Report No. 14.

SCIENTIFIC AND INDUSTRIAL RESEARCH COUNCIL
OF ALBERTA.

ANALYSES
OF
ALBERTA COAL

BY

EDGAR STANSFIELD, ROBERT T. HOLLIES
AND WILLIAM P. CAMPBELL.

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Chairman of the S. & I. Research Council of Alberta.

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ORGANIZATION

The Scientific and Industrial Research Council of Alberta, formed in January, 1921, carries on its work in co-operation with the University of Alberta.

The personnel of the Council at the present time is as follows:

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J. T. Stirling, Chief Inspector of Mines, Province of Alberta.

J. A. Allan, Geologist.

N. C. Pitcher, Mining Engineer.

R. W. Boyle, Dean, Faculty of Applied Science, University of Alberta.

Edgar Stansfield, Honorary Secretary, University of Alberta.

Requests for information and reports should be addressed to the Honorary Secretary, Industrial Research Department, University of Alberta, Edmonton, Alberta.

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LETTER OF TRANSMITTAL.

HONOURABLE HERBERT GREENFIELD,

Premier of Alberta,

Edmonton, Alberta.

Sir:

I have the honour to transmit herewith a report entitled "Analyses of Alberta Coal," prepared in co-operation with Mr. R. T. Hollies from analyses made by Mr. W. P. Campbell and others.

This report was compiled under instructions from the Scientific and Industrial Research Council of Alberta, to meet the many requests for analyses of the coals of the province.

Respectfully submitted,

EDGAR STANSFIELD,

Research Engineer, Fuels.

Department of Industrial Research,

University of Alberta,

Edmonton.

September 21, 1925.

ANALYSES OF ALBERTA COALS

INTRODUCTION.

This compilation of analyses has been prepared in response to a large number of requests for analyses of Alberta coals. It would be useless to publish all the analyses in the files of the Research Council, amounting to over 1,200, and it did not seem advisable even to publish analyses for every separate mine of the Province. It was therefore decided to publish analyses by coal areas only, or by districts in certain cases, as for example when there was too marked a difference between the analyses of coals from separate districts of an area. For each area, or district, a typical analysis is given, also maximum and minimum values to indicate the range of variations from the typical. The notes on page 18 should be studied carefully in order that the significance of the analyses may be thoroughly understood.

The figures published are based almost entirely on the analyses of 464 samples taken by the Provincial Mine Inspectors during the past two and one-half years, and analysed by carefully standardised methods in the laboratories of the Research Council. The values selected, however, were, in every case, checked (and modified if necessary) by comparison with all available analyses of samples taken by responsible government officials and analysed in government laboratories. These latter analyses were of samples taken during the past seventeen years, and but few of them were of recent date.

An appendix gives information with regard to the fusibility and clinkering properties of ash from a number of typical coal samples. The work was done by A. G. Scroggie, a graduate student of the University, as a research investigation carried out in order to gain a Master of Science degree. The Research Council supplied the necessary facilities and oversight for the work.

The compilation was made by Edgar Stansfield and R. T. Hollies, and the recent analyses referred to above were made by W. P. Campbell. R. T. Hollies drew the maps and charts. The analyses were made for the Provincial Mines Branch on samples supplied by them. The Mines Branch also supplied statistics as to outputs, and information as to location of the mines.

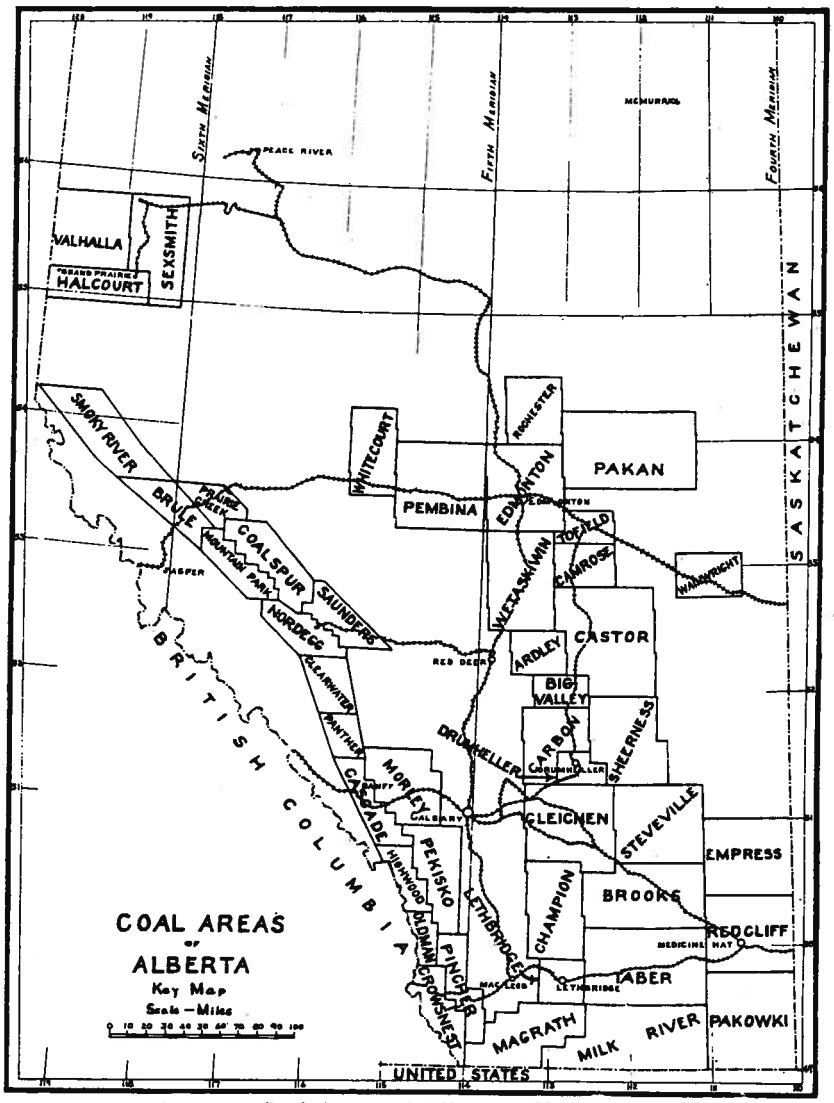

Fig. 1.—Coal Areas of Alberta—Key Map.

COAL AREAS OF ALBERTA

These coal areas originally adopted by the Scientific and Industrial Research Council of Alberta for its own use have since been accepted by the Provincial Mines Branch and by some of the Dominion Government departments principally concerned. These coal areas, moreover, were recorded as the "mine inspection districts" of the Province in "The Coal Sales Act, 1925," of the Provincial Legislature. This subdivision of the coal bearing areas of the Province, therefore, has received official recognition and supersedes all previous subdivisions.

There were originally 36 areas, but one of these has since been divided and 8 new ones added, so that there are now 45 areas, as shown in the key map.

The areas may be grouped according to the geological horizons in which they occur—Kootenay, Belly River, Edmonton. The horizon of each area is not shown in the map, but is given in the table on page 13.

The fourth annual report of the Council, pp 55-58, and the coloured map which accompanies it, should be consulted for a fuller account of the original 36 areas. The additional areas are described in the fifth annual report, pp. 44-45.

An estimate of the available tonnage of coal in each area can be found in a paper presented to the Annual General Meeting of the Canadian Institute of Mining and Metallurgy in March, 1925, by Dr. John A. Allan,* Professor of Geology, University of Alberta, and member of the Research Council.

The output from each area for the past two years, as reported by the Provincial Mines Branch, is given in the table on page 13.

*Geology of Alberta Coal, Trans. Can. Inst. of M. & M., Vol. XXVIII, 1925, pp. 403-405.

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LIST OF COAL AREAS OF ALBERTA

With their Production for the Years 1923 and 1924.

Geological Horizon.	Area.	Output in Short Tons. 1923.	1924.
KOOTENAY	Smoky River	.....	.....
	Brule	248,659	6,547
	Mountain Park	634,474	286,297
	Nordegg	493,378	174,772
	Clearwater	.....	.....
	Panther	.....	.....
	Cascade	264,554	134,827
	Highwood	.....	.....
	Oldman	.....	.....
	Crowsnest	1,604,248	918,845
BELLY RIVER	Valhalla	.....	.....
	Sexsmith	458	123
	Halcourt	193	658
	Prairie Creek	.....	.....
	Coalspur	377,574	506,050
	Saunders	73,295	68,546
	Morley	.....	121
	Pekisko	3,148	4,549
	Pincher	5,852	6,499
	Magrath	2,051	2,712
	Lethbridge	657,032	409,099
	Milk River	3,604	4,142
	Pakowki	3,141	2,672
	Taber	33,233	94,811
	Redcliff	20,761	48,327
	Brooks	7,251	6,351
	Steveville	922	739
	Empress	308	.....
	Wainwright	.....	160
	Pakan	.....	.....
	Rochester	.....	.....
EDMONTON	Whitecourt	107	443
	Pembina	168,139	197,024
	Edmonton	616,140	675,285
	Tofield	106,214	119,811
	Camrose	71,628	81,473
	Wetaskiwin	.....	12
	Castor	27,594	29,922
	Ardley	11,911	13,280
	Big Valley	45,380	54,019
	Carbon	101,454	185,536
	Sheerness	29,240	42,438
	Drumheller	1,239,253	1,112,757
	Gleichen	6,406	4,933
	Champion	9,321	9,933
TOTAL		6,866,923	5,203,713

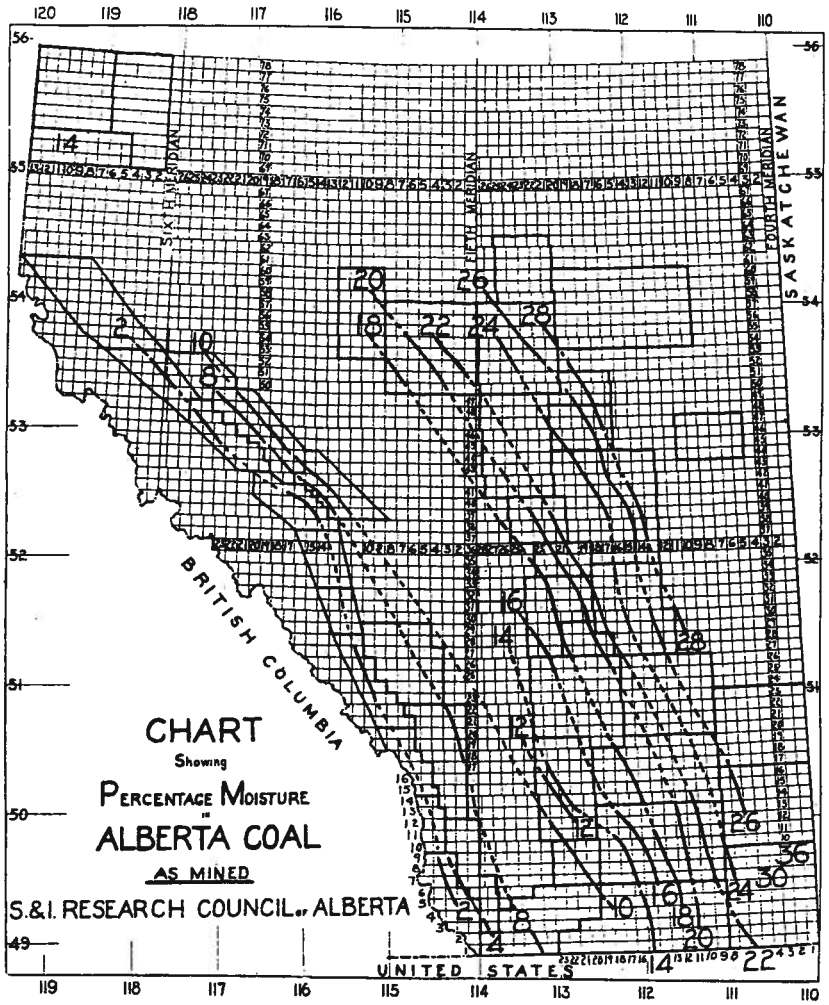

Fig. 2.—Chart Showing Percentage Moisture in Alberta Coal as Mined.

MOISTURE IN ALBERTA COAL.

The chart shown on page 14 indicates how the moisture contents of the coals of the Province vary with the locality in which they occur. It will be noticed that the lines of equal moisture are roughly parallel to the mountains on the west. The areas outlined in this chart are those shown in the key map on page 10. The chart is based on the analyses of nearly 500 coal samples analysed in these laboratories during the past two and one-half years.

This chart was prepared as follows: The percentages of moisture found were collected and averaged by townships, and the average values thus found for one hundred townships were recorded, each in its proper location, on a map of the Province. Using these figures as a guide, lines were drawn to represent the location of coals of equal moisture content from 2% to 36% at 2% intervals. The lines are shown full through areas of known moisture content and dotted where hypothetical. A few minor irregularities have been smoothed out, but some notable ones can be seen, particularly on the south east corner of the chart. On the whole there is a remarkably regular rise in the moisture content of the coals as the distance increases between their point of occurrence and the mountains along the west side of the Province.

This chart was first published in a paper presented to the Annual General Meeting of the Canadian Institute of Mining & Metallurgy in March, 1925, by Edgar Stansfield.* It has been revised and redrawn to include the more recent information, but on the whole the new values fitted into the old chart with little modification.

*A Chemical Survey of Alberta Coals, Trans. Can. Inst. of M. & M., Vol. XXVIII, 1925, p. 412.

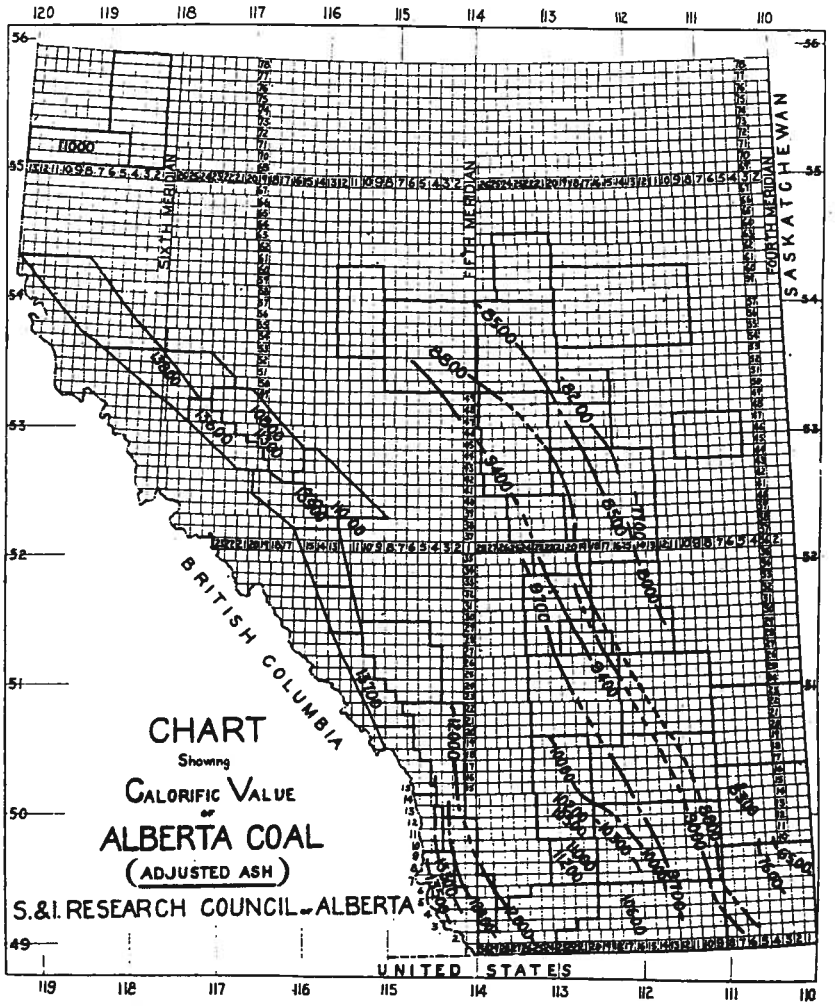

Fig. 3.—Chart Showing Calorific Value of Alberta Coal (Adjusted Ash).

CALORIFIC VALUE OF ALBERTA COAL.

The chart shown on page 16 indicates how the calorific values of the coals of the Province vary with the locality in which they occur. The figures represent the calorific value of coal of normal moisture content as mined, in British Thermal Units (B.T.U.) per pound.

As in many districts there are wide and quite erratic variations in the ash content of the coal, with corresponding wide variations in calorific value, all the figures given are calculated to an adjusted ash basis. This was done in order that the regularities in the calorific value of clean coal might not be masked by the irregularities in the amounts of impurities with which the coal is associated when mined. The adjusted ash referred to is such that the dry coal in each case contains 10% of ash.

Commercial shipments of coal from any locality will have a higher calorific value than that shown on the chart if the coal is cleaner than the "adjusted ash" basis taken for comparison, and a lower calorific value on the contrary, if less clean.

The same coal analyses as were used for constructing the chart showing moisture were used for this chart, and the averaging and plotting were done in a similar manner to that already described for figure 2.

The chart was first published in a paper presented to the Annual General Meeting of the Canadian Institute of Mining and Metallurgy in March 1925, by Edgar Stansfield.* It has been revised and redrawn to include the more recent information, but, as before, the new values fitted into the old chart with little modification.

If the calorific value of one sample of a coal is known, the calorific value of another sample of the same or similar coal may be calculated with reasonable accuracy by the following formula, if the moisture and ash content of both samples is known:

$$C_2 = C_1 \times \frac{100 - (M_2 + 1.1A_2)}{100 - (M_1 + 1.1A_1)}$$

Where C_1 and C_2 represent the calorific values of coals 1 and 2
M_1 and M_2 represent the percentage of moisture content in coals 1 and 2, and
A_1 and A_2 represent the percentage of ash content in coals 1 and 2.

The net calorific value of a coal is calculated by subtracting from the gross value a correction representing the latent heat of the steam in the products of combustion. The net values give a more correct comparison between the economic heat values of different coals, but they are not given in the tables as they are seldom used in Canada and their inclusion might cause confusion with those not familiar with the terms "gross" and "net" in this connection. The correction is roughly 300 B.T.U. per lb. for an anthracite with 10% volatile matter; 400 B.T.U. for bituminous coal with 25% volatile matter, and 550 B.T.U. for domestic coal with 25% moisture.

*A Chemical Survey of Alberta Coals. Trans. C.I. of M. & M., Vol. XXVIII, 1925, p. 414.

NOTES ON TABLES OF ANALYSES.

Summary of Notes.

The quoted analyses are of mine samples taken by the Provincial Mine Inspectors. They were analysed by the same analyst, using standard methods, so that they are strictly comparable not only amongst themselves, but with other reliable analyses.

The analyses are for coal with its full moisture as mined. The consumer will normally receive a dryer coal.

The typical analysis given in black-face type is the one to be used. The maximum and minimum values indicate variations from the typical met with in samples from the district in question.

The number of samples taken helps to indicate the reliance to be placed on each analysis. The larger the number, the more closely the typical value is likely to agree with the average value for the district.

Any exceptions to the above statements are recorded in the full notes which follow.

Analyses.—Official analyses of Alberta coals may be divided into five principal groups as follows: (a) Analyses made at McGill University in 1908 and 1909, in connection with an investigation of the coals of Canada.[1 and 2] (b) Analyses made in the Fuel Testing Laboratories of the Department of Mines at Ottawa[2]. (c) Analyses made in the Industrial Laboratories of the University of Alberta, for, and on samples supplied by the Provincial Mines Branch.[3] (d) Analyses made in the laboratories of the S. and I. Research Council of Alberta, for, and on samples supplied by the Provincial Mines Branch. (e) Analyses made in the two last mentioned laboratories on samples taken by the geologists of the Council in their field work, or on samples taken during special investigations. There have been, in addition, a large number of miscellaneous analyses of prospectors' and geologists' samples, operators' test samples and of samples from commercial shipments.

This compilation is based almost entirely on samples classed under group (d), but analyses in groups (a), (b) and (c) were carefully collected, averaged and compared, and in districts where analyses of group (d) were lacking, or few in number, the earlier analyses were employed.

Samples.—The samples taken by the Provincial Mine Inspectors are channel samples taken across the seam, from fresh working faces selected to represent as closely as possible the normal output of the mine. The Inspector includes or rejects clay or shale bands or other "partings" in the seam, according as these are included or

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[1]An Investigation of the Coals of Canada, Report No. 83, Mines Branch of the Department of Mines, Ottawa, 1912, Vol. II, Tables 61-63 and 65.

[2]Analyses of Canadian Fuels, Part IV, Alberta & Northwest Territories, Bulletin 25, Mines Branch of the Department of Mines, Ottawa, 1922.

[3]Annual Reports of the Scientific and Industrial Research Council of Alberta: First, pp. 20-32; Second, pp. 61-86; and Third, pp. 60-63.

excluded from the shipments from that mine. The samples are crushed and reduced according to recognized procedure and shipped to the laboratory in air-tight containers.* A few analyses of commercial shipments are also included in the compilation. These were carload samples and were also taken by the Provincial Mine Inspectors.

Commercial shipments of coal from many districts vary from mine to mine in the district, according to the mining conditions encountered in each mine, and according to the equipment available and the care taken in preparing the coal for shipment. The shipments also vary from time to time in the same mine, according to the conditions met with in the location worked at the time, and according to the care taken in preparation. Analyses given are for mine samples. The ash is normally less in the larger prepared sizes. With bituminous coals, the intermediate sizes usually contain most ash, whilst with the domestic coal, the fines are the dirtiest.

Channel samples, when carefully taken, do represent fairly closely the output of the mine sampled at the time of sampling. The average of all such samples from a district will represent, as closely as this can be done at present, the average output from the district. Individual mines may, regularly or occasionally, supply coal to their customers, distinctly above or below the average. The installation by any operator of a coal washery, or other special equipment for the purification of coal, would naturally be expected to result in shipments markedly above the average for the district. The range of variation between the individual samples gives an indication of the variability of the coal in the district, and therefore suggests how far commercial shipments are liable to vary from the typical analysis.

Location of Samples.—Circles are drawn on the accompanying area maps to show the approximate location of the different samples analysed. Where the samples from any area are divided into groups, or districts, this is indicated by the letters A, B, etc., in circles, which correspond with the districts A, B, etc., in the tables of analyses.

Usual Classification.—With a few exceptions, duly noted, the classification of the Provincial Mines Branch has been followed. The coals are classified into four broad groups or types of coal: Anthracite, Bituminous, Sub-bituminous and Domestic (or Lignite). It should be noted that all four classes of coal are burned for the generation of power, and that sub-bituminous, as well as domestic coals, are burned for house heating and other domestic purposes.

The mines now operating in the Province produce coals varying by very small gradations from a low volatile, short flamed, bituminous coal, sometimes called "smokeless steam coal" or "semi-bituminous" coal, down to a low grade or brown lignite. It is difficult to draw a sharp distinction between the different classes, and in this report only the usual broad distinctions have been made.

*First Annual Report S. & I. R. C. of Alberta, pp. 17-19, and Third Annual Report S. & I. R. C. of Alberta, pp. 15-17 and p. 59.

A tentative classification has been suggested by Edgar Stansfield for discussion,* but no generally accepted classes and definitions of classes are at present available.

Typical, Maximum and Minimum Analyses.—The typical analysis for the district is shown in black-face type. It is called typical rather than average because in cases where one or more exceptionally dirty samples were included in the list, so that the average was obviously not typical, the value was changed accordingly. Small adjustments were also made to bring the selected values into closer accord with the older analyses. The maximum and minimum values are the highest and lowest values for each item, amongst the available analyses of samples under class (d) referred to above. In one case where no such class (d) analyses were available, the typical, maximum and minimum values were all taken from the older analyses. The maximum and minimum values given for each item in the analyses can be usefully studied as an indication of the variability of the coal of the district. The presence of an exceptionally dirty or wet sample is also indicated where the maximum ash or moisture is markedly above the typical.

Proximate Analysis.—A proximate analysis is a conventional analysis which has a broad significance and real value only if made in accordance with accepted standard methods. The methods followed in the analyses were essentially those of the American Society for Testing Materials.† Where optional methods were available, or where modifications or refinements have been adopted, the exact methods followed have been described from time to time in the Annual Reports of the Council. These are very briefly outlined under the separate items below.

Moisture.—This is the loss in weight when a coal is dried for one hour in an oven heated to 106°C, through which a rapid stream of dry, neutral gas (carbon dioxide, or Edmonton natural gas) is passed. Many precautions are necessary in the handling, storage, grinding and analysis of coal samples, to avoid loss of moisture, and in consequence analyses are frequently reported which show too low a percentage, where such precautions are not taken.

The values given are for coal as mined. Coal as a general rule loses moisture during preparation, shipping and storage, unless exposed to rain or snow, so that it reaches the consumer with less moisture than the reported value. This is particularly the case with the higher moisture coals.

Ash.—The ash is the residue left when the coal is burned in a muffle furnace heated to a temperature of from 700 to 750°C.

Volatile Matter.—When one gram of coal is heated for seven minutes at a temperature of 950°C (±20°C) in a 20 c.c. platinum crucible, with a well fitting lid, the loss in weight represents the moisture and volatile matter in the coal. If the loss due to moisture

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*A Chemical Survey of Alberta Coals. Trans. C.I. of M. & M., Vol. XXVIII, 1925, p. 420.

†A.S.T.M. Standard Method D22-21.

is subtracted, the remainder is the volatile matter. This method is not applicable to lignitic coals, for which a preliminary slow heating is prescribed. With coals that retain over 10% of moisture after standard air drying, the crucible is preheated for five minutes in a muffle furnace heated to 800°C (±25°C). The crucible is placed on a cold scorifier which is then put in the hot muffle. At the close of the five minutes preheat it is at once given the usual full heat treatment, but for six minutes only.

Fixed Carbon.—The fixed carbon of a coal might be defined as its ashless coke. It is calculated by subtracting from 100 the sum of the percentages of moisture, ash and volatile matter found by analysis.

Calorific Value, gross.†—This is a measure of the heat given out when the coal is completely burned in compressed oxygen in a bomb calorimeter. The customary corrections are made for nitrogen and sulphur.

Moisture in Air Dried Coal.—Samples of crushed coal are air dried at room temperatures by exposure in shallow layers, for 48 hours, in a current of air of 60% humidity.* This standardised method of air drying has been adopted in Canada by several government departments. It is not an American Society for Testing Materials method. The moisture left in the coal after air drying is determined as above. The total moisture in the original sample is calculated from the loss during air drying and the moisture left after air drying. All the other analyses described were made on air dried coal and the results obtained calculated to the basis of the coal as mined.

Sulphur.—The sulphur was determined in the rinsings from the calorimeter. This method is rapid and convenient, but not standard practice. It was adopted because the low sulphur content of most Alberta coals makes great accuracy not important.

Fuel Ratio.—The fuel ratio of a coal is determined by dividing the percentage of fixed carbon by the percentage of volatile matter. This ratio gives a rough indication of the character of the coal. Anthracite has a high fuel ratio, whilst the lower grades of coal have lower values.

Coking Properties.—These comments refer only to the coking properties as observed when the coal was heated in a crucible for the determination of volatile matter. This test is only a rough indication of the coking properties that would be found if the coal were treated in a regular coke oven battery. Moreover, in a hilly country where the coal has been much disturbed, coals from two different seams, or even from the same seam in closely adjacent mines, may show markedly different coking properties. It is therefore difficult to compare the coking properties of two districts by this test, and the values should only be taken as an indication

†For net value see page 17.
*Fourth Annual Report S. & I. R. C. of Alberta, pp. 39-41.

of the probable value of the coal for coking purposes, and of its behaviour with respect to coking when fired in a furnace.

Number of Samples.—Two numbers are given in each case. The first is the number of samples available for each district in the class (d) group, defined on page 18. The second is the number of samples available in classes (a), (b) and (c). As has already been stated the compilation is based largely on the recent group (d) samples, but the older values were carefully studied and compared.

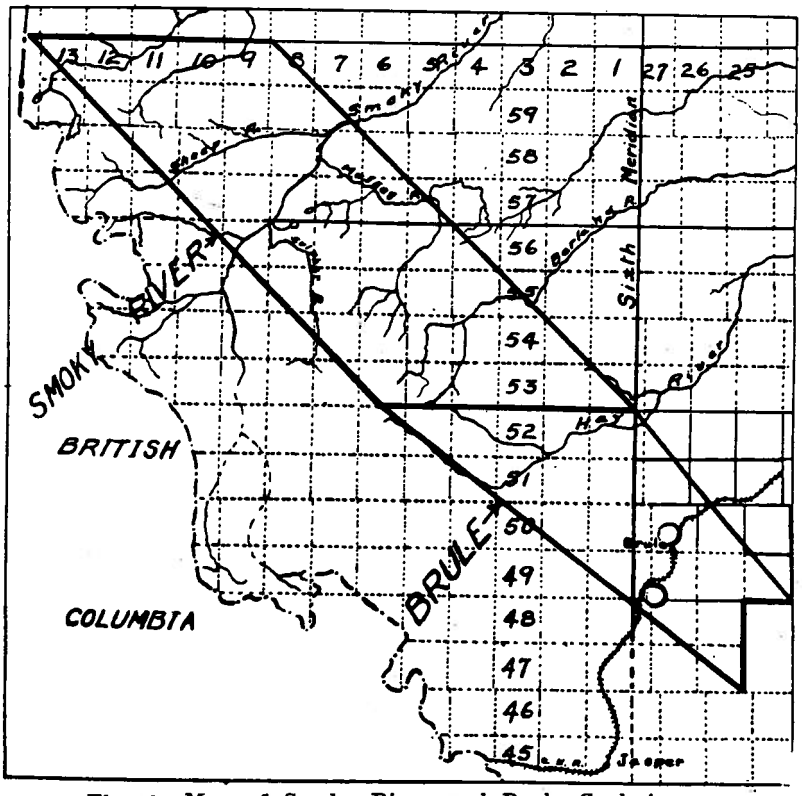

Fig. 4—Map of Smoky River and Brule Coal Areas.
(Scale 25 miles to 1 inch)

	BRULE AREA		
Location of Samples	See map on page 22		
Usual Classification	Bituminous		
	Typical	Max.	Min.
Proximate Analysis:			
Moisture %	**1.5**	1.7	1.3
Ash %	**16.7**	18.6	14.7
Volatile Matter %	**17.1**	17.5	16.8
Fixed Carbon %	**64.7**	67.0	62.8
Calorific Value, gross, B.T.U. per lb	**12,580**	12,830	12,420
Moisture in Air Dried Coal %	**0.8**	.....	.....
Sulphur %	.....	.....	.....
Fuel Ratio	**3.80**	4.00	3.65
Coking Properties	Very poor		
Number of Samples	4+23		

Notes on page 18 must be consulted for significance of analyses.

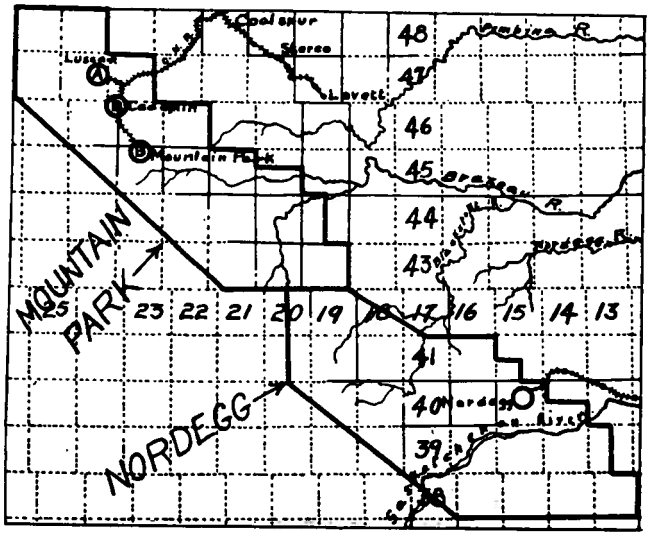

Fig. 5.—Map of Mountain Park and Nordegg Coal Areas.
(Scale 25 miles to 1 inch)

	MOUNTAIN PARK AREA					
Location of Samples	District A See map on page 24			District B See map on page 24		
Usual Classification	Bituminous			Bituminous		
	Typical	Max.	Min.	Typical	Max.	Min.
Proximate Analysis:						
Moisture .....%	**3.4**	4.3	2.0	**2.9**	3.4	2.3
Ash .....%	**15.4**	17.0	13.8	**10.3**	12.5	8.4
Volatile Matter .....%	**19.6**	20.6	18.9	**27.3**	29.2	26.0
Fixed Carbon .....%	**61.6**	64.6	59.8	**59.5**	60.9	56.8
Calorific Value, gross, B.T.U. per lb.	**12,560**	13,090	12,200	**13,470**	13,830	13,070
Moisture in Air Dried Coal .....%	**0.5**	0.9	0.4	**0.8**	1.1	0.6
Sulphur .....%	**0.4**	0.6	0.3	**0.4**	0.6	0.2
Fuel Ratio	**3.15**	3.30	3.00	**2.20**	2.30	2.05
Coking Properties	Poor			Cokes		
Number of Samples	7+0			5+10		

	NORDEGG AREA		
Location of Samples	See map on page 24		
Usual Classification	Bituminous		
	Typical	Max.	Min.
Proximate Analysis:			
Moisture .....%	**2.0**	2.6	1.5
Ash .....%	**7.9**	13.1	4.3
Volatile Matter .....%	**16.8**	17.2	16.4
Fixed Carbon .....%	**73.3**	76.6	68.5
Calorific Value, gross, B.T.U. per lb.....	**14,210**	14,890	13,270
Moisture in Air Dried Coal .....%	**0.8**	0.9	0.7
Sulphur .....%	**0.4**	0.4	0.4
Fuel Ratio	**4.35**	4.55	4.15
Coking Properties	Fair to poor		
Number of Samples	6+13		

Notes on page 18 must be consulted for significance of analyses.

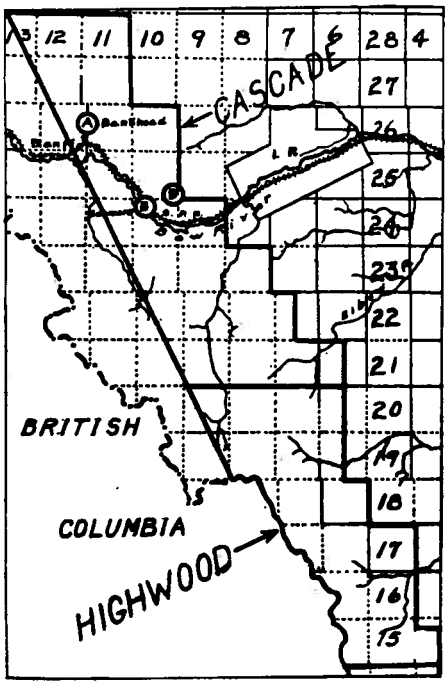

Fig. 6.—Map of Cascade and Highwood Coal Areas.
(Scale 25 miles to 1 inch)

	CASCADE AREA					
Location of Samples	District A See map on page 26			District B See map on page 26		
Usual Classification	Anthracite*			Bituminous**		
	Typical	Max.	Min.	Typical	Max.	Min.
Proximate Analysis:						
Moisture .....%	**0.8**	1.1	0.5	**1.7**	2.8	1.4
Ash .....%	**12.6**	18.4	9.6	**7.4**	11.8	3.3
Volatile Matter .....%	**11.0**	11.7	8.2	**15.2**	16.3	14.0
Fixed Carbon .....%	**75.6**	81.5	70.5	**75.7**	79.1	72.6
Calorific Value, gross, B.T.U. per lb.	**13,140**	13,750	12,180	**14,120**	14,980	13,390
Moisture in Air Dried Coal .....%	.....	.....	.....	**1.0**	1.2	0.9
Sulphur .....%	**0.5**	0.6	0.5	**0.5**	0.8	0.3
Fuel Ratio	**6.90**	9.95	6.45	**5.00**	5.35	4.50
Coking Properties	Non coking			Non coking		
Number of Samples	0+6			8+15		

Notes on page 18 must be consulted for significance of analyses.

*This coal would be more correctly classified as semi-anthracite.

**This coal approaches the anthracites in character and is sometimes classed as semi-bituminous.

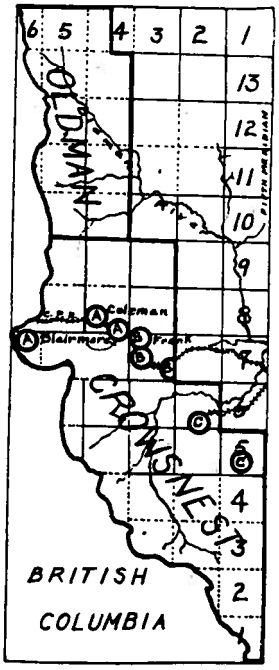

Fig. 7.—Map of Oldman and Crowsnest Coal Areas.
(Scale 25 miles to 1 inch)

	CROWSNEST AREA					
Location of Samples	District A See map on page 28			District B See map on page 28		
Usual Classification	Bituminous			Bituminous		
	Typical	Max.	Min.	Typical	Max.	Min.
Proximate Analysis:						
Moisture ..... %	**2.1**	4.3	0.9	**1.8**	6.5	1.1
Ash ..... %	**16.2**	22.7	10.0	**16.2**	22.9	10.6
Volatile Matter ..... %	**23.1**	25.4	20.1	**25.7**	27.1	23.3
Fixed Carbon ..... %	**58.6**	64.2	54.1	**56.3**	58.3	51.0
Calorific Value, gross, B.T.U. per lb.....	**12,400**	13,400	11,270	**12,370**	12,800	11,290
Moisture in Air Dried Coal ..... %	**0.9**	1.1	0.7	**1.0**	1.9	0.6
Sulphur ..... %	**0.5**	1.6	0.1	**0.6**	1.6	0.3
Fuel Ratio	**2.55**	2.95	2.25	**2.20**	2.35	2.00
Coking Properties	Cokes			Cokes		
Number of Samples	21+34			11+39		

	CROWSNEST AREA		
Location of Samples	District C See map on page 28		
Usual Classification	Bituminous		
	Typical	Max.	Min.
Proximate Analysis:			
Moisture ..... %	**5.4**	8.5	3.2
Ash ..... %	**12.1**	18.4	5.6
Volatile Matter ..... %	**29.4**	30.2	28.5
Fixed Carbon ..... %	**53.1**	56.3	49.9
Calorific Value, gross, B.T.U. per lb.....	**12,130**	12,360	11,670
Moisture in Air Dried Coal..... %	**2.6**	4.4	1.3
Sulphur ..... %	**1.0**	1.4	0.5
Fuel Ratio	**1.80**	1.90	1.75
Coking Properties	Fair to poor		
Number of Samples	3+0		

Notes on page 18 must be consulted for significance of analyses.

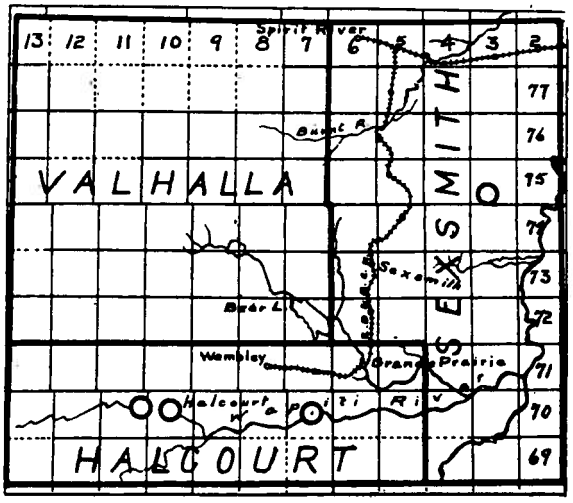

Fig. 8.—Map of Valhalla, Sexsmith and Halcourt Coal Areas.
(Scale 25 miles to 1 inch)

	HALCOURT AREA			SEXSMITH AREA		
Location of Samples	See map on page 30			See map on page 30		
Usual Classification	Sub-Bituminous*			Domestic**		
	Typical	Max.	Min.	Typical	Max.	Min.
Proximate Analysis:						
Moisture .....%	**13.6**	14.2	12.9	**29.6**	.....	.....
Ash .....%	**10.2**	13.6	7.4	**6.1**	.....	.....
Volatile Matter .....%	**31.7**	33.3	30.3	**27.8**	.....	.....
Fixed Carbon .....%	**44.5**	46.4	42.4	**36.5**	.....	.....
Calorific Value, gross, B.T.U. per lb.	**10,700**	11,220	10,110	**8,130**	.....	.....
Moisture in Air Dried Coal .....%	**6.0**	6.3	5.8	**13.4**	.....	.....
Sulphur .....%	**0.4**	0.5	0.4	**0.5**	.....	.....
Fuel Ratio	**1.40**	1.40	1.40	**1.30**	.....	.....
Coking Properties	Non coking			Non coking		
Number of Samples	3+3			1+0		

Notes on page 18 must be consulted for significance of analyses.

*The Provincial Mines Branch classes this coal as Domestic.

**Only one sample available for this area. This was from a stripping mine and may prove to have been weathered coal.

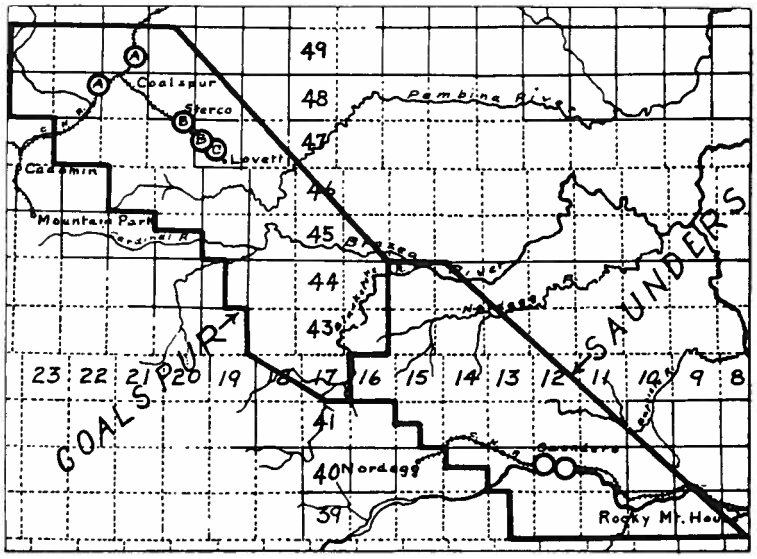

Fig. 9.—Map of Coalspur and Saunders Coal Areas.
(Scale 25 miles to 1 inch)

	COALSPUR AREA					
Location of Samples	District A See map on page 32			District B See map on page 32		
Usual Classification	Sub-Bituminous			Sub-Bituminous		
	Typical	Max.	Min.	Typical	Max.	Min.
Proximate Analysis:						
Moisture .....%	**9.8**	11.8	7.7	**7.3**	7.8	7.0
Ash .....%	**10.2**	12.8	7.8	**20.3**	20.7	20.0
Volatile Matter .....%	**35.4**	37.2	33.6	**30.5**	30.6	30.3
Fixed Carbon .....%	**44.6**	47.5	42.5	**41.9**	42.5	41.5
Calorific Value, gross, B.T.U. per lb.	**10,720**	11,350	10,140	**9,730**	9,940	9,570
Moisture in Air Dried Coal .....%	**6.7**	7.4	6.0	**6.1**	6.4	5.8
Sulphur .....%	**0.2**	0.4	0.2	.....	.....	.....
Fuel Ratio	**1.25**	1.35	1.20	**1.35**	1.40	1.35
Coking Properties	Non coking			Non coking		
Number of Samples	13+2			3+1		

	COALSPUR AREA			SAUNDERS AREA		
Location of Samples	District C See map on page 32			See map on page 32		
Usual Classification	Sub-Bituminous			Sub-Bituminous		
	Typical	Max.	Min.	Typical	Max.	Min.
Proximate Analysis:						
Moisture .....%	**11.9**	13.0	10.8	**10.5**	12.1	8.8
Ash .....%	**12.1**	13.6	9.2	**6.3**	8.1	5.2
Volatile Matter .....%	**31.7**	32.8	29.9	**33.5**	34.8	32.6
Fixed Carbon .....%	**44.3**	46.3	41.7	**49.7**	50.6	48.3
Calorific Value, gross, B.T.U. per lb.	**10,320**	10,660	9,820	**11,420**	11,570	11,110
Moisture in Air Dried Coal .....%	**7.6**	8.8	6.9	**7.7**	8.2	7.1
Sulphur .....%	**0.2**	0.3	0.1	**0.4**	0.9	0.2
Fuel Ratio	**1.40**	1.50	1.30	**1.50**	1.50	1.40
Coking Properties	Non coking			Non coking		
Number of Samples	7+5			6+10		

Notes on page 18 must be consulted for significance of analyses.

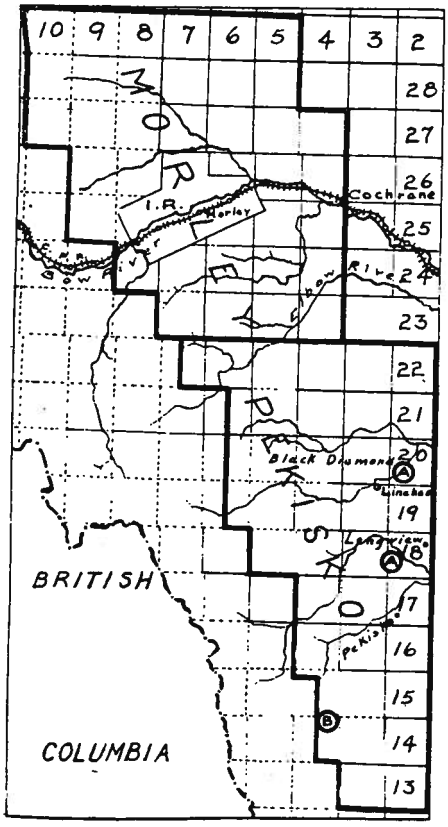

Fig. 10.—Map of Morley and Pekisko Coal Areas.
(Scale 25 miles to 1 inch)

	PEKISKO AREA					
Location of Samples	District A See map on page 34			District B* See map on page 34		
Usual Classification	Sub-Bituminous			Bituminous		
	Typical	Max.	Min.	Typical	Max.	Min.
Proximate Analysis:						
Moisture .....%	**7.7**	8.9	7.0	**4.0**	4.3	3.8
Ash .....%	**9.5**	11.9	7.7	**12.6**	12.6	12.5
Volatile Matter .....%	**35.9**	36.5	35.2	**21.9**	22.3	21.6
Fixed Carbon .....%	**46.9**	48.5	44.6	**61.5**	61.5	61.4
Calorific Value, gross, B.T.U. per lb.	**11,980**	12,350	11,450	**12,770**	12,800	12,740
Moisture in Air Dried Coal .....%	**4.2**	5.0	3.7	**1.0**	1.1	1.0
Sulphur .....%	**0.8**	1.1	0.5	**0.6**	0.7	0.6
Fuel Ratio	**1.30**	1.35	1.25	**2.80**	2.85	2.75
Coking Properties	Poor			Poor		
Number of Samples	5+0			2+0		

Notes on page 18 must be consulted for significance of analyses.

*This analysis of samples received in August, 1925, indicates that this is bituminous coal of Kootenay age, so that the district might more suitably have been included in the Oldman area.

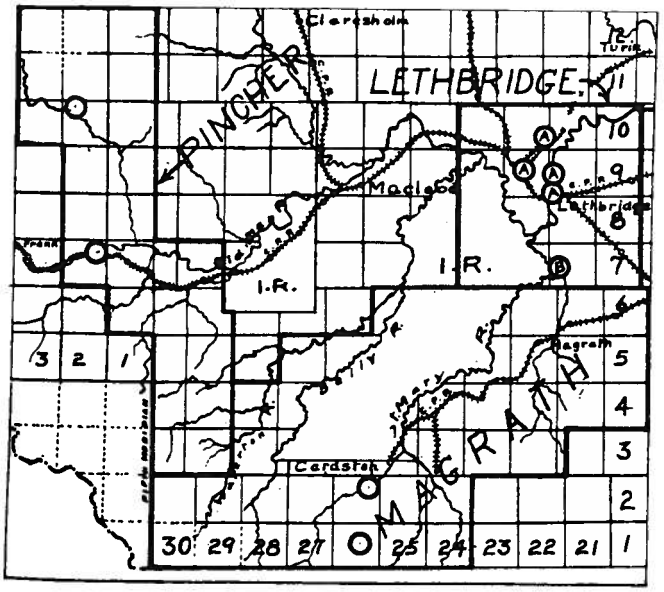

Fig. 11.—Map of Pincher, Magrath and Lethbridge Coal Areas.
(Scale 25 miles to 1 inch)

	PINCHER AREA			MAGRATH AREA		
Location of Samples	See map on page 36			See map on page 36		
Usual Classification	Sub-Bituminous			Sub-Bituminous*		
	Typical	Max.	Min.	Typical	Max.	Min.
Proximate Analysis:						
Moisture .....%	**6.9**	7.5	6.4	**7.1**	7.6	6.6
Ash .....%	**16.5**	19.0	13.2	**11.7**	18.3	7.8
Volatile Matter .....%	**33.6**	35.2	31.7	**35.5**	38.1	32.2
Fixed Carbon .....%	**43.0**	45.3	40.7	**45.7**	47.2	41.9
Calorific Value, gross, B.T.U. per lb.	**11,190**	11,880	10,740	**11,570**	12,250	10,570
Moisture in Air Dried Coal .....%	**3.4**	4.8	2.5	**4.7**	5.2	3.8
Sulphur .....%	**0.9**	1.1	0.5	**1.0**	1.5	0.7
Fuel Ratio	**1.30**	1.35	1.25	**1.30**	1.35	1.25
Coking Properties	Fair to poor			Very poor		
Number of Samples	7+1			5+0		

	LETHBRIDGE AREA					
Location of Samples	District A			District B		
	See map on page 36			See map on page 36		
Usual Classification	Sub-Bituminous*			Sub-Bituminous*		
	Typical	Max.	Min.	Typical	Max.	Min.
Proximate Analysis:						
Moisture .....%	**10.2**	10.9	9.2	**10.3**	11.2	9.6
Ash .....%	**9.3**	10.7	7.7	**13.3**	14.9	11.7
Volatile Matter .....%	**35.8**	37.7	34.8	**35.5**	37.0	34.3
Fixed Carbon .....%	**44.7**	46.0	43.3	**40.9**	42.8	39.7
Calorific Value, gross, B.T.U. per lb.	**10,980**	11,230	10,840	**10,560**	10,820	10,300
Moisture in Air Dried Coal .....%	**7.1**	7.3	7.0	**7.4**	8.5	6.3
Sulphur .....%	**0.6**	0.7	0.6	**1.0**	1.4	0.7
Fuel Ratio	**1.25**	1.35	1.20	**1.15**	1.20	1.10
Coking Properties	Non coking			Non coking		
Number of Samples	16+50			8+0		

Notes on page 18 must be consulted for significance of analyses.

*The Provincial Mines Branch classes this coal as Domestic.

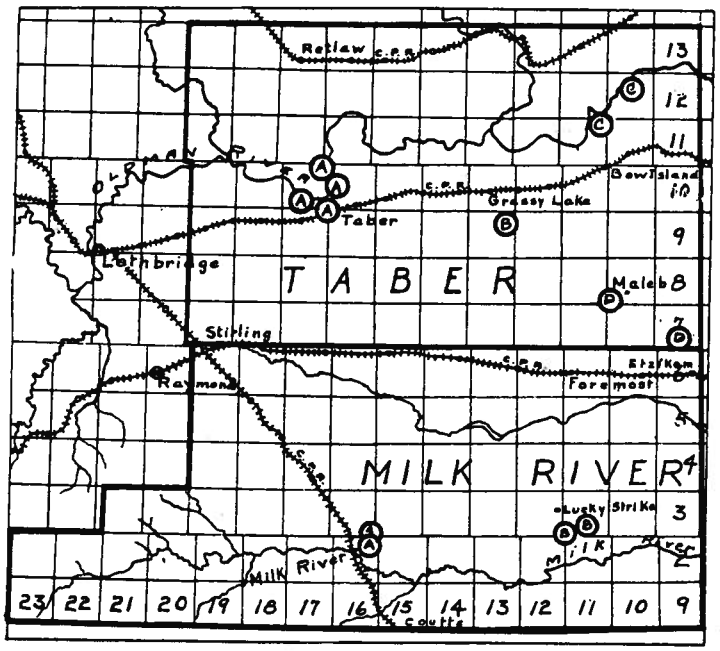

Fig. 12.—Map of Taber and Milk River Coal Areas.
(Scale 25 miles to 1 inch)

	TABER AREA.					
Location of Samples	District A See map on page 38			District B See map on page 38		
Usual Classification	Domestic			Domestic		
	Typical	Max.	Min.	Typical	Max.	Min.
Proximate Analysis:						
Moisture .....%	**15.0**	16.4	13.8	**18.5**	18.9	18.0
Ash .....%	**10.6**	12.8	7.3	**9.6**	10.4	9.2
Volatile Matter .....%	**31.9**	33.8	30.2	**30.8**	31.2	29.7
Fixed Carbon .....%	**42.5**	44.8	40.0	**41.1**	41.5	40.8
Calorific Value, gross, B.T.U. per lb.	**9,940**	10,200	9,730	**9,380**	9,480	9,230
Moisture in Air Dried Coal .....%	**12.4**	13.3	11.6	**14.6**	15.0	14.2
Sulphur .....%	**1.1**	1.8	0.8	**1.1**	1.3	1.0
Fuel Ratio	**1.35**	1.45	1.20	**1.35**	1.40	1.30
Coking Properties	Non coking			Non coking		
Number of Samples	14+14			7+0		

	TABER AREA.					
Location of Samples	District C See map on page 38			District D See map on page 38		
Usual Classification	Domestic			Domestic		
	Typical	Max.	Min.	Typical	Max.	Min.
Proximate Analysis:						
Moisture .....%	**22.2**	23.1	20.0	**22.1**	22.6	20.9
Ash .....%	**7.5**	10.1	6.3	**10.8**	12.5	9.0
Volatile Matter .....%	**29.1**	29.7	28.7	**29.9**	31.1	29.2
Fixed Carbon .....%	**41.2**	41.9	40.5	**37.2**	37.5	36.5
Calorific Value, gross, B.T.U. per lb.	**9,040**	9,190	8,890	**8,570**	8,660	8,460
Moisture in Air Dried Coal .....%	**16.5**	16.9	16.0	**16.7**	17.8	15.5
Sulphur .....%	**0.6**	0.8	0.4	**1.3**	1.4	1.2
Fuel Ratio	**1.40**	1.45	1.40	**1.25**	1.30	1.20
Coking Properties	Non coking			Non coking		
Number of Samples	6+0			4+0		

Notes on page 18 must be consulted for significance of analyses.

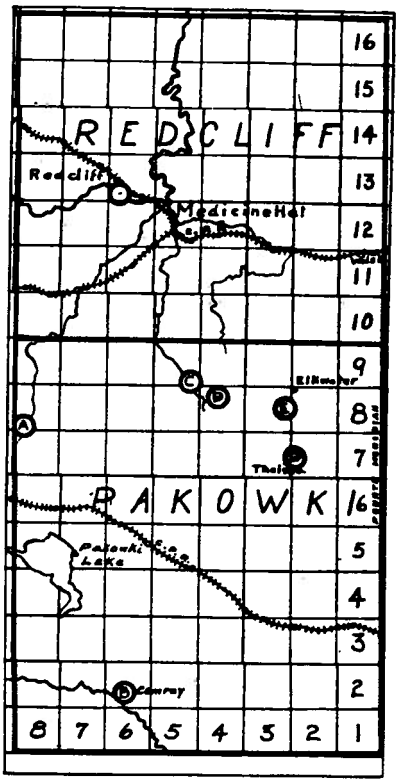

Fig. 13.—Map of Pakowki and Redcliff Coal Areas.
(Scale 25 miles to 1 inch)

	MILK RIVER AREA					
Location of Samples	District A See map on page 38			District B See map on page 38		
Usual Classification	Domestic			Domestic		
	Typical	Max.	Min.	Typical	Max.	Min.
Proximate Analysis:						
Moisture .....%	**13.4**	13.6	13.2	**20.1**	21.1	19.3
Ash .....%	**12.7**	13.1	12.0	**9.2**	9.5	9.0
Volatile Matter .....%	**30.7**	30.8	30.6	**29.4**	29.9	29.1
Fixed Carbon .....%	**43.2**	44.2	42.7	**41.3**	42.3	40.3
Calorific Value, gross, B.T.U. per lb.	**10,000**	10,150	9,850	**9,260**	9,430	9,050
Moisture in Air Dried Coal .....%	**11.0**	11.2	10.8	**15.8**	16.4	15.4
Sulphur .....%	**1.5**	1.7	1.4	**0.8**	1.1	0.7
Fuel Ratio	**1.40**	1.45	1.40	**1.40**	1.45	1.40
Coking Properties	Non coking			Non coking		
Number of Samples	3+0			4+0		

	PAKOWKI AREA					
Location of Samples	District A See map on page 40			District B See map on page 40		
Usual Classification	Domestic			Domestic		
	Typical	Max.	Min.	Typical	Max.	Min.
Proximate Analysis:						
Moisture .....%	**24.6**	25.2	24.1	**22.5**	22.7	22.3
Ash .....%	**6.7**	7.4	6.0	**11.0**	11.3	10.7
Volatile Matter .....%	**30.1**	30.3	29.8	**29.3**	29.4	29.1
Fixed Carbon .....%	**38.6**	38.7	38.5	**37.2**	37.6	36.9
Calorific Value, gross, B.T.U. per lb.	**8,630**	8,650	8,610	**8,460**	8,510	8,400
Moisture in Air Dried Coal .....%	**16.7**	16.9	16.5	**17.7**	17.9	17.5
Sulphur .....%	**0.8**	0.9	0.7	**1.4**	1.6	1.3
Fuel Ratio	**1.30**	1.30	1.25	**1.25**	1.30	1.25
Coking Properties	Non coking			Non coking		
Number of Samples	2+0			2+0		

Notes on page 18 must be consulted for significance of analyses.

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	PAKOWKI AREA					
Location of Samples	District C See map on page 40			District D See map on page 40		
Usual Classification	Domestic			Domestic		
	Typical	Max.	Min.	Typical	Max.	Min.
Proximate Analysis:						
Moisture .....%	**29.4**	.....	.....	**32.9**	33.0	32.9
Ash .....%	**8.3**	.....	.....	**8.1**	8.2	8.0
Volatile Matter .....%	**29.4**	.....	.....	**29.2**	29.5	28.9
Fixed Carbon .....%	**32.9**	.....	.....	**29.8**	29.9	29.6
Calorific Value, gross, B.T.U. per lb.	**7,400**	.....	.....	**6,920**	6,950	6,880
Moisture in Air Dried Coal .....%	**14.0**	.....	.....	**18.3**	18.8	17.9
Sulphur .....%	**0.5**	.....	.....	**0.4**	0.4	0.4
Fuel Ratio	**1.10**	.....	.....	**1.00**	1.05	1.00
Coking Properties	Non coking			Non coking		
Number of Samples	1+0			2+0		

	PAKOWKI AREA			REDCLIFF AREA		
Location of Samples	District E See map on page 40			See map on page 40		
Usual Classification	Domestic			Domestic		
	Typical	Max.	Min.	Typical	Max.	Min.
Proximate Analysis:						
Moisture .....%	**37.5**	.....	.....	**26.2**	26.6	25.7
Ash .....%	**9.4**	.....	.....	**7.4**	9.3	5.7
Volatile Matter .....%	**27.8**	.....	.....	**27.6**	28.5	26.7
Fixed Carbon .....%	**25.3**	.....	.....	**38.8**	39.4	37.8
Calorific Value, gross, B.T.U. per lb.	**6,060**	.....	.....	**8,320**	8,580	8,010
Moisture in Air Dried Coal .....%	**18.4**	.....	.....	**13.2**	14.6	12.5
Sulphur .....%	**1.1**	.....	.....	**0.5**	0.6	0.4
Fuel Ratio	**0.90**	.....	.....	**1.40**	1.45	1.35
Coking Properties	Non coking			Non coking		
Number of Samples	1+0			5+8		

Notes on page 18 must be consulted for significance of analyses.

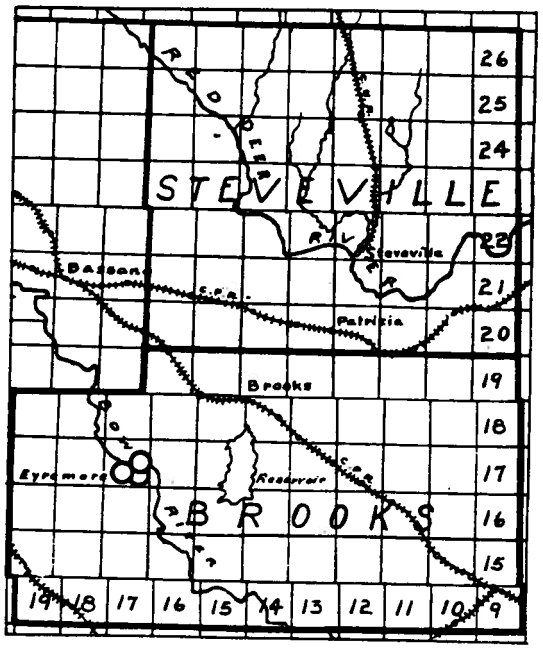

Fig. 14.—Map of Brooks and Steveville Coal Areas.
(Scale 25 miles to 1 inch)

	BROOKS AREA		
Location of Samples	See map on page 44		
Usual Classification	Domestic		
	Typical	Max.	Min.
Proximate Analysis:			
Moisture %	**17.6**	18.3	17.0
Ash %	**11.0**	14.2	8.1
Volatile Matter %	**31.5**	32.1	30.7
Fixed Carbon %	**39.9**	42.2	37.9
Calorific Value, gross, B.T.U. per lb.	**9,330**	9,680	8,980
Moisture in Air Dried Coal %	**13.8**	15.3	12.7
Sulphur %	**0.7**	1.0	0.6
Fuel Ratio	**1.25**	1.35	1.20
Coking Properties	Non coking		
Number of Samples	5+0		

Notes on page 18 must be consulted for significance of analyses.

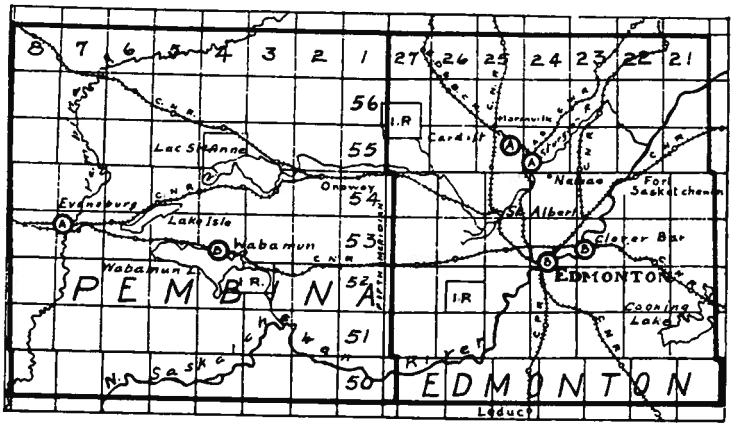

Fig. 15.—Map of Pembina and Edmonton Coal Areas.
(Scale 25 miles to 1 inch)

	PEMBINA AREA					
Location of Samples	District A See map on page 46			District B See map on page 46		
Usual Classification	Domestic			Domestic		
	Typical	Max.	Min.	Typical	Max.	Min.
Proximate Analysis:						
Moisture .....%	**19.0**	20.0	17.9	**21.8**	22.1	21.7
Ash .....%	**10.8**	11.9	7.6	**8.1**	8.6	7.8
Volatile Matter .....%	**27.4**	28.6	26.1	**28.4**	28.8	28.0
Fixed Carbon .....%	**42.8**	43.8	41.1	**41.7**	41.8	41.4
Calorific Value, gross, B.T.U. per lb.	**8,960**	9,280	8,710	**8,680**	8,710	8,620
Moisture in Air Dried Coal .....%	**14.6**	16.0	13.9	**12.8**	13.0	12.7
Sulphur .....%	**0.3**	0.3	0.3	**0.2**	0.2	0.2
Fuel Ratio	**1.55**	1.65	1.45	**1.45**	1.50	1.45
Coking Properties	Non coking			Non coking		
Number of Samples	5+5			3+14		

	EDMONTON AREA					
Location of Samples	District A See map on page 46			District B See map on page 46		
Usual Classification	Domestic			Domestic		
	Typical	Max.	Min.	Typical	Max.	Min.
Proximate Analysis:						
Moisture .....%	**25.7**	26.9	24.9	**25.0**	26.7	23.8
Ash .....%	**6.9**	8.7	5.2	**6.2**	8.2	4.6
Volatile Matter .....%	**28.7**	29.1	27.8	**28.6**	29.5	27.8
Fixed Carbon .....%	**38.7**	40.0	37.1	**40.2**	42.2	38.1
Calorific Value, gross, B.T.U. per lb.	**8,510**	8,650	8,190	**8,750**	9,080	8,400
Moisture in Air Dried Coal .....%	**15.7**	19.3	12.7	**17.5**	19.7	14.2
Sulphur .....%	**0.3**	0.4	0.3	**0.3**	0.4	0.2
Fuel Ratio	**1.35**	1.40	1.30	**1.40**	1.50	1.35
Coking Properties	Non coking			Non coking		
Number of Samples	7+16			24+35		

Notes on page 18 must be consulted for significance of analyses.

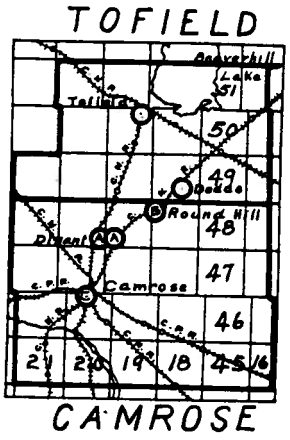

Fig. 16.—Map of Tofield and Camrose Coal Areas.
(Scale 25 miles to 1 inch)

	TOFIELD AREA			CAMROSE AREA		
Location of Samples	See map on page 48			District A See map on page 48		
Usual Classification	Domestic			Domestic		
	Typical	Max.	Min.	Typical	Max.	Min.
Proximate Analysis:						
Moisture .....%	**28.0**	29.7	25.5	**26.8**	27.4	26.1
Ash .....%	**6.0**	9.4	3.0	**4.8**	6.5	3.6
Volatile Matter .....%	**28.5**	30.3	26.5	**30.4**	31.4	28.7
Fixed Carbon .....%	**37.5**	39.7	34.6	**38.0**	39.1	36.7
Calorific Value, gross, B.T.U. per lb.	**8,300**	8,600	7,700	**8,470**	8,620	8,220
Moisture in Air Dried Coal .....%	**18.0**	20.9	12.2	**17.9**	.....	.....
Sulphur .....%	**0.5**	1.0	0.1	**0.3**	.....	.....
Fuel Ratio	**1.30**	1.45	1.25	**1.25**	1.35	1.20
Coking Properties	Non coking			Non coking		
Number of Samples	19+5			9+0		

	CAMROSE AREA					
Location of Samples	District B See map on page 48			District C See map on page 48		
Usual Classification	Domestic			Domestic		
	Typical	Max.	Min.	Typical	Max.	Min.
Proximate Analysis:						
Moisture .....%	**26.0**	28.3	24.3	**25.4**	26.6	24.5
Ash .....%	**4.4**	5.9	3.6	**5.5**	6.7	4.9
Volatile Matter .....%	**29.8**	30.7	28.6	**30.0**	30.5	29.2
Fixed Carbon .....%	**39.8**	41.3	37.5	**39.1**	39.9	38.3
Calorific Value, gross, B.T.U. per lb.	**8,750**	8,940	8,390	**8,770**	8,900	8,660
Moisture in Air Dried Coal .....%	**17.4**	18.9	16.0	**18.5**	18.7	18.2
Sulphur .....%	**0.4**	0.5	0.3	**0.2**	0.3	0.1
Fuel Ratio	**1.35**	1.35	1.30	**1.30**	1.35	1.30
Coking Properties	Non coking			Non coking		
Number of Samples	6+0			4+0		

Notes on page 18 must be consulted for significance of analyses.

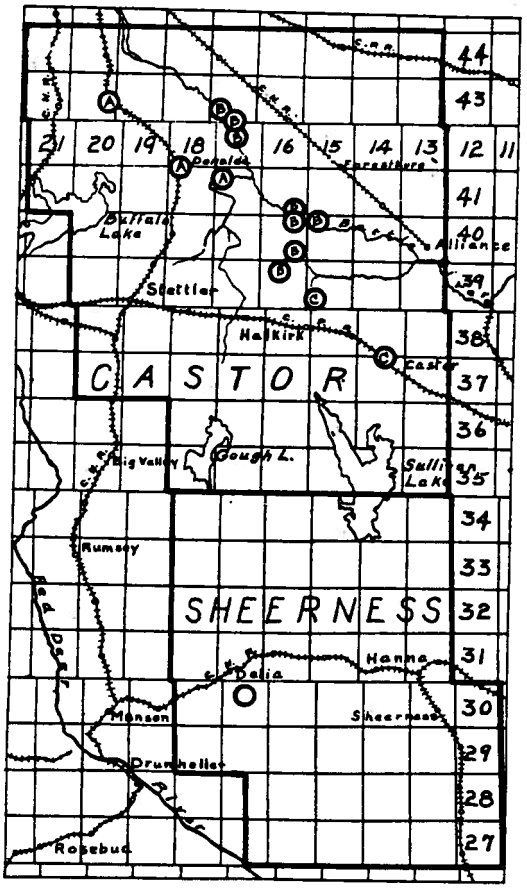

Fig. 17.—Map of Castor and Sheerness Coal Areas.
(Scale 25 miles to 1 inch)

	CASTOR AREA					
Location of Samples	District A See map on page 50			District B See map on page 50		
Usual Classification	Domestic			Domestic		
	Typical	Max.	Min.	Typical	Max.	Min.
Proximate Analysis:						
Moisture .....%	**24.4**	25.7	23.4	**25.8**	28.6	23.7
Ash .....%	**5.9**	8.6	3.8	**7.4**	15.9	3.6
Volatile Matter .....%	**30.2**	30.6	29.8	**29.1**	30.6	26.6
Fixed Carbon .....%	**39.5**	41.5	37.1	**37.7**	40.4	33.1
Calorific Value, gross, B.T.U. per lb.	**8,840**	9,110	8,630	**8,490**	9,060	7,540
Moisture in Air Dried Coal .....%	**17.7**	19.8	12.4	**15.8**	19.7	11.3
Sulphur .....%	**0.3**	0.4	0.3	**0.5**	0.7	0.4
Fuel Ratio	**1.30**	1.35	1.20	**1.30**	1.40	1.20
Coking Properties	Non coking			Non coking		
Number of Samples	5+0			17+9		

	CASTOR AREA			SHEERNESS AREA		
Location of Samples	District C See map on page 50			See map on page 50		
Usual Classification	Domestic			Domestic		
	Typical	Max.	Min.	Typical	Max.	Min.
Proximate Analysis:						
Moisture .....%	**28.8**	29.7	27.4	**24.6**	25.9	23.9
Ash .....%	**7.4**	9.5	5.6	**9.2**	11.6	6.7
Volatile Matter .....%	**28.8**	29.7	28.0	**27.5**	27.9	26.7
Fixed Carbon .....%	**35.0**	35.4	34.7	**38.7**	39.9	37.2
Calorific Value, gross, B.T.U. per lb.	**7,740**	7,870	7,650	**8,250**	8,400	8,050
Moisture in Air Dried Coal .....%	**17.2**	17.9	16.5	**18.7**	19.5	18.2
Sulphur .....%	**0.5**	0.6	0.4	**0.3**	0.4	0.2
Fuel Ratio	**1.20**	1.25	1.20	**1.40**	1.45	1.35
Coking Properties	Non coking			Non coking		
Number of Samples	4+10			6+3		

Notes on page 18 must be consulted for significance of analyses.

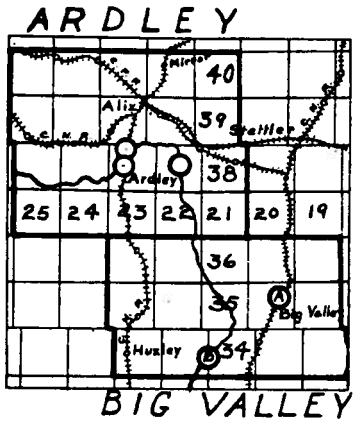

Fig. 18.—Map of Ardley and Big Valley Coal Areas.
(Scale 25 miles to 1 inch)

	ARDLEY AREA		
Location of Samples	See map on page 52		
Usual Classification	Domestic		
	Typical	Max.	Min.
Proximate Analysis:			
Moisture %	**20.0**	22.2	18.1
Ash %	**9.0**	14.5	7.1
Volatile Matter %	**28.4**	30.4	26.3
Fixed Carbon %	**42.6**	44.5	37.9
Calorific Value, gross, B.T.U. per lb.	**9,010**	9,490	8,440
Moisture in Air Dried Coal %	**14.6**	15.3	13.3
Sulphur %	**0.3**	0.5	0.1
Fuel Ratio	**1.50**	1.70	1.35
Coking Properties	Non coking		
Number of Samples	14+1		

	BIG VALLEY AREA					
Location of Samples	District A			District B		
	See map on page 52			See map on page 52		
Usual Classification	Domestic			Domestic		
	Typical	Max.	Min.	Typical	Max.	Min.
Proximate Analysis:						
Moisture %	**21.7**	22.1	21.4	**19.3**	20.5	18.1
Ash %	**11.3**	12.3	9.3	**13.3**	17.1	10.5
Volatile Matter %	**28.4**	28.8	28.2	**27.0**	29.4	25.4
Fixed Carbon %	**38.6**	39.8	37.9	**40.4**	41.5	37.2
Calorific Value, gross, B.T.U. per lb.	**8,370**	8,670	8,200	**8,700**	9,060	7,850
Moisture in Air Dried Coal %	**14.0**	14.5	13.5	**13.0**	13.9	12.1
Sulphur %	**0.4**	0.5	0.3	**0.2**	0.4	0.1
Fuel Ratio	**1.35**	1.40	1.35	**1.50**	1.60	1.40
Coking Properties	Non coking			Non coking		
Number of Samples	4+0			8+2		

Notes on page 18 must be consulted for significance of analyses.

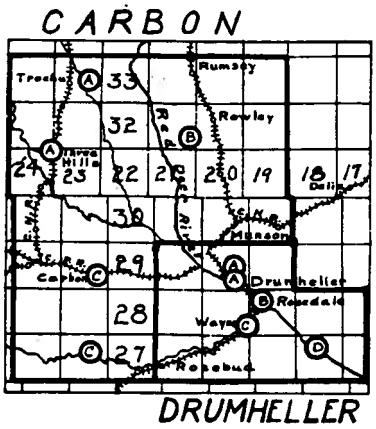

Fig. 19.—Map of Carbon and Drumheller Coal Areas.
(Scale 25 miles to 1 inch)

	CARBON AREA					
Location of Samples	District A See map on page 54			District B See map on page 54		
Usual Classification	Domestic			Domestic		
	Typical	Max.	Min.	Typical	Max.	Min.
Proximate Analysis:						
Moisture .....%	**17.5**	18.6	16.1	**19.5**	20.1	19.1
Ash .....%	**9.7**	13.7	6.0	**8.5**	9.2	7.7
Volatile Matter .....%	**28.0**	29.4	27.2	**30.6**	31.0	29.7
Fixed Carbon .....%	**44.8**	48.1	42.6	**41.4**	42.1	40.7
Calorific Value, gross, B.T.U. per lb.	**9,500**	10,010	9,100	**9,160**	9,290	9,030
Moisture in Air Dried Coal .....%	**13.5**	14.3	12.3	**15.2**	15.4	14.8
Sulphur .....%	**0.4**	0.4	0.3	**0.1**	0.1	0.0
Fuel Ratio	**1.60**	1.70	1.50	**1.35**	1.40	1.30
Coking Properties	Non coking			Non coking		
Number of Samples	16+5			4+0		

	CARBON AREA			DRUMHELLER AREA		
Location of Samples	District C See map on page 54			District A, Seam No. 1* See map on page 54		
Usual Classification	Domestic			Domestic		
	Typical	Max.	Min.	Typical	Max.	Min.
Proximate Analysis:						
Moisture .....%	**16.4**	17.5	15.1	**18.6**	19.8	17.4
Ash .....%	**9.0**	15.0	6.7	**6.0**	6.8	5.3
Volatile Matter .....%	**31.0**	31.9	29.4	**31.8**	33.2	30.8
Fixed Carbon .....%	**43.6**	45.8	40.5	**43.6**	44.6	41.6
Calorific Value, gross, B.T.U. per lb.	**9,810**	10,110	9,130	**9,830**	10,030	9,650
Moisture in Air Dried Coal .....%	**13.2**	13.8	12.7	**12.9**	15.0	11.5
Sulphur .....%	**0.3**	0.4	0.2	**0.4**	0.5	0.2
Fuel Ratio	**1.40**	1.50	1.30	**1.35**	1.45	1.25
Coking Properties	Non coking			Non coking		
Number of Samples	18+0			6+14		

Notes on page 18 must be consulted for significance of analyses.

*Formerly known as Lower Seam.

	DRUMHELLER AREA					
Location of Samples	District A Seam No. 5* See map on page 54			District A Seam No. 7 See map on page 54		
Usual Classification	Domestic			Domestic		
	Typical	Max.	Min.	Typical	Max.	Min.
Proximate Analysis:						
Moisture .....%	**19.7**	20.7	18.8	**18.6**	19.4	18.0
Ash .....%	**6.7**	12.6	3.8	**8.3**	9.5	7.7
Volatile Matter .....%	**30.5**	32.7	27.4	**29.8**	30.3	29.4
Fixed Carbon .....%	**43.1**	44.8	39.9	**43.3**	43.9	42.7
Calorific Value, gross, B.T.U. per lb.	**9,480**	10,040	8,690	**9,430**	9,590	9,320
Moisture in Air Dried Coal .....%	**14.4**	15.5	11.9	**15.1**	15.4	14.8
Sulphur .....%	**0.4**	0.6	0.2	**0.4**	0.4	0.4
Fuel Ratio	**1.40**	1.50	1.35	**1.45**	1.45	1.40
Coking Properties	Non coking			Non coking		
Number of Samples	21+9			4+0		

	DRUMHELLER AREA					
Location of Samples	District B Seam No. 1** See map on page 54			District B Seam No. 5* See map on page 54		
Usual Classification	Domestic			Domestic		
	Typical	Max.	Min.	Typical	Max.	Min.
Proximate Analysis:						
Moisture .....%	**19.3**	20.8	18.1	**19.6**	20.1	19.3
Ash .....%	**5.6**	6.6	4.4	**8.1**	8.8	7.5
Volatile Matter .....%	**31.7**	32.7	30.7	**29.5**	30.0	28.8
Fixed Carbon .....%	**43.4**	44.7	42.6	**42.8**	43.3	42.3
Calorific Value, gross, B.T.U. per lb.	**9,720**	10,060	9,500	**9,220**	9,310	9,070
Moisture in Air Dried Coal .....%	**14.0**	14.5	13.1	**15.5**	16.4	14.6
Sulphur .....%	**0.6**	0.7	0.5	**0.5**	0.5	0.4
Fuel Ratio	**1.35**	1.45	1.35	**1.45**	1.45	1.40
Coking Properties	Non coking			Non coking		
Number of Samples	8+4			4+0		

Notes on page 18 must be consulted for significance of analyses.

*Formerly known as Upper Seam.
**Formerly known as Lower Seam.

	DRUMHELLER AREA					
Location of Samples	District C Seam No. 1* See map on page 54			District C Seam No. 2 See map on page 54		
Usual Classification	Domestic			Domestic		
	Typical	Max.	Min.	Typical	Max.	Min.
Proximate Analysis:						
Moisture .....%	**18.3**	19.0	17.0	**19.6**	19.9	19.2
Ash .....%	**7.3**	9.9	5.8	**6.1**	8.2	3.8
Volatile Matter .....%	**31.9**	33.6	29.7	**30.5**	31.5	29.5
Fixed Carbon .....%	**42.5**	45.5	40.9	**43.8**	45.1	42.4
Calorific Value, gross, B.T.U. per lb.	**9,650**	10,040	9,410	**9,610**	10,010	9,210
Moisture in Air Dried Coal .....%	**14.7**	15.3	14.2	**14.4**	14.8	14.1
Sulphur .....%	**0.5**	0.6	0.2	**0.6**	0.8	0.5
Fuel Ratio	**1.35**	1.55	1.25	**1.45**	1.45	1.40
Coking Properties	Non coking			Non coking		
Number of Samples	22+1			8+1		

	DRUMHELLER AREA		
Location of Samples	District D Seam No. 1* See map on page 54		
Usual Classification	Domestic		
	Typical	Max.	Min.
Proximate Analysis:			
Moisture .....%	**20.9**	21.6	20.5
Ash .....%	**8.9**	10.0	7.8
Volatile Matter .....%	**29.3**	29.8	28.6
Fixed Carbon .....%	**40.9**	41.8	40.0
Calorific Value, gross, B.T.U. per lb.	**8,940**	9,110	8,730
Moisture in Air Dried Coal .....%	**15.3**	15.6	15.1
Sulphur .....%	**0.6**	0.6	0.6
Fuel Ratio	**1.40**	1.45	1.35
Coking Properties	Non coking		
Number of Samples	4+0		

Notes on page 18 must be consulted for significance of analyses.

*Formerly known as Lower Seam.

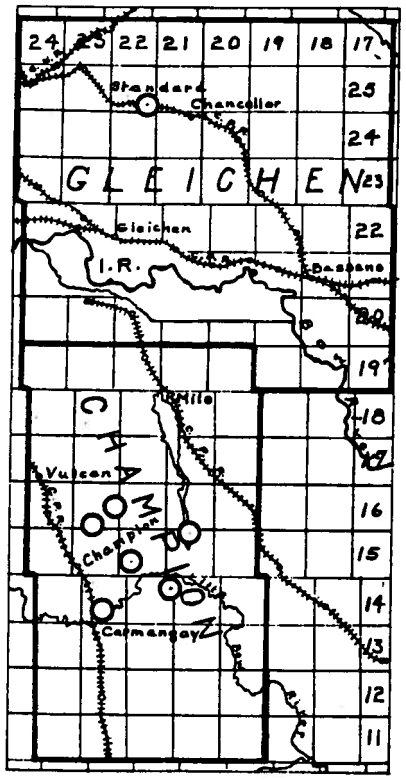

Fig. 20.—Map of Gleichen and Champion Coal Areas.
(Scale 25 miles to 1 inch)

	GLEICHEN AREA			CHAMPION AREA		
Location of Samples	See map on page 58			See map on page 58		
Usual Classification	Domestic			Domestic		
	Typical	Max.	Min.	Typical	Max.	Min.
Proximate Analysis:						
Moisture .....%	**16.8**	17.4	15.5	**13.4**	15.5	12.1
Ash .....%	**16.4**	26.5	9.9	**7.5**	11.6	5.1
Volatile Matter .....%	**29.6**	32.7	25.1	**34.4**	36.0	32.1
Fixed Carbon .....%	**37.2**	41.7	31.1	**44.7**	48.5	41.1
Calorific Value, gross, B.T.U. per lb.	**8,580**	9,540	7,090	**10,430**	10,760	9,950
Moisture in Air Dried Coal .....%	**14.3**	14.8	13.7	**11.1**	12.5	10.1
Sulphur .....%	**0.3**	0.3	0.3	**0.6**	1.1	0.5
Fuel Ratio	**1.25**	1.30	1.25	**1.30**	1.50	1.20
Coking Properties	Non coking			Non coking		
Number of Samples	4+0			13+1		

Notes on page 18 must be consulted for significance of analyses.

APPENDIX.

FUSIBILITY AND CLINKERING TENDENCIES OF THE ASH OF ALBERTA COAL.

DATA TAKEN FROM THESIS FOR THE DEGREE OF MASTER OF SCIENCE OF THE UNIVERSITY OF ALBERTA,

BY

ARTHUR G. SCROGGIE.

Mr. Scroggie, during the University session 1923-24, examined the fusibility of the ash from some 33 representative samples of coal supplied by the S. & I. Research Council of Alberta. He later examined 20 more samples from the same source. Details of the method employed and a discussion of the results may be found in his thesis in the University Library. It is anticipated that a short paper by Mr. Scroggie on this work will soon appear in Coal Age.

It must be clearly understood that although the results quoted indicate the relative clinkering properties of the coals tested, the number of tests made was far too small to allow any definite statements as to the trouble to be anticipated from clinker with coal shipments from any district.

The methods for determining fusibility were those specified by the American Society for Testing Materials.* Small cones of the ash were heated to fusion in a gas fired muffle furnace and the temperatures determined by an optical pyrometer. The following definitions explain the terms used in the table of values.

Temperature of Initial Deformation.

This is the temperature at which the apex of the cone first rounds or bends.

Softening Temperature.

The softening temperature is the temperature at which the cone either has fused to a spherical ball or has bent until its point touches the base on which the cone stands.

Softening Interval.

The difference between the temperature of initial deformation and the softening temperature is called the softening interval.

*A.S.T.M. Standard Method D-22-24.

Fluid Temperature.

This is the temperature at which the cone has spread out over the base in a flat layer.

Flowing Interval.

The difference between the softening temperature and the fluid temperature is called the flowing interval.

Clinkering Tendencies.

The softening temperature of an ash is commonly taken as a guide to the clinkering tendencies of a coal. But it is easily understood that a high-grade coal which produces an intensely hot fire may give more clinker trouble than a low grade coal with its comparatively cool fire, even though the ash of the former has a higher softening temperature. It therefore seems necessary to take account of the temperature which may be generated in the fire, as well as the softening temperature. This is done in the last three columns of the table.

Calorific Intensity.

This is a calculated value of the maximum temperature which might be generated by perfect combustion of a coal under specified conditions. In the table the values are calculated for combustion in air with a 50% excess of air. This probably represents good boiler practice.

Clinkering Index.

It will be clear from the above that the higher the combustion temperature, or calorific intensity, of the coal is above the softening temperature of the ash, the more readily the ash will fuse. The difference between these two temperatures is recorded as the "clinkering index." It is suggested that the clinkering index is a truer guide to the clinkering properties of the coal than the softening temperature. The higher the index the more clinkering trouble is to be anticipated, although no theoretical calculations can be made to cover the complicated conditions which exist in a boiler furnace.

FUSION DATA FOR ASH OF ALBERTA COALS.

Area	District and Seam	Initial Deformation °F.	Softening Interval °F.	Softening Temperature °F.	Flowing Interval °F.	Fluid Temperature °F.	Calorific Intensity °F.	Softening Temperature °F.	Clinkering Index °F.
Brule		2100	720	2820	?	*	2890	2820	70
Mountain Park	A.	2030	380	2410	180	2590	2890	2410	480
	B.	2050	770	2820	?	*	2910	2820	90
Nordegg		2040	480	2520	110	2630	2920	2520	400
Cascade	B. Carey Seam	1780	150	1930	140	2070	2870	1930	940
	B. Stewart Seam	1840	410	2250	120	2370	2930	2250	680
Crowsnest	A.	2060	760	2820	?	*	2910	2820	90
	B.	2070	710	2780	?	*	2820	2780	40
Coalspur	A.	1960	90	2050	50	2100	2870	2050	820
	B.	2030	310	2340	120	2460	2790	2340	450
	C.	2060	150	2210	70	2280	2820	2210	610
Saunders		1930	100	2030	100	2130	2830	2030	800
Pekisko	A.	1830	480	2310	100	2410	2850	2310	540
Pincher		1940	400	2340	110	2450	2840	2340	500
Lethbridge	A.	1920	230	2150	100	2250	2810	2150	660
	B.	1940	350	2290	90	2380	2810	2290	520
Milk River	B.	1860	90	1950	140	2090	2770	1950	820
Pakowki	B.	1830	90	1920	60	1980	2800	1920	880
	D.	2010	240	2250	60	2310	2690	2250	440
Taber	A.	1950	340	2290	60	2350	2790	2290	500
	B.	1830	380	2210	50	2260	2750	2210	540
	D.	2010	590	2600	40	2640	2740	2600	140
Redcliff		1880	90	1970	90	2060	2740	1970	770
Brooks		1890	210	2100	120	2220	2770	2100	670

Pembina	A.	2070	310	2380	40	2420	2730	2380	350
Edmonton	A.	1910	230	2140	90	2230	2740	2140	600
	B.	1930	190	2120	140	2360	2750	2120	630
Tofield		1890	130	2020	50	2070	2760	2020	740
Camrose	A.	1870	140	2010	90	2100	2740	2010	730
Castor	B.	1790	280	2070	50	2120	2740	2070	670
	C.	1860	130	1990	30	2020	2710	1990	720
Ardley		1970	130	2100	100	2200	2770	2100	670
Big Valley	A.	2150	320	2470	50	2520	2780	2470	310
	B.	1970	110	2080	180	2260	2740	2080	660
Carbon	A.	1830	140	1970	100	2070	2790	1970	820
	C.	1870	150	2020	190	2210	2780	2020	760
Drumheller	A. Seam No. 5	1880	100	1980	70	2050	2800	1980	820
	C. Seam No. 1	1800	220	2020	60	2080	2790	2020	770
Champion		1840	150	1990	50	2040	2810	1990	820

NOTE:—This table is based on tests of 53 samples only, seldom more than one from each district. The results are valuable and interesting, but must not be taken as definitely showing the relatives values of the coals with regard to clinkering.

*Above 2820°F.

LIST OF PUBLICATIONS

OF

THE SCIENTIFIC AND INDUSTRIAL RESEARCH COUNCIL OF ALBERTA

ANNUAL REPORTS OF COUNCIL

No. 3 (for the calendar year 1920); pp. 36. **Price 5 cents.**

No. 5 (for the calendar year 1921); pp. 86. **Price 35 cents.**

No. 8 (for the calendar year 1922); pp. 64. **Price 35 cents.**

No. 10 (for the calendar year 1923) with 4-colour map of Alberta coal areas; pp. 76. **Price 50 cents. Map No. 6 only, 15 cents.**

No. 12 (for the calendar year 1924); pp. 68. **Price 35 cents.**

REPORTS—FUELS

No. 10A (1923): COMBUSTION OF COAL FOR THE GENERATION OF POWER, by C. A. Robb, Professor of Mechanical Engineering, University of Alberta. Multigraphed copies only. **Price 50 cents.**

No. 14 (1925); pp. 64. ANALYSES OF ALBERTA COALS, with 18 maps and 2 charts. By E. Stansfield, R. T. Hollies and W. P. Campbell. **Price 25 cents.**

REPORTS—GEOLOGY

By J. A. Allan, Professor of Geology, University of Alberta.

No. 1 (1919); pp. 104.—A summary of information collected with regard to the mineral resources of Alberta. **Price 10 cents.**

No. 2 (1920); pp. 138+14. Supplements the information contained in Report No. 1. **Price 25 cents.**

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