FUELS OF WESTERN CANADA

AMES WHITE

Commission of Conservation
Canada

Commission of Conservation

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COMMISSION OF CONSERVATION
CANADA

Fuels of Western Canada

AND

Their Efficient Utilization

Revised Edition

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Fuels of Western Canada

THE principal fuels of Western Canada* are:

Coal	Electricity
Natural Gas	Peat
Petroleum	Wood

COAL

Coal is, of course, much the most important fuel of Western Canada, and ranges from the lignite of the prairies to the semi-anthracite of the Rocky mountains.

The *Coal Fields and Coal Resources of Canada*† contains a statement of the coal resources of the Dominion. This statement of reserves is divided into two groups.

Group I includes "coal in seams containing not less than one foot of merchantable coal occurring not more than 4,000 feet below the surface, including workable submarine areas." This group, Dr. Dowling states, includes the coal "of economic value contained in seams of workable thickness, situated within a mineable distance of the surface."

Group II includes seams containing not less than two feet of merchantable coal occurring at depths between 4,000 and 6,000 feet. Such seams are situated beyond present mineable distance of the surface and have not been considered in this paper.

Both groups are subdivided into (1) Actual Reserves, which includes cases in which the calculation of the amount was "based on a knowledge of the actual thickness and extent of the seams"; (2) Probable Reserves, which includes "cases in which an approximate estimate only" could be arrived at.

At the present time, to be economically 'workable,' a seam must be more than one foot thick, and no coal mine in Canada approaches 4,000 feet in depth, though, in the Crowsnest district, some workings have a 'cover' of several thousand feet. At great depths the greatly increased ventilation is a matter of expense and difficulty; 'creeps' and subsidences of strata are unavoidable and either crush the coal or render it inaccessible; the capital and current expenditure of the mine grows in a higher proportion than the depths; the costs of raising water, coal, miners, etc., increase.

Dr. Dowling's estimate of the coal reserves in Group I is as follows:

*For the purposes of this paper, Western Canada is taken as including Manitoba, Saskatchewan, Alberta and British Columbia, but not including Yukon or the Northwest Territories.

†The writer desires to express his indebtedness to the report on the *Coal Fields and Coal Resources of Canada*, by Dr. D. B. Dowling, Geological Survey of Canada.

ACTUAL RESERVES

(Calculation based on actual thickness and extent)

	Lignite	Lignitic or sub-bituminous	Low-carbon bituminous	Bituminous and high-carbon bituminous	Semi-anthracite	Total
	Metric tons	Metric tons	Metric tons	Metric tons	Metric tons	Metric tons
Saskatchewan	2,412 million	.....	.....	.....	.....	2,412 million
Alberta	.....	382,500 million	~~1,1917~~ 1,197 million	2,027 million	669 million	386,373 " †
British Columbia	.....	60 "	118 "	23,653 " *	.....	23,831 "
	2,412 million	382,560 million	1,315 million	25,680 million	669 million	412,616 million

PROBABLE RESERVES

(Approximate estimate)

	Lignite	Lignitic or sub-bituminous	Low-carbon bituminous	Bituminous and high-carbon bituminous	Semi-anthracite	Total
	Metric tons	Metric tons	Metric tons	Metric tons	Metric tons	Metric tons
Manitoba	160 million	.....	.....	.....	.....	160 million
Saskatchewan	57,400 "	.....	.....	.....	.....	57,400 "
Alberta	26,450 "	464,821 million	139,161 million	43,022 million*	100 million	673,554 "
British Columbia	.....	5,136 "	2,300 "	42,608 " ‡	.....	50,044 "
	84,010 million	469,957 million	141,461 million	85,630 million	100 million	781,158 million

*Includes semi-anthracite.
†Total after deducting 20 million tons mined in 1911.
‡Includes 1,800 million tons of cannel.

Total coal in Western Canada (Group I)—

	Tons	Per cent
Manitoba..................	160,000,000	0·1
Saskatchewan..............	59,812,000,000	6·1
Alberta...................	1,059,927,400,000	88·8
British Columbia..........	73,874,942,000	5·0
	1,193,774,342,000	

The classification of coals adopted in this paper is that used in the *Coal Resources of the World*, as below:

Anthracite—

Fuel ratio, *12 or over
Calorific value, 14,500 to 15,000 B.t.u.
Carbon, 93 to 95 per cent
Volatile combustible matter, 3 to 5 per cent

Semi-anthracite—

Fuel ratio, 7 to 12
Calorific value, 15,000 to 15,500 B.t.u.
Carbon, 90 to 93 per cent
Volatile, 7 to 12 per cent

Anthracitic and High-carbon Bituminous—

Fuel ratio, 4 to 7
Calorific value, 15,200 to 16,000 B.t.u.
Carbon, 80 to 90 per cent
Volatile, 12 to 15 per cent
Does not readily coke

Bituminous—

Fuel ratio, 1·2 to 7
Calorific value, 14,000 to 16,000 B.t.u.
Carbon, 75 to 90 per cent
Volatile, 12 to 26 per cent
Generally cokes

Low-carbon Bituminous—

Moisture content occasionally reaches 6 per cent
Volatile matter, up to 35 per cent

$$\frac{\text{Fixed carbon} + \frac{1}{2}\text{ volatile}}{\text{Hygroscopic moisture} + \frac{1}{2}\text{ volatile}} = 2{\cdot}5 \text{ to } 3{\cdot}3$$

Calorific value, 12,000 to 14,000 B.t.u.
Carbon, 70 to 80 per cent
Makes porous, tender coke

Cannel—

Yields 30 to 40 per cent volatile matter on distillation
Calorific value, 12,000 to 16,000 B.t.u.
Very porous coke

*The fuel ratio is obtained by dividing the percentage of fixed carbon by the percentage of volatile matter.

Lignitic or Sub-bituminous—

Generally contains over 6 per cent of moisture
Moisture, freshly mined, up to 20 per cent

$$\frac{\text{Fixed carbon} + \frac{1}{2}\text{ volatile}}{\text{Hygroscopic moisture} + \frac{1}{2}\text{ volatile}} = 1{\cdot}8 \text{ to } 2{\cdot}5$$

Calorific value, 10,000 to 13,000 B.t.u.
Carbon, 60 to 75 per cent

Lignite—

Moisture in commercial output, over 20 per cent
Calorific value, 7,000 to 11,000 B.t.u.
Carbon, 45 to 65 per cent

Manitoba

In Manitoba, the Turtle Mountain coal-field occupies an area of about 48 square miles. About 1890, an attempt to mine coal was made near Goodlands, but was unsuccessful, doubtless due to the poor quality and the thinness of the seams. Coal has also been mined near Deloraine, but only for local use. The insignificance of the production is indicated by the fact that the *Annual Report on the Mineral Production of Canada*, published by the Mines Branch, Ottawa, gives no statistics of coal production in Manitoba. The 'probable,' not 'actual,' reserves are estimated at 160,000,000 tons of lignite.

Dr. D. B. Dowling states that "the coal horizon does not appear to consist of a series of seams in continuous sheets, but rather of deposits which are limited in extent though repeated over large areas. A thick seam may thus be represented in an adjoining locality by a series of thin seams separated by sheets of sand or clay."

Saskatchewan

In Saskatchewan, two coal-bearing formations are exposed, namely (1) the Belly River formation of the Cretaceous and (2) Tertiary, which is much more important than the Cretaceous, and underlies the Estevan district, Wood mountain and the Missouri coteau. The two principal fields are roughly triangular in shape. The first is bounded on the east by a line extending from the vicinity of Carnduff to Johnston lake, on the west by a line thence to the international boundary west of Wood mountain and by the international boundary. The second field extends from the boundary between Saskatchewan and Alberta to the vicinity of Swift Current and includes the eastern portion of the Cypress hills.

The Souris valley is about 120 feet deep near Estevan and presents peculiarly advantageous conditions for prospecting and for mining the seams that outcrop in its banks and in the tributary gullies and ravines. Though there can be little doubt that enormous areas in Saskatchewan are underlain by coal seams, the heavy covering of boulder-clay conceals their outcrops and, except in occasional rock exposures in the hillsides and stream valleys, their existence can only be determined by boring. At the Estevan mines, most of the coal is produced from the lower measures, which, at this point, have a thickness of 8 feet of coal. In the western portion of the district, the seam splits up into several small seams, but it is reported that, to the northeast, it increases to 15 feet.

Lignite has also been reported near Cullen, 16 feet, Arcola, 14 feet, Wauchope, 8 feet, and in a number of localities, particularly in the Wood Mountain and Cypress Hills districts. Coal has been found in borings or natural exposures of rocks of the Belly River formation in the western portion of Saskatchewan, notably at Maple Creek, Brock and Salvador. It carries from 27 to 34 per cent fixed carbon. Coal carrying 35 per cent fixed carbon has also been found in the Dakota sandstone (Cretaceous) near lac la Ronge.

It is estimated that, in Saskatchewan, an area of 13,100 square miles is underlain by coal seams. The 'actual' and 'probable' reserves of coal aggregate 59,812 million tons, all lignite.

The annual production of coal in Saskatchewan during the period 1898-1917, is as follows:

	Tons	Value		Tons	Value
1898..........	25,000	$ 37,500	1908.......	150,556	$253,790
1899..........	25,000	37,500	1909.......	192,125	296,339
1900..........	40,500	60,750	1910.......	181,156	293,923
1901..........	45,000	72,000	1911.......	206,779	347,248
1902..........	70,400	112,640	1912.......	225,342	368,135
1903..........	116,703	169,618	1913.......	212,897	358,192
1904..........	124,885	187,021	1914.......	232,299	374,245
1905..........	107,596	152,334	1915.......	240,107	365,246
1906..........	108,398	164,146	1916.......	281,300	441,836
1907..........	151,232	252,437	1917.......	355,445	662,451

The output of the mines in the Souris field constitutes 95½ per cent of the production of the province. The mines at Gladman and Hart produce about 1½ per cent, the remainder of the output coming from mines that produce less than 1,000 tons each per annum.

ALBERTA

As indicated in the table on page 6, it has been estimated that the 'actual' and 'probable' reserves of coal in Alberta aggregate 1,059,927 million tons, which constitutes 87 per cent of the coal in Canada.

The coal horizons in Alberta are:

(1) Edmonton and part of Paskapoo formation
(2) Belly River formation
(3) Kootenay formation

Coal is found in the Tertiary rocks, but most of the seams are too thin to mine.

Edmonton Formation

Of the total area, 24,779 square miles, occupied by the Edmonton and Paskapoo beds, 22,475 square miles is assumed to be underlain by coal. The 'actual' and 'probable' reserves in these beds aggregate 789,600 million tons of lignitic or sub-bituminous coal and 11,358 million tons of low-carbon bituminous. Of the reserves in the Edmonton formation, 98·6 per cent is lignite or sub-bituminous and 1·4 per cent is low-carbon bituminous.

The Edmonton formation forms a wide trough lying approximately parallel to the Rockies and extending from the international boundary to about latitude 55° 30′. The central portion of the trough is occupied by Tertiary sandstones.

The 'Big' coal seam, which is 25 feet thick where it outcrops on the North Saskatchewan, consists of two 10-foot seams near the Grand Trunk Pacific crossing of the Pembina river. It is 10 feet thick on the Red Deer river near Alix, but decreases to about 5 feet south of the Bow river.

Another very persistent coal horizon is found 500 to 600 feet below the 'Big' seam. At Calgary, where it has been found in a bore-hole 1,800 feet below the surface, it is 13 feet thick, near Drumheller it is 6 feet 10 inches thick, on Battle river it has a thickness of 4 feet. At Edmonton, there are two seams of good domestic coal, each about 6 feet thick.

Belly River Formation

The Belly River formation occupies a considerable area in the southeastern portion of the province. The most important seams in this formation are exposed at Lethbridge. At this point, the main seam is 5 feet 6 inches in thickness. The probable reserves in the Belly River are: Lignite, 29 per cent; lignitic or sub-bituminous, 10½ per cent; low-carbon bituminous, 60½ per cent.

The discovery of a 4-foot and a 7-foot seam at Maple Creek, at depths of 197 and 292 feet, respectively, indicates that this formation contains workable seams as far east as southern Saskatchewan.

What is assumed to be the 'upper' seam has been found at Tofield, at a depth of 1,050 feet, and at Edmonton, at a depth of 1,400 feet, where it was 6 feet thick. At Calgary, a 5-foot seam found at 2,562 feet, a 7-foot seam at 2,656 feet and a 4-foot seam at 2,875 feet are believed to be in the Belly River formation.

Kootenay Formation

The Kootenay formation is exposed in and near the Rocky mountains. As a result of the great uplift of the Rockies, the upper measures were denuded and only remnants of the lowest division of the Cretaceous—the Kootenay—survived. These remnants are usually found occupying valleys between the mountain ranges, the mountains having served as a protecting agency. At the same time, the crumpling and folding of the strata during the uplift of the mountains have given us a coal that, in places, is semi-anthracite or is anthracitic. It is estimated that, of the 'actual' and 'probable' reserves, 1·7 per cent is semi-anthracite and 98·3 per cent is high-carbon bituminous or bituminous.

The coal in the Kootenay formation is the highest grade found in the Prairie Provinces.

In Alberta, the three principal seams in the Coleman area have a thickness of 16 feet, 10 feet, and 8 feet, respectively. In the Blairmore area there are seams 10, 17, 3½, 3½, 17 and 6 feet thick, respectively. A seam 20 feet thick has been reported in the Moose Mountain area.

In the Banff area, the coal varies from anthracite to bituminous. In the southeastern portion of the field, there is a total thickness of coal of from 41 to 86 feet. At Bankhead, the workings have cut seams 3 feet, 7 feet (in thin bands), 8 feet, 19 feet (in two benches), 13 feet (in three benches) and 6 feet thick, respectively.

In the Bighorn basin, seams aggregating about 60 feet of workable coal have been found. Seams of 21 feet, 7½ feet and 4½ feet are being mined at Mountain Park.

Coal is also found in the Kootenay formation at numerous other points in the Rockies and in the foothills. On the Muskeg river, seams 11½ feet, 25 feet and 7 feet thick, respectively, have been found.

Coal Production, Alberta

The Chief Inspector of Coal Mines for Alberta states that, in 1916, the total sales in Canada of coal produced in Alberta, were 4,227,164 tons; that 2,956,205 tons were sold for consumption in Alberta, 1,021,656 tons in Saskatchewan, 98,629 tons in Manitoba, 89,582 tons in British Columbia and 61,092 tons in the United States.

The coal production* of Alberta in the period, 1898-1917, was as follows:

	Tons	Value		Tons	Value
1898..........	315,088	$ 787,720	1908.......	1,685,661	$ 4,127,311
1899..........	309,600	774,000	1909.......	1,994,741	4,838,109
1900..........	311,450	778,625	1910.......	2,894,469	7,065,736
1901..........	340,275	850,687	1911.......	1,511,036	3,979,264
1902..........	402,819	960,601	1912.......	3,240,577	8,113,525
1903..........	495,893	1,117,541	1913.......	4,014,755	10,418,941
1904..........	661,732	1,404,524	1914.......	3,683,015	9,350,392
1905..........	931,917	1,993,915	1915.......	3,360,818	8,283,079
1906..........	1,246,360	2,614,762	1916.......	4,559,054	11,386,577
1907..........	1,591,579	3,836,286	1917.......	4,736,368	14,155,685

**The Production of Coal and Coke in Canada, during the Calendar Year 1916*, p. 29. By John McLeish, Mines Branch, Department of Mines, Ottawa.

The total coal production of Alberta, in 1917, was 4,736,368 tons. Of this production, 2,428,838 tons, or 51·3 per cent, was lignite; 2,199,305 tons, or 46·4 per cent, was bituminous; 108,225 tons, 2·3 per cent, was semi-anthracite.

PRODUCTION OF COAL IN ALBERTA, 1917, BY DISTRICTS

District	Production, short tons	Per cent of total
Anthracite—		
Banff	108,225	2·3
Bituminous—		
Crowsnest Pass	1,188,456	25·1
Canmore	196,947	4·2
Brazeau	266,823	5·6
Jasper Park	248,733	5·2
Yellowhead Pass	159,182	3·4
Mountain Park	139,164	2·9
Total bituminous	2,199,305	46·4
Lignite—		
Pincher Creek	4,652	·1
Lethbridge	614,017	13·0
Magrath	936	
Milk River	8,047	·2
Taber	157,373	3·3
Bow Island	6,043	·1
Medicine Hat	13,975	·3
Aldersyde	7,076	·2
High River	1,126	
Drumheller	631,767	13·3
Big Valley	26,753	·6
Brooks	9,233	·2
Hanna	25,670	·5
Lacombe	16,097	·3
Trochu	15,023	·3
Three Hills	22,457	·5
Carbon	4,301	·1
Battle River	9,862	·2
Camrose	56,625	1·2
Tofield	68,806	1·5
Clover Bar	256,208	5·4
Edmonton	121,080	2·6
Namao	18,195	·4
Cardiff	237,861	5·0
Wabamun	13,534	·3
Pembina	81,911	1·7
Peace River	210	
Total lignite	2,428,838	51·3
Total production	4,736,368	

British Columbia

Crowsnest Coal-field

The Crowsnest coal-field is the most important body of coal that is being mined in British Columbia. It includes an area of 230 square miles. The coal is a high grade bituminous, occasionally running into anthracite, averaging about 64 per cent fixed carbon. Much the greater portion of the coal is converted into coke, the remainder being sold as steam coal. There are 22 workable seams, with a total thickness of 216 feet, 100 feet of which is estimated as workable.

In addition to the Crowsnest field referred to above, areas of coal-bearing rocks are found at several points in southern British Columbia. The Princeton field includes an area of about 50 square miles. At Princeton, there is an 18½-foot seam of lignite carrying 42 per cent fixed carbon, 38 per cent volatile matter and 16 per cent moisture. At Nicola, seams 6 feet, 10 feet, 5 feet and 12 feet thick, respectively, have been mined. The Nicola coal is a sub-bituminous and analyzes about 47 per cent fixed carbon, 39 per cent volatile and 4 per cent moisture.

Coal has also been found at Tulameen, Kamloops, Hat creek and North Thompson river.

Vancouver Island Coals

The total area in Vancouver island underlain by coal seams is about 600 square miles. These coal-fields contain some of the best steam coals on the Pacific coast.

The coal of the Comox field is coking bituminous and contains 57·2 per cent of fixed carbon, the highest carbon content of all the Vancouver Island coals. Three seams have been mined in this field.

The Nanaimo field has a productive area of 65 square miles, though the area underlain by coal seams is somewhat larger. The seams vary in thickness. Occasionally a seam containing from 2 to 3 feet of dirty coal carries 30 feet of clean coal at a point only 100 feet distant. Run-of-mine coals from this field run as high as 56 per cent fixed carbon and 43 per cent volatile combustible; commercial samples, 12,470 to 13,160 British thermal units.

The coal-fields of the Queen Charlotte islands are of Cretaceous and Tertiary age. The Cretaceous coals range from semi-anthracite to low-carbon bituminous. The Tertiary coals are lignites. In 1871, mines were opened in the semi-anthracite at Cowgitz, but the coal was so badly crushed that the enterprise was abandoned. This coal analyzed 83 per cent fixed carbon and 5 per cent volatile combustible; fuel ratio, 16·5.

Central British Columbia

Lignite is found at Alexandria, Quesnel and Prince George on the Fraser, on the Nazco river, Nechako river, Dean river and Lightning creek. Three seams of bituminous coal, possibly a coking coal, aggregating 20 feet in thickness, have been reported on a tributary of Morice river, and three seams on Goat river, a tributary of the Telkwa, aggregate 56 feet in thickness.

Northern British Columbia

The most important coals thus far discovered in the northern portion of British Columbia are the semi-anthracites and anthracites of the Groundhog Mountain area. An area of 170 square miles is assumed to be coal-bearing, and contains 8 seams, with an aggregate thickness of 30 feet.

The 'actual' and 'probable' reserves in British Columbia are: Semi-anthracite, 1·9 per cent; bituminous, 85·4 per cent; low-carbon bituminous, 3·3 per cent; cannel, 2·4 per cent; lignitic, 7·0 per cent.

Lignites have been discovered on Kispiox river, Sustut river, Peace river and Liard river. Bituminous coal has been found near Peace River cañon, and on the Taku river.

The coal production in British Columbia during the period, 1898-1917, was as follows:

Year	Tons	Value	Year	Tons	Value
1898..........	1,263,680	$3,384,858	1908.......	2,333,708	$ 7,292,838
1899..........	1,431,101	3,833,307	1909.......	2,606,127	8,144,147
1900..........	1,791,833	4,799,553	1910.......	3,330,745	10,408,580
1901..........	1,919,488	5,141,487	1911.......	2,542,532	7,945,413
1902..........	1,808,441	4,844,040	1912.......	3,208,997	10,028,116
1903..........	1,676,581	4,490,844	1913.......	2,714,420	8,482,562
1904..........	1,862,625	4,989,174	1914.......	2,239,799	6,999,374
1905..........	1,945,452	5,211,030	1915.......	2,065,613	6,455,041
1906..........	2,146,262	5,748,915	1916.......	2,584,061	8,075,190
1907..........	2,364,898	7,390,306	1917.......	2,433,888	8,235,716

Coal Production

In the calendar year 1917, the coal production of the Prairie Provinces and British Columbia was:

	Tons	Per cent of Canada's production	Value
Saskatchewan..........................	355,445	2·53	$ 662,451
Alberta..........................	4,736,368	33·72	14,153,685
British Columbia..........................	2,433,888	17·33	8,235,716
	7,525,701	53·58	$23,051,852

Imports of Coal

In the year ending March 31, 1917, the imports into the Prairie Provinces, British Columbia and the portion of Ontario lying to the west of lake Superior were:

	Tons	Value
Bituminous lump	2,067,416	$2,850,121
Bituminous slack	260,197	337,655
Anthracite	521,611	2,924,308
	2,849,224	$6,112,084

Canada's total consumption of coal in 1916 was 29,865,856 tons. Of this total, 41·3 per cent was Canadian and 58·7 per cent was imported coal. In normal times, taking the average during the period, 1894-1913, the consumption is about 48 per cent Canadian and 52 per cent imported, the increase in imports at the present time being due largely to the demands for munition and other manufactures in the coal-less portion of Canada—Ontario and Quebec— and to the decrease in the production of Nova Scotia.

Locomotives, in 1916, consumed 8,677,354 tons. This constituted 29·1 per cent of all coal consumed in Canada. It was 34·3 per cent of the total consumption of bituminous and lignite in the Dominion and was 38·2 per cent of the total consumption of bituminous.

The Vancouver Island and Nicola Valley collieries, in 1917, exported 32·6 per cent of their output to the United States, exported 2·4 per cent to other countries and sold 65 per cent for consumption in Canada. The corresponding figures for 1912 are 21·2 per cent, 7·5 per cent and 71·3 per cent, respectively. In 1902, 75 per cent was exported to the United States. These figures show a remarkable change of market.

The production in the Crowsnest district in 1917, was 617,956 short tons. Of this production, 252,949 tons, or 40·9 per cent, was exported to the United States; 82,441 tons, or 13·3 per cent, was sold in Canada; 282,566 tons, or 45·7 per cent, was converted into coke or was used for colliery purposes.

In 1917, the Crowsnest Pass Coal Co. produced 504,762 short tons, the Canadian Collieries, 690,111 tons, and the Western Fuel Co., 714,533 tons, contributed, in the aggregate, 78·4 per cent of the production of British Columbia.

In 1917, the Vancouver Island collieries produced 1,648,201 tons, or 67·7 per cent of the output of the province; the Nicola-Princeton collieries, 167,731 tons, or 6·9 per cent; Crowsnest (East Kootenay) district, 617,956 tons, or 25·4 per cent.

ANALYSES OF SASKATCHEWAN COALS

District	Moisture condition*	Loss in air drying	Moisture	Volatile combustible	Fixed carbon	Ash	B.T.U. per lb., gross	Fuel ratio	Carbon hydrogen ratio	Coking properties	Name of mine	Authority for analyses†
Lignite—												
Estevan area..	A.D.	18.4	18.2	32.7	35.4	13.7	7,890	1.10	8.5	Non-coking	Estevan Coal and Brick Co.	Mines Br., B. 24
" " ..	A.D.	14.7	18.0	40.2	35.2	6.6	8,770	0.88	8.2	" "	West Dom. Collieries	" " " 24
" " ..	A.D.	14.0	23.6	31.4	38.6	6.4	......	1.25	......	" "	Bienfait mine	" " " 24
Willowbunch area.........	R.	......	8.5	39.5	35.4	16.6	......	0.90	......	" "	Waldon mine	" " " 24
Wood Mt. area..	R.	......	13.8	38.3	37.3	10.6	......	0.97	......	" "	Sec. 8, Tp. 1, R. II W. of 3rd Mer.	" " " 24

ANALYSES OF ALBERTA COALS

District	Moisture condition*	Loss in air drying	Moisture	Volatile combustible	Fixed carbon	Ash	B.T.U. per lb., gross	Fuel ratio	Carbon hydrogen ratio	Coking properties	Name of mine	Authority for analyses†
Anthracite—												
Banff, commercial..........	A.D.	0.5	0.5	11.7	75.7	12.1	13,250	6.45	22.0	Non-coking	Bankhead colliery	Mines Br., B. 25
Banff, briquettes‡	A.D.	1.8	0.9	17.0	68.0	14.1	12,970	4.00	20.2	" "	" "	" " " 25
Bituminous—												
Crowsnest Pass.	A.D.	1.3	0.7	24.9	54.7	19.7	11,640	2.20	16.7	....	Denison colliery	" " " 25
" "	A.D.	0.7	0.2	27.6	56.8	15.4	12,370	2.05	16.4	....	Bellevue Colliery	" " " 25
" "	A.D.	0.0	1.2	26.0	56.3	16.5	12,330	2.15	14.9	Good coke	Franco-Can. Col.	" " " 25
Canmore.......	A.D.	0.0	0.9	14.0	79.7	5.4	14,470	5.70	20.5	Very slight	No. 2 mine, Canmore	" " " 25
Brazeau........	A.D.	1.0	0.9	16.5	70.6	12.0	13,480	4.30	18.7	Poor coke	Brazeau collieries.	" " " 25
Jasper Park....	A.D.	1.8	0.5	18.8	58.9	21.8	11,790	3.10	17.6	Good coke	Jasper Park collieries	" " " 25
Yellowhead Pass	A.D.	1.8	7.5	30.3	54.6	7.6	11,480	1.80	12.9	Non-coking	Pacific Pass colliery	" " " 25
Mountain Park.	A.D.	1.4	1.9	30.9	62.9	4.3	14,400	2.05	15.5	Good coke	Mountain Park mine	" " " 25
Lignite—												
Pincher Creek..	A.D.	1.2	3.8	28.9	38.7	28.6	9,440	1.35	12.1	....	Breckenridge & Lund Coal Co.	" " " 25
Lethbridge.....	A.D.	0.5	7.9	34.5	47.5	10.1	10,790	1.35	11.3	Non-coking	Galt No. 3 mine	" " " 25
Magrath......	A.D.	0.0	9.6	32.8	47.8	9.8	10,640	1.45	11.9	" "	Chinook Coal Co.	" " " 25
Milk River.....		......	5.6	37.8	49.8	6.8	......	2.81	......	" "	Sec. 2, Tp. 4, R. XIX, W. 4.	Geol. Surv. M.53
Taber.........	A.D.	1.5	11.7	31.8	44.1	12.4	9,750	1.40	10.4	" "	Canada West Co.	Mines Br., B. 25

Bow Island	......	......	17.3	30.9	46.3	5.6	9,259	......	......	" "	....	Pearce.
Medicine Hat	......	......	19.9	33.3	41.6	5.2	......	1.59	......	......	Stair mine	Geol. Surv., M. 53
Aldersyde	A.D.	2.9	10.2	32.7	50.1	7.0	10,660	1.55	11.7	Non-coking	Ellis Bros. No. 1 mine.	Mines Br., B. 25
High River	......	......	2.2	34.6	56.4	6.8	......	3.78	......	......	Sec. 20, Tp. 19, R. IV, W. 5th.	Geol. Surv., M. 53
Drumheller	A.D.	7.2	8.8	34.6	48.4	8.2	10,350	1.40	11.9	Non-coking	Rosedale mine	Mines Br., B. 25
Big Valley	......	......	12.1	30.0	44.3	8.6	......	......	......	......	....	Pearce.
Brooks	......	......	11.1	38.7	40.9	9.2	......	1.97	......	......	Bow river, Horse-shoe bend.	Geol. Surv. M. 53.
Hanna	A.D.	4.2	20.8	31.0	42.4	5.8	9,120	1.35	9.4	Non-coking	Wadsworth mine, Hanna.	Mines Br., B. 25
Lacombe	A.D.	7.0	22.7	30.7	38.4	8.2	8,220	1.25	8.6	" "	McCormack mine, Castor.	" " " 25
Trochu	A.D.	2.4	15.3	27.9	48.2	8.6	9,810	1.75	11.2	" "	Halbert mine	" " " 25
Three Hills	A.D.	0 9	14.3	28.5	48.8	8.4	9,890	1.70	11.0	" "	Wilson mine	" " " 25
Carbon	......	......	9.9	34.9	46.6	8.7	......	2.35	......	......	Knee Hills creek, R. XXIII.	Geol. Surv., M. 53
Battle River	A.D.	3.1	23.0	28.7	42.3	6.0	8,770	1.45	8.9	Non-coking	Bish mine	Mines Br., B. 25
Camrose	......	......	18.3	31.8	44.7	5.1	9,250	......	......	......	....	Pearce.
Tofield	A.D.	8.7	15.9	34.3	44.2	5.6	9,800	1.30	10.1	" "	Tofield Coal Co.	Mines Br., B. 25
Clover Bar	A.D.	9.6	17.6	27.8	46.6	8.0	9,130	1.65	10.2	" "	Clover Bar Coal Co.	" " " 25
Edmonton	A.D.	5.8	18.2	33.6	38.9	9.3	8,780	1.15	9.0	" "	Strathcona Coal Co.	" " " 25
Namao	A.D.	4.6	22.1	29.7	43.1	5.1	9,050	1.45	9.2	" "	Comfort Coal Co.	" " " 25
Cardiff	A.D.	9.6	18.2	31.9	44.6	5.3	9,360	1.40	10.0	" "	Cardiff collieries	" " " 25
Wabamun	A.D.	2.5	16.8	32.4	45.1	5.7	9,150	1.40	10.8	" "	Security mine, Wabamun.	" " " 25
Pembina	A.D.	6.2	11.5	31.5	46.6	10.4	9,580	1.50	10.8	" "	Pembina mine	" " " 25
Peace River	A.D.	1.6	10.4	32.0	53.8	3.8	11,830	1.70	12.2	" "	Brown's pit, 21-70-10, W. 6.	" " " 25
Peace River	R.	......	1.1	23.0	70.6	5.3	......	3.05	......	Good coke	Abbott claim, 4-57-7 W. 6	" " " 25

*Figures in this column indicate moisture condition. "A.D." indicates that sample analysed was air-dried; "R" indicates fuel as received.

†"Mines Br., B. 24" or "Mines Br., B. 25" indicates that the analysis was extracted from *Bulletin 24*, or *25*, Mines Branch, Federal Dept. of Mines. "Geol. Surv. M. 53" indicates that it was obtained from Memoir 53, by D. B. Dowling, Geological Survey of Canada. "Pearce" indicates that the data were obtained from a blue print compiled by Mr. William Pearce, Calgary, and are "from various sources believed by the compiler to be reliable."

‡Coal dust briquetted with about 10 per cent coal tar.

ANALYSES OF BRITISH COLUMBIA COALS

Locality	Moisture condition*	Loss in air-drying	Moisture	Volatile combustible	Fixed carbon	Ash	B.T.U. per lb., gross	Fuel ratio	Carbon hydrogen ratio	Coking properties	Authority†
Crowsnest Pass—											
Corbin, No. 4 mine	A.D.	0.4	0.5	24.6	61.1	13.8	......	2.50	17.9	Poor coke	Mines Br., B. 26
Michel colliery	A.D.	1.2	0.7	22.4	65.0	11.9	13,260	2.90	16.9	....	" " " 26
Coal Creek colliery	A.D.	0.9	1.3	26.0	63.8	8.9	13,640	2.45	17.3	....	" " " 26
Flathead area—											
Butt's 31ft. seam	R.	......	4.7	24.1	59.2	12.0	......	2.45	......	Non-coking	" " " 26
Okanagan lake, B.C. seam	......	......	1.6	33.9	55.4	9.1	......	3.89	......	....	Geol. Surv., M. 53
Tulameen, Granite Creek	D.	......	......	33.7	54.0	12.3	......	1.60	14.9	....	Mines Br., B. 26
Nicola, Middlesboro collieries	A.D.	0.5	3.9	37.6	44.5	14.0	11,230	1.20	12.3	....	" " " 26
Chilliwack river, 5 miles up	......	......	....	‡35.7	63.9	0.4	......	......	......	....	Geol. Surv., M. 53
Vancouver, English bay	A.D.	4.6	14.5	34.3	44.3	6.9	......	1.30	......	Non-coking	Mines Br., B. 26
Nanaimo area—											
No. 1 mine, Douglas seam	A.D.	0.6	1.6	40.6	47.7	10.1	12,620	1.20	14.4	....	" " " 26
Newcastle seam	A.D.	0.5	1.9	40.7	45.7	11.7	12,230	1.10	14.3	....	" " " 26
Wellington seam	A.D.	0.7	1.1	39.7	49.2	10.0	13,020	1.25	15.0	....	" " " 26
Comox area—											
No. 4 mine, lower seam	D.	......	......	31.6	56.5	11.9	12,870	1.80	16.5	....	" " " 26
Comox lump coal	R.	......	1.1	32.2	56.3	10.4	13,210	1.75	15.3	Fair coke	" " " 26
Trent River seam	......	......	0.9	32.9	58.3	7.8	......	......	......	....	Geol. Surv., M.53
Browns River seam	......	......	0.9	23.8	70.9	4.3	......	......	......	....	" " " 53
Beaufort mine	......	......	......	‡29.3	55.7	14.9	......	......	......	Slow coking	" " " 53
Baynes Sd. mine, Richardson seam	......	......	1.2	34.1	48.5	16.2	......	......	......	....	" " " 53
" " " upper seam	......	......	......	‡29.1	57.5	13.4	......	......	......	Slow coking	" " " 53
" " " lower seam	......	......	......	‡29.5	64.7	5.8	......	......	......	"	" " " 53
Suquash, Pacific Coast mine	D.	......	......	34.3	42.7	23.0	11,100	1.25	......	....	Mines Br., B. 26
¾ m. south of Kliksiwi River seam	......	......	3.7	42.2	39.8	14.3	......	......	......	....	Geol. Surv., M. 53
Kink river, near Beaver Har. seam	......	......	3.7	39.3	47.0	10.0	......	......	......	....	" " " 53
Koskimo coal-field	......	......	1.0	34.4	54.0	10.6	......	......	......	....	" " " 53
Queen Charlotte Islands—											
Yakoun river, Masset inlet	......	......	2.7	38.2	53.7	5.4	......	......	......	....	" " " 53
Camp Wilson	R.	......	2.0	35.7	48.3	14.0	......	1.35	14.0	Firm, coherent coke	Mines Br., B. 26

British Pacific Coal Co.	R.		5.3	5.3	65.2	24.2		12.0	31.7	Non-coking	Mines Br., B. 26
Cowgitz	R.		2.2	7.9	75.3	14.6		9.55		“	“ “ “ 26
Fraser River above Lytton—											
Hat ck. 1 mile above Marble cañon			8.6	35.5	46.8	9.1					Geol. Surv. No. 53
North Thompson river, 45 miles up			2.2	38.1	46.8	12.9					“ “ “ 53
Kohasganko river			9.9	42.6	34.0	13.5					“ “ “ 53
Nechako river, Fort Fraser			10.5	41.4	43.2	4.9					“ “ “ 53
Skeena River—											
Skeena river, 9 miles above forks			1.0	19.1	39.0	40.9					“ “ “ 53
“ “ 20 miles above forks			1.5	7.2	46.0	45.2					“ “ “ 53
Watsonkwa river				‡40.5	57.5	2.0					“ “ “ 53
Morice river, seam No. 1			4.3	28.9	54.6	12.2					“ “ “ 53
“ “ seam No. 2, top			4.5	25.9	55.6	14.0					“ “ “ 53
“ “ bottom			3.6	28.2	53.9	14.3					“ “ “ 53
Coal creek, 5′ 6″ seam			1.4	10.9	80.8	6.9					“ “ “ 53
Tooza river, 16 m. from mouth			4.6	33.8	42.7	19.0					“ “ “ 53
Telkwa River—											
Goat creek	R.		1.3	31.0	59.8	7.9		1.90		Fair coke	Mines Br., B. 26
“ “	R.		2.7	4.9	76.4	16.0		15.60		Non-coking	“ “ “ 26
“ “ Transcontinental seam			0.8	8.2	81.6	9.4					Geol. Surv., M. 53
“ “ lower seam			1.0	9.9	80.8	8.3					“ “ “ 53
Hudson Bay mountain			9.2	5.6	74.7	10.5					“ “ “ 53
Tuchi river, Babine lake			2.5	17.3	52.2	28.0				Non-coking	“ “ “ 69
Coal creek, Zymœtz river			5.4	34.0	48.2	12.4				Partly fritted	“ “ “ 69
Shegunia river, Salmon r., No. 3 sm.			1.2	20.6	57.3	20.9				Coking	“ “ “ 69
Kispiox			1.2	10.3	64.8	23.7					“ “ “ 69
Groundhog area—											
Western Development Co.			1.2	6.5	83.4	8.9					“ “ “ 69
Trail creek			1.4	7.2	49.0	42.4					“ “ “ 69
Pelletier seam			1.3	7.7	61.9	29.1					“ “ “ 69
Firepan creek, Tacla lake	R.		8.7	36.7	44.3	10.3		1.20		Non-coking	Mines Br., B. 26
Peace river, Carbon river	R.		1.5	20.5	75.9	2.1		3.70		Barely agglomerates.	“ “ “ 26

*‘A.D.’ indicates that the sample analysed was air-dried; ‘R.’ indicates sample as received; ‘D’ indicates that sample was dried at 105° C.

†‘Mines Br., B. 26’ indicates that the information was obtained from Bulletin No. 26, Mines Branch, Federal Dept. of Mines. ‘Geol. Surv. M. 53’ and ‘Geol. Surv., M. 69’ indicates that it was extracted from Memoir 53 and Memoir 59, respectively, Geological Survey of Canada.

‡Moisture and volatile combustible combined.

ANALYSES OF NOVA SCOTIA COALS

(From *Analyses of Canadian Fuels, Part I, The Maritime Provinces.* By Edgar Stansfield and J. H. Nicholls, Bulletin 22, Mines Branch, Federal Dept. of Mines)

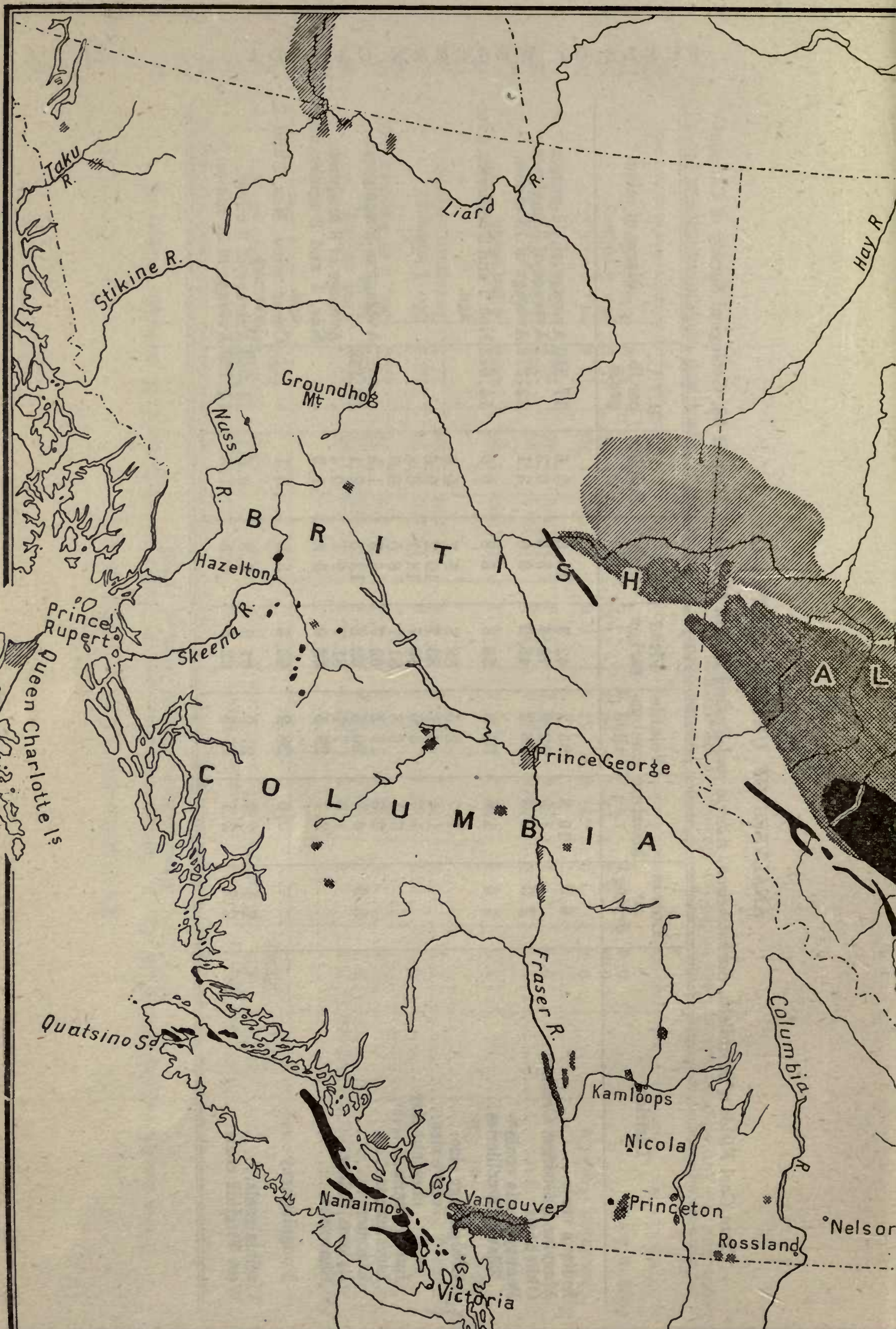
District	Moisture condition	Loss in air drying	Moisture	Volatile combustible	Fixed carbon	Ash	B.T.U. per lb. gross	Fuel ratio	Carbon-hydrogen ratio	Name of mine
Sydney area—										
No. 7 or Hub seam...	Air-dried	0.9	2.6	35.5	56.1	5.8	13,490	1.60	14.5	Hub colliery.
Harbour seam.......	"	0.8	1.6	38.0	54.6	5.8	13,780	1.45	14.3	No. 9 coll., Glace Bay.
Phalen seam.........	"	1.5	1.9	34.3	58.4	5.4	13,770	1.70	14.2	No. 5 or Reserve coll.
N.S.S. & C. Co., main seam.............	"	0.8	2.7	36.3	54.0	7.0	13,400	1.50	14.1	No. 1 colliery.
Inverness Ry. & Coal Co.	"	1.8	7.6	36.9	45.9	9.6	11,230	1.25	11.8	Inverness colliery.
Pictou area—										
Acadia Coal Co., Foord seam.......	"	1.9	1.8	32.7	54.4	11.1	13,000	1.65	15.3	Allan shaft.
Acadia Coal Co., Cage Pit seam.....	"	1.7	2.0	30.8	56.9	10.3	12,910	1.85	15.8	Albion colliery.
Intercol. Mining Co..	"	0.3	1.1	24.4	60.1	14.4	12,830	2.45	16.6	Drummond colliery.
Springhill area—										
Dominion Coal Co...	"	0.8	2.0	31.6	57.4	9.0	13,100	1.80	14.6	No. 2 colliery.
" " " ...	"	0.5	2.3	32.7	53.8	11.2	12,680	1.65	15.0	No. 3 colliery.
Joggins mines........	"	0.4	3.2	39.6	44.3	12.9	11,770	1.10	13.0	Chignecto colliery.

*Though not strictly germane to the subject of "Fuels of Western Canada," the analyses of typical and well-known coals of Nova Scotia and the United States have been added for purposes of comparison.

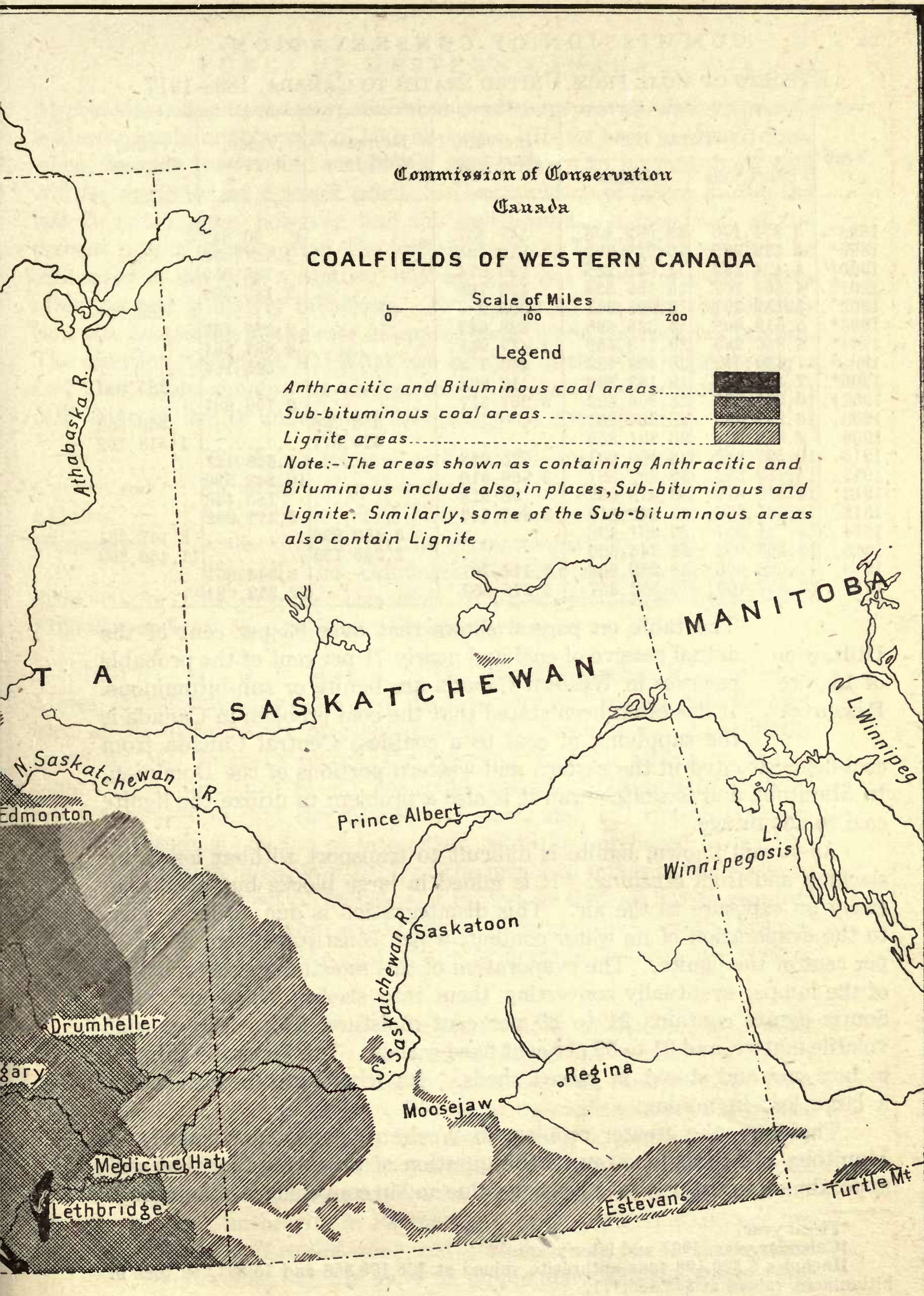
ANALYSES OF UNITED STATES COALS

(From *Coal Fields of Manitoba, Saskatchewan, Alberta and Eastern British Columbia*, Memoir 53, Geological Survey of Canada)

District	Loss in air drying	Moisture	Volatile combustible	Fixed carbon	Ash	Sulphur	B.T.U. per lb. gross	Name of mine.
Indiana coals	6.0	10.8	35.2	42.3	11.6	3.5	11,280	Average of 11 mines.
Maryland, Georges Creek	....	1.9	12.9	79.4	5.5	0.3	....	Average of 3 analyses.
Ohio coals	3.2	5.3	36.2	48.9	9.6	3.1	12,273	Average of 13 mines.
Pennsylvania coals—								
Ellsworth collieries	1.0	1.6	35.8	56.8	5.8	0.9	14,013	Nos. 1 and 2 collieries, average.
Lehigh, egg size	....	1.7	3.5	88.5	5.7	0.6	....	
" stove size	....	1.4	4.1	83.7	10.2	0.6	....	
" chestnut size	....	1.7	4.0	80.7	12.7	0.8	....	
Lackawanna	....	3.1	6.8	81.7	8.0	0.3	....	
Loyalhanna	....	2.3	17.5	62.7	6.3	1.1	....	Average of 2 analyses.
Ligonier	3.2	4.1	20.6	62.8	12.5	2.1	13,153	
Lykens Valley	....	1.6	7.1	81.7	9.1	0.4	....	Average of 3 analyses.
Shawmut	....	2.7	29.5	62.0	5.8	1.3	....	Nos. 1 and 2 mines, average.
Youghiogheny	....	2.6	28.2	63.6	5.6	0.1	....	Ocean mine, Nos. 1 and 2, average
Virginia coals	2.1	2.7	31.9	61.2	3.9	0.5	14,042	Average of 9 mines.
West Virginia coals	2.3	2.1	27.8	62.8	7.3	1.3	14,130	Average of 32 mines.



Taku R.
Liard R.
Hay R.
Stikine R.
Groundhog Mt.
Nuss R.
B R I T I S H
Hazelton
Prince Rupert
Skeena R.
Queen Charlotte Is.
A L
C O L U M B I A
Prince George
Fraser R.
Columbia R.
Quatsino S.
Kamloops
Nicola
Nanaimo
Vancouver
Princeton
Rossland
Nelson
Victoria


Commission of Conservation
Canada
COALFIELDS OF WESTERN CANADA
Scale of Miles
0
100
200
Legend
Anthracitic and Bituminous coal areas
Sub-bituminous coal areas
Lignite areas
Note:- The areas shown as containing Anthracitic and Bituminous include also, in places, Sub-bituminous and Lignite. Similarly, some of the Sub-bituminous areas also contain Lignite
MANITOBA
SASKATCHEWAN
T A
Athabaska R.
N. Saskatchewan R.
Edmonton
Prince Albert
L. Winnipeg
L. Winnipegosis
Saskatoon
S. Saskatchewan R.
Drumheller
gary
Regina
Moosejaw
Medicine Hat
Lethbridge
Estevan
Turtle Mt
Adapted from map prepared by Dr D.B. Dowling

Exports of Coal from United States to Canada, 1898-1917

Year	Total		Increase, short tons	Decrease, short tons	Value, increase	Value, decrease
	Short tons	Value				
1898*.	3,374,170	$9,099,836	147,837		$ 90,842	
1899*.	4,193,365	10,227,172	819,195		1,127,336	
1900*.	4,424,339	11,012,225	230,974		785,053	
1901*.	4,864,107	13,155,534	439,768		2,143,309	
1902*.	5,189,391	12,998,541	325,284			$ 156,993
1903*.	5,519,008	15,225,698	329,617		2,227,157	
1904*.	6,936,959	20,113,559	1,417,951		4,887,861	
1905*.	7,430,672	20,439,723	493,713		326,164	
1906*.	7,443,664	19,153,836	12,992			1,285,887
1907†.	10,651,281	28,860,523	3,207,617		9,706,687	
1908..	10,297,495	28,350,961		353,786		509,562
1909..	9,872,924	26,831,859		424,571		1,519,102
1910..	10,597,982	28,450,001	725,058		1,618,142	
1911..	14,558,892	39,292,591	3,960,910		10,842,590	
1912..	14,595,810	39,478,037	36,918		185,446	
1913..	18,201,953	47,949,119	3,606,143		8,471,082	
1914..	14,721,057	39,801,498		3,480,896		8,147,621
1915..	12,465,902	28,345,605		2,255,155		11,455,893
1916..	17,580,603	38,289,666	5,114,701		9,944,061	
1917..	20,857,460‡	70,562,357	3,276,857		32,272,691	

Utilization of Lignite Resources

The table on page 6 shows that over 93 per cent of the actual reserve of coal and nearly 71 per cent of the probable reserves in Western Canada are lignite or sub-bituminous. It has often been stated that the coal problem in Canada is the supplying of coal to a coal-less Central Canada from coal-fields situated in the eastern and western portions of the Dominion. In Manitoba and Saskatchewan it is also a problem to utilize the lignite coal to advantage.

As is well known, lignite is difficult to transport without loss from slacking and from crushing. It is mined in large blocks but breaks up easily on exposure to the air. This disintegration is due, in large part, to the evaporation of its water content, which constitutes from 20 to 35 per cent of the lignite. The evaporation of this moisture causes splitting of the lumps, eventually converting them into slack. When air dried, Souris lignite contains 24 to 29 per cent moisture, 27 to 31 per cent volatile matter, and 31 to 39 per cent fixed carbon. It is generally shipped in box cars and stored in closed sheds. Its friable nature also causes a large loss in mining.

Therefore, the greater problem in Western Canada, particularly in Manitoba and Saskatchewan, is the question of procuring fuel that will approximate to anthracite in heating value and in convenience of handling.

*Fiscal year.

†Calendar year, 1907 and later years.

‡Includes 5,320,198 tons anthracite valued at $28,109,856 and 15,537,262 tons of bituminous valued at $42,452,771.

At present, owing to the war, abnormal conditions prevail, and anthracite is almost unobtainable west of lake Superior. It has been predicted that, when the war is over and conditions approximate to normal, hard coal will be marketed at a lower price. An examination of prices during the last 20 or 25 years, however, and the well established fact that, at the present rate of consumption, the anthracite of the United States would be exhausted in less than a century, indicate that the theory of lower prices after the war is utterly fallacious. Even prior to the war, the production was decreasing at the rate of approximately one per cent per annum. The question, therefore, is: What can be done in the way of producing a fuel that approximates to anthracite or toward the production and utilization of lignite under more advantageous conditions.

Carbonized Lignite Briquettes

The briquetting of carbonized lignite promises to furnish an artificial anthracite. So far as the writer knows however, no plant has yet produced it on a commercial scale, though, on the recommendation of the Research Council, the Dominion Government has appropriated $200,000 for that purpose, this sum to be supplemented by votes of $100,000 each by Manitoba and Saskatchewan.

In 1917, Mr. B. F. Haanel, of the Mines Branch, Department of Mines, investigated the process of manufacture and practicability, costs, etc., of the manufacture of carbonized lignite briquettes. Presumably based on Mr. Haanel's report, the Research Council estimated that a plant with a capacity of 30,000 tons could produce the briquettes for $7.25 per ton, assuming that the lignite, half slack and half run-of-mine, required to produce one ton of briquettes, could be purchased for $1.12½. As the production of slack in 1917, at the principal mines in the Estevan district, was only about 55,000 tons, it is obvious that all lignite required over and above this amount would be run-of-mine, which, on the basis of costs in 1917, increases the cost of the briquettes 75 cents per ton, or to $8.00 in all.

In 1917, the Commission of Conservation instructed its Mining Engineer, Mr. W. J. Dick, to make an investigation of markets, freight rates and cost and tonnage of lignite in the Estevan district. Mr. Dick reported that, based on the figure for operating expenses supplied by the Research Council, and allowing the manufacturer a profit of $1.00 per ton, the briquettes could be marketed at a lower price than anthracite in western Manitoba and Saskatchewan, the price ranging from 45 cents per ton less than anthracite in Portage la Prairie to about $2.00 per ton less in Moose Jaw. If run-of-mine coal is used, it will, of course, decrease this profit by 75 cents, but will leave an ample margin in the Regina and Moose Jaw markets.

In manufacturing carbonized lignite briquettes, the raw material is ceated in closed retorts to drive off the moisture and nearly all the holatile matter. The carbonized material is left behind as a coke which vontains about double the amount of fixed carbon contained in the raw lignite. This carbonized material is mixed with a binder and compressed in a briquetting machine. Subsequently the briquettes are waterproofed by heating the binder to coke it. Two tons of raw lignite produce one ton of briquettes. This, of course, practically doubles the amount of fixed carbon and ash.

The question of the material to be used as a binder is an important one. Coal tar pitch makes an excellent binder, but it is reported that the cost is high; the quantity available in Canada is also somewhat limited. Sulphite pitch, produced in the manufacture of paper pulp, has been successfully used as a binder in experimental work.

The production of briquettes of all kinds in the United States in 1916, was 295,155 net tons; in 1917, it was 406,856 tons. In 1916, the plant at Bankhead, Alta., produced 82,249 tons of briquettes.

Pulverized Fuel

Pulverized coal was first utilized in cement plants and was found to be an excellent low-priced fuel of high efficiency. Later, it was applied in certain metallurgical processes and, during the last four years, several United States railways have successfully operated locomotives with this class of fuel.

In copper smelting, notable results have been achieved; furnaces, with a rated smelting capacity of 500 tons of ore per day, are now smelting twice that amount with pulverized coal. Notable economies have been obtained where it has replaced oil fuel, and a better distribution of heat has been obtained. Mr. W. G. Wilcox states that by comminution "we have changed entirely the characteristics of coal as commonly known." In addition to the greatly increased efficiency obtained, pulverized coal is practically smokeless, small coal can be utilized, anthracite culm, bituminous screenings and coke breeze assume a new importance, inferior grades of coal can be mixed with better grades and burned successfully, and the labour of the fireman is reduced to a minimum.

To obtain the best results, about 85 per cent should pass a 200-mesh screen and it should contain not more than 1 per cent of moisture. After being reduced to this high degree of fineness it is blown through a burner nozzle, the volatile gases of the pulverized coal igniting instantly. The fixed carbon is consumed by the heat of the volatiles, the flame resembling an oil or gas flame. By increasing or decreasing the supply of air or fuel, the operator regulates the supplies and has the operation under absolute control.

Mr. W. G. Wilcox, in the *Mining and Scientific Press*, June 22, 1918, p. 850, says: "By grinding an inch cube of coal so fine that 85 per cent will pass a 200-mesh screen, we have increased the surface exposure from 6 sq. in. to approximately 1,800 sq. in. Thus, we have increased the velocity of combustion 300-fold. By doing so, we have changed the characteristics of the fuel. We now have a fuel relatively 300 times more active than the inch cube of coal, a new type of fuel that has in it inherent possibilities not to be found in lump or slack fuel."

Mr. Wilcox further points out that the increasing of the surface exposure speeds combustion. The rise of temperature doubles the velocity of combustion for each rise of 10° C., and, thus, pulverized fuel affords a combustion that is hundreds of times faster than when burning lump coal.

Carbocoal

In the manufacture of carbocoal, a high-volatile coal, after crushing, is distilled at a low temperature, 850° F. to 900° F. This first distillation yields gas and tar and a product, called 'semi-carbocoal,' which is high in carbon. The first distillation is continuous, the coal being agitated and mixed by a twin set of paddles. Thus all portions of the charge are uniformly distilled.

After mixing the semi-carbocoal with part of the pitch obtained from the tar produced in the first distillation, the mixture is briquetted. The briquettes are then subjected to a second distillation at about 1,800° F., which yields carbocoal, additional tar and gas and a substantial amount of ammonium sulphate.

Carbocoal is dense, dustless, clean, uniform in size and quality, and stands transportation without disintegration; its density is greater than that of coke and more nearly approaches that of anthracite; the briquettes can be made in any size from ½ oz. to 5 oz., the larger sizes being better suited for locomotives and the smaller for domestic use; the yield of tar and ammonium sulphate is greater than in the by-product coking process.

Central Coking Plants

Where a coking coal is obtainable at a reasonable price, the establishment of central coking plants near large centres of population seems to offer the maximum of advantage. Such a plant would produce a coke or artificial anthracite, gas for cooking or heating, coal tar which contains the elements entering into the manufacture of a whole series of valuable substances, benzol, toluol and other raw materials for explosives, aniline oil whence aniline dyes are manufactured, and ammonia liquor from which is produced sulphate of ammonia, a valuable fertilizer. The coke thus produced can be used for all purposes for which anthracite is used. It requires a little more care in firing. Furnaces burning coke require a somewhat larger fire-box than for hard coal.

Mr. W. J. Dick estimates that: "Such a plant established in the city of Toronto to supply 300,000 tons of artificial anthracite per annum would not only provide such fuel cheaper than anthracite, but would supply 1,500,000 M. cubic feet of gas at a cost of 10 cents per M. at the plant; again, based on pre-war prices for cost of plant and bituminous coal, the profit on the undertaking would be considerably more than 50 per cent per annum."

Whether such coke plant be municipal or private-owned, it offers what is, at the present time, the most promising solution of the fuel question for Saskatchewan, Manitoba, Ontario and Quebec.

Substitutes for Anthracite

The steadily increasing price of anthracite and the decrease in the reserves of this valuable fuel emphasize the warnings the Commission of Conservation has issued from time to time, urging the greater utilization of our water-powers, both to decrease the consumption of imported coal and to use in bartering for such fuel in time of need. During the war, Canadians can not expect to receive their full quota of anthracite, and the consumer should appreciate the necessity of using other coal fuel. The citizen who has, heretofore, burned anthracite regards the prospect of general use of raw bituminous coal with dismay, and will turn with relief to a smokeless fuel, such as coke, provided we can supply him with an article that has most, if not all, the characteristics of anthracite.

The initial difficulty in the preparation of such a fuel lies in the fact that Nature, with the agencies of pressure and time duration far beyond anything that man can hope to approximate to, has produced the dense, stony fuel which we call anthracite, whereas our imitation—coke—has a cellular structure developed by escaping gas during distillation, a structure analagous to that produced in bread-making.

Hitherto, it has been assumed that coal should be coked practically at the pit mouth. The general acceptation of this idea is largely due to the fact that the coke was manufactured for metallurgical purposes, and the amount used by many smelters would not justify the erection of coke ovens at the smelter nor, in many instances, would it be possible to utilize all the gas produced in connection with the coking. On the other hand, a plant established near a large city has not only a market for the coke, or artificial anthracite, but also for all the gas produced.

To quote Mr. Chester G. Gilbert, in *The Mineral Industries of the nited States*, "the question which is slowly and certainly gaining in essure, is not that of providing a fuel competitive with anthracite on ual terms, but one capable of practical service in the capacity of a commodity as against anthracite in the growing capacity of a luxury. A tendency away from anthracite is certain to set in, and the only room for choice [for domestic fuel] lies between coke and raw bituminous coal. Relative economies are bound to be an important factor, if not the deciding one, in the choice. Right here the domestic fuel situation in the United States connects up with the coal production in a manner which renders the two interdependent in their requirements; for, if the general purpose use of coke fuel is to be economically practicable, it can be rendered so only through the support of values derived from that other third of bituminous coal mass removed as volatile matters in the course of carbonization, and, conversely, an extensive preparation of coal products necessitates an advantageous coke market. The answer to the whole question is to be found in the value of the distillates derivable. If this latter can be made to overbalance the cost of preparation, the surplus constitutes just so much potentiality for economic advantage in favor of coke for the householder."

Summing up the above discussion of the economic utilization of our coals under existing circumstances, the writer is of the opinion that, speaking generally, coking plants established in the immediate vicinity of large markets offer the most advantageous method of utilizing coal for domestic purposes.

For large individual consumers, locomotives, and certain other uses, pulverized fuel promises to revolutionize present practice.

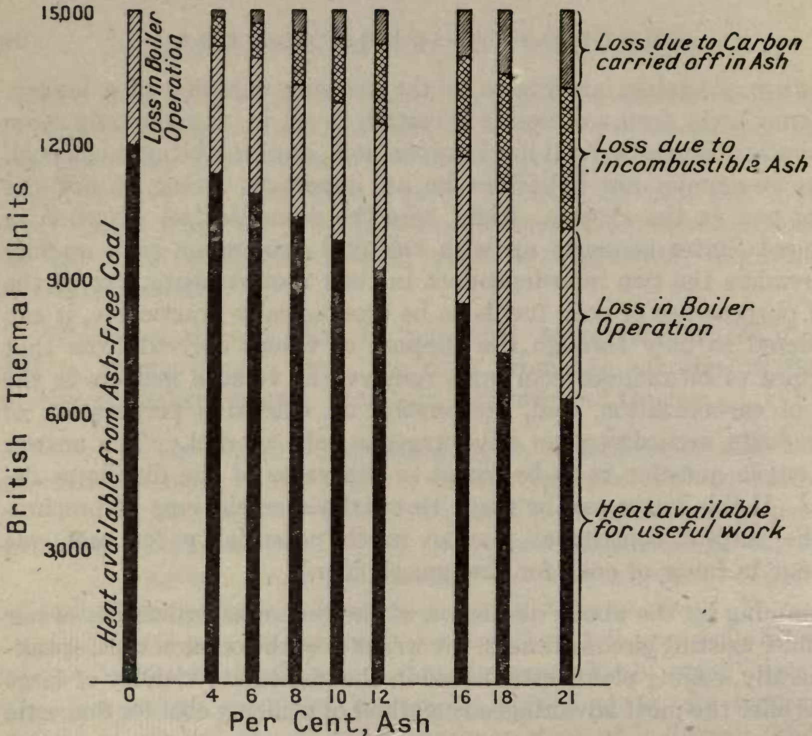
It is almost axiomatic that the less labour and cost expended on the preparation of coal fuel the better, and, other things being equal, the process that approximates most closely to this dictum is the most efficient and most economic.

Storing Lignite

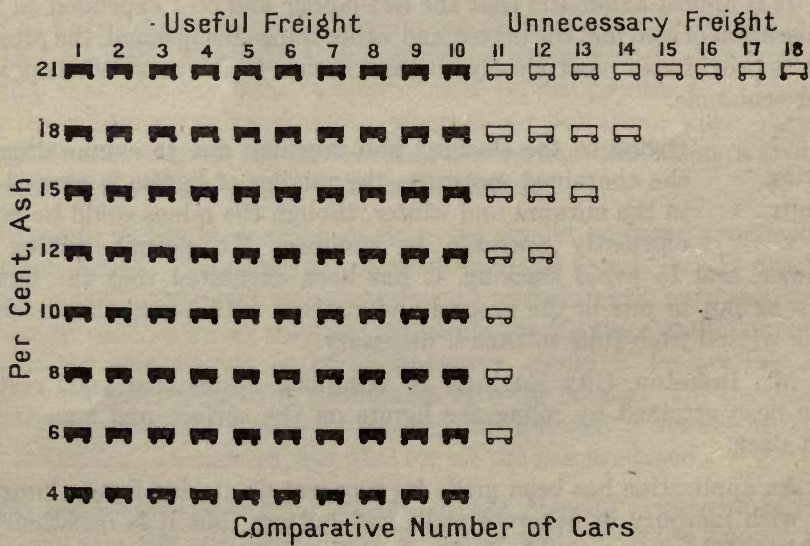
Owing to the slacking and crushing due to evaporation of the contained moisture, the mining of lignite is carried on in the autumn and winter, though the mines could be more efficiently operated in summer. To permit mining in summer, and to avoid slacking, it has been suggested that the lignite lump be put in pits in the ground and covered with earth, the covering being wetted from time to time if necessary.

Mr. Brereton, City Engineer of Winnipeg, states that good results have been attained by piling the lignite on the surface and covering it with slack.

An application has been made for a patent on storing lignite lump in pits with masonry or concrete walls and bottom, but it is questionable whether this is a patentable device.



REDUCTION IN HEAT VALUES DUE TO PRESENCE OF ASH IN COAL



INCREASED CARS NECESSARY FOR TRANSPORTATION OF HIGH-ASH COAL

Courtesy of The J. G. White Engineering Corporation, New York.

Effect of Excessive Ash

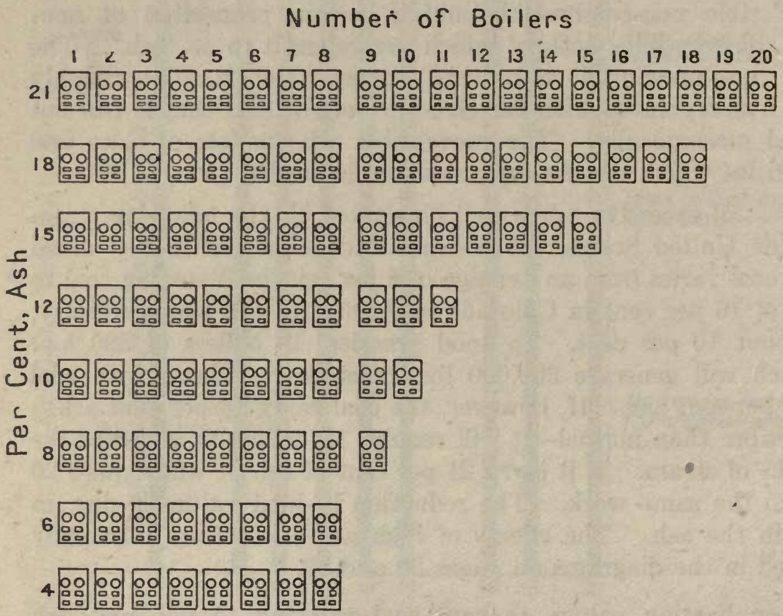
Coal as marketed contains a certain proportion of preventible non-combustible and a certain proportion of non-preventible, both of which are referred to as 'ash.' The non-preventible is mineral matter which is so thoroughly incorporated with the structure of the coal that it can not be separated mechanically. The preventible ash consists of slate and other impurities which can be separated mechanically.

The effect of excessive ash is well illustrated by the following statement: In the United States, the non-preventible ash content of clean bituminous coal varies from an average of 6 per cent in Wyoming coal to an average of 16 per cent in Colorado coal and, for the whole country, averages about 10 per cent. In good practice, 10 boilers of 500 h.p. capacity each will generate 300,000 lbs. of steam per hour with coal carrying 10 per cent ash. If, however, the coal carry 15 per cent ash—5 per cent more than normal—it will require 15 boilers to generate the same amount of steam. If it carry 21 per cent of ash, it will require 20 boilers to do the same work. The reduction in heat values is due, in carried off in the ash. The effects of high ash content are startlingly demonstrated in the diagrams on pages 30 and 32.

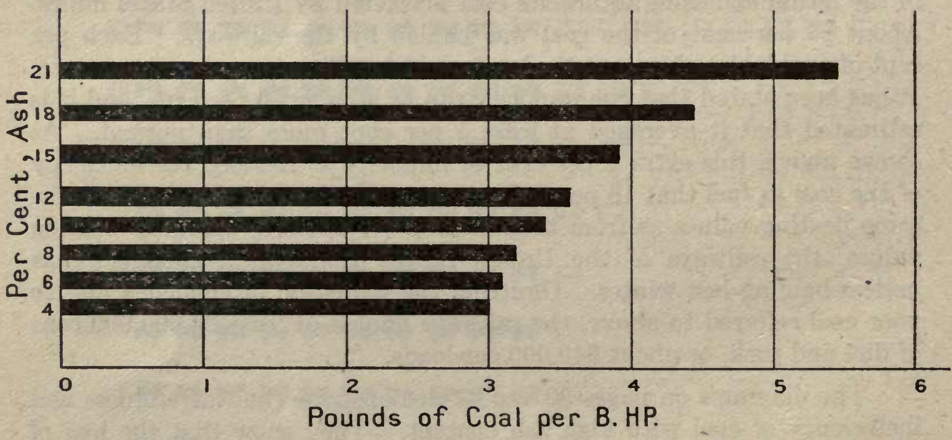
Based on heating values, to haul coal carrying 15 per cent ash necessitates the use of 18 per cent more cars than if the ash content were only 10 per cent, but coal carrying 21 per cent ash requires the use of 65 per cent more cars than if it contained 10 per cent.

Last year, enormous amounts of slate, shale and dirt were contained in the bituminous and anthracite coal marketed by United States mines. About 85 per cent of the coal was hauled by the railways. Each per cent of avoidable ash meant the haulage of 5 million tons of useless waste. It has been stated that the impurity ran as high as 20 per cent, and it is estimated that it averaged at least 5 per cent more than normal. As shown above, this extra 5 per cent of impurity so reduced the efficiency of the coal as fuel that 18 per cent more cars were required to obtain the same heating values as from normal coal. Therefore, based on heating values, the railways of the United States did about 80,000,000 tons useless hauling last winter. Omitting the reduction of efficiency due to poor coal referred to above, the railways hauled at least 32,000,000 tons of dirt and rock, or about 640,000 car-loads.

The diagrams on pages 30 and 32 demonstrate the wastefulness and inefficiency of coal with high ash content. They show that the loss of efficiency is not great so long as the ash does not run more than about 10 per cent, but the fact that 21 per cent of ash reduces boiler efficiency to *one-half* what it would be with coal carrying 10 per cent ash, is a startling demonstration of the inefficiency of dirty coal.



NUMBER OF 500-HP. BOILERS REQUIRED TO GENERATE 300,000 LB. STEAM PER HOUR



POUNDS OF COAL CONSUMED TO PRODUCE ONE BOILER HORSE-POWER

Courtesy of The J. G. White Engineering Corporation, New York.

NATURAL GAS

No reservoirs of natural gas have, as yet, been discovered in Manitoba or Saskatchewan. Gas has been reported at Morden and Treherne, Man., and at Pense, Estevan, Hanley and North Hanley, Sask., but not in commercial quantities.

In Alberta, four important gas-fields have been discovered, namely, the Medicine Hat, Bow Island, Viking and Pelican Rapids fields. The gas is derived from the top of the Colorado in the Medicine Hat field and from sands in the lower Colorado in the Bow Island and Viking fields.

Three anticlinal arches have been found. These arches are so low and diffuse that, owing to the scarcity of natural exposures of rock, it is difficult to trace them. The first extends from the Sweet Grass hills in Montana, thence northwestward to the Bow river. The Bow Island field is near the axis of this anticline. The second anticline extends northwestward from the Saskatchewan-Alberta boundary in approximate latitude 52°, to Viking. The third anticline crosses the Athabaska river about 20 miles above McMurray and, like the first and second, has a general northwest-and-southeast course.

It is a common experience in oil and gas-fields to find gas, oil and water, in the order of their respective specific gravities, namely, the gas at the top, then oil, then water, the gas being found at the crest of the anticlinal arches with the oil below it. When the reservoir is 'dry,' however, the oil tends to collect in the basins.

Medicine Hat Gas-field

In the Medicine Hat gas-field there are 33 wells, with an approximate capacity open flow* of from 90 million to 92 million cubic feet per day, which is equivalent to about 53 million feet, working capacity. The largest well has been reported to have a capacity of 6 million feet per day. The tested portion of this field has an area of about 30 square miles. The initial rock pressure was about 600 lbs. to the square inch. The gas-sand is found at a depth of from 1,000 to 1,200 feet and is about 900 feet above the Dakota sandstone. This field supplies Medicine Hat, Redcliff and the vicinity.

Bow Island Gas-field

The Bow Island gas-field has a tested area of about 25 square miles; the initial rock pressure was 790 lbs. and the gas-sand was found in the Dakota sandstone and at a depth of from 1,850 to 2,150 feet. This field supplies Macleod, Lethbridge, Calgary and the intermediate towns by a 16-inch pipe-line, 175 miles long. There are 21 wells drilled in this field and the

*Under working conditions, a well may be assumed to deliver about 60 per cent of the open flow capacity.

total daily capacity, open flow, is about 186 million cubic feet. No. 4 well has a capacity of 29 million cubic feet. The well at Foremost, 36 miles south of Bow Island, and on the same anticline, has an estimated open flow of 13 million cubic feet per day. A heavy oil-sand found at Foremost, 920 feet below the gas-sand, suggests a possible source for the gas.

Gas has also been found at Langevin, Cassils, Brooks and other points on the main line of the Canadian Pacific, in smaller quantities. At Langevin and Cassils, the gas-sand is at the horizon of the Medicine Hat sand; at Brooks, it is in a lower horizon.

In the Viking field, gas has been found in the Dakota sandstone at the depth of about 2,350 feet, and in the Grand Rapids sandstone at a depth of about 2,200 feet. The tested area is about 12 square miles. There are 8 wells in the Viking field, with a total daily capacity of 36 million cubic feet per 24 hours. The average rock pressure is 710 lbs. It is an ethane gas, in which respect it differs from the Bow Island and Medicine Hat gases, which are very dry. This, no doubt, will permit the production of gasolene by absorption as soon as it has been piped and is in use in Edmonton. There are two gas horizons, at 2,150 feet and 2,350 feet, respectively, the upper sand yielding more gas.

It is reported that the two wells on Sheep creek, 32 miles southwest of Calgary, drilled by the Calgary Petroleum Products Co., have a combined capacity of 5 million cubic feet per day.

A well at Vegreville, 30 miles northwest of Viking, has a flow of from 200,000 to 300,000 cubic feet per day. At Wetaskiwin, 40 miles south of Edmonton, a gas well has an open flow capacity of 300,000 to 350,000 feet.

The Three Creeks well, drilled for oil, is reported to have a large flow of gas. It is on Peace river, 13 miles below Peace River Landing.

At Pelican Rapids, on the Athabaska river, 160 miles north of Edmonton, a heavy flow of gas, under a rock pressure of 250 to 300 lbs., was struck in the McMurray sandstone at a depth of 800 feet when drilling for oil in 1897. Mr. Eugene Coste, M.E., states that it had an initial volume of 'several million' cubic feet. Gas has also been found in a deeper well, in the Devonian limestone. The wells at Pelican are reported to have, at present, a combined capacity of about 3 million cubic feet per day.

In 1917, the production of natural gas in Alberta was 6,744 million cubic feet, valued at $1,299,976, as sold by the producing companies.

PETROLEUM

Up to the present time, oil in considerable quantities has not been found in Western Canada. Respecting the possibility that petroleum will be discovered, particularly in the Viking area and the Peace and Athabaska valleys, the situation may be summed up as very promising.

A small quantity of dark oil obtained in one of the wells in the Viking gas-field is an encouraging indication, and oil has also been found in the Pelican Rapids gas-well. Seepages of oil have been found near Waterton lake in southwestern Alberta, and in the Flathead valley in southeastern British Columbia.

Northern Alberta Possibilities

In northern Alberta, there are enormous tar seepages which evidence an upwelling of petroleum unequalled elsewhere in the world. Along the Athabaska river, they extend from Pelican rapids to Fort McKay, a distance of over 100 miles. The known occurrences indicate that there is in sight at least $6\frac{1}{2}$ cubic miles of bitumen, and the petroleum from which it was derived must have been many times greater. While this enormous amount of petroleum has escaped, there must be untapped reservoirs in the Devonian limestones whence it was derived. Similar seepages occur near the Peace and Mackenzie rivers.

Near Peace River Landing, oil has been found in two wells, 900 and 1,100 feet deep, respectively. The first well is reported to have yielded 3 to 4 bbls. per day when oil was struck in the upper portion of the tar sands and to have had a maximum production of about 9 bbls. Drilling, however, was continued through the tar sands, which are about 80 feet in thickness at this point, and a heavy flow of water and gas was struck immediately below the sands.

The second well is in the tar sands and is reported to be yielding about 25 bbls. per day.

In the Sheep Creek district, about 32 miles southwest of Calgary, the production of oil is reported as follows:

Company	Depth of well, feet	Specific gravity (Beaumé)	Production, bbls. per day
Calgary Petroleum Products Co., No. 1 well*	3,920	62°	10
Alberta Petroleum Consolidated	2,720	38° to 40°	25
Canada Southern Co	2,400	55°	5
Northwest Pacific Co. (when operating)	3,500	38°	4
Alberta Southern Co., No. 1 well	3,200	55° to 56°	10 to 15
Southern Alberta Co., No. 1 well	3,300	58° to 60°	30

*Commonly known as the Dingman well.

Mr. Dingman, President of the Calgary Petroleum Products Co., states that the company's oil wells have a combined capacity of 5 million cubic feet of gas per day; that their measurements indicate a content of one gallon of gasolene per 1,000 cubic feet of gas and that, if only one-half the gasolene be recoverable, they could maintain an output of 2,500 gals. of gasolene per day.

The Mid-West, 3,200 feet deep, and the Acme, 3,200-3,300 feet, also in the Sheep Creek district, are reported to have struck oil.

As 'commercial' gasolene is 60° to 63° B., the oil produced by the Calgary Petroleum Products, Canada Southern, Alberta Southern and Southern Alberta companies approximates to the fuel ordinarily marketed as 'gasolene.'

In the year ending March 31, 1917, we imported into Western Canada, for fuel purposes, 95,693,497 gallons of petroleum, valued at $2,738,555. For refining, we imported, in the same year, 35,313,717 gallons, valued at $1,040,047. The discovery of extensive oil-fields in Alberta or Saskatchewan would retain in Canada at least $3,750,000 which we are now paying for petroleum importations and an additional $1,250,000 paid for petroleum products, such as gasolene and kerosene, or, in all, $5,000,000.

In 1917, 312,000 gallons of gasolene and kerosene were recovered from Alberta crude oils. Presumably, part of this production was from petroleum produced during 1916.

During 1917, the production of crude petroleum in Alberta amounted to 8,500 bbls., or 297,500 Imp. gallons.

ELECTRIC ENERGY

In Western Canada, electric energy in large quantities for use as fuel is not economically available at the present time, except in certain favoured localities in southern Manitoba and southern British Columbia.

Manitoba Water-Powers

In Manitoba, there are, on the Winnipeg river, two developed powers and seven undeveloped powers, ranging from 9,900 to 57,300 h.p. at 75 per cent efficiency on a 24-hour basis and assumed minimum flow of 12,000 second feet. These powers are as follows:

	H.P. at 75% efficiency on a 24-hour basis		Remarks
	12,000 sec.-ft.*	20,000 sec.-ft.†	
Winnipeg municipal plant	46,100	76,800	25,000 h.p. developed. 47,000 h.p. installed.
Slave Falls site	26,600	44,400	
Winnipeg Electric Ry. Co. plant	28,200*†	28,200*†	28,200 h.p. developed. 34,000 h.p. installed.
Upper Pinawa site	12,300	12,300	
Upper Seven Sisters site	9,900	29,600	
Lower Seven Sisters site	12,600	37,900	
McArthur site	18,400	30,700	
Du Bonnet site	57,300**	95,500	Final head.
Pine site	37,900	63,100	
Total power	249,300	418,500	53,200 h.p. developed, 81,000 h.p. installed.

*With unregulated river. †With regulated river.
*†28,200 h.p. developed at this plant.
**With the preliminary head, 47,100 h.p. can be developed with unregulated river and 78,700 h.p. with regulated river.

The Grand rapid of the Saskatchewan has 32,600 h.p., with an assumed minimum flow of 4,500 second-feet. It is not improbable, however, that the flow sometimes falls to about 3,500 second-feet.

On the Bow river, the Horseshoe and the Kananaskis falls have a capacity of 11,910 h.p. each, with a regulated river, or, with the minimum natural flow of the river, 4,780 h.p. each.

There are large powers on the Nelson, Churchill and Athabaska rivers, at Fort Smith rapids on the Slave, and at Vermilion and Peace cañon on Peace river, but detailed information respecting the low-water flow of these rivers is not available. In some instances, low banks and lack of concentrated fall would make development very costly.

British Columbia Water-powers

In British Columbia, there are many important water-powers. The investigation of the water-powers of British Columbia by the Commission of Conservation has disclosed the existence of two great water-power centres, namely, Nelson, with 400,000 h.p. within a radius of 50 miles, and Vancouver, with 300,000 h.p. within the same distance. Based on experience at Toronto, these quantities would suffice for a population of 1,700,000 at Nelson, or for 10 manufacturing cities of 170,000 each. The power near Vancouver would suffice for one manufacturing city of 1,250,000 population, or for 10 cities of 125,000 each.

There are 12 power-sites in British Columbia of 50,000 h.p. and upwards. With the exception of the South fork Quesnel and Peace river, all these powers are less than 125 miles from the 49th parallel.

Kootenay river, Upper and Lower Bonnington falls, possible development	125,000 h.p.
Pend d'Oreille river, Waneta	73,000 "
" " " Salmon river	50,000 "
*Thompson river	100,000 "
*Fraser river, Hellgate	200,000 "
Bridge River tunnel	70,000 "
Stave river, lower site	52,000 "
" " upper site	52,000 "
Coquitlam-Buntzen, North arm Burrard Inlet	84,000 "
Campbell river, possible	100,000 "
South fork Quesnel river	90,000 "
Peace River cañon	100,000 "

There are 18 power sites of between 20,000 and 50.000 h.p. Eight of these sites are distant less than 100 miles from the 49th parallel.

Kootenay river, Cora Lynn to Granite rapids	22,000 h.p.
" " rapids near mouth	20,000 "
Pend d'Oreille river, Nine-mile falls	32,000 "
" " " Fifteen-mile creek	34,000 "
Columbia river, Long rapids	30,000 "
Adams river	30,000 "
Barrière river, ultimate development	20,000 "
Murtle river, Helmcken falls	20,000 "
Nahatlatch river, rapids below lakes	30,000 "
Jones lake (Fraser river)	25,000 "
Jordan river (25,000 h.p. developed), ultimate	38,000 "
Cheakamus river, Bear Mount cañon	40,000 "
Powell river (24,000 h.p. developed), ultimate	32,000–35,000 h.p.

*Development debarred owing to presence of railways.

Nechako river, Grand cañon....................	30,000 h.p.
" " Tetachuck falls and rapids.......	30,000 "
Bulkley river, Hagwilget cañon..................	20,000 "
Nass river, falls below Cranberry river..........	20,000 "
" " rapids and falls below White river....	20,000 "

There are 29 power sites of between 10,000 and 20,000 h.p. capacity and 585 of less than 10,000 h.p. The report of the Commission of Conservation on the *Water Powers of British Columbia* includes all available data respecting 644 water-power sites.

Electric Heating

Heating on a large scale by electricity is only economically possible where energy can be generated at very low cost. As stated by Mr. Arthur V. White, Consulting Engineer, Commission of Conservation, "Let it be appreciated that Canadians need never expect to have electrical energy replace coal and other fuel for heating buildings except to a relatively limited extent."

With anthracite coal at $10.00 per ton and burned at 50 per cent efficiency, and with electric energy at one cent per kilowatt-hour, the coal will yield 14,000 B.t.u. for one cent as compared with 3,412 B.t.u. from the electric energy for one cent. This demonstrates that, on this basis, heating by electric energy would be four times as costly as with coal.

An estimate by Mr. Arthur V. White indicates that, in Ontario, the heating requirements of the average home in Toronto would require about five electrical horse power per capita. While weather conditions in winter in Toronto are much milder than in the Prairie Provinces, they are more severe than on the Pacific coast. On this basis, therefore, the 2,100,000 inhabitants of Western Canada would require not less than 10,500,000 electrical h.p. for heating alone.

As the hydro-electric energy already developed in Western Canada aggregates about 359,000 h.p. (76,000 in Manitoba, 33,000 in Alberta and 250,000 in British Columbia), it would require 29 times this amount to heat the homes in Western Canada. Again, as the total electric energy already developed in the whole of Canada is only about 1,800,000 h.p., it would require nearly six times this amount to replace the fuel used in the Prairie Provinces and British Columbia.

Again, it has been estimated that the total water-power in the Prairie Provinces is about 3,500,000 h.p.* and in British Columbia, 2,500,000 h.p.† Even assuming that it would be possible to utilize the powers in the northern portion of the Prairie Provinces and British Columbia, and the numerous small powers, the aggregate would still be 4,500,000 h.p. short of the heating requirements of that region.

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*This figure is probably too high.

†This is exclusive of 500,000 h.p. for power possibilities on rivers like the Fraser, Thompson, Skeena and Nass, where, because of the proximity of railways or possible interference with the salmon industry, economical development is, at present, debarred.

PEAT

The best basis of comparison of peat and coal, as they exist in a condition of nature, is to state that a peat bog 40 feet in thickness only contains the same amount of carbon as a bed of coal 1 foot thick.

During the last half century, numerous attempts have been made in Canada to manufacture a commerical peat fuel. In 1910, Dr. E. Haanel, Director, Mines Branch, stated that, up to that time, the attempts "have been failures and very little peat fuel is at present available. The chief cause of most of these failures has been in the ignorance of the nature of peat on the part of those who have engaged in the production of peat-fuel. In several instances the bogs chosen for the work have been unsuitable for the purpose in view. A proper investigation of the bog previous to the commencement of operations was seldom made; consequently, methods entirely unsuitable for the utilization of the bog in question have been employed. and the result has been failure. These failures, involving, as they did, considerable loss of capital, have created a profound distrust of everything connected with peat and the utilization of peat bogs."

Evaporation Difficulties

Peat, as found in nature, contains about 10 per cent combustible matter and 90 per cent water, the removal of this exceedingly high proportion of water constituting the great problem for the peat engineer. Dr. Haanel states that it has been "demonstrated, once and for all, that the water content of raw peat can not be reduced much below 80 per cent by pressure alone, and the process of wet carbonizing, upon which large sums have been expended, has not, up to this time, proved a success. In fact, it may be safe to make the statement that any process for the manufacture of peat fuel which depends upon the employment of artificial heat for the evaporation of the moisture will not prove economic. The only economic process in existence at the present time is that which utilizes the sun's heat and the wind for the removal of the moisture."

The Mines Branch, Department of Mines, Ottawa, has investigated 18 bogs in Manitoba. The report states that there are bogs in the Winnipeg River district containing 1,860,000 tons of peat fuel, 25 per cent moisture.

With its enormous coal resources, however, Western Canada will, for many years, depend upon coal and wood for heating and cooking. At the present time, the high labour cost alone is sufficient to render peat manufacture an unprofitable enterprise.

Local Use of Peat

In Western Canada, to meet the abnormal conditions created by the war, peat may be prepared and stored on a small scale by farming communities and villages where such are situated near peat bogs. This would not only increase the fuel supply, particularly during the autumn and spring, but would release railway cars that are urgently needed for other purposes.

The water in the peat should be reduced to 25 to 30 per cent before it can be used as fuel. The season for drying peat begins as soon as the frost is out of the ground, and ends in September. The bogs should be drained and the turf removed from its surface. The peat is cut in blocks about 9 inches by 4 inches and from 3 to 6 inches thick. At the end of about four weeks the blocks are ready for storage. During this period they should be kept covered and should be frequently turned. The quality of such peat is inferior to machine peat, but, in many localities, it will supplement the insufficient supply of better fuel.

Commercial peat (25 to 30 per cent moisture) has about one-half the heat value per pound of the best anthracite and its specific gravity is about one-half that of anthracite. Therefore, to obtain from peat the same number of heat units as from a specified amount of coal requires about four times the volume of peat.

The peat production of the United States in 1917, was 97,363 short tons (86,931 long tons). The average price to the consumer was $7.29 per short ton. No peat was produced in Canada in 1917.

WOOD FUEL

From a fuel standpoint, the principal trees of the Prairie Provinces, east of the Rocky mountains, are, in approximate order of importance, the jackpine, spruce, poplar, tamarack and birch.

In British Columbia and the Rockies, there are numerous fuel woods, most of the wood used as fuel being the refuse from the sawmills. Douglas fir, yellow or bull pine, spruce and cedar furnish most of the wood fuel in this area.

Heat Values of Wood

In a discussion by the Forest Products Laboratories, Montreal, of the heat values of dry wood, it is stated that the below amounts of wood have equal heating value to one ton of anthracite:

1.00 cord of birch	1.55 cords of poplar
1.15 cords of tamarack	1.60 " " hemlock
1.20 " " Douglas fir	2.10 " " cedar
1.50 " " jackpine	

The above comparison is based on the supposition that the calorific value of the coal is 13,000 B.t.u., but the grade of coal received in Canada last winter was much less, possibly as low as 10,000 B.t.u., which, in comparison, would decrease the above stated quantities of wood by 23 per cent.

FUEL SHORTAGE

In July, Dr. Garfield, United States Fuel Administrator, stated that 'an alarming shortage' faces the United States and Canada if the quantities of coal demanded by the various sections of the country are actually required.

In view of the fuel shortage during the winter of 1917-18, a brief review of the outlook for the coming winter is of interest.

During the period 1913-17, the production of anthracite in the United States was as follows:

Year	Anthracite production	Increase	Decrease
1913	91,524,922	....	....
1914	90,821,507	....	703,415
1915	88,995,061	....	1,826,446
1916	75,461,527	....	13,533,534
1917	86,389,101	10,927,574	....

As stated in the above table, the production of anthracite in the United States in 1917 was 86,389,101 tons, an increase of nearly 11 million tons over the output in 1916, but over 5 million tons (5,135,821) less than in 1913.

The production of bituminous in the United States in 1917 was 544,261,581 tons, an increase of 52⅔ million (52,670,610) tons, as compared with 1916, and an increase of 99 million tons as compared with 1915.

In the first 4 months, January to April, of this year, the production of U.S. anthracite increased nearly 1,400,000 (1,395,084) tons as compared with the same months in 1916, and the bituminous increased 4,838,000 tons in the same period.

The U.S. Fuel Administration does not anticipate that the increased production of anthracite will keep up in the same ratio during the remainder of the year. They estimate that the total production of anthracite will aggregate about 89 million tons, or 2½ million tons less than in 1913. Of this amount, about 54⅓ million tons will be available for domestic use, the remainder being consumed by railways and industrials. On the face of it, this would indicate that fairly ample supplies will be available, but an examination of the underlying factors discloses the fallacy of this conclusion.

In the past, the great bulk of the anthracite has been consumed in the northeastern and northwestern States and in Canada. Owing to the enormous development of industries connected, directly or indirectly, with the war, there has been a great influx of population into the north-eastern and Atlantic States, north of the Potomac, and, inasmuch as the productive capacity of these workers must be kept at the highest efficiency, the allotment to this section has been largely increased and the allotments to other sections have been decreased. The population in the area above referred to, namely, of Massachusetts, New Hampshire, New York, Pennsylvania, New Jersey, Delaware and Maryland, has increased by approximately 5 millions, or 15 per cent, since 1911.

	1916-17 Distribution	1918-19 Allotment	Per cent of increase	Per cent of decrease
Canada	3,856,021	3,602,000		6.59 *
New England states	8,833,379	10,331,000	17.00	
Atlantic states	27,878,233	31,417,154	12.69	
Central states	5,100,024	3,481,945		31.73
Northwest states	2,710,188	2,380,000		12.18
Trans-Mississippi and twenty-four states	765,931			100.00
Railways and miscellaneous	2,533,684	2,533,684		
U.S. army and navy camps		600,000		
Total	51,677,460	54,345,783	5.16	

The U.S. Fuel Administration estimates the bituminous coal requirements during 1918 will aggregate 634,594,000 tons, as compared with the production in 1917 of 554,738,000 tons—an increase of nearly 80 million tons.

Mr. Theodore M. Knappen states that the 1918 production of the bituminous mines of the United States, up to July 13, indicated that it would fall short of the estimated requirements by about 35,000,000 tons. This estimate is based on the assumption that average good weather will prevail during the winter months. If very bad weather prevails, the shortage may aggregate over 45,000,000 tons. On the other hand, the bituminous now being mined is somewhat cleaner than last year, enough to make 600 million tons equivalent to 610 million of last year's quality. This consideration will reduce Mr. Knappen's estimate of the shortage to 25,000,000 tons.*

*According to the U.S. Geological Survey, the production of coal in the United States from January 1 to August 24, totalled 384,000,000 tons. The mines, if working under full-time output, have, in theory, an aggregate capacity of 522,000,000 tons. The shortage of 138,000,000 tons is attributed to the following causes:

Car shortage	82,000,000	tons
Labour shortage and strikes	22,750,000	"
Mechanical disabilities	19,750,000	"
No market	4,000,000	"
Other causes	9,500,000	"
	138,000,000	"

* Compared with 1917 - 18, allotment is 23 per cent decrease

In this summary of the probable shortage, no consideration has been given to the possibility of congestion of traffic on the railways, to strikes or to other factors that may decrease production or interfere with transportation from the mine to the consumer.

On the whole, the situation may be summed up as indicating strong probability that there will be a shortage, and that nothing but use of other fuels, economy and conservation, will prevent at least a partial recurrence of the sufferings of last winter.*

**Coal Age*, New York, November 14th, 1918, contains the following:

"In response to the Fuel Administration's campaign for a maximum coal output, there was produced during the first seven months of the present coal year (April to October inclusive) 368,858,000 net tons of bituminous coal. This tonnage represents an increase of 42,437,000 net tons over the output of the similar period in 1917.

"With the country driving ahead at full blast on a war programme, the increased rate of production was far from being sufficient to meet the demands of industry. Industries that were considered unessential to the war programme were denied the use of coal, the extent of the stocks that would be accumulated by essential industries was specified by the Fuel Administration, and a zoning system was perfected which had for its object the elimination of the cross-hauling of coal from one mining section to another. These changes, and many others even more radical, were instituted for the sole purpose of enabling the country to concentrate its energies on one thing—the carrying on of a war that would bring about a speedy peace.

"Now, 19 months after our entry into the conflict, the war has come to an end. Though indications were many that the German war machine was disintegrating, still the end came with a suddenness which, for this country, was startling. Just as in the beginning our declaration against autocracy found us unprepared for war, so the signing of the armistice on Nov. 11 finds us unprepared for peace. This is evidenced by the fact that we have not, at this writing, passed one bit of legislation looking toward a well-defined reconstruction programme.

"The cessation of hostilities has, if anything, brought forcibly to the attention of the soft-coal operators the realization that they are confronted by a situation that threatens to become serious. Thanks to the methods pursued by the Fuel Administration, consumers of bituminous coal in almost every section of the country have large reserve stocks on hand. To put it plainly, there is an over-supply of soft coal in the hands of consumers, and many mines that, but a short time since, were hard put to it to meet their production quota, now find that they are unable to dispose of their output. The steel mills and the blast furnaces, for instance, are loaded down with coal, and, until they can utilize their large stocks in the manufacture of peace-time products, they will not come into the market for additional supplies.

"The foregoing is true of almost every other industry. Buyers who, a month or so ago, were eager, even clamorous, to obtain a meagre tonnage, are running along from hand to mouth in the hope of a break in the market that will enable them to buy fancy grades below the present Government prices. However, there is more than a possibility that these schemes will miscarry. As industries, one after the other, return to the manufacture of their pre-war products, and plants that were not permitted to function, or that were curtailed, resume full-time operations, the shortage which now exists on paper in the Fuel Administration records may become a sad reality. Weather conditions, too, up to the present, have aided those who are laying low on their purchases, and the mine workers have given of their best because they did not desire to interfere with the country's war programme. Who can tell how long these favourable conditions will continue?

"A quite different aspect is presented by the anthracite market. In fact, reverse what has been said of soft coal and the hard coal situation stands revealed. A shortage of labor during the entire war period, and an influenza epidemic to cap the climax, as it were, has brought the output of anthracite from April 1 tc date, behind the total production for the corresponding period of 1917. Estimates place the 1918 production from April 1 to November 2 at 60,588,000 net tons and 1917 production at 60,839,000 net tons. However, the discontinuance of munitions manufacture and the shutting down of other strictly war-work industries will doubtless lead to the return of many mine workers (particularly since the new wage increase in the hard coal industry has gone into effect) and, before long, it is possible that the output of anthracite may show the eagerly awaited upward trend."

The "New York Times", December 2nd, states that, as a
ult of the recent increase of wages of $1.00 per day and
release of thousands of miners from the military camps, it
expected that the production of anthracite will soon become
al.