

"A mass of copper pyrites from the same mine weighing 9½ lbs. was also assayed, which yielded 11·6 per cent of metallic copper. Acting on these and other favourable reports, the company began to sink shafts to test the extent and the quality of the ore, and one of these shafts at least attained a depth of 10 or 15 fathoms. Work was carried on energetically for some years, but the enterprise was finally abandoned, as the quantity of ore did not seem sufficient to justify further expenditure.

"In his report for 1856, Mr. Alex. Murray (see Report Geological Survey of Canada, 1853-56, p. 180) mentions the occurrence of a 'dingy

History of discovery.

green magnetic trap' associated with red syenite in the north-west corner of the township of Waters on Salter's meridian line. Specimens of this trap were given to Dr. Hunt for analysis, and the result of his investigation showed that it contained magnetic iron ore and magnetic iron pyrites, generally distributed through the rock, the former in very small grains; titaniferous iron was found associated with the magnetic ore and a small quantity of nickel and copper. The variation of the magnetic needle near this mass was from ten to fifteen degrees west of the true meridian. It can thus be seen that even at this early period of its history the officers of the Geological Survey were aware of the existence of nickel in this region, and had pointed out the probability that workable deposits would be found. Years passed by and the inaccessible nature of the country deterred prospectors from making very detailed exploration or examination, so that it was not till 1883, when the Canadian Pacific Railway was in course of construction, that the first discoveries of any consequence were made, since which time the whole belt of the Huronian district has been overrun with eager prospectors and miners. A not infrequent accident in newly settled districts led to the first important discovery. Judge McNaughton, stipendiary magistrate at Sudbury, had been lost in the woods to the west of that village, and diligent search was at once instituted for him. A party consisting of Dr. Howey and two others found the judge seated on the small eminence which then marked the site of what is now known as the "Murray mine." Early in 1884 the Canadian Pacific Railway made a cutting for their main line through this small hill, about 3½ miles north-west of Sudbury, and on July 12th of the same year Dr. Selwyn made a careful examination of the location and pronounced the lode to be one of the most promising he had yet seen in Canada. Other discoveries soon followed, and the McConnell, Lady Macdonald, Stobie, Blezard, Copper Cliff and Evans mines were all located. At first the wildest notions were entertained as to the extent of these deposits, and the most exaggerated reports circulated as to their value. It was even confidently asserted that these were immensely important discoveries, and would revolutionize the whole copper trade and render other mines then in operation quite unremunerative. Rounded hills of gossan, indicating the presence of the more solid and unaltered ore beneath, occur at intervals for miles in a southwesterly direction, conforming rudely to the strike of the rocks in the vicinity. This circumstance is all that seems to have justified the early discoverers in describing the deposits as veritable mountains of solid ore, many miles in extent and hundreds of feet thick. Closer investigation revealed the fact that these surface gossans everywhere indicate the presence of the ore beneath, and that the ore itself occurs in lenticular masses, entirely

separated from one another, whose longer axes correspond with the strike of the enclosing rock. This gossan has resulted, as is usual, from the formation of peroxide and hydrated peroxide of iron, due to the decomposition of the pyrrhotite and chalcopyrite which gives a prevailing red or reddish brown colour to the upper portion of the deposit. This covering of iron oxide is sometimes as much as six feet in depth. although usually it is only two or three feet, gradually merging itself into the unaltered ore beneath. During the last few years prospectors have not been idle, and at the present time about twenty very promising deposits of these ores have been "located" and "taken up." The McAllister mine, now called the Lady Macdonald mine, was the first property on which any work was done in the summer of 1885, although later in the fall the Evans mine was opened up and some preliminary tests made. On 6th January, 1886, the Canadian Copper Company was formed with a subscribed and paid up capital of $2,000,000, which was afterwards increased to $2,500,000, to operate the Copper Cliff, Stobie and Evans mines. History of discovery and development.

"On May 1st, 1886, work was started in earnest at the Copper Cliff mine, and later on in the same year both the Stobie and Evans mines were opened up, and with the exception of a few months last summer, when, on account of some difference with the Canadian Pacific Railway, the Stobie was shut down, these three mines have been in active operation ever since. The chief business of the Canadian Copper Company is done at Copper Cliff, for here they have prepared a well equipped roast yard, two smelting furnaces, laboratory and offices, and other things requisite for carrying on this mining on an extensive scale. The Stobie and Evans mines are provided with excellent rock houses, but all their ore is brought by branch railways to Copper Cliff to be roasted and smelted. In 1889 the Dominion Mineral Company was formed to operate the Blezard mine, and later on they purchased the Worthington mine from the original owners. During the past summer this company have had their smelter in operation, and both their mines are being energetically developed. During the summer of 1889 the Murray mine was prospected under bond by Messrs. Henry H. Vivian & Co., Swansea, England, and in October of the same year they purchased it. About the end of last September, everything being ready, the smelter "was blown in" and set to work on some ore which had been previously roasted. All three companies are now prosecuting the work vigourously, and the output of these mines has already reached very large proportions. The whole district has been prospected, and I think that a very conservative estimate would now place the number of promising deposits at twenty.

Geological conditions of occurrence of ore bodies.

"The Huronian system in which these ore deposits occur may be regarded as the oldest series of sedimentary strata of which we have at present any certain knowledge. Amongst the more important of these rocks may be mentioned quartzites, greywackes, conglomerates, slates, evenly laminated gneisses, felsites, hydromica, chloritic, epidotic, hornblendic and micaceous schists and narrow bands of cherty limestone. Most of these clastic rocks have been derived from the waste of older felspathic material, and hitherto it has been most generally supposed and stated that the Laurentian gneiss was the source from which the sediments had been derived. The Huronian conglomerates, however, hold no pebbles that are undeniably referable to the Laurentian, and the origin of the syenitic, quarzose and jaspery pebbles is still a matter of doubt. The microscope can throw no certain light on the original character of some of these rocks, for very often metamorphism and recrystallization has gone on to such an extent that the former structure has been either partially or completely obliterated. A close study of these uncertain rocks in the field, aided by the use of the microscope in the laboratory, will eventually enable us to assign them their proper place. We have thus numerous sedimentary rocks showing the various stages of this metamorphism, from the typical sandstone or greywacke, composed of well-rounded grains of quartz and felspar, to the compact felsite, which contains no trace of its original clastic structure. Associated with these sedimentary strata are certain undoubted eruptive and irruptive rocks, among which may be mentioned many varieties of diabase, diorite and gabbro. Besides these igneous rocks, there are some granites and gneisses concerning whose origin many are in doubt. After a close and careful study of these rocks, which have usually been classified as Laurentian, and their relations with the true Huronian stratified deposits, I have been fully convinced of their irruptive nature. These granites and gneisses probably represent the original crust of the earth which has undergone refusion, and was in a molten or plastic condition at a period subsequent to the hardening of the Huronian sediments. The earth gradually cooling from a state of original incandescence, had reached that stage in the process when it admitted of being surrounded by an ocean nearly, if not quite, universal. Then began that tearing down and building up which has since gone on in forming the sediments which subsequently hardened into rocks. The first formed crust was necessarily thin and weak, and it is therefore not surprising that there were frequent irruptions, accompanied by the fusion of the lower portion at least of the first formed deposits.

"It is unnecessary here to go into all the facts of the case, as my views have already been stated at some length in a paper read before

this club on 27th February of last year. Suffice it to say that the fuller examinations of last summer have served to further strengthen these views. Both clastic eruptive and irruptive rocks have been subjected to intense pressure, as evidenced by the extensive cataclastic structure which has been developed in both series of rocks. Frequently the rocks show a pyroclastic origin, and volcanic tuffs and breccias are very commonly met with. The relations of the diabase or basic irruptive rocks with the surrounding sedimentary strata was closely examined in a large number of instances, and revealed the fact that the diabase is apparently of later age, as it breaks through and alters the bedded Huronian. The occurrence of these masses of diabase with a surrounding breccia or agglomerate in many cases would seem to point to the fact that they are the bases of Huronian volcanoes, which continued in action after the latest sediment had been deposited. Some of these diabasic masses send out dykes which ramify through and alter the surrounding strata, these dykes frequently containing fragments of highly metamorphosed Huronian quartzite. These masses are usually lenticular, although occasionally rudely circular or oval in outline, and their longer axes correspond in general with the strike of the enclosing rock. They vary in breadth from a few chains to half a mile, or even more, and frequently extend for miles in length. The origin of the nickel and copper is closely connected with this diabase or gabbro, and the formation of the fissures containing these ores was no doubt due to the disruptive forces of the intrusion, and the contraction caused by the subsequent cooling of the igneous rock matter. These fissures were necessarily most frequently formed along the line of contact with the cooler sedimentary strata, although in certain cases they were formed in the midst of the igneous mass itself. In nearly every case, therefore, the deposits of nickel and copper occur close to the contact of the diabase with the stratified rocks, although in a few cases they are found in the diabase near its junction with granite or micropegmatite. Another proof of the common genesis of these ores and the enclosing diabase is that the diabase itself commonly contains these sulphides disseminated through its mass, these impregnations occasionally forming such considerable and rich deposits as to be workable.

Geological conditions of occurrence of ore bodies.

"All geologists who have examined these deposits agree that they are not true fissure veins, and although at times a certain sloping surface is obtained which seems to have a uniform inclination, yet it seems certain that there are no regular walls in the miner's sense of the term, and at both sides of the deposits the enclosing rock is impregnated more or less with the pyritous matter. Though mining is thus rendered somewhat difficult and uncertain on account of the absence of the walls and irregu-

Characteristics of ore bodies.

Characteristics of ore bodies.

larity in the distribution of the ore, so that there is no means of knowing in what direction to drive the levels, this uncertainty is more than compensated by the extent and massiveness of the deposit when found. The ore bodies like the masses of diabase with which they are so intimately associated are lens or pod-shaped and 'pinch out' in both directions. This structure is also characteristic of their downward extension, and the deposits have been very truly likened to a string of sausages, so that when one lenticular body of ore gives out another commences close at hand, which in its turn gives place to another, and though at the Copper Cliff they are down about 600 feet on a slope of 45°, the quantity and quality of the ore shows no diminution. I have occasionally found true veins of quartz holding this pyrrhotite, but such evidences of secondary action are extremely rare and proves nothing in regard to the origin of the more massive deposits. The ores and the associated diabase were therefore in all probability simultaneously introduced in a molten condition, the particles of pyritous matter aggregating themselves together in obedience to the law of mutual attraction. The ore bodies were, therefore, not contemporaneous with the stratified Huronian, although there is nothing to prove that they do not belong to the close of the Huronian period. Mr. Ferrier, of the Geological Survey, has noticed the occurrence of this nickeliferous pyrrhotite in a specimen of chloritic schist and gneissic granite, which had been taken to show the contact between the two rocks.

"The ore itself is a mixture of pyrrhotite, a monosulphide of iron ($Fe_7 S_8$) and chalcopyrite, a sulphide of copper and iron ($Cu Fe S_2$). The two minerals are not so intimately commingled as to form a perfect homogeneous mass, but one may be described as occurring in pockets, spots, bunches or threads in the other. The chalcopyrite is not so closely intermixed with the pyrrhotite, but isolates itself rather in spots and patches enclosed by massive pyrrhotite, so that it is not hard to separate considerable masses of chalcopyrite that will assay over 30 per cent of copper, or pyrrhotite that will only show traces of that metal. In practice, however, careful examination and trial have proved that the two minerals are too intimately associated to make sorting by hand at all practicable, and the pyrrhotite is very often so feebly magnetic as to preclude the possibility of separation by magnetism. Although the chalcopyrite seldom occurs free from the pyrrhotite, large and massive deposits of the latter occur comparatively free from copper. In this connection Dr. Peters mentions a stope which, having furnished about 2,000 tons of pyrrhotite, gave place, just before the end boundaries were reached, to a deposit which afforded nearly 20 tons of almost pure chalcopyrite. In some instances these ore bodies show a brecciated

character, large angular or partially rounded boulders or 'horses' of almost barren rock being mingled with the ore, which seem to evidence the disruptive force of the intrusive mass, while in others, as at the Worthington mine, the diabase in which the ore occurs has developed a concretionary structure while cooling, and large irregularly rounded concretions, which, on weathering, peel off in concentric layers, are cemented together, so to speak, by a very pure chalcopyrite and highly nickeliferous pyrrhotite. The concretions themselves usually contain more or less pyritous matter disseminated through them, but are usually cast aside as too barren for the roast heap. The pyrrhotite varies in colour from steel-grey to bronze-yellow, and the chalcopyrite is the usual brass or deep yellow colour. Both tarnish readily, and very beautiful iridescent specimens can be easily obtained from the ore heap or scattered around the works. These sulphides, therefore, may be said to occur in three distinct ways— Characteristics of ore bodies.

"1st. As contact deposits of pyrrhotite and chalcopyrite situated between the clastic rocks, such as felsites, quartzites, etc., and igneous diabase or gabbro, or between these latter and granite or micropegmatite. Good examples of the former are furnished by the Evans, Stobie and Copper Cliff, while the Murray mine may be cited as illustrating the latter.

"2nd. As impregnations of these minerals through the diabase or gabbro, which are sometimes so rich and considerable as to form workable deposits. These sulphides are in no case present as disseminations through the clastic rocks very distant from the diabase or gabbro, which seems clear evidence that they have been brought up by the latter.

"3rd. As segregated veins which may have been filled subsequently to the irruption which brought up the more massive deposits. These veins are not very common, although certain portions of the more massive deposits may have been dissolved out and re-deposited along certain faults and fissures.

"The composition of the ore varies according to the preponderance of either the pyrrhotite or chalcopyrite in the specimen examined. The pyrrhotite may be said roughly to be composed of 40 per cent sulphur and 60 per cent iron, with a varying proportion of the iron replaced by nickel, while the chalcopyrite contains 35 per cent sulphur, 35 per cent copper and 30 per cent iron. The mines of the Canadian Copper Company, as the name of the company indicates, were first opened for their copper contents, and it was not until considerable work had been done that nickel was discovered to be present in the ore. A large shipment of ore had been made to New York, and a chemist Composition of ore.

there who was making a volumetric determination of the copper contents by the Potassium Cyanide process, was struck by the great variation in his results, which led him to make a more minute examination of the ore, when he found that nickel was present. The ore has now become of more value on account of its nickel than its copper contents, and Dr. Peters himself greatly doubted if the mines would pay to work for copper alone. The percentage of nickel and copper varies greatly, as might be expected, but assays of nine samples from the different mines of the Canadian Copper Company, made in November, 1888, will show the usual percentage of these metals. These assays were made by Mr. Francis L. Sperry, and show a range in the percentage of nickel from 1·12 per cent to 4·21 per cent with an average of 2·38 per cent., while the copper varied from 4·03 per cent to 9·98 per cent, with an average of 6·44 per cent. A minute proportion of cobalt also occurs in the pyrrhotite usually about $\frac{1}{50}$th as much as the nickel present. Mr. G. C. Hoffman assayed four samples from this district which I collected last summer, and these showed the nickel contents to vary from 1·95 per cent to 3·10 per cent with an average of 2·25 per cent. Three of these samples contained traces of cobalt, which are included in the above percentage of nickel. The nickel is usually spoken of as replacing an equal quantity of iron in the pyrrhotite; but the discovery of undoubted crystals of millerite or sulphide of nickel 150 feet below the surface at Copper Cliff Mine, as well as the more recent recognition of polydymite, a ferriferous sulphide of nickel, at the Vermilion Mine, in the township of Denison, seems to justify the assumption that in the more highly nickeliferous deposits of the region at least, the nickel is also present as a sulphide, disseminated through the ore mass like the iron and copper.

"This view is also borne out by Dr. Hunt's analysis of the ore of the old Wallace mine which seems precisely analogous to some of the richer deposits nearer the Canadian Pacific Railway. Traces of gold and silver, as also platinum are also usually found in these ores, and in this connection it was thought advisable to call your attention to the detection of what Messrs. Clarke & Catlett call a 'platiniferous nickel ore from Canada.' They say (see article xxxix, page 372, *American Journal of Science*, 1889.) During the autumn of 1888 we received, through two different channels, samples of nickel ores taken from the mines of the Canadian Copper Company at Sudbury, Ont. From one source we obtained two masses of sulphides to be examined for nickel and copper, from the other came similar sulphides together with a series of soil and gravel-like material (gossan), seven samples in all. In the latter case an examination for platinum was requested, and in five of the samples abovementioned it was found the gravel yielded 74·85 ozs. of metals of the

platinum group to the ton of 2,000 lbs. The sulphide ores submitted to us from Sudbury were all of a similar character. They consisted of mixed masses in which a grey readily-tarnishing substance was predominant with some chalcopyrite, possibly some pyrite and a very little quartz. Two samples were examined in mass: one gave 31·41 per cent nickel with a little copper, and the other gave 35·39 per cent nickel and 5·2 per cent copper. The nickel mineral itself proved to be a sulphide of nickel and iron, and as ores of that composition are not common, it was thought advisable to examine the substance further. It is steel-grey massive and exceedingly alterable in the air with a specific gravity of 4·5. An analysis of carefully selected material gave:—

Nickel	41·96
Iron	15·57
Silica	1·02
Copper	·62
Sulphur	40·80

"These figures give approximately the formula $Ni_3 Fe S_5$. Neither cobalt nor arsenic could be detected. If we deduct silica together with the copper reckoned as admixed chalcopyrite and re-calculate the remainder of the analysis to 100 per cent we get the following figures:—

Nickel	43·18
Iron	15·47
Sulphur	41·35

"In short the mineral has the composition of $Ni_4 S_5$ with about $\frac{1}{4}$th of the nickel replaced by iron, which seems to agree with Laspeyres polydymite of which it is doubtless a ferriferous variety. Probably in most cases the nickeliferous constituent of pyrrhotite is millerite, but other sulphides like polydymite may occur too. The polydymite which was selected for the above analysis came from the mass in which the average of 35·39 per cent nickel and 5·20 per cent copper had previously been found.

"The mass weighed several kilograms and was remarkably free from quartz. The same mass, with two smaller pieces resembling it, were also examined for platinum. The results were as follows, "A" representing the large mass in which the polydymite was determined:— Platinum assays.

A	2·55 oz.	platinum per ton, or	·0087	per cent.
B	1·8 oz.	do do	·0060	do
C	7 oz.	do do	·024	do

"Probably the platinum exists in the ore as sperrylite, although this point was not proved. The amount of platinum in the mass most thoroughly examined would require to form sperrylite only about ·007.

per cent of arsenic, which is too small a quantity for detection by ordinary analysis. That platinum should exist in appreciable quantities in an ore of such a character is something quite extraordinary, but whether it could be profitably extracted is an open question. Sperrylite.

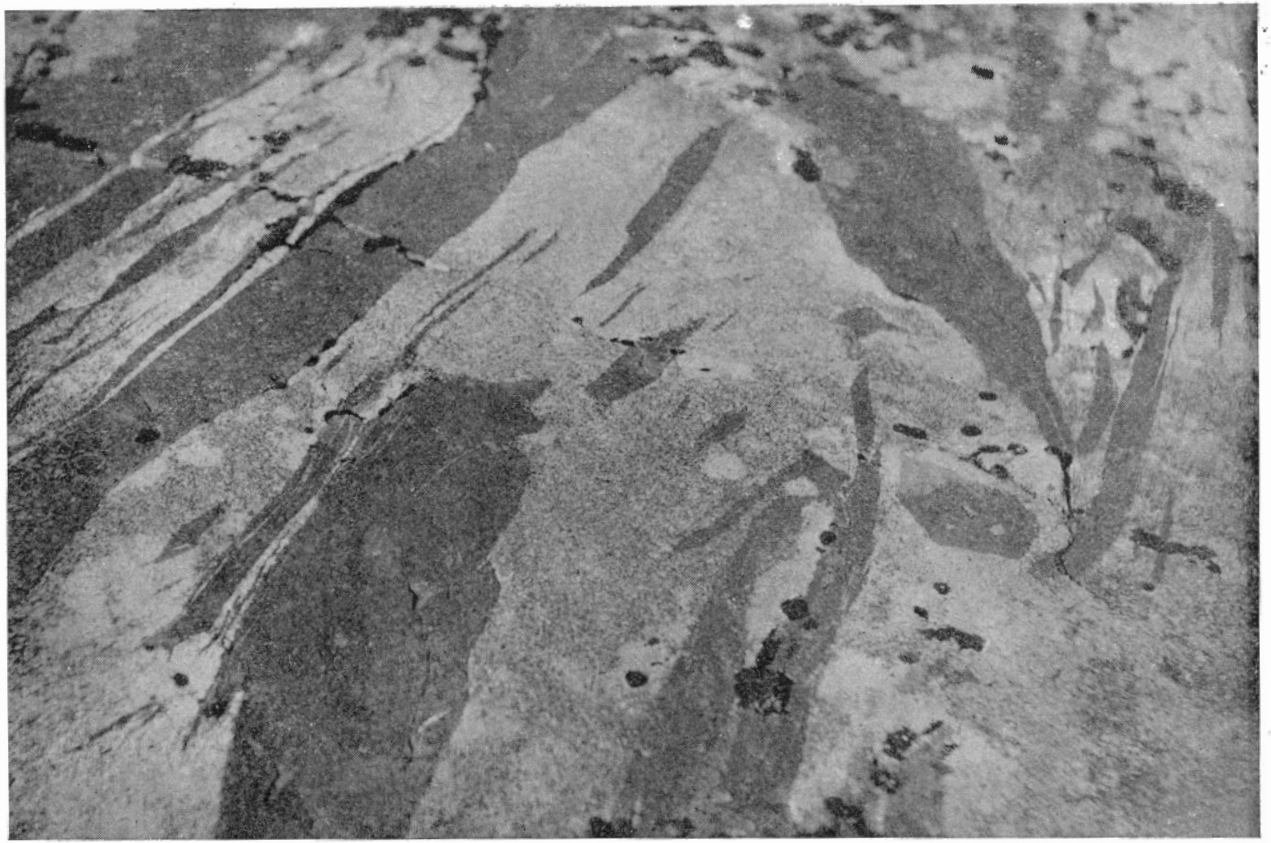
Sperrylite was first found at the Vermilion mine in the gossan or loose material, and was named after Mr. Francis L. Sperry, of the C. C. C., by Messrs. Horace L. Wells and S. L. Penfield, of the Sheffield Scientific School, who examined and described this new species. It is isometric; simple cubes are common, octahedrons are exceptional, while the majority of the crystals are combinations of the cube and octahedron. H.—Between six and seven, as it scratches felspar but not quartz. The crystals have no distinct cleavage, but are very brittle and break with an irregular, probably conchoidal fracture. The chemical composition, according to the mean of two analyses was as follows :—

Arsenic	40·98
Antimony	·50
Platinum	52·57
Rhodium	·72
Palladium	trace.
Cassiterite or oxide of tin	4·62

"The composition is therefore represented by the formula $Pt\,As_2$, a small portion of the platinum being replaced respectively by rhodium and antimony. The colour of the mineral was nearly tin white or about the same as metallic platinum. The fine powder is black. Nearly all the grains showed extremely brilliant crystal faces, though most of the crystals were fragmentary in size they were usually $\frac{1}{50}$—$\frac{1}{500}$th of an inch in diameter. Sp. Gr. 10·602.

Metallurgical treatment.

Roasting.—"The metallurgical treatment of this ore commences at the roast yard whither it is conveyed, and, being piled in convenient heaps on previously laid cordwood, is exposed at high temperatures without fusion, or, at most, incipient fusion, to the action of a current of air. The objects of this roasting are, 1st, an oxidation of the iron, and, incidentally, of the sulphur, as complete as is possible without involving an undue loss of copper in the slags of the following smelting, and, 2nd, the expulsion of arsenic, if there is any present. If the oxidation be very imperfect the resulting matte will contain so much iron that its bringing forward will be unduly costly, while, if the oxidation be too thorough, an undue loss of metal will occur on smelting the roasted ore. At Copper Cliff the Canadian Copper Company have spared neither trouble nor expense in the construction and equipment of their roast yard. The natural rough and uneven surface has been cleared and levelled, and the whole given a gentle slope, which, with carefully made drains serves to remove at once any rain or surface water. These precautions have to be taken to

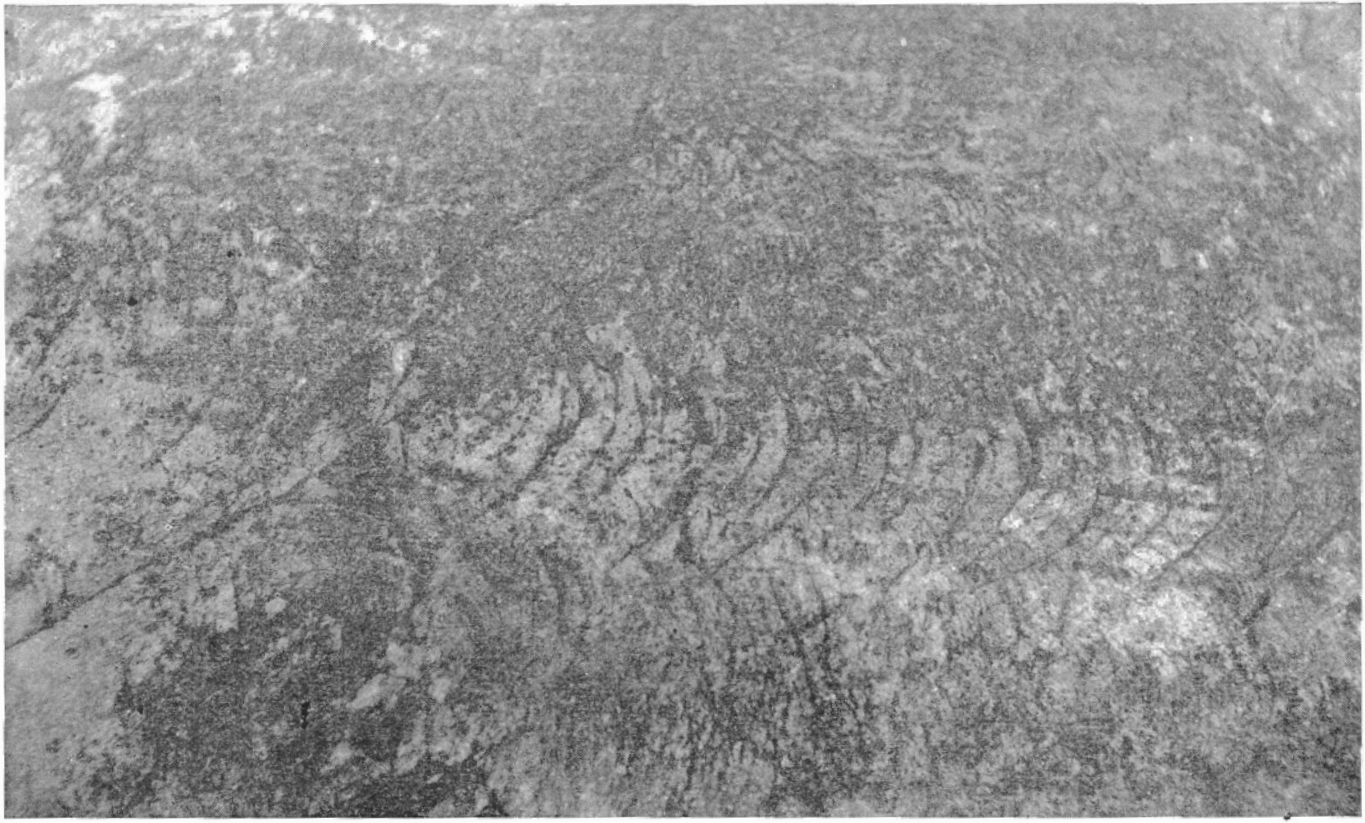


A. C. Lawson, Photo., 1889.

CONTACT OF LAURENTIAN AND KEEWATIN ON THE NORTH SIDE OF SAGANAGA LAKE, SHEWING SHARPLY ANGULAR SCATTERED FRAGMENTS OF HORNBLENDE SCHIST ENCLOSED IN HORNBLENDE-GRANITE GNEISS.

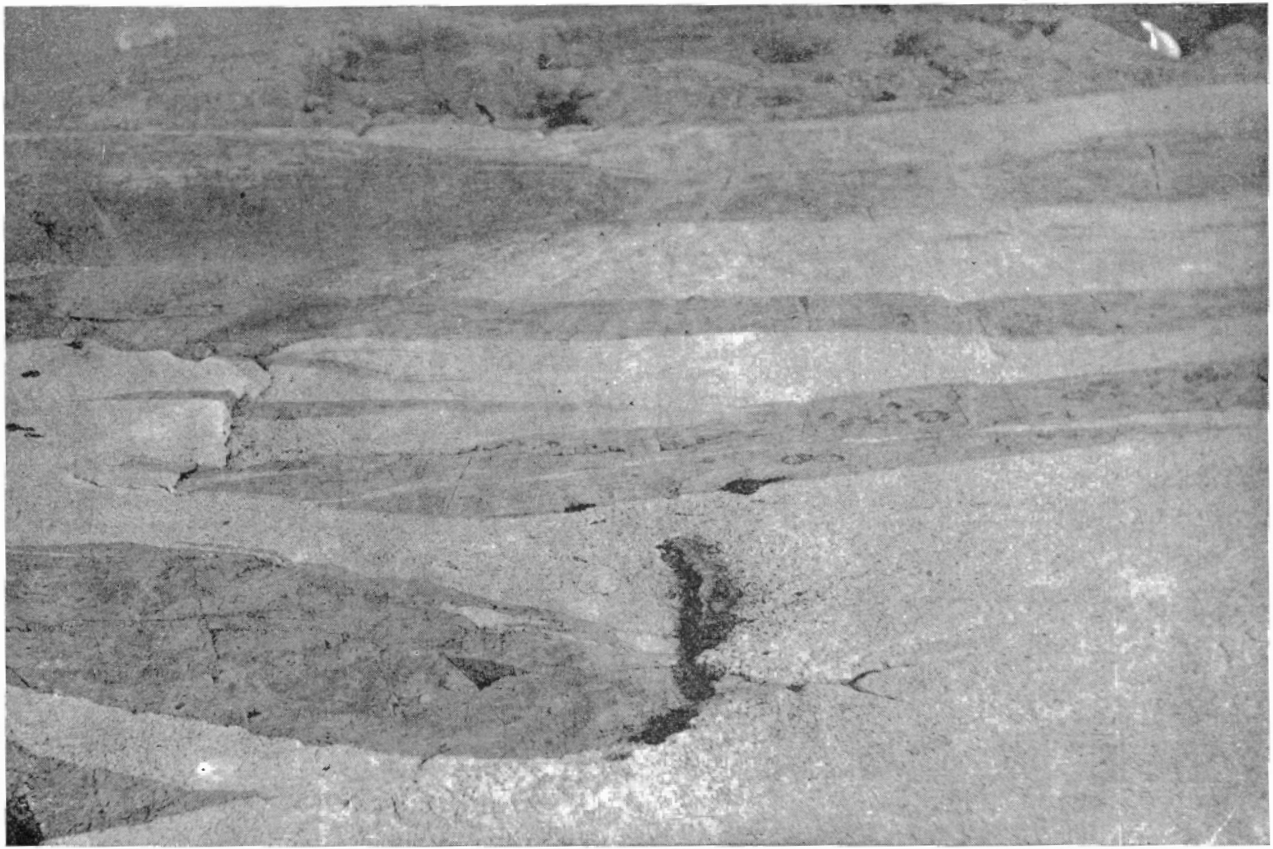
A. C. Lawson, Photo., 1889.

CONTACT OF LAURENTIAN GRANITE-GNEISS AND KEEWATIN SCHISTS, ON THE NORTH SIDE OF CACHE BAY, SAGANAGA LAKE, SHEWING BIFURCATING DYKE OF THE FORMER CUTTING THE LATTER.



A. C. Lawson, Photo., 1889.

GLACIAL GROOVES WITH "CHATTER" CRACKS, ON LAURENTIAN GNEISS, BASSWOOD LAKE.



A. C. Lawson, Photo., 1889.

CONTACT OF LAURENTIAN AND KEEWATIN ON THE NORTH SIDE OF SAGANAGA LAKE, SHEWING LENTICULAR SHEETS OF HORNBLENDE SCHIST ENCLOSED IN HORNBLENDE-GRANITE GNEISS, SIMULATING BEDDING.

prevent loss of copper as soluble sulphate of copper, which is liable to be washed out by the rain.

"At the Murray mine a large shed has been erected to roast ore during the winter months, with openings in the roof to allow of the escape of sulphurous fumes, but during last summer they had no regular roast yard, and the few heaps burnt could only be placed where the surface of the ground would permit. This was also the case at the Blezard and Worthington mines, and the mechanical loss alone from this carelessness must have been of considerable moment. The shaft of the Copper Cliff mine, on an incline of 45°, has reached already a depth of nearly 600 feet. It is provided with a double skip road, the skips dumping automatically at the mouth of the breaker in the top of the rock house. Here the ore is sledged to a proper size for the 15 x 9 in. Blake crusher set to about $1\frac{3}{4}$ inches, which has a capacity of nearly 20 tons an hour. It is then passed through a revolving screen where it is sized into three classes for the succeeding operation of roasting. The coarse size passes a 4-inch ring, the medium or ragging a $1\frac{3}{4}$-inch ring, while the fines pass through one $\frac{3}{4}$ of an inch in diameter. Each of these sizes falls into a separate bin under which a car runs. Thus the ore is loaded automatically into cars holding $1\frac{1}{2}$ tons, whence it is transported to the upper story of the ore shed. There it falls into a series of bins from which it is loaded by means of inclined steel shutes into the cars and taken up a rather steep grade to a high trestle which extends the whole length of the roast yard. The only wood that can be obtained is dead pine, a good deal of the surrounding district having been burnt over about 20 years ago. This can be procured very cheaply, and although it does not roast the ores as thoroughly as hard wood, it makes very fair and economical fuel, and serves on account of its short fierce heat to ignite the pile, and this once started continues burning on account of its sulphur contents. These piles are built as follows:—The place selected is first covered with about six inches of fine ore distributed as evenly as possible over the clay soil. Sticks of cordwood of nearly uniform size should be placed side by side across both sides and ends of the rectangular area. The whole interior of this can be filled in with old stumps, roots, ties or cordwood, but in such a way as to form a level and solid bed for the ore to rest on. Over all this is placed small wood and chips to fill up all interstices, care being taken to provide small canals filled with kindlings at intervals of 8 to 10 feet leading from the outer air to the chimneys along the centre of the heap. These chimneys which assist in rapidly and certainly kindling the whole heap are usually built of four sticks or old boards, so fixed together as to leave an opening and communicating below with the draught passages. Five or six of Roasting.

Roasting.

these chimneys suffice for each pile, and they should project 2 feet above the upper surface of the heap, so that no pieces of ore could fall into the flue opening. The coarsest class of ore is first thrown on, then the ragging or medium, on top of which is scattered a layer of rotten wood or chips, and lastly the whole heap is covered over with fines till it reaches a height of about 6 feet. The whole structure should then form a shapely rectangular pile with sharp corners and as steeply sloping sides as the ore will naturally lie on without rolling (about 45°). Only a portion of the fine ore is put on at first, the rest being shovelled on after the fire is fairly started. The best way to light the pile is to place a quantity of ignited cotton waste saturated with coal oil down each of the chimneys. About twelve hours after firing the whole heap should be pouring forth dense yellow fumes of sulphurous acid. Great attention is at first paid to the pile to prevent undue local heating which frequently causes partial fusion of the ore, and this can at once be prevented by covering the place with more fines. This heap should then burn from 50 to 70 days when the outer covering of raw or partially roasted ore is removed, and the remainder of the heap conveyed a few yards in wheelbarrows to a sunken railroad which runs alongside of the roast-yard. When filled, the cars are pushed up another steep grade along a track running over the bins back of the smelter. The sloping sides and corners of a pile are frequently covered with almost raw ore, this evil being often remedied by placing ignited sticks of cordwood around the whole structure, or by building a new pile in the passageway between two others which have been almost burned out, the latter plan adding very materially to the capacity of the roast yard. After this operation the ore is invariably so thoroughly roasted that it is necessary to add from 10 to 25 per cent of raw fine ore during the smelting to prevent the matte from being too rich. Each pile usually contains about 600 tons of ore, and requires 30 cords of wood to roast it. The roast yard at Copper Cliff is nearly half a mile long by 100 feet wide, while each pile occupies a space of 40×80 feet, room being left to get round them, and for drains. The present capacity is about 60,000 tons, which, with a little extra work, could be increased to 90,000 tons. Working full power each roast bed can be used four times a year, counting the time in making, roasting and clearing the beds. The yearly capacity would therefore be 240,000 tons, and by increasing the space, 360,000 tons. The unroasted ore contains from 35 to 40 per cent sulphur, and assays of a large number of samples of the roast heaps have varied from $2\frac{1}{2}$ to 8 per cent of sulphur. One analysis taken at random which may be taken as a fair sample of all the rest, gave 5·40 per cent copper, 2·43 per cent nickel, 7·92 per cent sulphur and 25 per cent iron, lime, mag-

nesia, etc., and the residue chiefly hornblende. Up to 1st October, 1890, 56,534 tons had been taken to the roast yard.

"*Smelting of the Ore.* There are two smelting furnaces at Copper Cliff, and the building which contains these is 65 feet long by 40 feet wide. Thirty-five feet of this length is on a level with the ground, while the rest of the floor is 8½ feet higher, and it is on this upper flat that the ore and fuel bins are situated. The daily capacity of each of these furnaces is 125 tons, although one of the furnaces has reduced 187 tons of ore in one day, and the furnace manager says that 135 tons could be reduced without much forcing. The furnace itself is a steel plate water jacket of the Herreshof patent, made in Sherbrooke, P. Q., by the Jenckes Manufacturing Company. It is nearly oval in form, the longer diameter at the tuyères being 6 ft. 6 in., while the shorter one is 3 ft. 3 in. There are 11 2½ in. tuyères through which the blast enters from a Baker's rotary blower under a pressure of about 9 ounces per square inch. It is 9 feet high from these tuyères to the charging door, and is an unbroken water jacket from the cast iron bottom up. It is made of rolled steel with only a two inch water space, and not a single brick of any description. The well is a circular, cast-iron water jacketed vessel, mounted on four strong wheels for convenience of moving it when repairs are necessary, and so made that the hole in one side connects with the outlet hole of the furnace, which is also thoroughly protected by water and it is through this that the matte and slag flow out of the furnace as rapidly as formed. They thus escape the influence of the blast, and prevent what Vivian calls 'the sole objection to blast furnaces' the so-called 'sows' or 'salamanders' as great masses of metallic iron which choke up the furnace and tie up large quantities of copper and other metals. The charging door is situated on the upper floor, as also the bins for roast ore and coke. The coke used is from Connellsville, Pa., and is brought by way of the Great Lakes and the Sault Branch of the C.P.R. The charge for the furnace consists of 1,800 or 2,000 lbs. of ore and coke mixed, one ton of coke usually sufficing for eight tons of ore. The mass as it melts gathers at the bottom of the furnace, and flows through the outlet into the well or reservoir, where the heavier and metallic portions sink to the bottom while the lighter slag remains on the surface, running in a continuous stream over the jacketed spout into pots on wheels, which are removed when filled, an empty one always being ready to take the vacant place. The matte is drawn off at intervals of 15 or 20 minutes through a separated bronze water-cooled tap-hole casting, near the bottom of the well, and which is filled as usual with a clay plug that can readily be removed with a few blows from a steel bar. The smelting of the ores is greatly facilitated by the basic character of

Smelting.

Smelting.

the accompanying gangue rock, for instead of quartz and acid silicates there is chiefly hornblende and very fusible felspars. This circumstance, as well as a judicious mixture of the different qualities of ore obviates the necessity of any flux, which is a very fortunate circumstance, as limestone is somewhat distant and suitable iron ore difficult to procure. The slag buggies or pots are made as strongly and lightly as possible, are case-hardened and shaped like inverted hollow cones, and before each tap are thickly washed with clay water to prevent the matte from welding to the iron mould. This matte is sampled and weighed and allowed to cool before being dumped from the pots and the slag also is sampled and assayed once every 24 hours, so that an accurate record can be kept of the composition of both. An average of two analyses of this matte in February and March, 1889, will probably give us the usual composition: Copper, 26·91; nickel, 14·14; iron, 31·335; sulphur, 26·95; cobalt, ·935. Mr. F. L. Sperry says that platinum exists in quite appreciable quantities, so that the matte contains some ounces per ton of that rare metal, while gold and silver occur in strong traces. The first blast furnace was started on the 24th December, 1888, and with slight interruptions has been running ever since. The second furnace was built in the summer of 1889, and was started on the 4th of September of the same year. On 1st October, 1890, there was about 6,500 tons of matte, and the ore on the roast beds would produce about 6,000 tons more, containing 922 and 852 tons of nickel respectively, or a total of 1,774 tons of metallic nickel, and 3,362½ tons of metallic copper.

"The average daily output of matte for the month of September, 1890, was 25 tons, but the full capacity of both furnaces would be about 60 tons of matte. If the former average was kept up, the yearly production of matte would reach 9,125 tons, but if the furnaces were run at their full capacity they would average nearly 8½ tons of nickel a day, or nearly 3,066 tons of metallic nickel and 5,913 tons of copper a year. At present the matte is piled in heaps outside of the smelters, and, when wanted to be shipped, is broken up in pieces and placed in old oil barrels, the chinks between the larger pieces being filled with smaller fragments, so that the whole is packed tolerably firm and close. It is then sent to the various refiners in Europe or the United States according to their respective bids. So far no refining works have been built at Sudbury, but the vast quantity of material to treat, the tedious and costly process for the further refining of the ore, consisting as it does of alternate roastings and smeltings, in addition to the great expense incurred at present in shipping the matte to such long distances, seem great incentives to the early erection of refining works, so that the ore could be fully treated on the spot. The proposition to build nickel steel

works was lately submitted to the Government by the Canadian Copper Company, and it is to be hoped that some satisfactory arrangement will be arrived at to give a further impetus to our present mining activity in this region.

"Nickel is a comparatively new metal for it was not recognized as an element till 1751, when Cronstedt, the Swedish mineralogist, in examining the ores of certain veins in the German copper mines made the discovery of the two new metals, nickel and cobalt, which names he retained as they were in use amongst the miners. Nickel in its pure state is silver white in colour, hard, tough, fusible with difficulty, and is susceptible to magnetism, although not to the same extent as iron. Its use in the industrial arts has rapidly increased since it has been produced in a pure state, as it formerly existed only as an impure alloy, and so could not be so suitable for the purposes for which it is now used. The demand has only grown at a moderate rate as compared with the growth and demand for other useful metals, and a decrease in price from $2.60 per pound in 1876 to the present price, which varies from 50 to 60 cents per pound, seems to have had no very important influence in increasing that demand. The supply of late years has been more than sufficient for the demand and new deposits have always been found in advance of any necessity for their product. The first chief demand for this metal was for making nickel or German silver as a substitute for the more precious metal in making spoons and forks and other ware in general for which silver had been previously used, and its whiteness and the facility with which it received and held the silver, after the process of what is known as electro-plating was introduced, cause it to be still more widely used. It is also made use of to plate iron, zinc, etc., and also in alloy with copper for the manufacture of small coins, which are used so extensively in the United States, Germany, Belgium and other countries. The proposition to use rolled nickel plate as an advance over ordinary tin plate, is one which is receiving attention at present. It has also been recommended for making nickel crucibles to replace those of silver used in chemical manipulations as they would cost less and have the great advantage of melting at a higher temperature. Markets and uses.

"Nickel plated kitchen utensils are coming into general use as in Germany, and as it is well known that acids have a more or less solvent action on nickel, an investigation was undertaken which showed that 7½ grains of nickel could be taken into the stomach and repeated for a long time without any noticeably bad effects. There is thus no ground for uneasiness in the use of such utensils, especially if the same precautions are used as in the case of copper vessels, namely, thoroughly cleaning them and avoiding the storing of food in them. The proposi-

Markets and uses.

tion to use nickel in alloy with steel to increase the strength and quality of the latter, will, if carried out, increase the consumption very materially, and all have been eager to know the result of the recent experiments undertaken at the instigation of the United States Government. A French invention has effected the means of regulating the composition of such an alloy, and subsequent experiments in Glasgow revealed the fact that this alloy could be made in any good open hearth furnace working at a fairly high temperature as wel las in the crucible. In obtaining a correct idea of the value or usefulness of alloys of nickel with iron or steel it should be borne in mind that the composition is complicated by manganese, carbon, silicon, sulphur and phosphorus whose influence must be carefully watched, requiring a long series of experiments. A comparison of steel alloyed with 4·7 per cent nickel raised the elastic limit from 16 up to 28 tons, and the breaking strain from 30 up to 40 tons, without impairing the elongation or contraction of area to any noticeable extent. A further gradual increase of hardness was noticed until 20 per cent is reached, when a change takes place, and successive additions of nickel tend to make the steel softer and more ductile. The alloys polish well, and the colour of the steel is lightened as the proportion of nickel increases. They do not corrode as readily as other steel. The 1 per cent nickel steels welds fairly well, but this property lessens with each addition of nickel. It can, therefore, be seen that considerable advantage may be expected from these alloys, especially where the percentage of nickel is less than five.

"The consumption of nickel and nickel alloy in the United States has increased from 294,000 pounds in 1880 to 421,000 pounds in 1888, while the total consumption of the world was estimated not to exceed 700 or 800 tons of the pure metal. The chief supply at present comes from New Caledonia, a penal colony of France (long. 165° E., S. lat. 22°). M. du Peloux states that the cost of production at this place could be so reduced that the company could sell at from 37 to 46 cents per pound, and yet have a good profit. Dr. Peters in his evidence before the Ontario Mining Commission states that the Canadian Copper Company could sell it from 25 to 30 cents per pound with a handsome profit. A commission appointed by the United States Government to examine the probable quantity of nickel in the Sudbury district has given a very glowing report to their government. It is highly probable, however, as can be seen from the above figures that our mines could supply the whole demand, even if the other sources of supply did not produce anything. It has been decided by the United States Government to make use of nickel steel armour plates, and already the contract has been awarded so that there is every prospect of a brilliant future for this

mining industry around Sudbury. In view of our immense deposits it will be necessary to increase its consumption in every possible direction."

Plant at Messrs. H. H. Vivian & Co's mine.

The plant at the works of Messrs. Vivian & Co. differs somewhat from the rest. The cupola blast furnace is water-jacketed below, but the upper part is of brick and the matte and slag flow out into a fixed forehearth built also of brick, instead of into a movable "well" as at the two other mines. A further difference lies in the fact that in order to minimise the loss of nickel in the slag the production of a much lower grade matte is aimed at, whose percentage is subsequently raised by a sort of Bessemerizing process. For this purpose the matte is run into barrel shaped Manhé converters mounted on wheels. These are run on tracks from the furnance, under a hood connected with a stack. Air is blown through the molten matte by means of tuyeres penetrating the lower part of the converter and a further proportion of the sulphur and iron is removed by oxidation, the latter by combining with the silicious material present forming slag. The converters are lined with fire-clay and fine quartz mixed. After the matte is sufficiently Bessemerized most of the slag is run off and the last of it is chipped off the surface of the concentrated matte produced.*

Exploration and discovery.

Besides those of the Sudbury district, reports of discoveries from numerous other points have been rife. Many of these reports have been ill-founded or unimportant, but two deserve special notice.

One of these is situated about two miles east of Schrieber Station on the Canadian Pacific Railway, where Messrs. Marks, of Port Arthur, have located what is said to be a large deposit similar to those at Sudbury.

New Brunswick.

The other is situated about three miles from the town of St. Stephen, in Charlotte county, New Brunswick. It is said to contain 3 to 4 per cent of nickel. A correspondent in that district writes us that it is a very large deposit and describes the enclosing rocks as highly altered sandstones, argillites and fine conglomerates, cut in all directions by dykes of trap, in which felspar and black mica are the prominent minerals. This locality is underlain by rock marked as of Cambro-Silurian age on the published maps of the survey, but which, it is believed, may contain areas of older rocks.

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*Mr. A. Merry, jr., who was for many years on the technical staff of Messrs. H. H. Vivian's Smelting Works at Swansea, England, and who was manager for the firm at Sudbury during the erection of the plant and inauguration of the works, makes the following comments, comparing the cupolas in use by the different companies:—

"There are two such cupolas, the one has a fixed 'forehearth' or 'well,' and the other is on wheels, though there is not much advantage in the latter as the former seldom requires more than slight repairs necessitating no greater delay than the time spent in blowing down to change the movable well on wheels. We have worked both systems for many years and this is the opinion on their comparison. The wells are built to suit the requirements of the converter which is not the case with the wells of the other companies who hitherto only smelted to cupola matte."

New Brunswick.

Mr. W. F. Best, of St. John, N.B., who is local Dominion Analyst, furnishes the following data. He says :—

"Samples were taken at about 17 feet from surface, and a New York chemist finds—

Sulphur	32·93
Iron	56·00
Copper	1·03
Nickel	2·04
Gold	Trace.
Silver	"
Insoluble residue	8·00
	100·00

"I have found as high as 2·48 per cent of nickel at nineteen feet from surface in pit No. 2." *

British Columbia.

The report of the Minister of Mines of British Columbia alludes to the existence of a deposit of nickel ore on the west bank of the Kootenay River in the Toad Mountain district. It is said a crosscut eight feet long failed to reach the wall of the deposit, thus proving it to have at least that thickness.

Outside of the Sudbury district the developments made on the deposits of ores of this metal have been slight, simply consisting of preliminary testing of the same.

Nickel City.

At Nickel City, near Whitefish Station on the Algoma branch, works are being erected, which it is hoped will be operating next year, where it is proposed to grind and then treat the ore by a special method, of which particulars could not be obtained, but which is said to be some sort of wet process, gold and silver ores being also dealt with.

Production.

There were shipped from this district, by rail, the following quantities of nickeliferous material :—

Matte	3,693 tons.
Ore	1,351 "

The amount of fine nickel in the matte, etc., produced and shipped during the year, by direct returns, came to 1,435,742 pounds, which, taken at the average market value of 65 cents per pound, is worth $933,232. As the above basis of valuation has been commented upon, it may be well to explain that it has been thought best to adopt it owing

* A sample subsequently collected from the deposit weighing about 75 pounds and consisting almost altogether of pyrrhotite, chalcopyrite being practically absent, has since been subjected to analysis in the Laboratory of the Geological Survey and found to contain nickel, 1·718, cobalt, 0·165 per cent, with 5·43 per cent of gangue matter. For further details regarding which see forthcoming Chemical Contributions to the Geology of Canada, Vol. V, Report of Geological Survey Department.

to its being in keeping with the practice commonly followed for the metals. It also recommends itself as the only method of attaining a common basis of valuation, when, as in the case of the metals, the material is shipped in such various stages of concentration or preparation. Of course, owing to the expense of the subsequent stages of extraction, the price obtainable for the metal in the matte would be much below the market price as given above for fine nickel, only counting about 13 cents per pound for the nickel and 6 cents per pound for the copper. Where no allowance is made by the buyers, the price given for the nickel would range from 22 to 24 cents per pound. Assuming then an average price of 23 cents, this would make the total value of all the matte shipped $330,220, or at 13 cents per pound, $186,646.

Imports into U.S.A. and prices.

We are indebted to the kindness of the Engineering and Mining Journal of New York for the following figures relating to prices, imports, etc., by the United States, the result of enquiries made by them. They point out with regard to price that as the nickel trade is conducted, the bulk of transactions are made for long periods and the spot business is small, so that it is impossible to show the actual condition of the markets at short intervals. However, during 1890 it ranged between 60 and 80 cents per pound. At the beginning of the year it was 60 cents and some large contracts were made at even slightly lower figures. The price reached 80 cents about the middle of the year and remained at that point until the financial troubles in November, after which it fell to 60 cents.

NICKEL.

TABLE 1.

IMPORTS BY THE UNITED STATES.

Imports of Nickel by the United States—Calendar Year 1890.

	Lbs.	
In ore and matte....	78,685	$ 20,683
Nickel, nickel in alloys, and nickel oxide.....	611,898	300,231
	690,583	320,914

NICKEL.

TABLE 2.

IMPORTS BY THE UNITED STATES.

Imports of Nickel by the United States—Fiscal Year ending 30th June, 1890.

			Lbs.	
In ore, matte and other crude forms, all from Canada.....			111,201	$ 11,687
Nickel, nickel in alloys and nickel oxide, from England.....			208,309	105,572
do	do	France.....	85,410	33,485
do	do	Germany..... ...	127,771	52,256
			532,691	203,000

Uses.

Besides the already mentioned uses a large demand should eventually arise for nickel steel, apart from its application to armour plate, in the general construction of ships and in many other directions, so that a market should grow up for this metal at fairly remunerative prices. It is hardly likely, however, that the price will keep very high, as apart from all the foreign deposits at present known to exist, there is every likelihood of the discovery of other important districts in Canada itself. The known areas of similar Huronian rocks are quite numerous and extensive, especially in the great Archæan region extending all the way from the coast of Labrador, along the northern side of the St. Lawrence and Ottawa River valleys and the north shores of Lakes Huron and Superior, to the edge of the younger rocks underlying the prairie sections of the west at Lake Manitoba, whilst the belt of Huronian rocks of the Sudbury district itself is known to extend a long way to the north-east. Whilst many of these areas are too far away to be sufficiently accessible for a long time, yet there are many which are well within reach of, or actually traversed by, the Canadian Pacific Railway. Whether the geological conditions favourable to the existence of nickeliferous pyrrhotite bodies, other than the existence of Huronian rocks, are there to be found, remains yet to be proved.

Probable supply.

We cannot say either that nickel-bearing ores are confined to this formation, so that many of the large bodies of pyrrhotite already known to exist in various places may on examination be found to carry the metal in workable quantities.

Considerable interest has been taken in this industry during the past year, owing to the prominence given to it in the newspapers, following on the successful trials of nickel steel for armour plate. This led to

renewed activity in prospecting, the subject being brought into further prominence by the visits of the allied societies of the British Iron and Steel Institute and the American Institute of Mining Engineers, on two successive occasions, to the Sudbury mines, which has led to a certain amount of acquisition of properties by outside capital.

The temporary withdrawal of the mineral lands from sale by the Ontario Government, and the proposed imposition of a royalty, has, however, toward the end of the year, caused somewhat of a lull in the activities of the Sudbury district.

PETROLEUM.

The only oil-producing territories in Canada during 1890 were as in previous years the Petrolia and Oil Springs fields, in the township of Enniskillen, Lambton county. Ontario.

No new developments are reported from this township, nor has the field been extended, though drilling operations are constantly being carried on, new wells being "brought in" to replace those abandoned. For a description of this field see report of the Division of Mineral Statistics and Mines for 1889, part S, Vol. IV, 1888-89.

In no other part of Ontario were drilling operations undertaken in search of oil, though it is said that in boring for gas at Comber, in Essex county, oil was obtained, though not in sufficient quantity to be of commercial value.

In Quebec operations were being carried on in the vicinity of Gaspé Basin though with what success was not ascertained. Quebec.

It is proposed to further investigate this district during the present year.

Oil has several times been reported as occurring in commercial quantities near Pointe aux Trembles. That there is no truth in the reports may be readily understood by the following words of Mr. A. P. Low, who during his investigations in that district, visited and thus reports upon the locality:—

"The indications of petroleum at Pointe aux Trembles were investigated; the Utica shales were there found to be highly impregnated with oil, but as the shale and limestone appear to form a synclinal basin in the Archæan valley, with only a few low, narrow anticlinal ridges, the possibility of a large collecting area for oil under the shales is doubtful."

An important discovery was made during the year in the South Kootenay Pass in Alberta and British Columbia, where oil was found occurring in natural springs, but in what quantity is not yet known. It is of a pale greenish yellow and appears to be of very light gravity, similar to the British Columbia.

celebrated Washington county crude oil of Pennsylvania. Very little is as yet known of this occurrence, though in all probability investigations will shortly be made.

North-West Territories.

Regarding the occurrence of tar sands and maltha deposits in the Athabasca region, Mr. R. G. McConnell, who carried on investigations in that district, in his summary report to the Director of the Survey, says:—

Athabasca, Tar-sands.

"The valley of the Athabasca for a hundred miles above Lake Athabasca shows only alluvial sands, and the boulder-clays associated with stratified sands and gravels. Beds of rolled tar-sand pebbles occur in the latter in a number of places. A coarse gravel bed which immediately underlies the surface, and overlies the boulder-clay was found to be completely saturated with soft tar. Ten miles below Calumet River the Devonian limestone rises to the surface of the valley from beneath the glacial beds and almost immediately afterwards is overlaid by the tar-bearing sands of the Cretaceous. From this point the Devonian limestones undulating at low angles, and accompanied by the tar-sands, are exposed at frequent intervals as far as Crooked Rapid, a distance of about eighty miles. At Crooked Rapid they become affected by a slight south-westerly dip and sink below the surface of the valley, and eight miles farther on, at Boiler Rapid, the tar-sands also disappear, and are replaced by higher divisions of the Cretaceous.

"The tar-sands mentioned above belong to the Dakota formation and constitute in this region the basal member of the Cretaceous system. They rest unconformably on the Devonian limestones. Lithologically they may be described as soft sandstone, the cementing material of which is a bitumen or inspissated petroleum derived from the underlying limestones. The sands are siliceous and usually rather fine-grained, but also grade occasionally into a coherent grit. The eastern boundry of the tar-sands was not precisely defined, but their outcrop was estimated to have a minimum distribution of fully 1,000 square miles. In thickness they vary from 150 to 225 feet. The tar is unequally distributed through the sands, in some places merely staining the grains, but in most of the sections examined it is present in sufficient quantity to render the whole mass more or less plastic. An analysis by Mr. Hoffmann of a specimen collected some years ago by Dr. Bell gave by weight:—

Bitumen	12·42
Water (mechanically mixed)	5·85
Siliceous sands	81·73

A cubic foot of the bituminous sand rock weighs, according to Mr. Hoffmann, 117·5 lbs. This figure multiplied by the percentage of bitumen, 12·42, gives 14·59 lbs. as the amount of bitumen present in a cubic foot,

or $\frac{14}{68}\cdot\frac{59}{7} = 22{\cdot}9$ per cent in bulk. At the minimum thickness of 150 feet, and assuming the distribution as given above at 1,000 square miles, the bituminous sand rock in sight amounts to 28·40 cubic miles. Of this mass, if the preceding analysis is taken as an average, although this is probably rather high, 22·9 per cent in bulk or 6·50 cubic miles is bitumen. This calculation can, of course, only be ragarded as an approximation, but will serve to give some idea of the enormous outpouring of bituminous substances which has taken place in this region. The amount of petroleum which must have issued from the underlying limestones required to produce 6·50 cubic miles of bitumen cannot be estimated, as the conditions of oxidation and the original composition of the oil are unknown. It must, however, have been much greater than the amount of bitumen. Athabasca tar-sands.

"A few miles west of the Athabasca the sand rock, still saturated with tar, passes below the higher divisions of the Cretaceous, and its extension in this direction can only be ascertained by boring. It was not recognized on Peace River nor on the lower part of Red River, and must disappear somewhere in the intervening region.

"In ascending the Athabasca the tar-sands, after an exposure of over twenty miles, pass below the surface at Boiler Rapid and are not seen again. Above this the upper divisions of the Cretaceous, influenced by a light south-westerly dip, and also by the grade of the stream descend gradually in the banks of the valley and disappear in succession. The Cretaceous section is as follows in descending order:—

		Feet.
Cretaceous.	Pierre shales	700
	Niobrara sand and sandstone	35
	Niobrara shales	90
	Niobrara sand and sandstone	300
	Benton shales	275
	Dakota tar-sands	175
		1,575
	Devonian limestone	

"The commercial value of the tar-sands themselves, as exposed at the surface, is at present uncertain. But the abundance of the material and the high percentage of bitumen which it contains makes it probable that it might, in the future, be profitably utilized for various purposes. It proves a flow of petroleum to the surface unequalled elsewhere in the world, but its more volatile constituents have long since disappeared, and the rocks from which it issued are probably exhausted. In their extension under cover, however, the case is different, and it is here that oils of economic value must be sought. Above Boiler Rapid the tar-sands

Athabasca tar-sands.

are overlaid by a cover of shales, sufficient to prevent the oil from rising to the surface, and as we ascend the river this cover gradually thickens. The geological attitude of the cover is not the most favourable, as the beds dip away from the outcrop at the rate of about six feet to the mile, and it is possible that part or even the whole of the oil may have flowed northwards and eastwards through the Dakota sands and escaped where these come to the surface. It is unlikely, however, that all the oil has escaped in this manner, as small anticlinals in the covering beds are almost certain to exist, and a differential hardening of the sands themselves may serve to enclose reservoirs or pools of large capacity. It is also possible that the sands at their outcrop, may, by the deposition of tarry substances, be plugged tightly enough to prevent further egress.

"Favourable indications of the presence of oil are afforded by the existence of several natural gas springs in the valley of the Athabasca above Boiler Rapid. One of these occurs at the mouth of Little Buffalo River and is twenty miles distant in a straight line from the outcrop of the tar-sands. The gas here forces its way from the sands up through a covering of 250 feet of Benton shales and issues from the surface in numerous small jets distributed over an area fifty feet or more in diameter. Some of the jets when lighted burn steadily until extinguished by heavy rains or strong wind, and afford sufficient heat to cook a camp meal. A second spring was noticed thirteen miles below the mouth of Pelican River, or forty miles in a straight line from the outcrop of the tar-sands at Boiler Rapid. The volume of gas escaping here is less than at the mouth of Little Buffalo River, and in order to reach the surface it is obliged to penetrate 570 feet of shales and sand. Escaping jets of gas were also noticed at several points further up the river, but these were mostly small and may possibly be due to decaying vegetable matter.

"The question of the continuity of the tar-sands, and their petroliferous character under cover, can only be settled in a decided manner by boring, and it is highly desirable that drilling operations should be undertaken for this purpose. The indications seem amply sufficient to warrant the small expenditure involved, and the advantages which would accrue from a successful issue of the search to this portion of the North-West are almost incalculable. The southern limit of the field cannot, without present knowledge or without boring, be defined; it may possibly extend to the Saskatchewan or beyond, as even as far as Manitoba the rocks are more or less petroliferous.

"Two bore holes, one at the mouth of Lac la Biche River, and the other at the mouth of the Pelican, would add largely to our knowledge of the underground geology of this region, and would either settle posi-

tively the question as to the presence or absence of petroleum in paying quantities, or at least afford valuable data for future action. At the mouth of the Pelican River, a bore hole, in order to reach the tar-sands, would require to be sunk 700 feet, and at the mouth of Lac la Biche River about 1,200 feet. The former locality is 50 miles distant in a straight line from the outcrop of tar-sand at Boiler Rapid. The latter is 106 miles distant from the same point, and is only 110 miles from Edmonton."

Statistics.—During 1890 there were twelve refineries in operation, eight of which are located in Petrolia, two in London, one in Sarnia and one in Hamilton, as follows :— Producers.

Imperial Oil Co	Petrolia.
M. J. Woodward & Co	do
John McDonald	do
Petrolia Oil Co	do
Consumers' Oil Co	do
McMillan, Kittridge & Co	do
Premier Oil Co	do
Jno. McMillan	do
Jno. R. Minhinnick	London.
W. Spencer & Co	do
Sarnia Oil Co	Sarnia.
Canadian Oil Co	Hamilton.

These refineries employ about 250 men in and about the works, and throughout the oil-producing territory there are about 2,000 men employed either directly or indirectly in the production of crude and refined oil. The wages paid for skilled labour in the production of refined oil are from $2.00 to $2.50 per day, while ordinary labour, in and around the refineries, is paid for at the rate of from $7.00 to $10.00 per week.

Apart from those engaged in the refining of oil there is quite a staff of drillers busily engaged throughout the year in sinking wells, of which about 400 are annually drilled, to replace a nearly similar number that are annually abandoned.

From returns made direct to this office there were 28,412,341 gallons, or 811,781 barrels, of crude oil received at the refineries, of which 28,267,746 gallons were consumed in the manufacture of the various products of petroleum, deducting from this a decrease in stocks of the tanking companies, amounting to 117,089 barrels, there is found to have been an approximate production of crude oil of 695,000 barrels, an Production.

increase, when compared with the figures of the year previous, obtained in the same manner, of 54,701 barrels.

These figures are, of a necessity, only approximate, as the change in stocks at the refineries, if any, was not obtained. At the average price of oil for the year, $1.18, the value of the above quantity of oil would be $820,100.

As in previous years, however, the production and value of oil as shown in the summary table of production is obtained by computation from the inspection returns of the Inland Revenue Department.

Tanking companies.

The tanking companies operating as such were:—

The Petrolia Crude Oil and Tanking Co., Petrolia; The Crown Warehousing Co., Petrolia; The Producers Tanking Co., Petrolia, all of whom have kindly furnished us with returns of the year's operations, of which the following is a résumé:—

Stocks, 1st January, 1890	213,772 $\frac{32}{35}$
Quantity of oil received	480,963 $\frac{8}{35}$
do delivered	598,052 $\frac{7}{35}$
Stocks, 1st January, 1891	96,683 $\frac{33}{35}$
Decrease of stocks during year	117,088 $\frac{34}{35}$

The returns of the several refineries above referred to give the following results:—

PETROLEUM.

TABLE 1.

PRODUCTION OF CANADIAN OIL REFINERIES.

Products.	1889.		1890.	
	Quantity.	Value.	Quantity.	Value.
Illuminating oils galls.	9,479,917	$1,084,829	11,129,277	$1,264,677
Benzine and naphtha "	409,135	34,861	636,247	37,026
Paraffine oils "	703,025	87,936	446,888	64,713
Gas oil "	2,917,346	65,954	4,246,447	84,752
Lubricating oils and tar "	2,191,881	96,407	2,877,388	130,349
Paraffine wax lbs.	561,820	44,197	913,730	56,903
Totals		$1,414,184		$1,638,420

PETROLEUM.

TABLE 2.

CONSUMPTION OF CRUDE OIL AND CHEMICALS.

Articles.	1889.	1890.
Crude petroleum..... ....galls.	25,066,275	28,267,746
Sulphuric acid.... . .....lbs.	3,638,704	4,284,826
Soda..... ... . "	380,487	336,758
Litharge .. .. "	477,969	443,922
Sulphur ..... "	76,325	85,729

Inspection returns.

The following figures and tables, 3 and 4, are taken from the books of the Inland Revenue Department, and show the number of packages of Canadian oil inspected during the calendar year 1890, as well as the total quantity of refined oil, imported and domestic, inspected during the *fiscal* years from 1881 to 1890, inclusive.

During 1890 the packages of Canadian oil inspected were:—

236,997 . ... @ 10 cents inspection fee
9..... @ 5 do do
44,186..... .... @ 2½ do do

Assuming that these packages contain 42, 10 and 5 gallons respectively, there is found to be an approximate inspection of

9,953,874 gallons in packages of 42 gallons each.
90 do do 10 do
220,930 do do 5 do

or a total inspection of 10,174,894 gallons.

This amount computed at an average percentage of the crude oil of 38 would be equivalent to a consumption of crude of 26,776,037 gallons, or 795,029$\frac{22}{35}$ barrels, which at the average price of crude oil during the year, $1.18 per barrel, would be valued at $902,734.

PETROLEUM.

TABLE 3.

CANADIAN OILS AND NAPHTHA INSPECTED AND CORRESPONDING QUANTITIES OF CRUDE OIL.

Fiscal Year.	Refined Oils Inspected.	Crude Equivalent Calculated.	Ratio of Crude to Refined.
	Galls.	Galls.	
1881	6,406,783	12,813,566	100 : 50
1882	5,910,787	13,134,993	100 : 45
1883	6,970,550	15,490,111	100 : 45
1884	7,656,011	19,140,027	100 : 40
1885	7,661,617	19,154,042	100 : 40
1886	8,149,472	21,445,979	100 : 38
1887	8,243,962	21,694,637	100 : 38
1888	9,545,895	25,120,776	100 : 38
1889	9,462,834	24,902,195	100 : 38
1890	10,121,210	26,634,763	100 : 38

In the following table (4) is given the total amount of illuminating oil, both domestic and imported, inspected during the fiscal years from 1881 to 1890, and represents the market for that product in Canada :—

PETROLEUM.

TABLE 4.

TOTAL AMOUNT OF OIL, IMPORTED AND CANADIAN, INSPECTED.

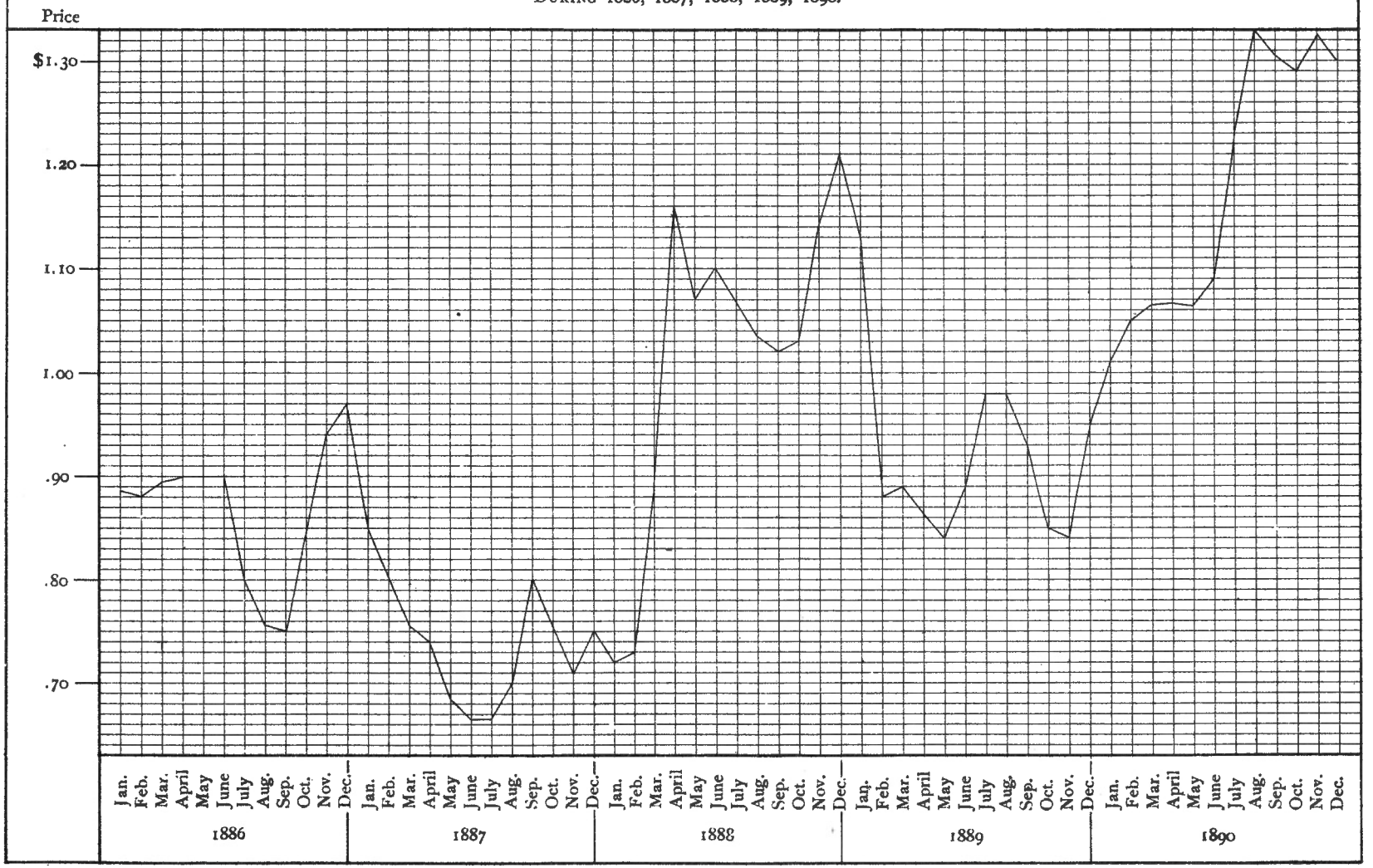
Fiscal Year.	Imported.	Canadian.	Total.
	Galls.	Galls.	Galls.
1881	476,784	6,406,783	6,883,567
1882	1,351,412	5,910,747	7,262,159
1883	1,190,828	6,970,550	8,161,378
1884	1,142,575	7,656,011	8,798,586
1885	1,278,115	7,661,617	8,939,732
1886	1,327,616	8,149,472	9,477,088
1887	1,665,604	8,243,962	9,909,566
1888	1,821,342	9,545,895	11,367,237
1889	1,767,812	9,462,834	11,230,646
1890	2,020,742	10,121,210	12,141,952

Prices. The following information regarding prices of crude oil has very kindly been furnished by Mr. James Kerr, and indicates the prices of crude oil as quoted on the Petrolia Oil Exchange :—

PETROLEUM

TABLE A

RANGE OF PRICE (AVERAGE CLOSING PRICE) OF CRUDE OIL
DURING 1886, 1887, 1888, 1889, 1890.



PETROLEUM.

TABLE 5.

PETROLIA OIL EXCHANGE, CRUDE PETROLEUM BUSINESS FOR THE YEAR 1890.

1890.	Opening Price.	Highest Price.	Lowest Price.	Closing Price.	Average Closing Price.	Sales. (Barrels.)
January	$1 01½	$1 03	$1 01¼	$1 02¼	$1 02	41,417
February	1 02¼	1 11	1 02	1 08½	1 06	43,872
March	1 08½	1 09½	1 05½	1 05½	1 07¼	31,494
April	1 07¾	1 10	1 06¼	1 08½	1 08	19,551
May	1 08	1 08	1 07	1 07½	1 07½	28,284
June	1 07¾	1 16	1 07¾	1 16	1 10¼	40,063
July	1 16	1 37	1 16	1 37	1 23	33,679
August	1 35½	1 35½	1 31	1 32	1 32¾	27,271
September	1 31⅝	1 31⅝	1 27¾	1 30¾	1 30½	32,047
October	1 31	1 32	1 28	1 28	1 29	36,822
November	1 28½	1 36¼	1 28½	1 35	1 32¾	27,600
December	1 35	1 35	1 27	1 30	1 30	32,824
Year 1890	1 01½	1 37	1 01¼	1 30	1 18	394,924
do 1889	1 21	1 21	80	1 01	92¾	400,932
do 1888	75½	1 23½	71	1 23	1 02¾	516,007

The following tables of exports and imports of oil are compiled from information obtained from the Customs Department and explain themselves:— Exports and imports.

PETROLEUM.

TABLE 6.

EXPORTS OF CANADIAN CRUDE AND REFINED PETROLEUM FROM 1873 TO 1890.

Calendar Year.	Gallons.	Value.
1873	5,869,579	$1,287,576
1874	28,946	2,509
1875	11,836	2,214
1876	2,533,772	583,550
1877	1,431,883	323,013
1878	609,171	85,571
1879	235,171	17,032
1880	3,085	751
1881	501	99
1882	1,119	286
1883	13,283	710
1884	1,098,090	30,168
1885	337,967	10,562
1886	241,716	9,855
1887	473,559	13,831
1888	196,602	74,542
1889	235,855	10,777
1890	420,492	18,154

PETROLEUM.

TABLE 7.

IMPORTS OF CRUDE AND REFINED PETROLEUM.

Fiscal Year.	Gallons.	Value.
1880	687,641	$131,359
1881	1,437,475	262,168
1882	3,007,702	398,031
1883	3,086,316	358,546
1884	3,160,282	380,082
1885	3,767,441	415,195
1886	3,819,146	421,836
1887	4,290,003	467,003
1888	4,523,056	408,025
1889	4,650,274	484,462
1890	5,075,650	515,852

Subtracting the quantities of imported oils inspected (table 4) from those shown in table 7, there is found to have been an annual importation of oil, crude, and other than illuminating, as is shown in the following table 8:—

PETROLEUM.

TABLE 8.

IMPORTS OF CRUDE AND MANUFACTURED OILS OTHER THAN ILLUMINATING.

Fiscal Year.	Gallons.
1881	960,691
1882	1,656,290
1883	1,895,488
1884	2,017,707
1885	2,489,326
1886	2,491,530
1887	2,624,399
1888	2,701,714
1889	2,882,462
1890	3,054,908

The imports of paraffine wax and paraffine wax candles are given in the following tables 9 and 10:— Paraffine wax.

PETROLEUM.

TABLE 9.

IMPORTS OF PARAFFINE WAX.

Fiscal Year.	Pounds.	Value.
1883.	43,716	$ 5,166
1884.	39,010	6,079
1885.	59,967	8,123
1886.	62,035	7,953
1887.	61,132	6,796
1888.	53,862	4,930
1889.	63,229	5,250
1890.	239,229	15,844

PETROLEUM. Paraffine wax candles.

TABLE 10.

IMPORTS OF PARAFFINE WAX CANDLES.

Fiscal Year.	Pounds.	Value.
1880.	10,445	$2,269
1881.	7,494	1,683
1882.	5,818	1,428
1883.	7,149	1,734
1884.	8,755	2,229
1885.	9,247	2,449
1886.	12,242	2,587
1887.	21,364	3,611
1888.	22,054	2,829
1889.	8,038	1,337
1890.	7,233	1,186

PHOSPHATE.

The production of this mineral for 1890, as shown by direct returns to this office, amounted to 31,753 tons, having a spot value of $361,045. These figures show an increase of 765 tons and $44,383 as compared with the figures of production for last year. Production

The yield of the two districts to the grand total is as follows:—

	No. of tons.	No. of Producers.
Quebec district	27,172	11
Ontario do	4,581	15

Exports.

The following tables, Nos. 1 and 2, explain themselves, graphic table A giving the total exports for the whole Dominion for this and past years:—

PHOSPHATE.

TABLE 1.

EXPORTS OF PHOSPHATE.

Year.	Ontario.		Quebec.	
	Tons.	Value.	Tons.	Value.
1878. ...	824	$12,278	9,919	$195,831
1879.....	1,842	20,565	6,6(4	101,470
1880.....	1,387	14,422	11.673	175,664
1881.....	2,471	36,117	9,497	182,339
1882.....	568	6,338	16,585	302,019
1883.	50	500	19,666	427,168
1884.....	763	8,890	20,946	415,350
1885..	434	5,962	28,535	490,331
1886.....	644	5,816	19,796	337,191
1887.	705	8,277	22,447	424,940
1888.....	2,643	30,247	16,133	268,362
1889....	3,547	38,833	26,440	355,935
1890..... . .	1,866	21,329	26,591	478,040

PHOSPHATE.

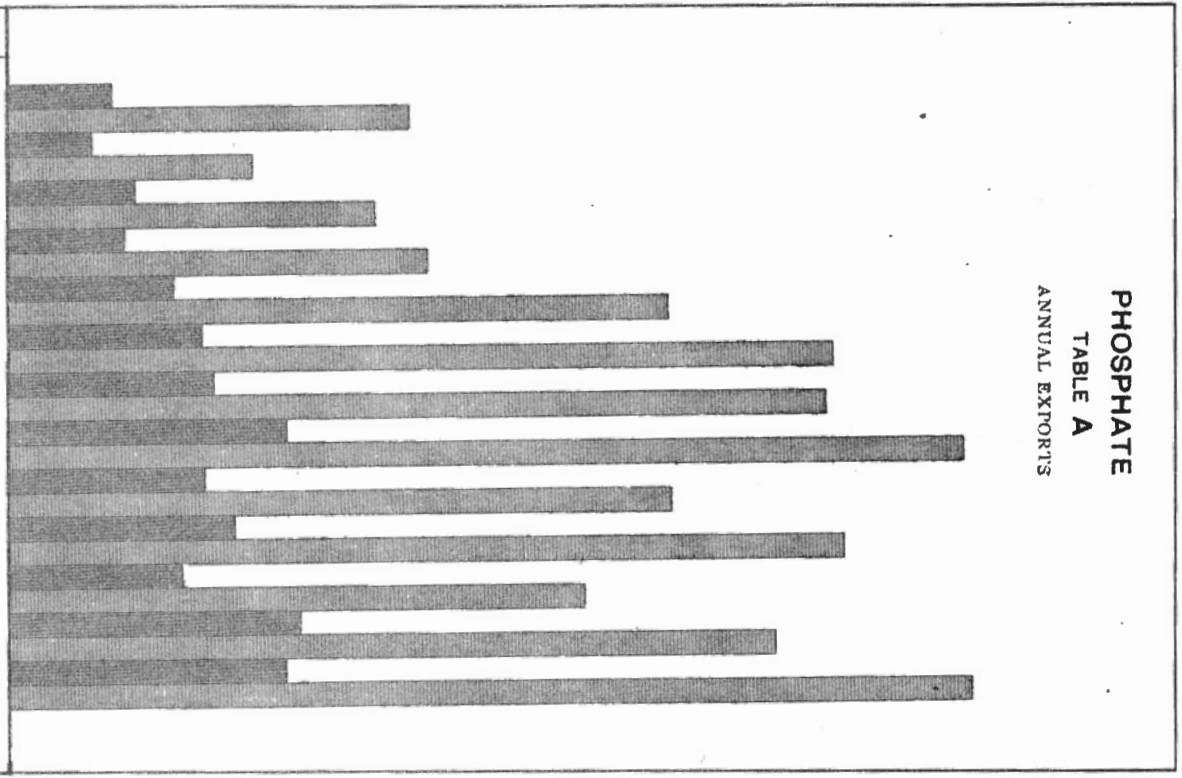
TABLE 2.

G. B. imports

GREAT BRITAIN: IMPORTS OF CANADIAN APATITE COMPARED WITH TOTAL IMPORTS OF PHOSPHATES IN THAT COUNTRY.

Year.	Canadian Apatite.		Total Phosphates.		Per cent of Value of Canadian Apatite to total Value.
	Long Tons	£ stg.	Long Tons	£ stg.	
1882.....	8,187	39,851	199,428	613,198	6·5 per cent.
1883.....	16,531	66,714	246,945	813,825	8·2 do
1884.....	15,716	52,370	219,225	643,851	8·1 do
1885.....	21,484	76,179	238,572	628,027	12·1 do
1886..	18,069	63,490	223,111	526,885	12·0 do
1887..... ...	19,194	65,974	283,415	614,088	10·7 do
1888.	12,423	42,291	257,886	544,919	7·7 do
1889..	23,123	71,037	304,953	703,704	10·1 do
1890.....	21,089	65,420	343,501	849,452	7·8 do

Year	Quantity	Value
	Tons	$
1878	10,743	208,109
1879	8,446	122,035
1880	13,060	190,086
1881	11,968	218,456
1882	17,153	338,357
1883	19,716	427,668
1884	21,709	424.240
1885	28,969	496,293
1886	20,440	343,007
1887	23,152	433,217
1888	18,776	298,609
1889	29,987	394,768
1890	28,457	499,369



PHOSPHATE
TABLE A
ANNUAL EXPORTS

The industry continues to be prosecuted as formerly in the two districts of Ottawa county, Quebec, and in that of Eastern Ontario. In these two districts the phosphate deposits are found in rocks of Laurentian age. Occurrence of deposits.

In the Ottawa county district these consist largely of gneisses, granitic gneisses with pyroxenite belts and considerable areas of crystalline limestone. The pyroxenite rocks are apparently intrusive in the gneissic rocks and all the phosphate deposits of importance occur in them. The gneissic rocks form the greater proportion of the area in which the working mines of this district are included and often merge into rocks having a similar mineralogical composition, but a granitic structure, the parallel arrangement of the minerals being entirely absent. Quebec.

The belts of pyroxenite run parallel with the general strike of the surrounding rocks, but at their contact show evidences of their intrusive nature and throughout them at places there are developments of a rock consisting almost altogether of somewhat coarsely crystallized felspar which frequently shows a peculiar violet or blue colour on the cleavage faces.

The phosphate bodies are distributed through these belts in the most irregular manner. Each one varying from the other in the details of its characteristics, showing in common, however, the feature of extreme irregularity. In a few instances they show a general extension of the phosphate in a plane which gives the openings made on them the appearance of having followed a vein, but there are no walls nor sharp planes of division which persist for any distance between the phosphate and enclosing rock. Most of the excavations made show the bodies of mineral to have been of extremely irregular shape; merging into the enclosing rock and holding a very varying proportion of intermixed rock. At places very large bodies of almost pure phosphate have been encountered, yielding many thousand tons.

The intermixed material consists, almost without exception, of pyroxenite, although some pits show considerable developments of pink calcite and at places a good proportion of pyrite distributed through the phosphate.

A survey of the group of mines belonging to the Phosphate of Lime Company and the Canadian Phosphate Company, all of which are on one belt, shows a long string of pits and openings and strippings of very varying dimensions, numbering probably 200 and covering a length of nearly two miles, the width of the strip being about ten chains. This pyroxene belt has a general strike of N. 50° W. passing through the Crown Hill mine, at its southern end and on to the High Rock and Star Hill mines. Further north, about a mile, are the openings known as the Central Lake

mine which also seems to be on an extension of this belt; it must therefore take a more northerly course, coming round to a strike of N. 25° W. Here, also, there are a number of openings extending on the belt for about three-quarters of a mile. Some work has also been prosecuted on the same belt south of the Crown Hill mine on the Ross Mountain, so that with these five mines we have a proved length of the belt of some four miles and a half with a possible continuation a mile further north to the High Falls mine of the General Phosphate Company, Limited.

The above constitute the largest connected group of mines of the district tributary to the River du Lièvre, on the west side of which they are situated, at a distance of about twenty miles above Buckingham village.

The other chief mines of this district are as follows:—

The North Star mine on the east side of the river near Tamo Lake and opposite the lower end of the High Rock belt, the output of which is carted a distance of about four miles to the river bank, to be shipped. The works at this place are concentrated within a length of about twenty chains on a narrow belt of pyroxenite about 120 feet wide striking N. 20° W. Here there are some fifteen or twenty openings of various dimensions, one shaft having attained a depth of about 600 feet. The surrounding rocks consist of distinctly banded gneisses with quartzite bands.

Passing down the river towards Buckingham we come to the group of mines in the vicinity of Little Rapids. Of these there were six working during the year. Five are on the east bank of the river, viz., the London and Little Rapids mines, near the Little Rapids locks, and the Emerald, Squaw Hill and Ætna mines, two miles and a half further down. The fourth, known as the Sprucé Lake mine, is about opposite the Emerald on the other side of the river, about four miles in from the same. The strike of the pyroxene belts here was not so fully worked out as those further up the river, but they range about N.E. and S.W. or roughly at right angles with the others. The London and Little Rapids mines seem to be on two parallel and adjacent belts, or what may on further study turn out to be one belt divided at this point by a "horse" of barren rock. The Emerald and Squaw Hill workings are close together, comprised within a radius of about five chains whilst the Ætna mine is about half a mile further inland, and would seem to be on the extension of the same belt.

The mode of occurrence of the phosphate at these places shows no features very strikingly different from those above enumerated, except at the Emerald Mine where for the amount of mineral yielded during

the working of the mine it has been concentrated in a very small compass, the hill in which it occurs being fairly honey-combed with extensive excavations.

All these mines bring their product to the River du Lièvre where it is loaded on large scows and towed down the river to Buckingham village. Here it is transhipped into railroad cars and taken thence over the Canadian Pacific Railway to Montreal.

The Templeton sub-district is adjacent to that of the River du Lièvre, but being the other side of the watershed of that river all its product is taken out to the Canadian Pacific Railway at East Templeton station.

Here there is a large area of pyroxenite, throughout which deposits of apatite seem to be plentifully distributed. The most extensively worked mine is that known formerly as the McLaurin and Blackburn property, now owned and operated by the Templeton District Phosphate Mining Syndicate, Limited, who are also opening up deposits at several other points in the vicinity. Here is the famous "Big Pit" out of which such large quantities of the mineral have been taken since the commencement of operations several years ago. Around it, within a radius of a mile, a number of other properties have been worked at various times during past years.

Chief amongst those in operation during 1890 are the following, viz.:— S. ½ lot 9, range XII. worked by Mr. Lewis McLaren, of Templeton; the E. ½ of lot 9, range X, worked by Mr. Falardeau; lot 9 in range IX, worked by Messrs. Courselles & Belcourt, of Ottawa, and lot 14, in range X, or the Pearson property, worked under the direction of Mr. Charles Lionais. The operations at most of these are of a preliminary nature, designed to open up and develop the properties.

In this locality the mode of occurrence of the phosphate is very similar to that of the district first described, although at the last named, Pearson property, the mineral occurs in a number of well-defined veins cutting the containing pyroxene rock. On a visit to the property there were seen several veins running north-east and south-west, which seemed persistent and regular, and were crossed by others striking W. N. W. These veins, as far as exposed, showed a filling of calcite, in which the apatite occurred being in the form of crystals where vugs had been uncovered.

In the Gatineau River district, to the west of the last named, a number of properties have been proved to carry phosphate deposits on which during former years a fair amount of work was done, but of late there is very little to report from there in the way of development.

The working mines in the Ontario district are situated mainly in that part of the county of Frontenac south of the Canadian Pacific line from Ontario.

Montreal to Toronto and tributary to the Kingston and Pembroke Railway, comprising the townships of Oso, Hinchinbrooke, Bedford, Loughboro' and Storrington. Some few places were also worked in the townships of North Burgess and South Sherbrooke, Lanark county and in North Crosby township, Leeds county. This district will be all comprised within the triangular area bounded on the south and east by the Rideau canal, on the north by the Canadian Pacific Railway and on the west by the Kingston and Pembroke Railway.

The geological conditions are in general similar to those already described for the Ottawa county district, similar Laurentian rocks being found to occur. The phosphate deposits, however, take more the shape of regular veins and much of it is extracted from the crystalline limestones.

Some activity in the matter of developing phosphate deposits is reported from near Carp village, in Carleton county, and from Sebastopol township, in Renfrew county.

Characteristics of Canadian apatite.

Canadian apatite is generally of a green colour of varying shades, although more rarely red. Its texture varies much, even in the same pocket or deposit from the crystalline or "rock phosphate" to the finely granular aggregates aptly called "sugar phosphate." The former has the advantage that in process of extraction it can be obtained clean, forming the best grade of "lump phosphate." The latter kind in blasting out gets broken up finely and is apt, on account of the intimate intermixture of foreign material, to be classed and shipped as "seconds."

The mineral both of the Ontario and Quebec districts belongs to the variety fluor apatite. A series of eight analyses made by the chemical branch of the Survey in 1878* gave the following proportions:—tribasic phosphate of lime, 88·138 per cent. to 89.810 per cent. One exceptional specimen, however, ranging as low as 74·295 per cent—fluorine from 3·311 per cent to 3·863 per cent with a little chlorine, carbonate of lime and other things. These specimens were selected so as to be as free as possible from mechanically intermixed impurities that they might represent the composition of the pure mineral itself.

Mining methods.

The mining methods adopted are quite simple, viz.: Opening up pits wherever phosphate is found outcropping on surface either of sufficient purity and extent to pay or where it is believed development may prove a sufficiently extensive body. If such does not prove to be the case, the working is of course abandoned, otherwise the pit is extended in every direction, following the body of mineral until exhausted or until

*See Report of Progress, Geological Survey of Canada, 1877-78.

the policy of the management points to the advisability of suspension of work in order to concentrate on some more profitable body. Mining methods.

Thus a phosphate "mine" presents the appearance of a number of pits of all sizes and shapes, mostly abandoned either permanently or temporarily and full of water, dotted irregularly all over the area of the phosphate-bearing belt comprised within the property of the company, amongst which at a few points active operations will be seen to be progressing. Owing to these facts mining operations must always be very irregular in their nature, nor can the economies due to a far-seeing arrangement of the work on a defined plan be secured, because the centre of operations is ever changing, and it is impossible to predict from month to month where it will be.

The larger operators use machine drills almost altogether, some few having large permanent air compressor plants supplying power over the whole property, by means of a system of pipes supplementing this at outlying points with machine drills worked from small portable boilers. Hoisting is done almost altogether by means of derricks erected and moved about as required, small portable steam or horse power hoists being used.

The material to be handled is considerable in comparison with the yield of pure phosphate, for whilst work may be carried on for short periods in almost solid mineral the average of a good pit will run nearer five of rock hoisted to one of phosphate and oftener near ten to one at the less profitable points. As the pits are generally working downwards the waste rock has all to be hoisted, forming the extensive "dumps" which are so noticeable a feature dotted all over a worked area.

The phosphate is cobbed and hand picked to free it from intermixed foreign matter and graded into "firsts" and "seconds." The "firsts" consist of the clean phosphate that can be picked out by hand, the "seconds" of the more finely divided material in which a certain amount of intermixed rock, etc., must be left, which it would not pay to pick out. The "firsts" will range from 75 to 85 per cent, and the "seconds" from 60 to 75 per cent of tribasic phosphate of lime. The cobbing is either done at the pit's mouth or in temporary sheds at convenient places in the vicinity, or, as with some of the larger mines, where the works are more concentrated and systematised, they have one or two central cobbing sheds, stove heated for winter work, to which the material is brought by tramways. The interior of one of these will show a large square table on to which the mineral is dumped from the car coming in above and around, which may be seen about 40 or 50 small boys busily hammering and sorting. Screening is used to a certain

extent in separating the more easily pulverized phosphate of the "seconds" from the associated rocky portion, which on account of their greater hardness or toughness form the larger particles.

Owing to the often intimate admixture of phosphate through the rock the waste from the cobbing sheds and the dumps at the pits still shows a considerable amount of the mineral, which, however, it would not pay to extract.

In the River du Lièvre district the larger mines have tramways of considerable length for bringing their product to the shipping point on the river bank, where they have complete wharfage arrangements for either the direct placing of the mineral in the scows or for its temporary storage. The subsequent methods of shipment have been already described.

The operators of the Templeton sub-district suffer from having to haul their product some eleven miles out to the railway, waggons being the only available means. This adds from $2 to $3 per ton to the cost of laying down at the shipping point.

In the Ontario district the material will be brought out to the Canadian Pacific and Kingston and Pembroke railways, or the Rideau canal by waggon and shipped, most of it going to Montreal to join that from the other districts.

Markets and uses.

Nearly all the phosphate shipped from Canada finds a market in continental Europe and Great Britain, where it is used by the manufacturers of superphosphate. Some little, however, is similarly used in Canada, at the works of Messrs. Brodie, at Smith's Falls, and Messrs. Nichols & Co., at Capelton, P.Q. The latter firm continues to manufacture chemical manures of various grades, using Canadian phosphate and acid from their own sulphuric acid works at that place. The home consumption would not, however, amount to more than 600 or 700 tons.

A small quantity which is exported to the United States consists mostly of the lower grade mineral which is ground at the mills at Buckingham station.

With regard to the general course of the industry outside of the change of ownership of some of the older mines, the main feature has been the formation of a large company in London, England, known as the General Phosphate Corporation, Limited, with the purpose of making extensive purchases of phosphate lands. Although disappointed in raising the whole of the capital asked for, several properties were acquired and operations commenced late in the fall at the Ross Mountain and High Falls mines in the River du Lièvre district, where, also, two other new companies operated during the year, viz., the Dominion

Mining Company, at the London mine, and the Anglo-Continental Guano Company, at the Squaw Hill and Ætna mines.

Outside the operations in the old districts there is little to report regarding discovery and development of phosphatic materials elsewhere, except to allude to an interesting occurrence mentioned in the Summary Report of the Director of the Geological Survey for 1890, which speaks as follows:—"A specimen of phosphatic shale collected by him (Mr. Tyrrell) from the Niobrara formation on Wilson River, on the Lake Dauphin Plain, in Manitoba, was given for analysis to Mr. Hoffmann, who reports that it contains 17·27 per cent of phosphoric acid, equivalent to 37·7 per cent of tribasic phosphate of lime. A very small outcropping of this shale which is largely composed of fragments of fish remains was seen in the bank of the river, but if the bed proves to be an extensive one it will furnish a very valuable source of supply of phosphate of lime for the benefit of Manitoba and the country further west, being very similar in character to the coprolite beds of England and France."

PYRITES.

Production.

The Canadian sulphur ore produced and used during the year amounted to 49,227 tons, which, taken at the current price of such ore for the year, *i. e.*, $2.50 per ton, would have a value of $12,067.50.

As in former years this production resulted from mining operations at the group of copper mines near Sherbrooke, P.Q., which have been fully described in the article on copper in this report.

A small proportion is used locally in the manufacture of acid at the works of Messrs. Nichols & Co., at Capelton, the rest all being shipped to the United States, where it is used for a similar purpose.

The amount of pyrites imported into that country during 1890, as given by the *Engineering and Mining Journal* of New York, was 115,000 tons, with an average of 43 per cent of sulphur.

The ore carries sulphur to the extent of 35 to 40 per cent, which is burnt off in the process of use, leaving only from 2 to 3 per cent in the residue.

In calculating from the returns received, only that portion of the ore shipped from these mines which was actually used in sulphuric acid manufacture, was included in the above total.

The ores of nickel and copper mined at Sudbury represent of course a very considerable amount of sulphur, but none of it becomes available for any useful purpose, being all dissipated into the surrounding atmosphere in the process of heap-roasting adopted, it having been decided after consideration of the subject by some of the companies that their

ends would be better served than by erecting the very extensive and costly plant, which would be necessary to handle such large quantities of ore and utilize their sulphur contents, the profitable result of such a proceeding being also open to considerable doubt.

Imports.

The following table (No. 1) gives the imports of brimstone and crude sulphur, and illustrates the Canadian market for the same, which it is hoped may eventually be supplied, at all events partially, by pyrites of home production :—

PYRITES.

TABLE 1.

IMPORTS: BRIMSTONE OR CRUDE SULPHUR.

Fiscal Year.	Pounds.	Value.
1880	1,775,489	$27,401
1881	2,118,720	33,956
1882	2,375,821	40,329
1883	2,336,085	36,737
1884	2,195,735	37,463
1885	2,248,986	35,043
1886	2,922,043	43,651
1887	3,103,644	38,750
1888	2,048,812	25,318
1889	2,427,510	34,006
1890	4,440,799	44,276

SALT.

Returns of the production of salt are, as in previous years, made from Ontario and New Brunswick, and show a marked increase over the figures given for the year 1889. Outside of these two provinces no salt is made except in Manitoba and the North-West Territories where it is produced in small quantities by the Indians.

Ontario.

In Ontario the salt is obtained from beds at or near the base of the Onondaga formation, where it occurs inter-stratified with marls, dolomites and shales.

The following record of a boring made by Mr. H. Attrill, at Goderich, in 1876* may be taken as an index to the general character of the wells, which are sunk to various depths, ranging from 1,000 to 1,500 feet :—

	Feet.	Inches.
Surface deposits	78	9
Dolomite with thin limestone layers	278	3
Limestone, with corals, chert and beds of dolomite	276	0
Dolomite with seams of gypsum	243	0

*See Report of Progress, Geological Survey of Canada, 1876-77, pp. 226 227.

	Feet.	Inches.
Variegated marls with beds of dolomite...	121	0
Rock salt, first bed.....	30	11
Dolomite with marls towards the base.....	32	1
Rock salt, second bed.....	25	4
Dolomite.....	6	10
Rock salt, third bed.....	34	10
Marls with dolomite and anhydrite.....	80	7
Rock salt, fourth bed.	15	5
Dolomite and anhydrite.....	7	0
Rock salt, fifth bed.....	13	6
Marls, soft, with anhydrite.....	135	6
Rock salt, sixth bed.....	6	0
Marls, soft, with dolomite and anhydrite...	132	0
Total depth.....	1,517	0

It will be seen on reference to the above section that there is in a distance of 520 feet a total thickness of 126 feet of rock salt.

The salt is obtained in the form of brine, in most cases of full saturation, the natural waters of the well acting as a solvent upon the salt beds.

The brine so formed is pumped into settling tanks, from whence there is a constant stream feeding the evaporating pans. By reason of the gradual dissolving away of the salt at the base of the well large cavities are formed into which the rocks constituting the roof of the cavity are continually falling, where owing to their marly and clayey composition they are in a measure taken into mechanical suspension and pumped into the evaporating pans causing a slight falling off in the purity of the salt.

Analysis of Goderich salt.

Regarding the quality of salt obtainable in Ontario, the following analysis conducted by Dr. T. Sterry Hunt, may not prove uninteresting.

The salt chosen for examination was from the second bed in Mr. Attrill's well and gave the following results:—

Sodium chloride.....	99·687
Calcium do	0·032
Magnesium do	0·095
Sulphate of lime.....	0·090
Insoluble in water.....	0·017
Moisture.....	0·079
	100·000

Analysis of Cheshire salt.

Dr. Hunt in the report of the Geological Survey, 1876–77, compares this analysis with one made of the famous Cheshire rock salt in 1872, the salt chosen for comparison being "crushed Marston rock salt" manufactured by Messrs. Fletcher & Rigby.

The analysis shows a proportion of foreign matter equivalent to 2·67 per cent, as follows:—

Sodium chloride	96·70
Calcium do	0·68
Magnesium do	Trace
Potassium do	——
Sulphate of lime	0·25
Insoluble matter	1·74
Moisture	0·63
	100·00

Comparison of various salts.

Again in the same report Dr. Hunt gives the following list of salts containing impurities, with the amount of foreign matter found in each respectively:—

Cheshire salt (analysis above)	2·67	per cent.
Cordova, Spain, salt	1·45	do
Turk's Island salt	2·34	do
Saginaw salt	2·00	do
Syracuse solar salt	1·15	do
do boiled salt	1·50	do
Goderich coarse salt (analysis made in 1871)	1·09	do
Goderich medium salt	1·28	do
do fine salt	1·62	do

It will be seen, therefore, that the salt produced in Ontario is of superior quality, ranging in amount of contained foreign matter from 1·09 per cent to 1·62 per cent, or an average of about 1·36 per cent.

No boring operations in search of salt were made during the past year, the only new feature in the trade being the erection of a block at Parkhill by Messrs. Hutchins & Co.

It is intended to make use of a well sunk some years ago by the Parkhill Salt Company, which, owing to the low price of salt prevailing at the time, was never put into service.

Producers Ontario.

The operators during 1890 were:—

Courtright	Courtright Salt Company.
Parkhill	Hutchins & Company.
Port Franks	Jos. Williams.
Exeter	Exeter Salt Works Company.
Hensall	Geo. McEwen.
Clinton	Henry Ransford.
Goderich	N. A. Chemical Company.
do	Ogilvies & Hutchison.
do	Peter McEwen.
do	Jos. Kidd, jr.
Warwick	Elarton Salt Works Company.
Wingham	Grey, Young & Sparling Co.
Blyth	do do
Kincardine	L. Rightmeyer.
do	Ontario People's Salt Company.
Brussels	T. T. Coleman.

During 1890 the industry was on a better footing than for the past few years, owing to the formation of a trust or combine of the various manufacturers under the title of the "Canada Salt Association." A similar association was in existence from 1882 to 1885, when owing to dissension among the members, it was dissolved in the end of March, 1885. In the interregnum between that date and 1890 the industry fell off greatly, many of the works being closed, if not for the whole period, at least for a very considerable portion of each year.

The industry, notwithstanding the efforts of the producers, suffers greatly from its competition with English salt, which is admitted duty free.

In the report of this Division for 1886, this point is alluded to as follows: "Another thing which militates against the Canadian salt industr is the competition of English salt coming in duty free, and with discriminatory freight rates in its favour. Even were this removed, there would remain the natural disadvantage of the distance of the chief market for salt in the Dominion, *i.e.*, the sea fisheries, from the centre of production, the cost of carrying the salt over such long distances doubling, or more than doubling, its price at the point of consumption. The discrimination mentioned in favour of the competing English salt arises from the fact that both the railways and steamship lines can afford to carry material moving west at a very much lower rate than that moving east. In fact, a large quantity of English salt comes out to Montreal as ballast, paying either none or a mere nominal freight charge."

New Brunswick.

In New Brunswick the salt production is as in previous years the result of the operations of the Messrs. Heinrichs, at Plumweseep, near Sussex, King's county, where a brine is obtained from natural springs that affords a very superior quality of dairy salt; the output being only sold locally and as such.

Production.

The quantity of salt produced during the year 1890 was 43,754 tons, having a net value of $198,897, an increase over last year of 10,922 tons and $69,350.

The production for the past five years is given below:

1886.....	62,359	tons,	valued at.....	$227,195
1887.....	60,173	do	do	166,394
1888.....	59,070	do	do	185,460
1889.....	32,832	do	do	128,547
1890.....	43,754	do	do	198,897

Exports and imports.

In the following tables will be found the exports and imports for the past eleven years:

SALT.

TABLE 1.

EXPORTS.

Year.	Bushels.	Value.
1880.....	467,641	$46,211
1881.....	343,208	44,627
1882.....	181,758	18,350
1883.....	199,733	19,492
1884.....	167,029	15,291
1885.....	246,794	18,756
1886.....	224,943	16,886
1887.....	154,045	11,526
1888.....	15,251	3,987
1889.....	8,557	2,390
1890.....	6,605	1,667

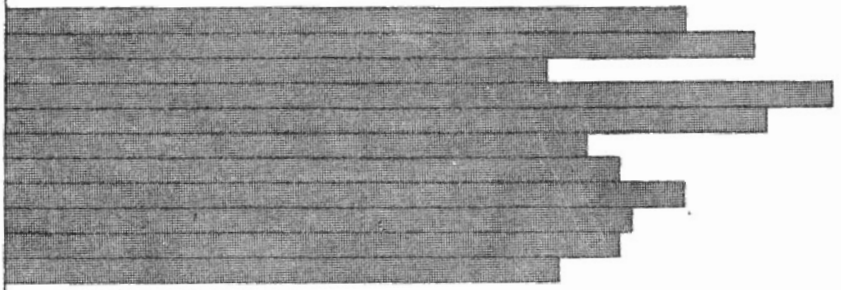
SALT.

TABLE 2.

IMPORTS: SALT PAYING DUTY.

Fiscal Year.	Pounds.	Value.
1880.....	726,640	$ 3,916
1881.....	2,588,465	6,355
1882.....	3,679,415	12,318
1883.....	12,136,968	36,223
1884.....	12,770,950	38,949
1885.....	10,397,761	31,726
1886.....	12,266,021	39,181
1887.....	10,413,258	35,670
1888.....	10,509,799	32,136
1889.....	11,190,088	38,968
1890.....	15,135,109	57,549

Fiscal Year	Tons
1880	106,720
1881	117,115
1882	84,932
1883	129,442
1884	119,081
1885	90,984
1886	96,236
1887	106,728
1888	97,338
1889	96,019
1890	86,813



SALT

TABLE A

IMPORTS OF SALT ALL SORTS.

SALT.

TABLE 3.

IMPORTS: SALT NOT PAYING DUTY.

Fiscal Year.	Pounds.	Value.
1880	212,714,747	$400,167
1881	231,640,610	488,278
1882	166,183,962	311,489
1883	246,747,113	386,144
1884	225,390,121	321,243
1885	171,571,209	255,719
1886	180,205,949	255,359
1887	203,042,332	285,455
1888	184,166,986	220,975
1889	180,847,800	253,009
1890	158,490,075	252,291

In the graphic table "A" opposite is given the total quantity of salt imported for the past eleven years, the quantity being given in tons.

SILVER.

The total production of this metal for 1890 was 400,687 ounces, valued at $420,722, as compared with 383,318 ounces, valued at $343,848 for 1889. This represents an increase of 17,369 ounces and $76,814. Production.

The following table gives the relative contributions of the different provinces to the total for the past four years, as given in previous reports, all showing an increase:—

SILVER.

TABLE 1.

PRODUCTION OF SILVER.

Year.	Ontario.		Quebec.		British Columbia.		Total.	
	Ozs.	Value.	Ozs.	Value.	Ozs.	Value.	Ozs.	Value.
		$		$		$		$
1887	190,495	190,495	146,898	146,898	11,937	11,937	349,330	349,330
1888	208,064	208,064	149,388	149,388	37,925	37,925	395,377	395,377
1889	181,609	162,309	148,517	133,666	53,192	47,873	383,318	343,848
1890	158,715	166,652	171,545	180,122	70,427	73,948	400,687	420,722

The record of the progress and development in the various provinces during the year is given below.

There is nothing much to note with regard to this province. The return given represents, as formerly, the silver contents of the pyritous Quebec.

ores shipped from the mines in the vicinity of Capelton in the Eastern Townships district of Quebec. A gratifying addition was also made in the shipments of argentiferous galena from the Temiscamingue Mine up the Ottawa River. Further particulars regarding these two districts will be found in the articles on Copper and Lead.

Ontario

The silver from this province is, as formerly, the product of the mines in the vicinity of Thunder Bay, Lake Superior. As this district has been fully described in Part H, Vol. 1887-1888, and also alluded to in Parts S., Vols. 1886, 1887 and 1888, there will be no need to give the details of the mode of occurrence of the veins here.

The mines working at present are in two groups situated at distances of 20 and 32 miles from Port Arthur, on a line extending W. S. W. from that place. The chief producing mines of these two groups, known respectively as the Rabbit Mountain and Silver Mountain districts, are the Beaver, Badger and Porcupine mines in the former, and the Shuniah-Weachu and West End mines at Silver Mountain. Prospecting and development work has been prosecuted on a number of properties throughout the district as follows:—In the region north and west of Whitefish Lake preliminary work has been done on a number of properties as far west as Arrow Lake. In the Silver Mountain district work was prosecuted on the Crown Point, Silver Centre (R. 64) and Augusta properties, the latter being immediately west of the West End mine. In the Rabbit Mountain district some half dozen properties were working outside of the three producing mines, whilst further east in the township of Paipoonge, Neebing and McIntyre and east of Port Arthur along the line of the Canadian Pacific Railway, small forces of men have been at work on several properties.

A certain amount of work has also been prosecuted in testing veins at the headwaters of the Pine River, south of Silver Mountain, and at Cloud Lake towards the centre of the area of these silver-bearing rocks. These experiments are specially interesting, as they are in a part of the district which has been comparatively unexplored, owing to its inaccessibility, but where, for geological reasons, any veins found might be expected to have as good a chance of proving rich as in the other parts of the district. In fact, the greater thickness of the favourable black slates, which there is reason to believe will be found to characterise this vicinity would assure the favourable character of one set of the conditions necessary for the existence of payable ore in any fissures that may be discovered there.

The developments on the chief mines begin to assume considerable proportions. The No. 3 shaft at the Shuniah-Weachu mine, Silver Mountain, is said to be down 800 feet, whilst the greatest depth attained,

so far, at the other end of the same vein, is said to be 225 feet in one of the shafts of the West End mine. Of the Rabbit Mountain group the most extensive developments are to be found at the Beaver mine which has attained a depth of 600 feet. These depths are, of course, measured from the tops of the shafts which are at various levels.

British Columbia.

It will be noted that the amount of silver produced and shipped from this province still continues to show an increase which amounts to 17,235 ozs., and $26,075 as compared with last year. These figures do not seem to be very exact, as the Report of the Minister of Mines for British Columbia, from which they were taken, states that they represent 110 tons of ore, valued at $409 per ton for both silver and copper, but that the relative value of each metal has not been made known. Thus this item may represent the value of a certain amount of copper.

The total amount of the silver produced as yet is not, of course, large, but from the promising nature of the districts, as reported by Dr. Selwyn, Dr. G. M. Dawson and other reliable authorities, there can be no doubt but that with the advent of better means of communication they will speedily become large contributors to the silver production of the country.

The districts of East and West Kootenay and Yale, constituting that part of the province bounded on the west and north by the Canadian Pacific Railway, on the east by the interprovincial and on the south by the international boundary, include the chief discoveries of silver, copper and lead bearing veins at present made.

The chief centres of activity at present lie in the Toad Mountain, Hot Springs or Ainsworth and Hendryx camps and the Illecillewaet subdivision of the West Kootenay district and the Cherry Creek and Rock Creek camps of the Yale district.

As mentioned in the articles on gold and copper, these veins so often show an intimate association of the ores of all these metals that it is impossible to definitely classify them under either one head or the other, so that for convenience the information about them is given here.

The silver produced in the province as above given was all the result of operations on the Toad Mountain and Hot Springs groups of veins.

The reports of the progress of mining in the various districts are reproduced below from the report of the Minister of Mines of the province for 1890.

The silver veins of East and West Kootenay are mentioned as follows :—

"*Illecillewaet Subdivision.*—Under the able superintendence of Mr. Jas. Brady, C.E., the tunnel in the Lanark is now over 500 feet long, 300 feet of which was completed this season. The lode in this claim is from

British Columbia.

2½ to 5 feet wide and of a high grade character. Sixteen car loads, shipped some three or four years ago, returned in silver alone 89 oz. to the ton. The company has expended a large amount of money in developing its property and is deserving of the utmost success.

"The Maple Leaf has two shafts sunk, one at the upper end of the claim 35 feet deep, the other at the lower extremity, 45 feet. The vein is 4½ feet wide. Returns from a previous shipment yielded 90 oz. in silver, $\frac{175}{1000}$ oz. gold, and 28 per cent lead. The Crystal adjoins the Maple Leaf on the west. In performing the assessment work on this claim last summer a solid body of good ore was struck, the width of which was not ascertained. A shipment of ore will be made to the sampling works to test its value.

"The Oak Leaf is owned by Messrs. Jowett and Haig, and with more work will probably become a valuable property. The vein is 2 feet wide, composed of galena in a slate formation. Assays range from 45 to 200 oz. of silver to the ton, and from 50 to 60 per cent lead.

"The Cariboo Company have extended their tunnel 100 feet farther this summer. The vein is galena, lying between walls of porphyry, and varies from 6 to 12 feet in width. The assay value is $30 per ton. This claim shows a large body of ore, which can be made very profitable on being provided with cheap transportation to the railway.

"The Gladstone is owned by Messrs. McArthur and Kennedy, of Illecillewaet. A shaft has been sunk 20 feet, and a tunnel run on the vein 30 feet; width of lode from 18 to 30 inches. The ore is of a high grade character. About 20 tons is on the dump ready for transportation by mule train.

"On Gold Hill are located the Cora, Spanish Fly, Crown Point, Vulture and some others. They are situated in a depression, about 12,000 feet long, which extends across the mountain. The vein matter is lead carbonates from 6 to 12 feet wide, possessing an assay value of 20 oz. in silver to the ton. A trail was constructed by the Government last summer, which starts from a point on the Cariboo Creek trail, about two miles east of Illecillewaet, and terminates at the above group of mines, a distance of about 5½ miles. This improvement will prove a great assistance to mining operations in that direction.

"The Goat Cave is located south of the railway track, back of the town of Illecillewaet, on the steep slope of a mountain. A specimen of the ore yielded an assay amounting to 120½ oz. in silver and 63 per cent lead. A tunnel is in about 20 feet on the lode, which is composed of quartz and galena. One half of the claim was sold last fall by the proprietors, Messrs. Scott and Chisholm, to Mr. Sando, of London, England. I did

not learn the amount, but one of the conditions is that the sum of $4,000 be expended by the purchaser in development. British Columbia.

"At Albert Cañon, the Wild Fox, owned by Abrahamson Bros., of Revelstoke, has a tunnel 47 feet long; vein matter is galena, 3 feet wide; assay value 22 oz. silver to the ton, and 47 per cent lead. There are two other locations of the same character upon which insufficient work has been accomplished to determine their value.

"It is a matter of surprise to every one that the Illecillewaet subdivision has not attracted more attention from capitalists and mining men in general. Many of the veins are rich and well defined, exhibiting large bodies of ore, and possessing the great advantage of being situated within easy reach of a railway, and, in some instances, quite close to this means of transportation. It is, therefore, not owing to the absence of any of these features that development has not been more actively prosecuted, but to the fact that here and elsewhere the majority of mine owners cannot afford the heavy expenditure required for that purpose, and they demand too high a price for their property to secure the investment of capital. Some of the richest mining sections in the adjoining States have experienced similar periods of depression, ascribed to the same cause, until the capitalist was offered sufficient inducements to come to their rescue. It is evident that a more liberal course will have to be pursued to attain the benefit of the great wealth lying dormant by this means in the principal mining districts of the province.

"*Fish Creek.*—The Dunvegan mine, which looked so promising last year, has remained idle since spring. The Kootenay Smelting and Trading Syndicate had it bonded for the sum of $60,000 for three months. After the expiration of that time a further extension was demanded but refused, and work was discontinued.

"The Mogul is an extension of the Dunvegan. It has a drift in the ledge 23 feet, exposing a fair body of high grade ore of the same character as that found in the last-mentioned claim.

"*East Arm, Upper Arrow Lake.*—With the exception of assessment work little has been accomplished on the locations, about a dozen in number. The Kootenay Smelting Company have done some drifting on one of their claims without satisfactory results. The ore is rich, but the vein is broken and difficult to trace.

"*Lardeau River Country.*—On the 29th of September J. W. Haskins recorded at the Revelstoke office five mineral claims discovered by him in the Lardeau country. They are situated about six miles east of Trout Lake, and, judging by the assays, indicate the existence of a rich mineral belt in that direction. Specimens from the different claims were assayed

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by Mr. Rosser, the assayer for the Smelting Works, and gave the following returns :—Alice, 1st assay, 10 oz. gold, 50 oz. silver, 72 per cent lead, to the ton; 2nd assay, from different portions of the vein, 20 oz. silver, trace of gold, 40 per cent lead. Homestake, 0·86 oz. gold, 102 oz. silver, to the ton, 16 per cent lead; 2nd assay, from another portion of the lode, 75 oz. silver to the ton. Copper King, 11 oz. silver; no assay made to ascertain percentage of copper. Clara, 31 oz. silver to the ton; traces of gold.

"The discoverer, during an absence of several months, explored Fish Creek and the mountain ranges bordering on that stream, without finding anything worthy of attention. East of the lake mentioned, however, he detected the presence of mineral indications, which he followed, and led to the discovery of these ore deposits. The veins average from 2½ to 3 feet wide, and are about 18 miles from the head of navigation on the East Arm."

"*Toad Mountain Subdivision.*—On the west side of Cottonwood Creek, about three miles south of Nelson, is an important group of locations which will prove profitable to their owners when in a position to make shipments. The vein is between four and five feet wide, possessing an average assay value of $30 to the ton. The ore is capable of being concentrated. A shaft is sunk on the Lizzie Co. 38 feet deep, and one on the Umatilla and Uncle Sam, 40 feet. A drift has also been run on the two latter claims. These mines are well situated for transportation facilities.

"On the Sandy Creek slope of the mountain are some important locations, among which are the Toughnut and Evening. On the former a shaft has been sunk 80 feet, and a tunnel run 127 feet. The vein is from four to eight feet wide, and contains ore of a high grade character. This mine will be an ore producer next summer. A tunnel has been run in the Evening, which is an extension of the Toughnut, a distance of 137 feet, in addition to an incline 65 feet.

"On the Give Out slope are a number of mines, the principal ones being the following:—The Jim Crow, with a shaft 25 feet deep; the Dandy, a shaft 40 feet deep, which will be sunk to a depth of 100 feet this winter. The lode in this claim is changing from galena to grey copper, which returns high assays. The Grizzly Bear is opened up by a shaft 68 feet deep. The Iroquois, a tunnel 90 feet long. The Give Out, a shaft 30 feet. The Newmarket, a shaft 40 feet deep.

"All the foregoing mines show excellent bodies of ore of a high or medium grade character, which will be industriously worked with the advent of cheap transportation.

"The celebrated Hall mines, comprising the Silver King, Kootenay Bonanza, and American Flag, are situated on the summit of Toad Mountain. They would have employed a large number of men last summer had it not been for the litigation in which they were involved. The tunnel in the Silver King is 330 feet long, in which are employed fourteen men. A large quantity of ore is on the dump awaiting the completion of the waggon road for shipment. One hundred and ten tons of ore were forwarded last fall from this mine to Helena, Montana. It was taken from a cross-cut at the bottom of the incline, and sampled from $404 to $414 to the ton in silver and copper. British Columbia.

"On the north side of the Kootenay River, the Alaska, a late discovery, is located on a ledge over 30 feet wide, existing in a granite formation. The vein matter consists of dolomite, carrying galena and copper pyrites. The returns from the assays have not yet been learned.

"Assessment work merely has been done on the Copper Queen and other claims situated on the same side of the river.

"*Hot Springs Subdivision.*—Development in this subdivision has been prosecuted with diligence in the principal mines. The Skyline forwarded last fall 95 tons of ore to the smelter at Anaconda, which sampled 280 ounces of silver to the ton. An engine has been erected for pumping and hoisting purposes, and a shaft-house 70 by 31 feet. A contract for sinking 200 feet has been awarded, besides 200 feet of cross-cutting and drifting. A pack trail has been graded from the waggon road to the mine, a distance of 10 miles. The Union has an engine erected on the ground, and will sink to a depth of 200 feet. The Krao has also pumping and hoisting works about ready for operation. The Number One Company have struck the vein within fifteen feet of the bottom of their old incline. The ore is high grade and averages nearly four feet of solid ore. This claim was formerly considered a failure, but additional work has proved it to be one of the best locations in the camp. The lode will now be tapped and prepared for stoping.

"The Little Donald has changed hands, Mr. Stevens, of Spokane Falls, being the purchaser. This year a deep tunnel will be started provided with the best improved machinery for the purpose.

"The Crescent, Eden, Tenderfoot, Vancouver, Old Timer and Neosha Companies have all within a few weeks struck bodies of rich ore, carrying native silver, and are sacking it for shipment. The Old Timer and Tenderfoot cover the intervening ground between the United and Krao, and demonstrate the permanent character of the ore body that extends through this mineral belt.

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"The Maestro, Spokane, and Libby Companies are to drive their tunnels this winter. These claims are certain to develop into first-class properties. The contract for work on the Gallagher will be given this winter. The following work has been accomplished on the undermentioned mines:—

	Feet.
Skyline, incline and drifts	490
United, shaft	60
Gallagher, shaft and drifts	220
Krao, shaft and drifts	350
Fourth of July, tunnel and drifts	100
Union, shaft	85
Arkansas, shaft	50
Spokane, tunnel and drifts	350
Maestro, tunnel and drifts	260
Lady of the Lake, tunnel	60
Dictator, tunnel and drifts	200
Number One, tunnel and drifts	1,200
Lakeview, shaft	25
Little Donald, shaft and drifts	250
Black Chief, tunnel	30
Pataha, tunnel and drifts	120

Besides many others having shafts and tunnels from 30 to 50 feet.

"The intrusion of a 'horse' in the Union shaft for a time prevented satisfactory results. Since then the vein has assumed its proper position, and now looks as well as ever.

"The amounts of ore on the dump ready for shipment, which will be largely increased during this winter, are as follows:—The Skyline, 1,000 tons that will return 45 ounces to the ton; United, 1,200 tons; Krao, 1,000 tons; Number One, 2,000 tons, besides 50 tons of high grade. The quantity sacked by other companies has not been learned.

"*Hendryx mines.*—Development in the Blue Bell mine has been steadily carried on under the management of Dr. Hendryx. The tunnel and drifts have attained an aggregate length of 1,500 feet. The work accomplished last year has only corroborated the knowledge previously obtained as to the apparently inexhaustible supply of ore in this valuable property. I have been informed that the adjoining extensions, two in number, have been purchased from Mr. Ainsworth for the sum of $100,000. This will necessitate the construction of a smelter to render the large body of mineral wealth controlled by the Hendryx Company available.

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"*Goat River.*—The Goat River mines are situated about eight miles north of the boundary line. They were discovered about the latter end of July, by James King. An Indian happened one day to show him a piece of float he had found, which Mr. King recognized to be rich. The latter at once instituted a strict search, which was rewarded by finding the lode whence it had been detached. The ore is galena, three feet on the surface, and assaying from $30 to $80 in silver to the ton. A tunnel 125 feet long has tapped the vein at a depth of 100 feet, which, at the point of intersection was found to be six feet wide. Twelve locations have been recorded. These mines are situated within four miles of the Kootenay River, and will enjoy the advantages resulting from cheap transportation. They will attract a number of men next summer. Anticipating the importance this camp will attain, the Government has lately appointed a gentleman residing in the vicinity to discharge the duties of a mining recorder.

"*Trail Creek.*—Trail Creek is situated on the west bank of the Columbia river, about 20 miles below Sproat, and 10 miles north of the 49th parallel. The mines are scattered over an extent of country extending back from the river from three to eight miles, including Red Mountain, which contains some of the most promising locations. One hundred and sixteen claims have been recorded, which are divided into two distinct groups, the smaller one, containing about forty locations, possesses veins from two to ten feet wide, assaying as high as $180 in the precious metals, silver predominating; the vein matter also carries lead, zinc and antimony.

"The principal mines in this belt are the Lily May, Zwiloo, Blossom and Homestake. A shaft in the Lily May at the depth of 20 feet shows a vein four feet wide, carrying about 80 ounces of silver to the ton, choice pieces running up to 180 ounces. The Zwiloo also shows up equally as well, and is considered one of the best locations in the camp.

"The larger group commences about two miles north of the first mentioned. Copper and iron are here the most widely disseminated ores. with a little antimony, more or less gold, and a small quantity of silver, A cross-cut in the vein of the Le Roi exposes a solid body of ore 18 feet wide, which will run about 8 per cent copper, 10 ounces in silver, and varies from $3 to $500 in gold to the ton. A part of this mine has been bonded by a Spokane Falls company, who are steadily working it with two shifts of men. There is every probability this will turn out to be a first class mine. Three other locations on this vein exhibit similar favourable indications. The St. Elmo, Mountain View and Spar have been bonded by Portland, Oregon, capitalists. These are the only claims that possess galena veins. Six or seven others are under bond,

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but work will not be actively carried on before the approach of spring. The Josie, owned by R. E. Lemon, which returned large assays, was also bargained for, but I have not learned whether the bargain was effected.

"The ore bodies in this district exist in a syenite formation, and are generally capped with iron rock. Some of them are of great width, varying from four to fifty feet, and cut the stratification of the rock at right angles. Their general course is east and west, with the exception of the Lily May, and its extensions, which runs north-east and south-west. Excellent facilities for shipping are provided by the easy access to the Columbia River, whence freight can be cheaply transported to Revelstoke, or the Dalles, where connection can be made with the Spokane and Northern Railway.

"The belief is entertained that with the attaining of greater depth copper will be found in paying quantities. This has proved to be the case in the Le Roi, the copper having increased from seven per cent on the surface to fifteen per cent at a depth of ten feet; also a perceptible improvement in the quantity of silver. The surrounding country presents an inviting appearance to the eye, consisting of level benches, covered with grass and timber. The latter is open and affords no obstacle to prospectors.

"The climate is mild and agreeable, and the snowfall amounts to only nine or ten inches in depth. About fifty men will winter there this year. A mining record office has been established, which is a great convenience to miners, who, previously, had to undergo the loss of time and expense incurred in travelling to Nelson on business connected with their claims."

East Kootenay.—The particulars of progress, &c., in this district are reported as follows:—

"The mineral of the district, as far as at present ascertained, lies in two main belts. The mineral at Ottertail and Field, in the Rockies, appears to be local, no continuation of large extent having been traced. The first of these belts commences in the Selkirk Range, at the head of the North Fork of the Spillemcheen River, near Mount Sir Donald, and runs thence in a south-easterly direction on the easterly slope of the Selkirks, passing through the McMurdo district, including Cariboo Basin, Carbonate Basin, and cutting McMurdo Creek, Copper Creek, Vermont Creek, Horse Thief Creek, Toby Creek, &c., gradually approaching the Columbia valley and passing into the Rockies to the south of the Columbia lakes.

"The minerals discovered up to the present in this belt are gold in sulphurets (free milling at the surface), silver-bearing galena and grey copper, antimony, bismuth and other minerals occurring casually.

"The minerals of this belt are *high grade*, especially the grey copper and antimonial copper ores, assays as high as 1,024 oz. to the ton having been obtained. Test lots of ore, amounting to about 50 tons, shipped last season from the neighbourhood of Vermont Creek, gave excellent results. British Columbia.

"The second important belt, mentioned above, runs about parallel to the Selkirk mineral belt, generally in the limestones and quartzites at or close to their contact with the slates (Cambrian) of the Selkirk formation, along the valley of the Columbia southwards, crossing the valley and passing into the Rockies near the Columbia lakes. The discoveries in this belt are probably some of the most important of the district, though less continuous than those of the Selkirk belt, viz.: Jubilee Mountain, Spillemcheen Mountain, Steamboat Butte, Windermere Mountain, and various promising discoveries of copper ore in the Hughes Range, east of the Kootenay River. The bulk of the ore so far extracted is of copper and lead, carrying silver. Some high assays in silver and gold have been obtained principally from Jubilee Mountain.

"The Field discoveries, of which the 'Monarch' mine is the most important, also those in the neighbourhood of Ottertail, both quite close to the Canadian Pacific Railway in the Rockies, would appear to be more local in their character, no continuous belts having been traced for any considerable distance.

"The region down the Columbia to Canoe River, north of the railroad, has not yet been prospected for quartz.

"*Field.*—The 'Monarch' mine, situated on Mount Stephen, near the summit of the Rockies, a quarter of a mile from and at an elevation of 850 feet above the Canadian Pacific track, is at present the only fully equipped working mine in the district. The company has resumed work this fall. A force of ten miners is now at work, terms having been arranged to supply the Revelstoke Smelter Company with 200 tons of ore per month. The shipping ore averages about 60 per cent lead with 10" (ozs.?) "of silver to the ton.

"The ore occurs in somewhat irregular chambers, pockets and other deposits in the limestone, with but little gangue, and seems abundant. It is expected that the mineral will lie in more regular form and even greater body when more depth into the mountain has been reached. The mine was discovered in 1884. About 1,500 tons of ore have been extracted and shipped up to the present time. The underground workings amount in the aggregate to about 450 feet of tunnelling, with larger chambers opened out in places where ore was more abundant. A considerable amount of work has also been executed on the outside, consisting of a tramway, galleried out of the face of the mountain, leading to

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the principal ore bins, and a gravity road from thence to the bins on the railroad, together with all the necessary plant for working the mine.

"On the various other claims in the vicinity of Field, little more than prospecting and assessment work has been done, though some of the prospects look as favourable as the 'Monarch' did before it was opened up.

"The ores so far found in the locality have been very pure galena ores, low grade in silver, containing occasionally a small percentage of zinc.

"*Ottertail.*—No work of consequence has been done in this locality for several years.

"*Selkirk Mineral Belt, including McMurdo District.*

"*Cariboo Basin.*—On the north side of the Middle Fork of the Spillemcheen, or McMurdo Creek, on which a number of claims, showing good croppings, have been located, has not received much development work this season beyond assessment work on some of the claims.

"*Carbonate Mountain*—On the south side of McMurdo Creek, has many important claims. Messrs. Rand Bros., of Vancouver, on behalf of English capitalists, purchased a property of ten claims in the fall of 1889, to which they have added other locations. The most important of these prospects, showing on the surface, occur on the 'Monitor,' 'Southern Cross' and 'Polly Brown' claims. The previous development done on these claims was unimportant. The vein can be traced continuously along the whole length of the property, extending from McMurdo Creek along the summit of Carbonate Mountain into Copper Creek. This main lead, like most of the mineral in the belt, runs in a south-easterly and north-westerly direction, lying almost vertically between walls of slate, mica-schist and granitic rock. The width of the vein on the surface is estimated as varying from 2 to 5 feet, fairly well mineralized. The property was examined by Mr. Giffard, the well known English expert, in the summer of 1889, in the interest of Messrs. Rand Bros., prior to their purchase, whose report, of course a private one, was understood to be favourable. Messrs. Rand Bros. have been actively at work since that time prospecting their property, and are at present engaged in driving a tunnel and cross-cut from McMurdo Creek, which is expected to cut the lead at a depth of 2,500 feet from the croppings along the top of the mountain. From the latest reports the tunnel was in 300 feet and the cross-cut commenced. The ore of the croppings is composed of sulphides of lead, iron and antimony, averaging about 50 oz. to the ton of silver.

"About three miles further up McMurdo Creek from the above line of claims, near the summit of the range, a number of claims have been located, amongst the most important of which are the 'Bobby Burns' and 'Chief of the Selkirks,' the original discovery claims of the locality. Little work has been done heretofore on these. The 'Bobby Burns' contains a large vein of gold quartz, free milling on the surface. A 3-stamp mill has been purchased by the owners, and is now at Golden to work on this claim next summer. Gold is visible in some of the surface rock, and assays of 35 oz. of gold have been obtained. British Columbia developments.

"The 'Chief of the Selkirks' and adjoining claims at the summit contain galena and grey copper ores.

"Continuing south-eastward from the Carbonate Mountain claims, between Copper Creek and the South Fork of the Spillemcheen, several claims have been located on which only assessment work has been done. These are favourably reported on. On the southern slope of this divide, running down into Vermont Creek, occur the 'Dark Horse,' the 'Agnes,' and the 'Syenite Bluff.' A 6-ton sample lot of galena ore was shipped from the Dark Horse claim last summer, also a shipment from the Agnes claim. Both gave very favourable results.

"On the south side of Vermont Creek, near its junction with the South Fork, a block of claims, discovered in the summer of 1889, contain a number of veins of galena and grey copper, about ten in number, varying in width from 2 inches to 20 inches, in the slate formation. It is considered that these veins will in some cases run together. Thirty-five tons of ore were packed out on horses from these veins to the Columbia River, a distance of about 21 miles, thence by steamboat to Golden and by rail to Revelstoke, realizing, under all these difficulties, a handsome profit to the owners. The ore was pronounced to be of excellent quality at Revelstoke.

"Good prospects have been located further south, on Crystal Creek and Bugaboo Creek in the same belt. The country between this point and Horse Thief Creek has been but little prospected. In this latter locality, and on Toby Creek, very promising new discoveries were made last season and a number of claims recorded. The 'Little Fellah' claim, on Horse Thief Creek, is described by a reliable and disinterested person as a magnificent prospect. It is stated to be a well-defined lode in talc slate, about 20 feet in width. Assays from 20 to 50 per cent of copper and 20 to 100 oz. of silver have been made. Several other good copper prospects have been located on this creek.

"New discoveries, stated to be large veins, containing high grade galena, are also reported from about 20 miles up Toby Creek.

"Mineral Locations along the Columbia Valley Belt referred to in General Description" (pp. 176–179).

British Columbia developments.

"*Jubilee Mountain*—situated about 42 miles up the Columbia River from Golden, on the Canadian Pacific Railway, has mineral claims located along its ridge and western slope for a distance of over four miles. About 30 tons of copper glance and carbonates of very fine quality, averaging 55 per cent copper, were shipped from the 'Lancaster' claim, owned by John McRae, during last summer to Swansea, as a sample lot, by C. F. Law, agent for Toronto capitalists. A good body of silver-bearing galena ore has been opened up on the 'Constance' claim this winter, and development work on a large scale is looked forward to in the spring. The claims on which most development work has been done are the 'Constance,' 'Lancaster,' 'Horseshoe' and 'Alice.'

"*Spillemcheen Mountain.*—A considerable amount of work has been done on various claims on this mountain during the past few years. Messrs. Wells and Pollock have been at work this winter driving a tunnel to reach the 'Big Lead,' understood to lie at the contact between the lime quartzite and the slate, at a low depth. They have drifted altogether 260 feet up to date, and expect to cut the lead within 20 feet further. The results of other prospecting work recently done on the mountain have been very favourable; a large quantity of ore has been taken out. The claims showing most development work are the 'Spillemcheen,' 'Homestake,' 'Rothschild,' 'Tiger' and 'Eureka.'

"*Windermere Mountain*—situate about four miles north of Windermere, on the Lower Columbia Lake, has been drawing much attention during last summer. Mr. O. A. Brown, of Spokane, became interested in claims on this mountain in July last, and has been actively developing with excellent results, having exposed a large body of copper glance and carbonates. He has from 75 to 100 tons of ore on the dump at present, and expects to make some shipments in the spring. Two shafts, 40 feet and 20 feet respectively, have been sunk, and a tunnel to tap the lead in depth is contemplated. The ore consists of copper glance, carbonates and red oxides. A large number of assays have been obtained, ranging from 10 to 80 per cent in copper, and from $3 to $130 in silver, to the ton. Two principal ore bodies have been cut through, one 18 feet in width, the other 7 feet. There are fourteen claims taken up in this locality. Some of these promise to prove valuable.

"In the neighbourhood of Wild Horse Creek some development has been done on a galena ledge about three miles above the old camp. It would appear that a large quantity of concentrating ore, carrying silver, has been met with.

"Prospectors have brought in samples of ore from about 25 miles up Wild Horse Creek, which are stated to have assayed $225 in gold, silver and copper. British Columbia developments.

"The discovery of a new mineral district is reported about 11 miles in a south-easterly direction from Fort Steel. A sample from this locality assayed: gold, $96; silver, $300; and copper, 12 per cent."

From Yale district the following items are reported:—

"*Yale Creek.*—The owners of the Queen silver mine, in which extensive tunnelling and sinking has been done, still persevere at heavy outlay to develop their property, from which very rich prospects in silver have been obtained, assaying as high as $500 in silver and $140 per ton in gold.

"*Silver Peak, near Hope.*—The Eureka and Victoria Companies have not been carrying on work of late years, but I am pleased to say the company (composed of wealthy Victorians) has been remodelled in the past year, with a view to resume vigorous operations next season. Rich assays have been obtained from these mines, ranging from $100 to $800 per ton in silver.

"*Stump Lake Mines.*—This locality was fully reported upon last year. During the past twelve months, assessment work has been done on a number of claims, but I regret to say that the Nicola Milling and Mining Company have, for the present, discontinued working their mines. It is expected, however, that they will resume operations early next spring. No new discoveries of quartz have been made during the past season.

Dr. Dawson in his Summary Report to the Director of the Geological Survey for 1890, speaks of these mines thus:—

"The metalliferous deposits in the vicinity of Stump Lake referred to in the Summary Report for 1888 (p. 8) and in the Mineral Wealth of British Columbia (p. 69 R) notwithstanding the favourable conditions for their development and the high assay value of some of the ores, have not yet assumed a position of permanent importance. The Nicola Mining and Milling Company have now sunk in the 'Joshua' shaft to a depth of about 400 feet, and have done considerable drifting, for the purpose of exploration, but with this exception 'assessment work' only has been carried out on the various claims taken up in this vicinity. The general parallelism and the evident connection of the veins of this locality with the outline of the great granitic area to the west rendering it important that this should be done, the remaining part of the line of contact of this granite with the stratified rocks was traced in detail. The vicinity of this line of contact, like that of several other similar contact lines and numerous places not distinctly connected with granitic masses,

is characterized by a great abundance of vein quartz. Many specimens of such veins have been collected for the purpose of assay, the results of which it is hoped will afford some definite information as to the habitus and mode of occurrence of the gold and silver ores."

In the Similkameen sub-division very little was done in quartz mining, the owners of mineral claims having satisfied themselves with merely performing the necessary work to hold their locations.

Prices. The appended graphic table A opposite, shows the prices obtained for the metal during the year. The very considerable fluctuations were due to the legislation, actual, and proposed by the United States Government, looking to the enforced purchase by the Treasury Department of 4,500,000 ozs. of the metal each month, and the consequent operations of speculators.

Exports. The export figures of this metal as found in the books of the Customs Department, are given in Table 2 below:—

SILVER.

TABLE 2.

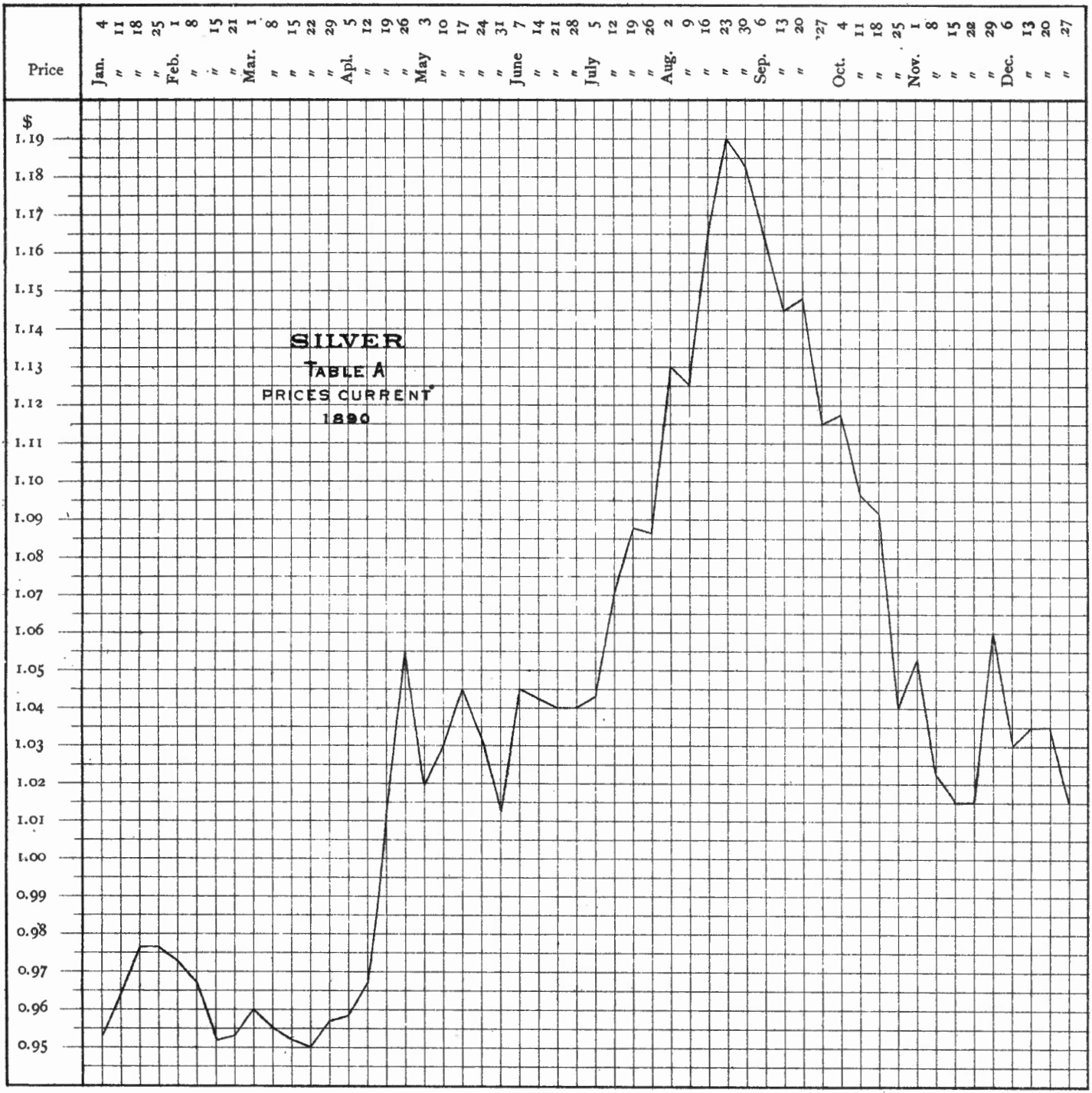
EXPORTS OF SILVER ORE.

Province.	1886.	1887.	1888.	1889.	1890.
Ontario	$16,505	$184,763	$208,064	$203,871	$203,142
Quebec	8,000	450	5	2,500	900
Nova Scotia				50	
Manitoba	1,452	3,741		5	
British Columbia		17,331	10,939	5,737	100
Totals	$25,957	$206,285	$219,008	$212,163	$204,142

STRUCTURAL MATERIALS.

Building stone. *Building stone.*—No new features were noticeable in the trade for the past year, the industry being carried on in the same lines as in years previous, with the exception, possibly, that the various varieties are now shipped to more distant points and not as before used almost altogether locally. For example, a very considerable quantity of New Brunswick sandstone now finds a market in Montreal, Toronto, Hamilton and other western cities, while stone from the quarries near Credit Forks, Peel county is delivered as far east as Montreal.

Ontario. In Ontario the production has been somewhat less than in 1889 owing to the fact that in several of the largest buildings erected during the


Price
Jan. 4 " 11 " 18 " 25
Feb. 1 " 8 " 15 " 21
Mar. 1 " 8 " 15 " 22 " 29
Apl. 5 " 12 " 19 " 26
May 3 " 10 " 17 " 24 " 31
June 7 " 14 " 21 " 28
July 5 " 12 " 19 " 26
Aug. 2 " 9 " 16 " 23 " 30
Sep. 6 " 13 " 20 " 27
Oct. 4 " 11 " 18 " 25
Nov. 1 " 8 " 15 " 22 " 29
Dec. 6 " 13 " 20 " 27
$
1.19
1.18
1.17
1.16
1.15
1.14
1.13
1.12
1.11
1.10
1.09
1.08
1.07
1.06
1.05
1.04
1.03
1.02
1.01
1.00
0.99
0.98
0.97
0.96
0.95
SILVER
TABLE A
PRICES CURRENT
1890

year, New Brunswick or Ohio stone has been used and also that considerable quantities of ornamental terra-cotta and pressed bricks are now used in the erection of large buildings. The points of greatest production were as in years previous in the vicinity of Caledon township, Peel county, the Niagara escarpment between Hamilton and Queenston in Wentworth and Lincoln counties, and Belleville, considerable quantities also being obtained at Owen Sound, St. Marys, Amherstburg, Elora, Kingston, Cornwall, Ottawa and Pembroke.

Quebec. In Quebec large quantities of limestone are quarried in the vicinity of Montreal and between that place and Terrebonne; at Hull, Ottawa county, and at many points on the north side of the St. Lawrence river. Sandstone is obtained in considerable quantity at Chateau Richer.

New Brunswick. In New Brunswick the most important quarry is the "French Fort Quarry" near Newcastle, Northumberland county, the other large quarries being in the south-eastern part of Westmoreland county.

Nova Scotia. In Nova Scotia a considerable quantity of stone is raised throughout Cumberland and Pictou counties, a very large proportion of which is used in the repairing of railway works and in the construction of the Chignecto Ship Railway.

The stone quarried in Prince Edward Island and the Western Provinces amounts to but little, and is almost entirely used locally.

Production. The production for the year, as returned to this office, is given in the following table, which shows an increase over similar returns for 1889 of 41,226 cubic yards and $51,092.

STRUCTURAL MATERIALS.

TABLE 1.

PRODUCTION OF BUILDING STONE.

Province.	No. of Returns	Cub. Yards.	Value.
Ontario	47	113,465	$347,252
Quebec	30	217,595	456,703
Nova Scotia	.....	37,835	92,211
New Brunswick	10	8,934	54,697
Prince Edward Island	1	140	180
Manitoba	2	2,098	5,140
North-West Territories	3	2,496	8,600
Totals	93	382,563	$964,783

As there are many small producers in Canada who cannot be reached, or who have failed to make returns, these figures are not complete, but are supposed to represent about four-fifths of the production; assuming that such be the case, there was a production during 1890 of about 480,000 cubic feet, having an approximate value of about $1,200,000.

Exports and imports.

The following tables show the exports of wrought and unwrought stone and marble, and the imports of building stone and manufactures of stone :—

STRUCTURAL MATERIALS.

TABLE 2.

EXPORTS OF STONE AND MARBLE, WROUGHT AND UNWROUGHT.

Province.	1889.		1890.	
	Wrought.	Unwrought.	Wrought.	Unwrought.
Ontario	$ 3,422	$ 271	$ 7,284	$ 6,474
Quebec	.....	391	53	1,613
Nova Scotia	2,714	1,060	252	16,821
New Brunswick	15,226	26,482	13,649	11,275
Manitoba	.....	.....	.....	9
British Columbia	12	.....	487	7,419
Totals	$21,374	$28,204	$21,725	$43,611

STRUCTURAL MATERIALS.

TABLE 3.

IMPORTS OF BUILDING STONE.

Fiscal Year.	Value.
1880	$ 35,970
1881	58.149
1882	33,623
1883	35,061
1884	51,088
1885	30,491
1886	41,675
1887	54,368
1888	86,373
1889	100,314
1890	132,155

STRUCTURAL MATERIALS.

TABLE 4.

IMPORTS OF MANUFACTURES OF STONE OR GRANITE, N. E. S.

Fiscal Year.	Value.
1880	$29,408
1881	36,877
1882	37,267
1883	45,636
1884	45,290
1885	39,867
1886	41,984
1887	41,829
1888	47,487
1889	61,341
1890	84,396

During the past year Canada afforded a market for building stone of about $1,350,000, as follows:— Canadian market.

Production	$1,200,000	
Imports of building stone	132,155	
Imports of stone and granite	84,396	
		$1,416,551
LESS—Exports, wrought stone	$ 21,725	
Exports, unwrought stone	43,611	
		65,336
		$1,351,215

The production of building stone for the past four years, according to direct returns, and supposed to represent approximately the same proportion to the total output as do the figures for 1890, is as follows:—

1886—165,777	cubic yards	$642,509
1887—262,592	do	552,267
1888—411,570	do	641,712
1889—341,337	do	913,691

Marble.—The production for 1890 amounts to 780 tons, valued at $10,776, and is altogether from Ontario. The output for the past four years has been as follows:— Marble production.

1886—501	tons, valued at	$9,900
1887—242	do	6,224
1888—191	do	3,100
1889— 83	do	980

Notwithstanding the many extensive deposits throughout Canada, more particularly in the pre-Cambrian areas of the Eastern Townships of

Quebec and the Laurentian areas of Hastings, Frontenac and other counties in Ontario, no work to any extent was performed, with the exception of that necessary to extract the above small amount, which was produced at Arnprior and Renfrew, Ont.

During the year operations were begun on a band of Huronian limestone, affording a handsome banded marble, near the Garden River Settlement, about ten miles east of Sault Ste. Marie. Only development work was done and no shipments were made.

Imports.

The following table shows the imports of marble, all sorts, since 1880; there were no exports reported as such :—

STRUCTURAL MATERIALS.

TABLE 5.

IMPORTS OF MARBLE.

Fiscal Year.	Value.
1880	$ 63,015
1881	85,977
1882	109,505
1883	128,520
1884	108,771
1885	102,835
1886	117,752
1887	104,250
1888	94,681
1889	118,421
1890	99,353

Granite production.

Granite.—The production of granite during 1890 amounted to 13,307 tons, valued at $65,985 at the quarry. This shows an increase in quantity over the previous year of 2,152 tons, while the value has decreased to the extent of $13,639.

The following figures show the production for the past four years:—

1886—6,062 tons, valued at ..... $ 63,309
1887—21,217 do 142,506
1888—21,352 do 147,305
1889—10,197 do 79,624

Of the production for 1890, the following subdivision may be made to show the production of provinces :—

Nova Scotia, 2,000 tons. ..... $ 9,200
New Brunswick, 5,195 do 33,224
Quebec, 2,870 do 14,200
Ontario, 3,242 do 9,361

It will be seen on reference to the above that the granite raised in Ontario is quoted at less than $3 per ton; subtracting the amount credited to that province the remainder has a value of about $5.60 per ton. This value, although less than that of 1889, is believed to represent more closely the net price *at the quarry*.

Slate.—The production of this material for 1890 is altogether that of the province of Quebec, no slate being quarried elsewhere in the Dominion. Slate

The area from which this production is reported lies in the three townships of Melbourne, Cleveland and Shipton in Richmond county, Quebec, wherein the more important slate bands are found. To the south of Richmond, the production consisted almost altogether of roofing slates, mantels and slabs for sinks, billiard tables, &c., while to the north of that place large quantities of school slates are annually produced, though during 1890 a considerable proportion of the production of that district was in the form of roofing slate.

The following data are furnished by the new Rockland Slate Company, giving the results of tests of their product, and will illustrate the qualities of the slate of this district:—

Analysis made by B. J. Harrington, B. A. Ph. D., Professor of Chemistry, Mineralogy, &c., McGill University.

Silica	65·39
Alumina	15·97
Ferrous oxide	4·66
Manganous oxide	0·39
Lime	0·67
Magnesia	2·99
Potash	3·60
Soda	3·33
Loss by ignition	3·26
	100·26
Specific gravity	2·75

Tests

Made at the Testing Laboratory of the Bridge Company, Lachine, P.Q., on an Emery Testing Machine:

1*st Test. Crushing.*—Strain perpendicular to lamination.

A 2″ cube failed at 108,570 lbs. = 26,574 lbs. per square inch.

2*nd Test. Crushing.*—Strain perpendicular to lamination.

A 2″ cube failed at 129,880 lbs. = 32,069 lbs. per square inch.

3*rd Test. Crushing.*—Strain parallel to lamination, but perpendicular to grain, *i.e.*, edgewise.

A 2″ cube *was not crushed* at 151,000 lbs. = 36,531 lbs. per square inch.

4*th Test. Breaking.*—Strain perpendicular to lamination.

A piece of slate 3′ long 4″ wide and 1″ thick on bearers 30″ apart, failed by splitting at 950 lbs. Modulus of rupture 10,000.

A beam 12″ long 1″ square, supported at both ends and loaded in in the centre, fails at 556 lbs.

5*th Test. Breaking.*—Strain perpendicular to lamination.

A piece of slate 3′ long 4″ wide and 1″ thick, on bearers 30″ apart, failed by splitting at 1,092 lbs. Modulus of rupture 11,667.

A beam 12″ long 1″ square, supported at both ends and loaded in the centre, fails at 558 lbs.

Production.

Deflection with pressure at 690 lbs. was $\frac{7}{10}$ of 1″

The amount produced during the year was 6,368 tons, having a net value of $100,250, showing a decrease from 1889 of 567 tons and $18,910. The production for the past four years is as follows:—

1886—5,345 tons	$ 64,675
1887—7,357 do	89,000
1888—5,314 do	90,689
1889—6,935 do	119,160

Exports and imports.

As may be seen on reference to the following table the market is almost entirely a domestic one, small quantities only being exported:—

STRUCTURAL MATERIALS.

TABLE 6.

EXPORTS OF SLATE.

Year.	Tons.	Value.
1884	539	$6,845
1885	346	5,274
1886	34	495
1887	27	373
1888	22	475
1889	26	3,303
1890	12	153

The following table shows the imports during the past eleven years :—

STRUCTURAL MATERIALS.

TABLE 7.

IMPORTS OF SLATE.

Fiscal Year.	Value.
1880	$21,431
1881	22,184
1882	24,543
1883	24,968
1884	28,816
1885	28,169
1886	27,852
1887	27,845
1888	23,151
1889	41,370
1890	22,871

Flagstones.—The production of flagstones during 1890 was altogether that of Dudswell and Brompton townships in Wolfe and Richmond counties, Quebec, from the various quarries of which a small quantity of a superior quality of stone is shipped for flagging. Returns were not received of any stone produced in Ontario for this purpose, though it is believed that considerable quantities of limestone were sawn to dimension for flagging. Flagstones.

The use of flagtones has been lessened of late years by the introduction of "granolithic" and other artificial pavements, which are being laid in many cities at a much less cost than flagging, and apparently meeting all the requirements of natural stone, so that the market has not increased as much as might be expected.

The production for 1890 was 17,865 square feet, valued at $1,643, which shows when compared with the year previous an increase of 3,865 square feet and $243. The production during the past four years was :— Production

1886—	70,000 (?) feet	$ 7,895
1887—	116,000 do	11,600
1888—	64,800 do	6,580
1889—	14,000 do	1,400

Imports.

The imports are given in the following table ; no export of flagstones, as such, are reported :—

STRUCTURAL MATERIALS.

TABLE 8.

IMPORTS OF FLAGSTONES.

Fiscal Year.	Tons.	Value.
1881	23	$ 241
1882	90	848
1883	10	99
1884	137	1,158
1885	205	1,756
1886	1,602	9,443
1887	1,316	10,966
1888	2,642	21,077
1889	1,669	15,451
1890	5,665	48,995

Cement.

Cement.—There were during 1890 seven makers producing natural cement, as follows :—

T. A. Gauvreau & Co..... Quebec, Que.
C. B. Wright & Co.....Hull do
Napanee Cement Works Co.....Napanee Mills, Ont.
Jas. Marshall .....Rymal do
Toronto Lime Co.....Limehouse do
John Battle .....Thorold do
Isaac Usher & Sons..... do do

These makers all produce a *natural* cement made from rock obtained in the immediate vicinity of their works. One company, The Imperial Portland Cement Co. (Ltd.), produce Portland cement only, and have their works at Pointe Claire, near Montreal, Another company, The English Portland Cement Co. (Ltd.), had under construction an extensive plant for the manufacture of Portland cement at Marlbank, Ontario, where they will during 1891 commence producing on a large scale, marl obtained in the neighbourhood entering largely into the manufacture.

Method of manufacture.

The method employed in the manufacture of *natural* cement is simple, and consists in the calcination of the raw stone or so-called "cement rock," after which it is ground by means of ordinary buhrstones. Before grinding, however, it is generally necessary that it should be broken into comparatively small lumps, which is accomplished by means of an ordinary cracker or crusher. The rock that produces a good natural cement consists essentially of an impure limestone or rather a carbonate of lime and magnesia with a definite proportion of silicate of alumina or clay and it is upon the amount of silica the rock contains that the quality of the finished product depends.

The quantity of cement produced during 1890 was, according to returns received at this office, 102,216 brls., valued at $92,405, showing an increase over that reported for 1889 of 11,742 brls. and $22,615. The production for the past three years was as follows:— Production.

1887—69,843 brls. $81,909
1888—50,668 do 35,593
1889—90,474 do 69,790

The greater part of this production finds a market in Canada, as may be seen on reference to the table of exports of lime and cement, wherein the amount of cement is known to be inconsiderable. The increase in production since 1888 is understood to be on account of the wider use of granolithic pavements and roadways. Imports.

The imports of cement are given in the following tables:—

STRUCTURAL MATERIALS.

TABLE 9.

IMPORTS OF CEMENT IN BULK OR BAGS.

Fiscal Year.	Bushels.	Value.
1880	65	$ 28
1881	579	298
1882	386	86
1883	1,759	548
1884	4,626	1,236
1885	4,598	1,315
1886	6,808	1,851
1887	5,421	1,419
1888	23,919	5,787
1889	32,818	10,668
1890	21,055	5,443

STRUCTURAL MATERIALS.

TABLE NO. 10.

IMPORTS OF HYDRAULIC CEMENT.

Fiscal Year.	Barrels.	Value.
1880	10,034	$ 10,306
1881	7,812	7,821
1882	11,945	13,410
1883	11,659	13,755
1884	8,606	9,514
1885	5,613	5,396
1886	6,164	6,028
1887	6,160	8,784
1888	5,636	7,522
1889	5,835	7,467
1890	5,440	9,048

Portland cement.

STRUCTURAL MATERIALS.

TABLE 11.

IMPORTS OF PORTLAND CEMENT.

Fiscal Year.	Barrels.	Value.
1880	.....	$ 55,774
1881.....	.. ....	45,646
1882..... ..	....	66,579
1883	. ...	102,537
1884..	. . ....	102,857
1885.....	....	111,521
1886.....	.....	120,398
1887...	102,750	148,054
1888	122,402	177,158
1889	122,273	179,406
1890..... ...	192,322	313,572

Assuming that the imports for the fiscal year represent those for the calendar year, there was, during 1890, a market for cement in Canada amounting to over $400,000.

Roofing cement.

Roofing Cement.—There was during the year a production of cement for roofing purposes of 1,171 tons, valued at $6,502. This is altogether the result of the manufacture of certain refractory minerals mined in Ontario.

Lime.

Lime.—Although the quantity produced is less than that made in 1889 there is a marked increase in total value, attributable almost entirely to the province of Ontario, where the prices ruled higher than during the year previous. In New Brunswick there is an apparent falling off in production of about 19 per cent, due no doubt to the introduction of the McKinley Bill, as the greater part of the production of that province finds a market in Boston and the New England states where it commands a good price on account of its superior quality.

There is nothing worthy of mention regarding the industry during 1890, the production as previously being that of works scattered throughout the various provinces and territories.

Production.

The amount produced during the year was, according to returns made to this office, 2,501,079 bushels, valued at $412,308, a decrease in quantity compared with 1889 of 447,170 bushels, whereas there is shown to be an increase in value of $49,460.

The production by provinces, as well as the totals for the past four years, are given below:—

STRUCTURAL MATERIALS.

TABLE 12.

PRODUCTION OF LIME.

Province.	No. of Returns	Bushels.	Value.
Ontario	60	1,234,975	$ 185,602
Quebec	15	116,593	23,274
Nova Scotia	.....	217,944	44,565
New Brunswick	11	814,662	136,586
Prince Edward Island	3	17,355	3,581
Manitoba	3	69,550	10,700
British Columbia	1	30,000	8,000
Totals	93	2,501,079	$ 412,308

STRUCTURAL MATERIALS.

TABLE 13.

ANNUAL PRODUCTION OF LIME.

Year.	No. of Returns	Bushels.	Value.
1886	87	1,535,950	$ 283,755
1887	133	2,269,087	394,859
1888	93	2,216,764	339,951
1889	106	2,948,249	362,848

Full data cannot of course be obtained, though all the principal makers have made returns, and it is supposed that the production shown above is equivalent to about four-fifths of the total amount, the returns not received being principally those of farmers and small local producers.

In the following tables may be found the exports of lime and cement and imports of lime:— Exports and imports.

STRUCTURAL MATERIALS.

TABLE 14.

EXPORTS OF LIME AND CEMENT.

Province.	1887.	1888.	1889.	1890.
Ontario	$4,269	$12,262	$12,877	$17,341
Quebec	83	398	71	.....
Nova Scotia	142	278	11,017	17,137
New Brunswick	77,518	97,318	135,222	130,180
Prince Edward Island	4	....	2	5
Manitoba	241	.....	.....	.....
British Columbia	4	.....	2,060	4,141
Totals	$82,261	$110,256	$161,249	$168,804

STRUCTURAL MATERIALS.

TABLE 15.

IMPORTS OF LIME.

Fiscal Year.	Barrels.	Value.
1880	6,100	$6,013
1881	5,796	4,177
1882	5,064	5,365
1883	7,623	9,224
1884	10,804	11,200
1885	12,072	11,503
1886	11,021	9,347
1887	10,835	8,524
1888	10,142	7,537
1889	13,079	9,363
1890	8,149	5,360

Bricks.

Bricks.—There is very little to report in this industry during 1890, the production and distribution of operators being about the same as in past years. A feature worthy of mention is the fact that there are much larger quantities of pressed and fancy bricks made than heretofore, such works as those in the vicinity of Milton, Ont., and Ormstown, Que., turning out large quantities of fancy and more particularly pressed fancy bricks.

Production.

The production according to returns received at this office amounted during 1890 to 211,727 thousands, valued at $1,266,982. These returns are not considered complete, but are supposed to represent about four-fifths of the total, thus making the actual production about 260,000 thousand. The production by provinces is as follows:—

STRUCTURAL MATERIALS.

TABLE 16.

PRODUCTION OF BRICKS DURING 1890.

Province.	No. of Returns.	Thousands.	Value.
Ontario	221	138,491	$807,389
Quebec	27	44,331	238,572
Nova Scotia	.....	8,400	55,360
New Brunswick	10	9,335	68,885
Prince Edward Island	5	1,150	8,775
Manitoba	2	1,200	10,800
North-West Territories	3	900	10,000
British Columbia	9	7,920	67,201
Totals	277	211,727	$1,266,982

The total production per annum for the previous four years as returned to this office is as follows:—

1886—139,345	thousand,	valued at	$ 873,600
1887—181,581	do	do	986,689
1888—165,818	do	do	1,036,746
1889—200,561	do	do	1,273,884

These figures may be taken as are those for 1890, as representing about four-fifths of the total output.

A small quantity of bricks were exported during the year, principally from Ontario, as may be seen on reference to the following figures:— Exports and imports.

Ontario	715 M	$3,449
Nova Scotia	19 M	156
Prince Edward Island	15 M	157
Total	749 M	$3,762

Of the imports (table 17) a great proportion is of fancy bricks imported into Ontario from Ohio, Pennsylvania and New Jersey. That the amount is small is attributed to the fact that the market for them is largely supplied by domestic manufacturers:—

STRUCTURAL MATERIALS.

TABLE 17.

IMPORTS OF BUILDING BRICK.

Fiscal Year.	Value.
1880	$ 2,067
1881	4,281
1882	24,572
1883	14,234
1884	20,258
1885	14,632
1886	5,929
1887	2,440
1888	20,720
1889	24,585
1890	12,500

Terra-Cotta.—The terra-cotta industry, although comparatively new in Canada, has sprung into a state of no insignificance, the production for the year 1890 amounting to about $90,000. Terra-Cotta.

The producers operating during the year were:—

The Hynes Terra-cotta and Brick Company, Toronto, Ont.

The Ontario Terra-cotta Brick and Sewer Company, Toronto, Ont.

The Toronto Pressed Brick and Terra-cotta Company, Toronto, Ont.

The Rathbun Company, Deseronto, Ont.

The Ormstown Brick and Terra-cotta Company, Ormstown, Que.

The works of the Hyne's Terra-cotta and Brick Company are in Toronto. Those of the Toronto and Ontario Companies between Milton and Campbellville, Ont., while the two last company's works are at Deseronto, Ont., and Ormstown, Que., respectively. Besides producing a considerable quantity of pressed fancy bricks, these companies (with the exception of the Rathbun Company) produce large quantities of ornamental terra-cotta work, such as tiles, panels, string courses, roofing and ridge tiles, finials, chimney pots and garden vases and pedestals. Clay, eminently suitable for the manufacture of terra-cotta, occurs in many parts of the Dominion, though more especially in the Province of Ontario. Throughout the area underlain by the Medina and Clinton formations, this is particularly so, as the shales of these formations on decomposing, afford a good clay, containing a sufficient amount of iron oxide for colouring. The more important localities are of course those at present being operated, viz.:—Streetsville, Campbellville, Milton and Napanee Mills. Other localities are Freeman and Hamilton, in Wentworth county, and Limehouse, in Halton county.

Porous terra cotta.

At Deseronto the Rathbun Company are making a terra-cotta suitable for the fire-proofing of buildings. This material is made from a mixture of clay and sawdust in about equal proportions, when on firing in kilns the sawdust is burnt out, leaving a vesicular product known to the trade as "porous terra-cotta."

An experiment was made in the presence of the writer, where, in a small building 6x6x10 feet, built of 1-inch lumber and lined with 1½ inch terra-cotta furring, about one quarter of a cord of slabs and edgings, thoroughly saturated with kerosene, was ignited and allowed to burn for half an hour. Notwithstanding the intense heat in the interior, the sides and ends of the building were practically cool, while the roof (a flat one) was only warm. The fire was, at the end of half an hour, extinguished quickly with water, after which the walls were intact and had apparently suffered no injury. This company also manufacture porous terra-cotta in shapes suitable for the protection of wooden and iron beams and joists, as well as for arches for flooring, which have the advantage that, besides their fire-proof qualities, they add very materially to the strength of the flooring.

Test made at Toronto.

The following extract from the Toronto *Globe* of the 20th of May, 1890, gives an account of a test made at the Board of Trade building at that time in course of construction in Toronto :—

"An interesting test was made at the new Board of Trade buildings yesterday and is still in progress. The Rathbun Company, of Dese-

ronto, manufacturers of terra-cotta fire proof flooring, made a test in the presence of Mr. E. A. Kent, Buffalo, architect of the building; Mr. W. Phillips, superintendent of the works; Mr. Wills, secretary; Mr. J. I. Davidson, president of the Board of Trade; and Mr. E. D. Morris, representing the Rathbun Company. An arch which was thought to be defective was selected for the test. The arch, composed only of terra-cotta fire proof, is held between iron beams. A slab of iron about a foot square was placed in the centre of the arch, the span being 4 feet x 3 feet. Over 5,000 lbs. of iron was piled on the piece of iron. More iron was piled on the arch in the afternoon, so as to ascertain the breaking weight of the arch. It finally broke under a pressure of 6,981 pounds, or 5,800 pounds to the square foot."

In commenting on this account of the test the Rathbun Company make the following remarks:—

"The test was made on the level floor of arch (no concrete) and commenced at 11 a.m. when 5,800 lbs. was placed on the arch; the weight was left in position until 4:15 in the afternoon when 1,181 lbs. were added, making in all 6,981 lbs., the last 116 lbs. causing the breakage.

"This test proves that the arch withstood 6,865 lbs. on 1 foot by 1 foot 2 inches superficial area, or 5,721 lbs. to the square foot, the material being 8 inches thick in hollow blocks forming a flat arch."

No statistics regarding terra-cotta are available beyond those of production already given, nor is it possible to give figures of production for previous years.

Drain Tiles.—The manufacture of ordinary drain tiles is carried on at many of the brick yards throughout the Dominion, though there are many yards which produce tiles alone. The state of the industry is very similar to that of the year previous, no new features having been developed. Drain tiles

According to returns made direct to this office, and supposed to represent about two-thirds of the total output, the production for the year 1890 was 10,521 thousands, valued at $140,877, which, compared with 1889, shows a decrease in quantity of 5 thousands and an increase in value of $6,612. The production by provinces is shown as follows:— Production.

STRUCTURAL MATERIALS.

TABLE 18.

PRODUCTION OF TILES DURING 1890.

Province.	No. of Returns.	Thousands.	Value.
Ontario	84	10,372	$138,647
Quebec	1	35	525
Nova Scotia		11	160
New Brunswick	2	103	1,545
Totals	87	10,521	$140,877

Returns of the production of tiles have been published by this office for the past four years, as follows :—

1886	12,416 M	valued at	$142,617
1887	14,658 M	do	230,068
1888	7,518 M	do	114,057
1889	10,526 M	do	134,265

The imports are included with those of sewer pipes in table 19. No exports are reported.

Sewer pipes.

Sewer Pipes.—During 1890 there were produced $348,000 worth of sewer pipes, which were made altogether from domestic clay and salt glazed. Statistics of imports only are available, and it is presumed that there were no exports. The following table shows the imports of sewer pipes and drain tiles :—

Imports.

STRUCTURAL MATERIALS.

TABLE 19.

IMPORTS OF DRAIN TILES AND SEWER PIPES.

Fiscal Year.	Value.
1880	$ 33,796
1881	37,368
1882	70,065
1883	70,699
1884	71,755
1885	69,589
1886	57,953
1887	71,203
1888	101,257
1889	83,215
1890	77,434

Pottery.—Returns were received from 21 producers of pottery, aggregating $195,242. This amount is supposed to represent about four-fifths of the total output, as returns were not received from several operators known to have been producing during the year. The articles principally manufactured are flower pots, chimney pots, jars, crocks and all varieties of Rockingham and cane ware and earthenware. As may be seen on reference to the following table the production is largely that of the province of Quebec, where the larger and more important potteries are situated. Pottery.

Ontario	$ 76,242
Quebec	106,500
Nova Scotia	5,000
Prince Edward Island	3,000
Manitoba	4,500

The following table shows the imports during the past eleven years, of which the greater part is made up of stoneware demijohns and jugs, Rockingham and other heavy stoneware:— Earthenware imports.

STRUCTURAL MATERIALS.

TABLE 20.

IMPORTS OF EARTHENWARE.

Fiscal Year.	Value.
1880	$322,333
1881	439,029
1882	646,734
1883	657,886
1884	544,586
1885	511,853
1886	599,269
1887	750,691
1888	697,082
1889	697,949
1890	695,206

Sands and Gravels.—No returns of production of sands and gravels have been received nor asked for, as it would be impossible to arrive, even approximately, at the amount produced. The following table, however, represents the amounts exported during the past two years by provinces:— Sands and gravels.

STRUCTURAL MATERIALS.

TABLE 21.

EXPORTS OF SAND AND GRAVEL.

Province.	1889.		1890.	
	Tons.	Value.	Tons.	Value.
Ontario	282,774	$51,830	341,656	$64,398
Nova Scotia	172	690	170	750
New Brunswick	80	80	210	290
Manitoba			122	80
British Columbia	18	47		
Totals	283,044	$52,647	342,158	$65,518

The exports for the past fourteen years are as follows :—

STRUCTURAL MATERIALS.

TABLE 22.

EXPORTS OF SAND AND GRAVEL.

Year.	Tons.	Value.	Year.	Tons.	Value.
1877	11,998	$ 2,151	1884	73,741	$19,978
1878	50,140	8,381	1885	110,661	22,878
1879	46,999	9,438	1886	124,865	24,226
1880	53,951	11,177	1887	180,860	30,307
1881	58,693	15,129	1888	260,929	38,398
1882	60,158	16,218	1889	283,044	52,647
1883	55,346	14,065	1890	342,158	65,518

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