MAY, 1972

ALBERTA PLAINS COALS

EXTRACTS

FROM PUBLISHED REPORTS

OF

RESEARCH COUNCIL

OF ALBERTA

WITH ANNOTATIONS

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EARTH SCIENCES, COAL

RESEARCH COUNCIL OF ALBERTA

TABLE OF CONTENTS

ACCOMPANYING MAPS

FIGURES

TABLES

ALBERTA PLAINS COALS

I. INTRODUCTION

Within the last three years, virtually all potentially economical coking coal deposits of the Alberta Foothills have been explored and placed under lease; more recently, the commercial interest engendered by the search for coking coals has shifted its focus to deposits of non-coking thermal coals, both within the Foothills and in the Plains regions. It is foreseen that thermal coals will experience heavy demand for electric power production in thermal steam plants and for manufacturing high BTU "SNG" (substitute natural gas) in coal gasification plants.

The geology of Plains regions coal-bearing strata is well known from published studies of the Geological Survey of Canada, Research Council of Alberta and numerous geologists associated with the petroleum industry; and the Canada Mines Branch has reported numerous chemical analyses of coals from producing mines in its irregular publication entitled "Analysis Directory of Canadian Coals". However, the only single compendium of information on the chemical nature and commercial value of Alberta coals has been Report 35 of the Research Council of Alberta (Stansfield and Lang, 1944), unfortunately slanted towards the defunct domestic market, and in any case now out of print. The Research Council of Alberta is in the process of compiling a somewhat different and more up-to-date, comprehensive report on systematics and chemistry of Alberta coals, but this will not be available to the general public for some time to come. As a temporary measure in 1970, Research Council staff compiled a free "Information kit" entitled "Alberta Foothills Coals".

In response to the new interest in Plains coals, this companion "Information Kit", similar to the previous, is offered for free distribution, containing:

1. Pertinent notes extracted by xerocopy, chiefly from RCA Report 35 and RCA Report 64-3 (Campbell, 1964), together with a few paragraphs of annotation where necessary;

2. Map A, scale 1 inch equals 40 miles; Geology of coal-bearing bedrock in Alberta Plains;

3. Map B, scale 1 inch equals 40 miles; Major coal "Fields" of Alberta Plains.

II. COAL RANK AND DISTRIBUTION

Coal is a solid rock composed dominantly of organic materials. Invariably it derives from plants, usually massive woody land plants, accumulated in one place, preserved, usually by burial under succeeding layers of inorganic sediment, and fossilized en masse.

With age and with the influence of the external physical forces, pressure and temperature, coal matures or progresses through a sequence of degrees of transformation; these degrees of maturation are conventionally divided into a series of "Ranks" as follows:

Rank	Abbreviations
Parent Plant Material	-
Peat	-
Lignite B	lig B
Lignite A	lig A
Subbituminous C Coal	sub C
Subbituminous B Coal	sub B
Subbituminous A Coal	sub A
High Volatile C Bituminous Coal	hv C b
High Volatile B Bituminous Coal	hv B b
High Volatile A Bituminous Coal	hv A b
Medium Volatile Bituminous Coal	mvb
Low Volatile Bituminous Coal	lvb
Semi-Anthracite	sa
Anthracite	a
Meta-Anthracite	ma
Graphite	-

Table 1

All coals of the Alberta Plains lie within the range Lignite A to High Volatile C Bituminous, although by far the largest percentage of mineable reserves are Subbituminous C, B or A.

Low sulphur content is an attractive feature of all Alberta coals.

N.B. - Largely for administrative purposes, the province of Alberta has been divided into "Coal Areas" which are somewhat misleading from a scientific point of view. However, since much of the material in Report 35 is presented in terms of these areas, a map is included showing their boundaries (Fig. 17).

CANADIAN CLASSIFICATION OF COAL BY RANK

(from Stansfield and Lang, 1944)

In the past the coals of Alberta were classed, and output statistics collected, under four heads:

Anthracite coal—mined at Bankhead in the Cascade area.

Bituminous coal—all coals, other than anthracite, mined from the Kootenay geological horizon in the mountains of western Alberta.

Subbituminous coal—coals mined in the foothills.

Domestic coals—coals mined in the prairies.

No exact definitions of these classes were made; and changes of classification were sometimes found advisable.

In 1934 a tentative classification, the joint work of United States and Canadian chemists, fuel technicians, geologists, and others, was adopted by the American Society for Testing Materials. This classification was later slightly modified. It was referred to Canadian coal operators in 1937 and as no objections were raised it was adopted for Canada in 1938.

This A.S.T.M. classification* is employed throughout this report. It might be noted that coals are not only classed by rank, a classification which indicates the degree of transformation of the original plant material towards anthracite; but are also classed by grade and by type. Grade classification gives a commercial evaluation of the coal as sold, and type classification is based on the origin of the coal; but neither of these is here discussed.

In the classification by rank, as shown in Table 1, high rank coals are classified primarily according to the percentage of fixed carbon in the dry and pure, that is mineral-matter-free, coal; whilst lower rank coals are classified according to the heat value of the mineral-matter-free coal, but moist as the coal occurs in the seam. Secondary distinctions are made according to whether the coal is agglomerating, that is forms a firm button in the volatile matter test, or otherwise; and according to the coal being weather resistant, that is loses less than 5% through disintegration in the accelerated weathering test, or otherwise.

TABLE 1

Table 2

Classification of Coals by Rank

Legend: F.C.=Fixed Carbon. B.t.u.=British thermal units.

Class	Group	Limits of Fixed Carbon or B.t.u., Mineral-Matter-Free Basis	Requisite Physical Properties
I.—Anthracitic	1. Meta-anthracite	Dry F.C., 98% or more	
	2. Anthracite	Dry F.C., 92% or more and less than 98%	
	3. Semianthracite	Dry F.C., 86% or more and less than 92%.	Non-agglomerating [1]
II.—Bituminous [3]	1. Low volatile bituminous coal	Dry F.C., 78% or more and less than 86%	
	2. Medium volatile bituminous coal	Dry F.C., 69% or more and less than 78%	
	3. High volatile A bituminous coal	Dry F.C., less than 69% and moist [2] B.t.u. 14,000 [4] or more	
	4. High volatile B bituminous coal	Moist [2] B.t.u. 13,000 or more and less than 14,000	
	5. High volatile C bituminous coal	Moist B.t.u. 11,000 or more and less than 13,000 [4]	Either agglomerating or non-weathering [5]
III.—Subbituminous	1. Subbituminous A coal	Moist B.t.u. 11,000 or more and less than 13,000 [4]	Both weathering and non-agglomerating
	2. Subbituminous B coal	Moist B.t.u. 9,500 or more and less than 11,000 [4]	
	3. Subbituminous C coal	Moist B.t.u. 8,300 or more and less than 9,500 [4]	
IV.—Lignitic	1. Lignite	Moist B.t.u less than 8,300	Consolidated
	2. Brown coal	Moist B.t.u less than 8,300	Unconsolidated

1 If agglomerating, classify in low-volatile group of the bituminous class.

2 Moist B.t.u. refers to coal containing its natural bed moisture but not including visible water on the surface of the coal.

3 It is recognized that there may be non-caking varieties in each group of the bituminous class.

4 Coals having 69 per cent or more fixed carbon on the dry, mineral-matter-free basis shall be classified according to fixed carbon, regardless of B.t.u.

5 There are three varieties of coal in the high-volatile C bituminous coal group, namely, Variety 1, agglomerating and non-weathering; Variety 2, agglomerating and weathering; Variety 3, non-agglomerating and non-weathering.

*Specification D388-38.

The following formulae have been used for calculating the fixed carbon and heat value on the above bases.

$$\text{Dry, mm-free F.C.} = \frac{\text{F.C.}}{100-(\text{M}+1.1\text{A}+0.1\text{S})} \times 100$$

$$\text{Moist, mm-free B.t.u.} = \frac{\text{B.t.u.}}{100-(1.1\text{A}+0.1\text{S})} \times 100$$

Where:

mm=Mineral matter
B.t.u.=British thermal units
F.C.=percentage of fixed carbon
M=percentage of moisture
A=percentage of ash
S=percentage of sulphur, and

Moist refers to coal containing its natural bed moisture, but not including visible water on the surface of the coal.

The following diagram shows graphically the boundaries selected for the different classes. Coals with more than 69% fixed carbon, on the dry, mineral-matter-free basis are classified by this fixed carbon, whilst coals with lower fixed carbon are classified by their heat value on the moist, mineral-matter-free basis. The chart also shows that in some cases coals with certain percentages of fixed carbon or with certain heat values, can be placed in either of two classes according to their agglomerating and weathering properties.

It must be noted that the above is only an abbreviated description of the classification with some details omitted.

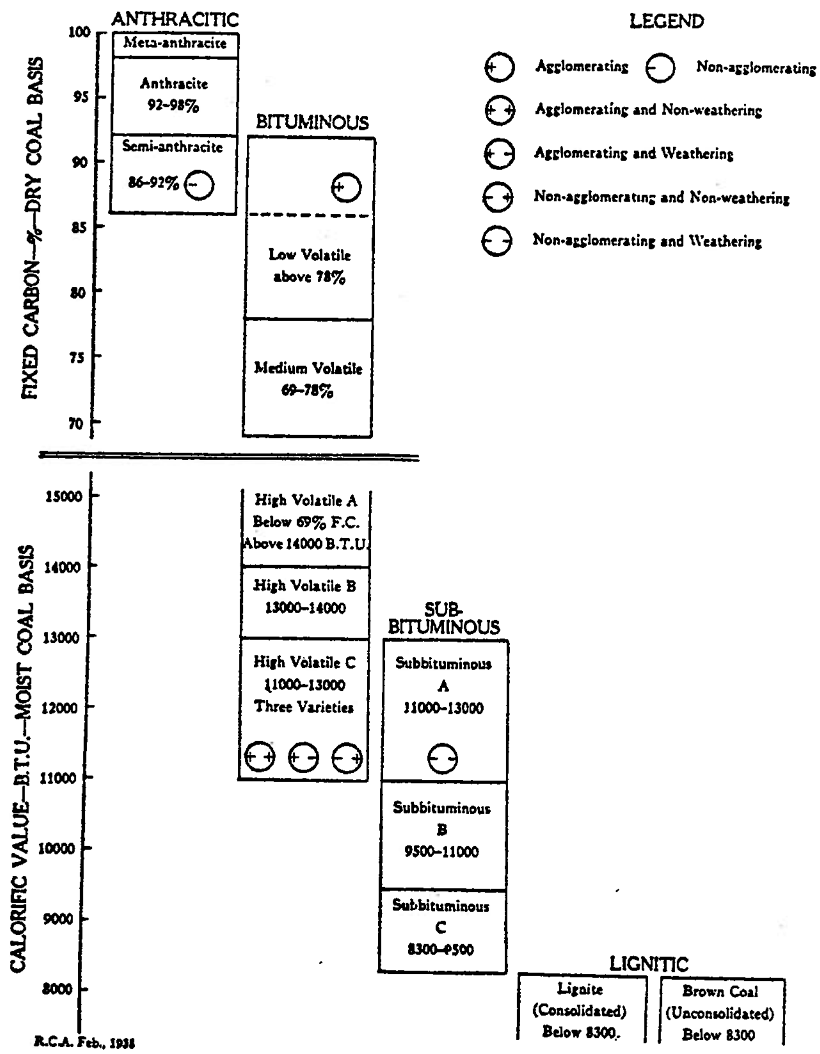


Fig. 1.—Canadian Classification of Coal by Rank. Graphical representation of Canadian (A.S.T.M.) classification by rank, illustrating the relations of requisite physical (agglomerating and weathering) properties of overlapping groups. All analyses on the mineral-matter-free basis.

Table 3

N.B. - Since publication of Report 35, the ASTM specifications for coal ranks have been slightly changed as shown in the following table extracted from the <u>1968 Book of ASTM Standards</u>, <u>Part 19</u> (American Society for Testing and Materials, 1968).

SPECIFICATIONS FOR CLASSIFICATION OF COALS BY RANK (D 388)

Table 4

TABLE I.—CLASSIFICATION OF COALS BY RANK.[a]

Class	Group	Fixed Carbon Limits, per cent (Dry, Mineral-Matter-Free Basis)		Volatile Matter Limits, per cent (Dry, Mineral-Matter-Free Basis)		Calorific Value Limits, Btu per pound (Moist,[b] Mineral-Matter-Free Basis)		Agglomerating Character
		Equal or Greater Than	Less Than	Greater Than	Equal or Less Than	Equal or Greater Than	Less Than	
I. Anthracitic	1. Meta-anthracite	98	...	...	2	...	...	Nonagglomerating
	2. Anthracite	92	98	2	8	...	...	
	3. Semianthracite[c]	86	92	8	14	...	...	
II. Bituminous	1. Low volatile bituminous coal	78	86	14	22	...	...	Commonly agglomerating[e]
	2. Medium volatile bituminous coal	69	78	22	31	...	...	
	3. High volatile A bituminous coal	...	69	31	...	14 000[d]	...	
	4. High volatile B bituminous coal	...	...	...	...	13 000[d]	14 000	
	5. High volatile C bituminous coal	...	...	...	...	11 500	13 000	
						10 500	11 500	Agglomerating
III. Subbituminous	1. Subbituminous A coal	...	...	...	...	10 500	11 500	Nonagglomerating
	2. Subbituminous B coal	...	...	...	...	9 500	10 500	
	3. Subbituminous C coal	...	...	...	...	8 300	9 500	
IV. Lignitic	1. Lignite A	...	...	...	...	6 300	8 300	
	2. Lignite B	...	...	...	...	...	6 300	

[a] This classification does not include a few coals, principally nonbanded varieties, which have unusual physical and chemical properties and which come within the limits of fixed carbon or calorific value of the high-volatile bituminous and subbituminous ranks. All of these coals either contain less than 48 per cent dry, mineral-matter-free fixed carbon or have more than 15,500 moist, mineral-matter-free British thermal units per pound.

[b] Moist refers to coal containing its natural inherent moisture but not including visible water on the surface of the coal.

[c] If agglomerating, classify in low-volatile group of the bituminous class.

[d] Coals having 69 per cent or more fixed carbon on the dry, mineral-matter-free basis shall be classified according to fixed carbon, regardless of calorific value.

[e] It is recognized that there may be nonagglomerating varieties in these groups of the bituminous class, and there are notable exceptions in high volatile C bituminous group.

COAL CHARTS

The coal samples studied have been represented in three different coal charts. In Fig. 6 they are plotted according to the above classification criteria, and the classification boundaries are also shown, It might be noted that as this chart is on a mixed basis, dry for the ordinates and moist for the abscissae, combustion data could not be shown satisfactorily.

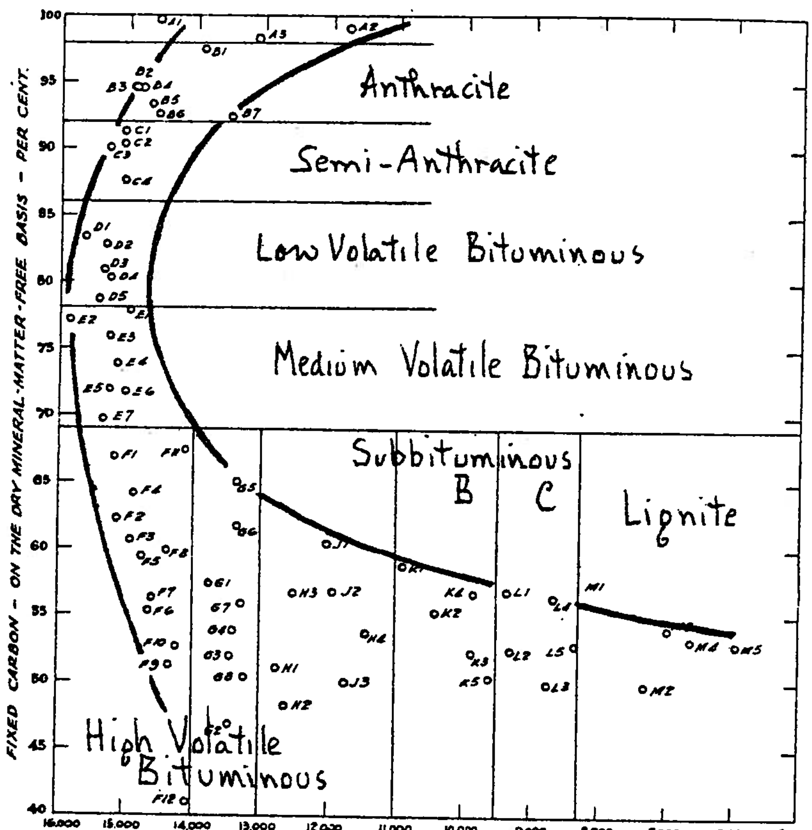


Fig. 6—Coal chart. Coals plotted on A.S.T.M. classification basis.

Figure 1

The following characteristics of Alberta Plains coals should be emphasized.

1. All ranks of coal represented in the Alberta Plains (e.g., Lignite A to High Volatile C Bituminous) are officially defined (ASTM) by their Calorific Value in BTU alone.

2. Low rank coals such as these have high inherent moisture contents and lose moisture rapidly (and possibly erractically) so that "As Received" or "Air-Dried" moisture determinations are largely meaningless; only "Capacity Moisture" determinations have meaning.

3. Low rank Plains coals exhibit a regular, almost linear relationship between Calorific Value and Capacity Moisture (see figure 2) so that coal rank of a sample may be estimated closely enough to satisfy requirements of a reconnaissance survey by determining the ash-free Capacity Moisture alone, a much less tedious analysis than Calorific Value.

4. Rank of near-surface coals in the Alberta Plains varies with geographic position (Fig. 3). Specifically, there appears to be a roughly geometric relationship between rank (as expressed by Calorific Value) and distance from the Foothills front (Fig. 4a). There are, however, two areas of slight anomaly where relatively high rank coals are found farther from the mountain front than expected (see figure 3). A southern area around Lethbridge is believed to be related to the existence of the Sweetgrass Arch; a northern area around Halcourt-Grande Prairie is believed to be related to an important subsurface feature called the "Peace River High". Rank also increases with present depth below ground level; samples from a typical Alberta Plains oil-well were found to have about 0.7 BTU per pound greater Calorific Value for every foot of depth (see figure 4b).

5. Geographic variation of rank is independent of stratigraphic position of coals (cf. Fig. 3 with Map A).

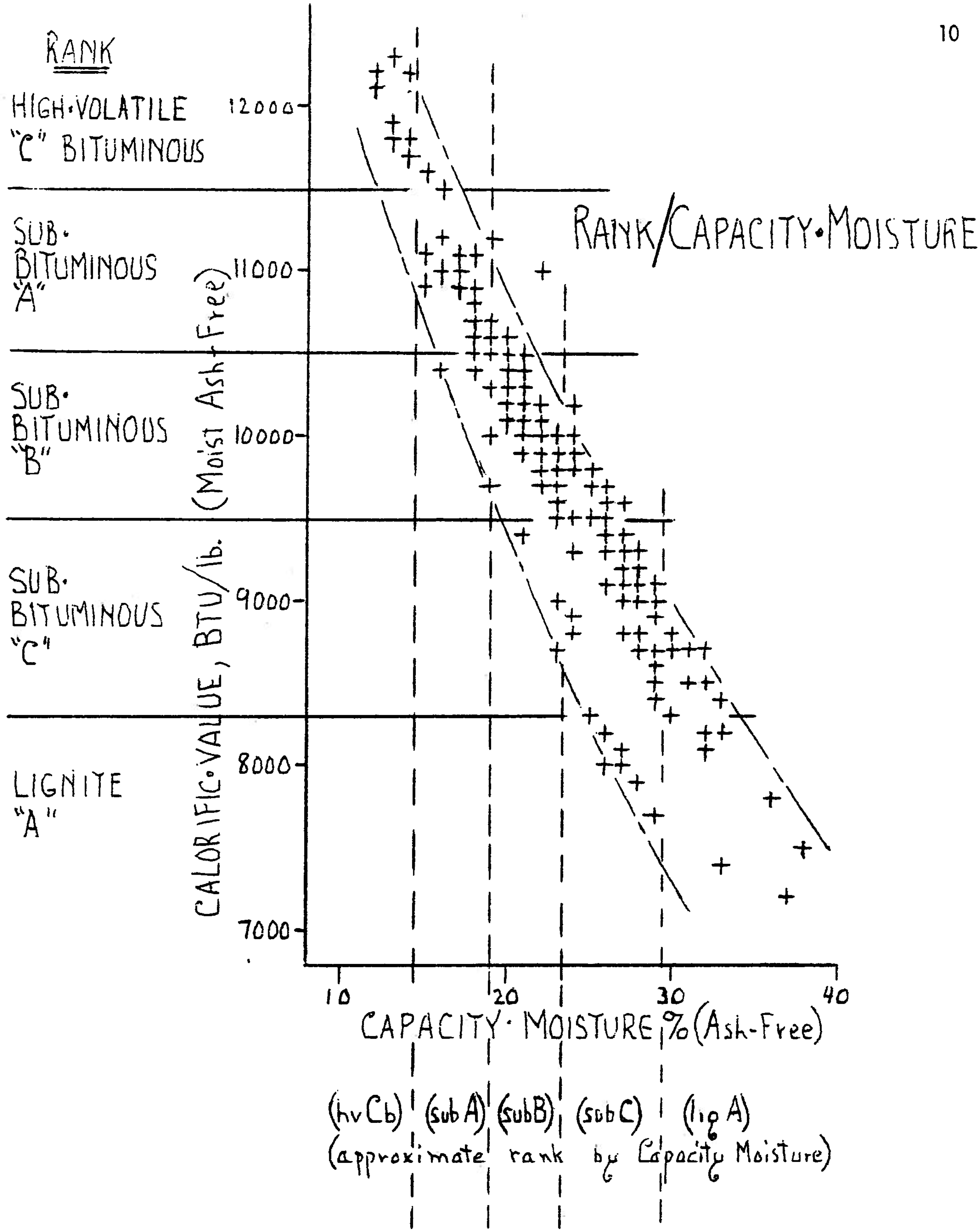


Figure 2. Relationship between Rank (based on Calorific Value) and Capacity Moisture in Alberta Plains coals.

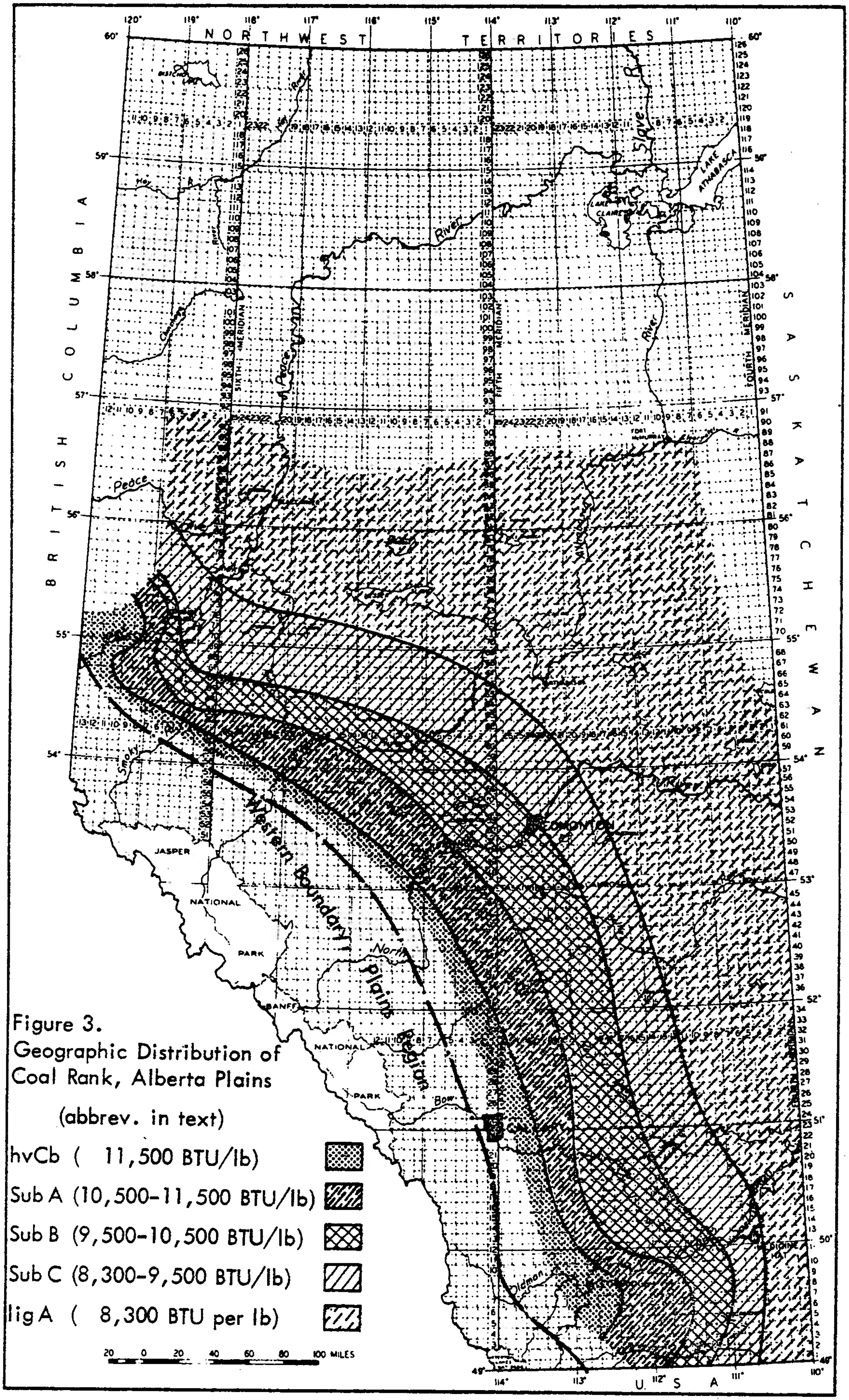
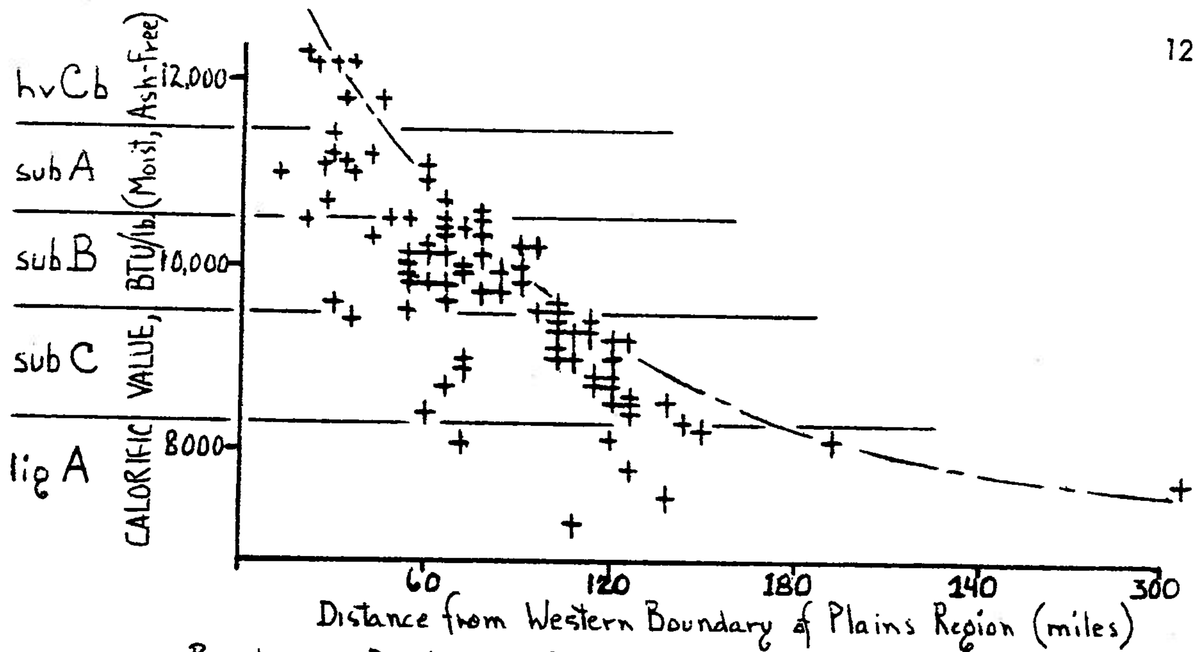
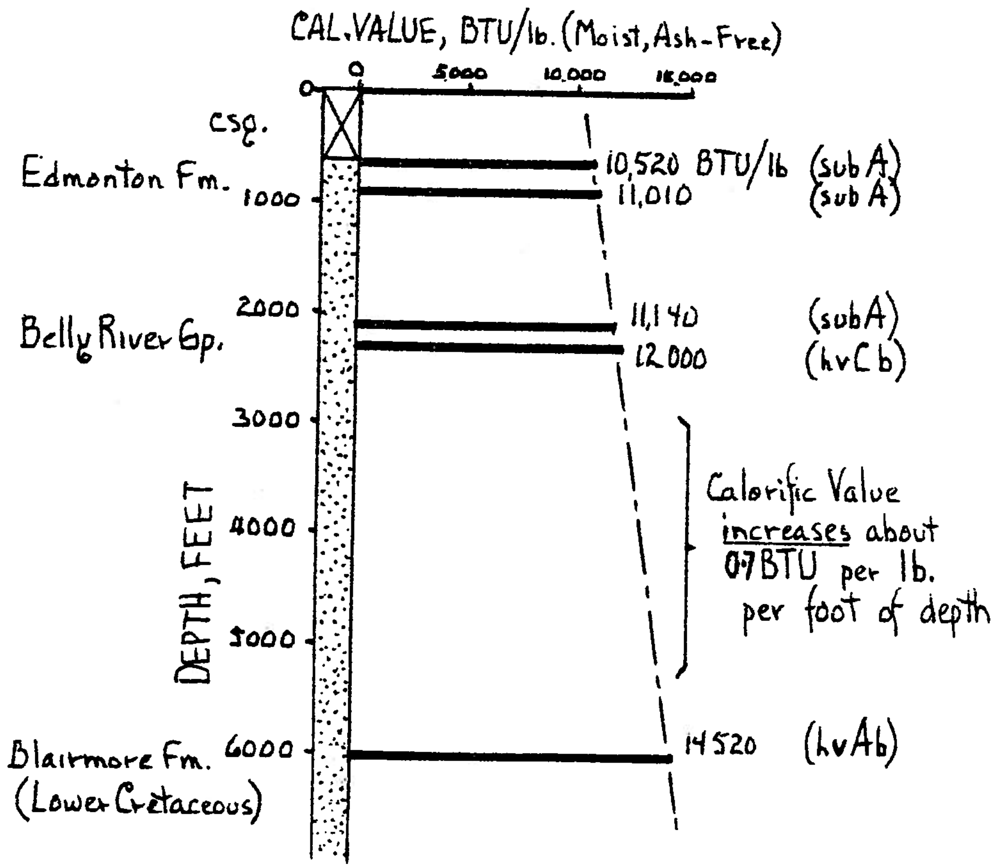


Figure 3.
Geographic Distribution of
Coal Rank, Alberta Plains

(abbrev. in text)



a. Rank vs. Distance from the Mountains



b. Rank vs. Depth; eg. a Typical Plains Oil-Well

Figure 4. Rank Relationships, Alberta Plains

OCCURRENCE AND PRODUCTION OF ALBERTA COAL

The locations from which the different ranks of coals have been mined in Alberta are shown in Table 2 and in eight skeleton maps of the coal areas—Maps 2-9.

Table 3 shows for each rank of coal the areas where such coal has been mined. In Table 4 the coal areas are listed with the classification of the coal mined in each.

Table 5 gives the coal production in Alberta for the years 1941, 1942 and 1943, tabulated by class and area.

It can be seen, in Table 2, and in the eight skeleton maps, that the distribution of the coal ranks is irregular within the mountains forming the western boundary of the Province; but that progressively lower ranked coals are found with increasing distance east of the mountain face. Since rank and moisture content of coal are closely related, maps 10 and 11 show clearly, as might be expected, that as the distance east of the mountain face increases the moisture content also increases. Similar curves, paralleling the mountain face, could be drawn for heat content and for other analytical values.

It has been found that in Alberta the rank of the coal is primarily dependent upon the mountain building pressure to which it has been subjected, and only to a lesser degree dependent upon its geological age or the depth of the seam below the surface.

All the coals of Alberta are of Post-Carboniferous age, and therefore younger than the Carboniferous coals of Great Britain, Nova Scotia and New Brunswick, and the eastern United States. Those coals in and near the mountains, however, have been subjected to such prolonged and intense mountain building pressure that they have been converted to high rank coals, comparable with those of the Carboniferous age.

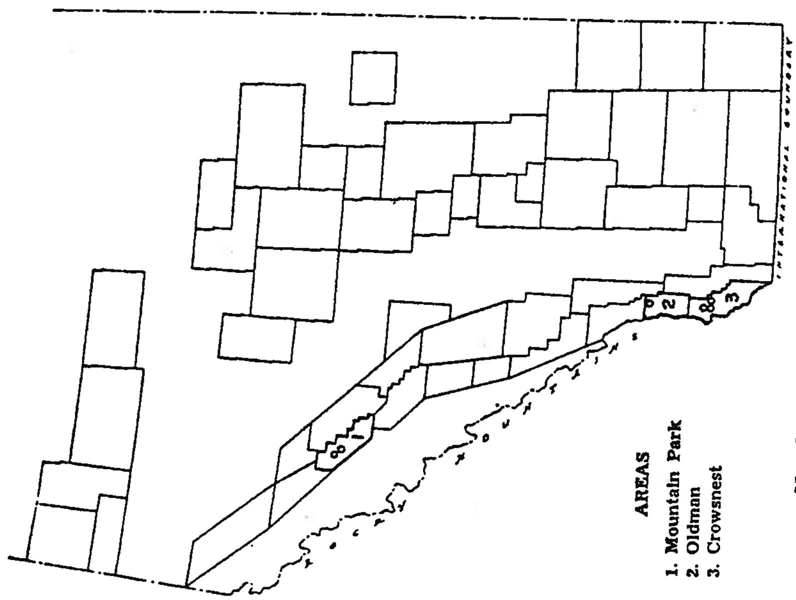
ill. E

TABLE 2

Coal Ranks and Locations Where Mined

(As shown by Sampling and Analysis)

Meta-anthracite	None
Anthracite	None
Semi-anthracite—Cascade Area	Tp. 26, R. 11, W. of 5th meridian Tp. 24 R. 10, W. of 5th meridian
Low volatile bituminous	See map 2
Medium volatile bituminous	" " 3
High volatile A bituminous	" " 4
High volatile B bituminous	" " 5
High volatile C bituminous	" " 6
Subbituminous A	" " 7
Subbituminous B	" " 8
Subbituminous C	" " 9
Lignite—Pakowki Area	Tp. 9, R. 5, W. of 4th Tp. 8, R. 3 and 4, W. of 4th Tp. 7, R. 2, W. of 4th
Brown Coal	None

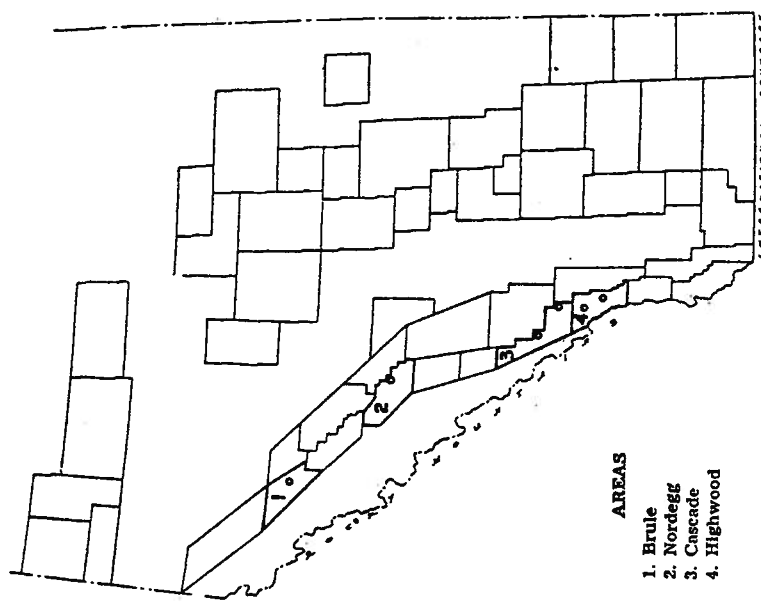


AREAS
1. Mountain Park
2. Oldman
3. Crowsnest

Map 3.—Medium Volatile Bituminous

Figure 6

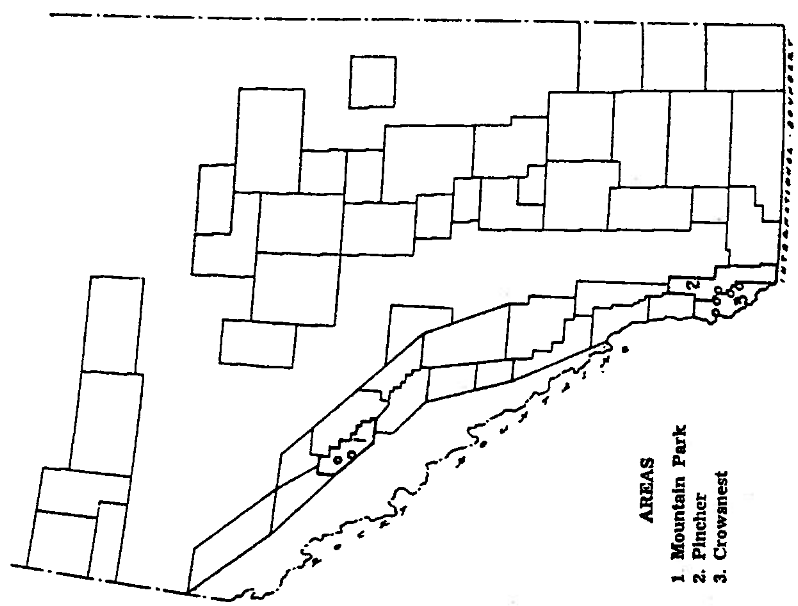
COAL CLASSIFICATION BY RANK



Map 2.—Low Volatile Bituminous

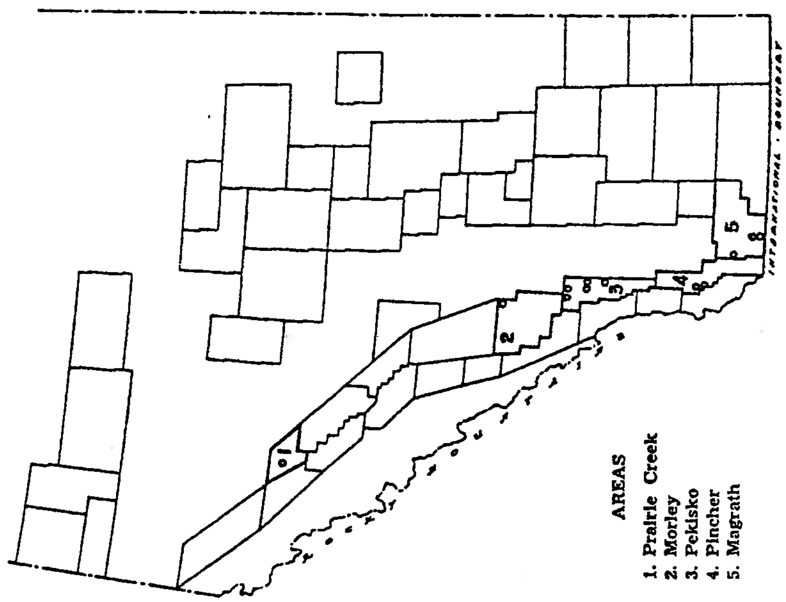
AREAS
1. Brule
2. Nordegg
3. Cascade
4. Highwood

Figure 5



Map 4.—High Volatile A Bituminous

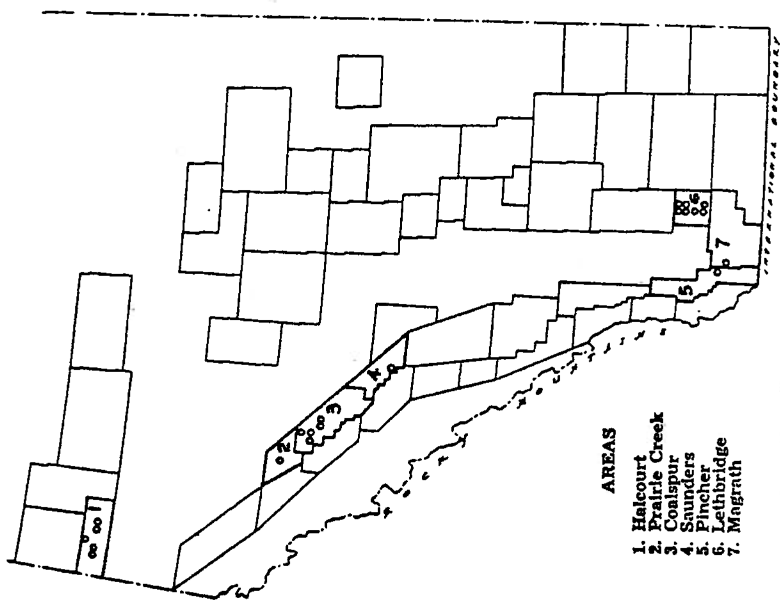
Figure 7



Map 5.—High Volatile B Bituminous

Figure 8

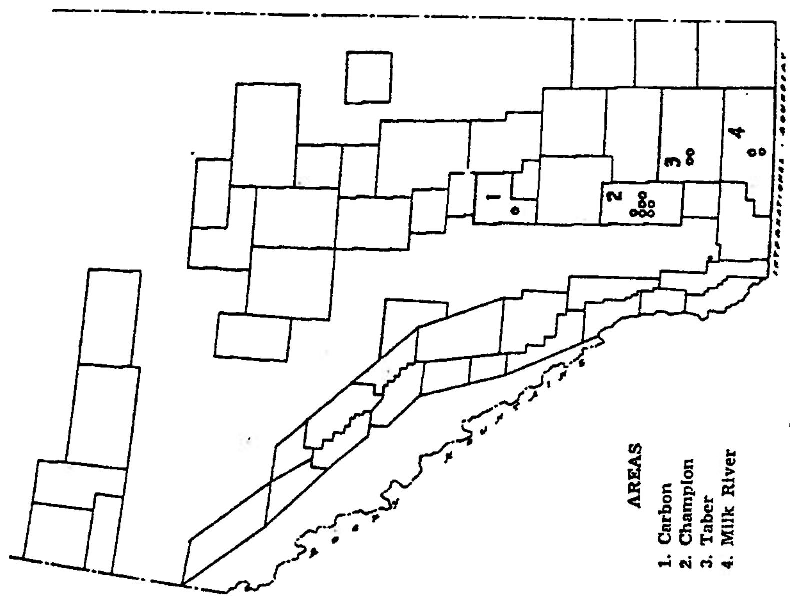
COAL CLASSIFICATION BY RANK



AREAS
1. Halcourt
2. Prairie Creek
3. Coalspur
4. Saunders
5. Pincher
6. Lethbridge
7. Magrath

Map 6.—High Volatile C Bituminous

Figure 9



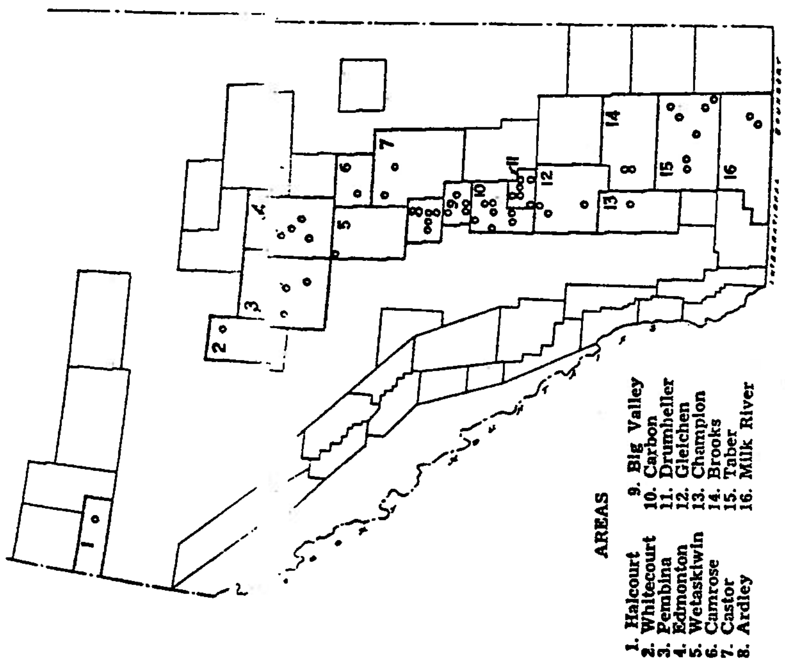
AREAS
1. Carbon
2. Champion
3. Taber
4. Milk River

Map 7.—Subbituminous A

Figure 10

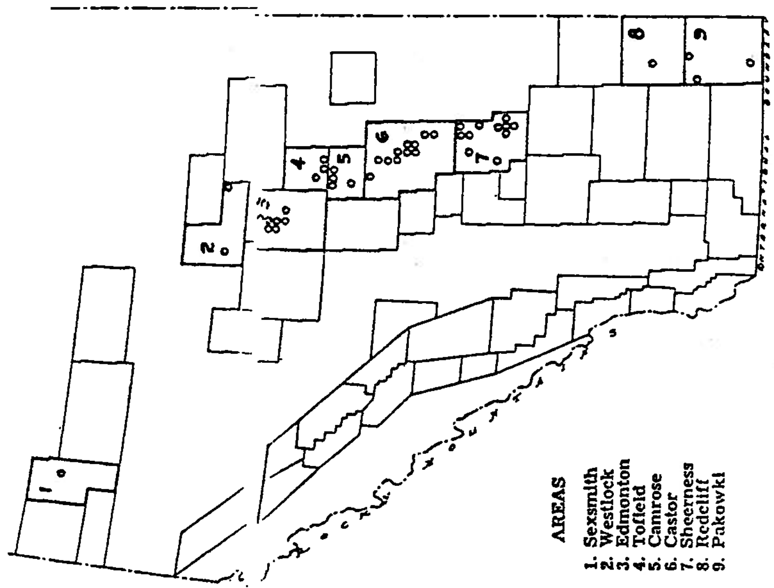
COAL CLASSIFICATION BY RANK

COAL CLASSIFICATION BY RANK



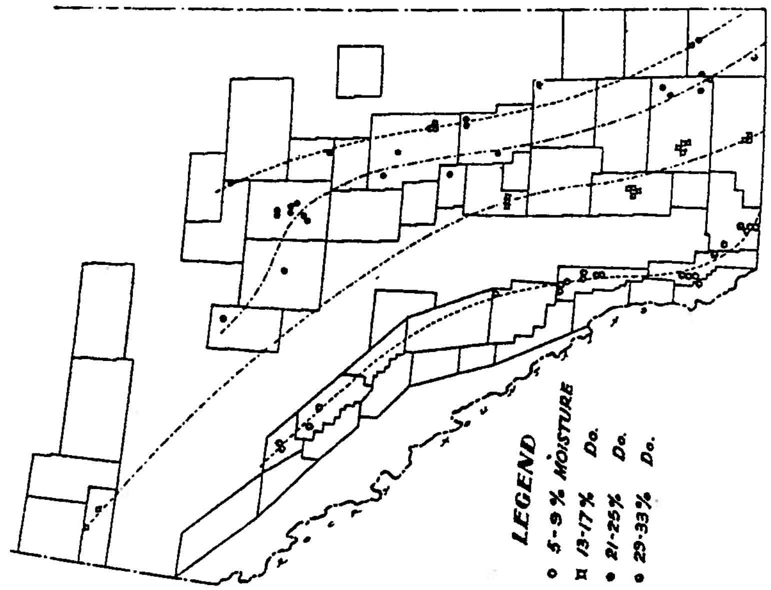
Map 8.—Subbituminous B

Figure 11



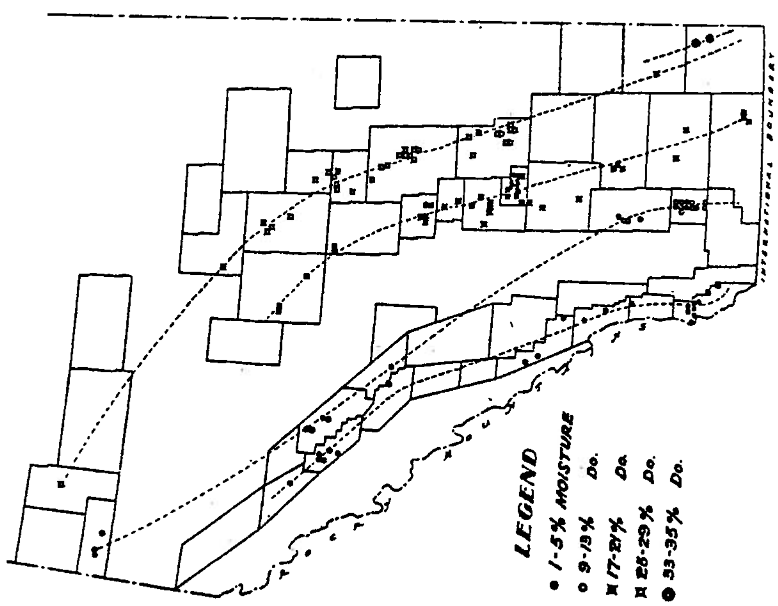
Map 9.—Subbituminous C

Figure 12



Map 11

Figure 14



Map 10

Figure 13

DISTRIBUTION OF ALBERTA COALS BY MOISTURE CONTENT

III. ANALYSES

(Extract from Stansfield and Lang, 1944)

PART II

Notes on Analyses, Special Tests and Terms

THE SIGNIFICANCE OF AN ANALYSIS OF COAL

Many of the qualities of a coal are revealed by its proximate, ultimate and calorific analyses. The evaluations made in a proximate analysis are conventional and do not represent actual specific constituents of the coal, nor has their determination an absolute significance. Their empirical determination, however, does give a measure of the quality of the coal and the proximate analysis is used as criterion for classification and for combustion.

The ultimate analysis is more precise than the proximate in that it determines the percentages of the elements which go to make up the coal substance. The ultimate analysis does, however, serve as a guide to the nature and rank of the coal and is often used for classification. Furthermore, the ultimate analysis of a coal is essential for calculating the amount of air required for its economical combustion and for other combustion data. It is, therefore, valuable for the efficient design and control of power plants.

The calorific analysis of a fuel gives a definite measure of the potential heat value which it contains, and is therefore a prime consideration when buying coal.

Moisture.—Moisture is inherent in the coal substance, but it may be increased by seepage in the mine or by subsequent wetting. Moisture also may be lost from coal if the coal is exposed to a dry atmosphere. High moisture in a coal usually indicates a free-burning, smokeless fuel, but otherwise moisture is a disadvantage. It is uneconomical to pay freight on water, and a high moisture coal stores badly.

Ash.—Ash is the inorganic residue remaining after complete ignition of the coal. It is derived from the mineral constitutents in the coal. Ash not only has no heating value, but may by clinkering interfere with combustion. Freight must be paid not only on coal but also on its impurities. A slag forming coal may damage furnace equipment, and removal of ashes involves expense. A low ash is essential for some uses. Some Alberta coals are naturally clean, and a number of Alberta operators are equipped to sell a washed coal.

Volatile Matter and Fixed Carbon.—Volatile matter is that portion of a coal, other than moisture, that is driven off as a gas or vapour by a heat treatment in the absence of air. The remaining material, after correction for ash content, is reported as fixed carbon. The percentage of fixed carbon divided by the percentage of volatile matter is known as fuel ratio.

The combustion characteristics, the uses for which a coal is suited and the amount of heat to be derived are dependent on the amount of fixed carbon and volatile matter. The coking property of a coal is closely tied to its volatile matter content. Both the low volatile and the high volatile, high moisture coals are non-coking, whilst the coals with intermediate volatile are the coking bituminous coals. The percentages of volatile matter and fixed carbon have also been used extensively for classifying coals. The higher rank coals are classified on a basis of fixed carbon by the A.S.T.M. standard specifications.

When coal is burned in a furnace the volatile matter coming off burns with a flame, but incomplete combustion due to lack of air causes a black smoke consisting of droplets of tar and particles of carbon. The tarry volatiles have a high heat value and such material if unconsumed represents a direct loss of heat. Part of the unburned volatiles may settle as soot in furnace casings, flue pipes and chimney where it not only interferes with heat transference, but is a distinct fire hazard. Smoke is also a public nuisance.

In order to ensure as complete combustion of the volatile matter as possible, and therefore smokeless combustion, three conditions are essential, namely, (1) sufficient air (2) intimate mixture of air and fuel, (3) sufficient secondary air over the fuel bed. The consumer can, by recognized methods of good firing, reduce the potential smoke tendencies of a coal to a minimum.

Fuels of Group I, having a large amount of fixed carbon and a relatively small amount of volatile matter, burn with a short flame; and the whole process of combustion takes place at or near the fuel bed. Such coals can be burned in domestic installations without visible smoke. Group II coals have a relatively large percentage of tarry volatile matter and therefore burn with a longer flame, producing visible smoke. These high volatile fuels are usually used on railways and for power installations where the coal can be burned efficiently and without smoke. The volatile matter of Group III coals, although high, contains a higher percentage of oxygenated compounds and burns with little smoke. The high volatile, low rank coals of Group IV and V are free-burning and smokeless when properly fired.

Calorific Value.—In the purchase of a fuel the consumer desires that coal which will give him the greatest number of recoverable heat units for his money, provided it also has suitable firing properties for his installation. The cost of a coal is largely based on its heat or calorific value. Nevertheless, a high heat value coal, if carelessly fired, or if not suited to the particular installation, may give poorer results than a lower heat value coal carefully fired and suited to the installation. The heat value of a coal is usually stated as gross B.t.u. per pound although actually the net B.t.u. is a better criterion of the recoverable heat (see page 33). Coal is sold at a price per ton, but it would be more logical if it were sold on a heat basis.

Carbon and Hydrogen.—Carbon and hydrogen are the two most important elements in the coal substance. High rank coals are high in carbon and low in hydrogen, while the low rank coals are low in carbon and high in hydrogen. Broadly speaking, the carbon of a coal may be considered as having the same significance as fixed carbon, and hydrogen as having the same significance as volatile matter, but the percentages of these elements in the coal are mainly used in exact calculations of combustion data. The higher the hydrogen content of the coal the greater the drop from gross to net calorific value.

Sulphur.—Sulphur occurs in coal in three forms namely, (1) as organic compounds in the coal substance, (2) as iron pyrites (FeS_2), and (3) as gypsum ($CaSO_4.2H_2O$). Sulphur, if present either as pyritic or as organic sulphur, contributes a trivial amount of heat when the coal is burned, but is objectionable if present in considerable amounts since the products of combustion will combine with any condensed moisture to form a corrosive liquid. Sulphur is also deleterious in fuels used for metallurgical purposes since it may pass into the metal under treatment. Some of the sulphur, however, is driven off during carbonization or coking so that there is less sulphur in coke or char than in the original coal.

Nitrogen.—Nitrogen occurs in coal to the extent of 1 to 2 per cent. Its only importance is in the recovery of ammonia from carbonization and coking processes with by-product recovery. Now, however, that most of the industrial ammonia is made synthetically the nitrogen content of most coal is not of particular significance.

Oxygen.—The amount of oxygen in a coal has an important bearing on its rank and properties. Low oxygen coals are high in rank and heat value, while high oxygen coals are low in rank and heat value. With coking coals an increase in oxygen usually means a decrease in coking quality. High oxygen coals have the merit that they are free burning and practically smokeless.

TECHNICAL DETAILS OF SAMPLING AND ANALYSIS

The following is a summary of the methods employed in sampling and analysis, for the information of samplers and analysts. These specifications are in principle those of the American Society for Testing Materials* with certain modifications to make them more exact and suited to Alberta coals.

Sampling.—The analyses in this report are, in the main, based on samples taken by the Provincial Mine Inspectors by a specified method.† These are channel samples, about 4″×3″, taken across the seam, from a cleaned, fresh, working face 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, in his judgment, these are included or excluded from the coal as shipped from the mine. The samples are crushed, to less than ½″ size, and reduced by the method of cone and quarter, and then filled into quart sealers with rubber gaskets for shipment to the laboratory. The above is done quickly at the mine face to avoid loss of moisture.

Air-Drying and Preparation of Laboratory Sample. — The coarsely crushed coal, as received in the laboratory, is subjected to a preliminary partial drying, termed "air-drying", before the sample is pulverized for analysis. Air-drying is carried out, (a) to bring the coal to such a condition that it will not either lose or gain moisture appreciably during the subsequent crushing, grinding and weighing for analysis, (b) to facilitate grinding—coal cannot be ground if too moist, (c) to evaluate the moisture holding property of the coal.

A simple procedure has been developed by the R.C.A. for air-drying coal without oxidation. The coal (100-200 grams) is subjected for 48 hours to a relative humidity of 32% at 30°C in an evacuated desiccator containing a saturated solution of magnesium

*Specification D271-42.
†Research Council of Alberta, First Annual Report (1921), p. 17.

chloride, and crystals of the same, to maintain the humidity. The air-dried sample is then crushed and finely ground in a ball mill for further analysis. The use of a ball mill minimizes loss of moisture.

All determinations made subsequently on this air-dried laboratory sample have to be calculated to the "as received" basis with consideration of the moisture loss during air-drying.

Moisture.—The ground, air-dried sample is used for this and subsequent determinations. The moisture remaining at this stage is determined by the loss in weight when one gram of the sample is dried for one hour, at 106°C, in a rapid stream of dry natural gas, and cooled in an evacuated desiccator.

The total moisture, to be reported as the moisture in the coal "as received", is calculated from the percentage loss of weight during air-drying, and the percentage loss in the moisture determination on the air-dried sample.

Capacity Moisture.—A simple procedure has also been developed* by the R.C.A. whereby it is possible to distinguish between the true water of the coal substance, termed capacity moisture, and the free or adventitious water. The method employed is as in air-drying—exposure for 48 hours at 30°C, in an evacuated desiccator and controlled humidity—but in this case 5 gram portions are used, and successive portions are dried at some ten humidities ranging between 11% and 98% relative humidity, by use of a suitable selection of salts. A fresh portion of the original sample, crushed to 14 mesh size, is used for this determination. The moisture held by the coal after attaining equilibrium with the controlled humidity, is determined by drying in vacuum, at 105-110°C, for three hours.

The retained moisture in each portion, plotted against the relative humidity to which it was brought to equilibrium, gives a series of ten points which lie along a curve. This curve if extrapolated from the 98% humidity point to 100% humidity, gives the capacity moisture of the coal.

As a routine method it has been found, based on several hundred full curve determinations, that the percentage moisture retained in this test by a coal dried over a saturated solution of potassium sulphate (97.6% relative humidity), when multiplied by $\frac{100}{98.6}$ gives the capacity moisture of the coal. A test over a saturated solution of ammonium nitrate (60% relative humidity) is also made in routine analyses as a further measure of the moisture holding capacity of the coal.

Ash.—One gram portions of the laboratory sample are completely burned in an electric muffle furnace—with free access of air—at a temperature of 725±25°C.

Volatile Matter.—Two alternative methods are used for this determination according to the character of the coal. The quick heat method is used for all high rank, low moisture coals. The pre-heat method is used for all high moisture coals. The boundary has been chosen so that coals, from any area where samples have been tested that retain more than 10%moisture after air-drying to 60% humidity, are tested by the pre-heat method. Coals which are close to the boundary line are found to give from 1 to 1½% less volatile

*E. Stansfield and K. C. Gilbart. Trans. A.I M.M.E., Coal Division (1932), pp. 125-147.

matter by the pre-heat method than by the quick heat method. Lethbridge Area coals, which are in this category, are now tested by the pre-heat method.

A vertical electric furnace* is employed for both methods. This is closed at the top, and the crucible is introduced into the furnace from below. Standard practice is to use a furnace open at the top. This inversion gives an initial heating of the coal from the top and thus reduces the tendency to spark. It also gives a very steady temperature, less convection currents and consequently a less oxidizing atmosphere.

In the quick heat method one gram portions of the laboratory sample are each heated for seven minutes at a temperature of 950±20°C in a 20 c.c. platinum crucible with a well fitting, capsule shaped lid. The loss in weight represents the moisture and volatile matter in the coal. If the loss due to moisture is subtracted the remainder is volatile matter.

High moisture coals, if tested by the quick heat method, spark badly and the results are erroneous. A pre-heat method is therefore employed. In the method used until recently, one gram portions were each weighed into a platinum crucible as before; but the crucible set on a cold 3″ scorifier which was placed in an electric muffle furnace at 800±25°C. It was left in the pre-heat furnace for five minutes and immediately transferred to the volatile matter furnace, and heated for six minutes at 950±20°C.

The above method, in general, gave remarkably concordant results, but a few exceptional samples have been noted, which tended to spark even by this method. A revised method therefore has been adopted recently which works well even with such samples. The temperatures towards the opening at the bottom of the furnace were calibrated, and the crucible is given its preheat by moving it up into the furnace by timed steps as follows: 3 minutes at 500°C, 2 minutes at 700°C, 1 minute at 850°C, and 6 minutes at 950°C. The temperatures were measured by a thermocouple touching the side of the crucible just above the level of the coal.

This method is in accordance with the A.S.T.M. method of D271-42, but is far more specific. The results are in close agreement with those by the earlier method.

Fixed Carbon.—The non-volatile residue left in the platinum crucible in the volatile matter determination is fixed carbon and mineral impurities. The percentage of this residue, minus the percentage of ash as found above, gives the percentage of fixed carbon. The nature of the above residue is recorded as a guide to the coking properties of the coal.

Proximate Analysis.—The four percentages thus found in the air-dried coal—moisture, ash, volatile matter, and fixed carbon—add up to 100, and constitute the analysis known as "proximate". The values thus found can be calculated to the "as received" basis by allowance for the moisture lost in air-drying, or calculated to the "dry" basis by elimination of the moisture in the air-dry analysis.

The ratio of fixed carbon divided by volatile matter is known as "fuel ratio".

Calorific Value.—The gross calorific value is determined by the complete combustion of the coal in compressed oxygen in a bomb

*Research Council of Alberta, Tenth Annual Report (1929), p. 17.

calorimeter.* The bomb is of stainless steel, 315 c.c. volume, and the bomb and calorimeter have a water equivalent of 2,250 grams. A weight of coal is taken estimated to give a rise of 2.5°C, and oxygen is charged to 375 lbs. per sq. in., or to 400 lbs. for difficultly combustible fuels. This gives at least five times as much oxygen as is theoretically required for the combustion. A platinum hair wire and a short cotton thread are used for firing, and the temperature rise is measured with a standardized Beckmann thermometer. The water equivalent of the calorimeter is restandardized, using standard benzoic acid, with each fresh oxygen cylinder. The cooling correction is found from the initial and final rates of cooling by means of a nomogram. The usual corrections are made for firing heat; thermometer bore irregularities, setting factor, and emergent stem; and for sulphur and nitrogen. The calorific value is calculated by the following equation which permits ample accuracy with a slide rule:

Calorific value,

$$\text{in B.t.u. per lb.} = 10{,}000 + \frac{R}{W}\,4{,}050 + \frac{8{,}100 - 10{,}000\,W}{W}$$

This is derived from the equation $\text{B.t.u./lb.} = \frac{(2+R)\ 2250 \times 1.8}{W}$

where weight of coal in grams = W
the rise in temperature = 2° + R° Centigrade, and
the water equivalent of the calorimeter = 2250 grams.

The equation is suitably adjusted whenever a change is made in the water equivalent.

The net calorific value is calculated by deducting from the gross value 91.2 B.t.u. per pound for each one per cent of hydrogen in the coal.

Ultimate Analysis.—This analysis determines the elements carbon, hydrogen, sulphur, nitrogen and oxygen. The percentages of these elements, together with the percentage of ash found in the proximate analysis, are assumed to add up to 100%. The determinations are made on the air-dried laboratory sample, and the results later calculated to the "as received" and "dry" bases.

Carbon and Hydrogen.—These elements are determined, as in the regular method for the analysis of organic compounds, by burning a fifth of a gram of the coal in a current of pure, dry oxygen and collecting and weighing the carbon dioxide and the water produced. The R.C.A. has developed a modification of the apparatus† which has been found to be conducive to ease of operation, prolonged life of the quartz combustion tube, and consistently good results even in the hands of beginners.

Sulphur.—The method normally employed for sulphur determination is the Eschka process as specified by the A.S.T.M. Recently, with low sulphur coals—below 0.5%—the sulphur has been determined in the rinsings from the bomb calorimeter by precipitation with benzidine hydrochloride followed by titration with standard alkali. These results have been found to be in reasonable agreement with those of the Eschka process, and the saving in time is considerable.

Nitrogen. — The method employed is the Kjeldahl-Gunning method as specified by the A.S.T.M.

*E. Stansfield and J. W. Sutherland, Can. Jour. Research, Vol. 3 (1930), pp. 464-472.
†E. Stansfield and J. W. Sutherland, Can. Jour. Research, Vol. 3 (1930), pp. 318-320.

Oxygen.—No satisfactory method has yet been devised for the determination of oxygen. The percentage reported as oxygen in an ultimate analysis is merely the value obtained by subtracting from 100 the sum of all the other percentages, including that of ash.

Moisture.—Moisture is not included as such in an ultimate analysis, as the hydrogen and the oxygen of the water are included in the reported values of these elements.

Fusion Temperatures of Coal Ash.—Two methods have been used for the determination of the fusibility of coal ash, one according to A.S.T.M. specifications, the other a modification thereof. In the latter method the conditions specified by the A.S.T.M. with respect to size and shape of cones, rate of heating and atmosphere are followed exactly, but, instead of only heating 3 or 4 cones at once and closely watching their behaviour, a batch of 20 or more different cones are simultaneously heated to some prearranged temperature, and then rapidly cooled and withdrawn from the furnace. Similar batches are likewise heated to other temperatures until for each ash a series of cones is obtained heated to temperatures at 45°F (25°C) intervals, and covering the range from the initial deformation to the fluid temperature, or to the maximum temperature obtainable in the furnace. The series can then be arranged in order and examined at leisure for the fusion characteristics. Fig. 4, p. 43.

Two furnaces have been used, a No. 3 gas-fired Melter's Furnace, and a molybdenum wound, electric, resistance furnace. Some difficulties are experienced with the gas-fired furnace at temperatures above 2600°F, but the electric furnace can be heated to 2800°F without difficulty.

The A.S.T.M. specifications call for a mildly reducing atmosphere around the cones. In both methods employed by the R.C.A., and in both furnaces, this required atmosphere is ensured by vapourizing a methyl alcohol-water mixture, containing 51% of alcohol by volume, and passing the vapours through a refractory tube into the ash cone chamber. The alcohol is decomposed, also some of the steam, producing a mixture containing about 50% reducing gases (hydrogen and carbon monoxide), and 50% oxidizing gases (steam and carbon dioxide).

MOISTURE AND CAPACITY MOISTURE

All coals contain moisture which is definitely part of the coal substance. Coal may also have free moisture, on the surface, and in the cracks if, for example, the mine from which the coal was taken is a wet mine; but, on the other hand a sample of coal may have been partially dried before it reaches the chemist. A coal analysis therefore may show either more moisture or less moisture in the sample than the true moisture of that coal.

A method was developed* in 1931, in the laboratories of the Research Council of Alberta, by which a distinction can be made between the moisture that really belongs to the coal and additional or free, surface moisture. The same method will also indicate if there has been a partial drying of the moisture of the coal, but in this case the true moisture cannot be determined if the partial drying has been more than slight. A coal which has been notably dried will not take up again as much moisture as it held originally.

The true or inherent moisture of a coal has been called the "capacity moisture" of the coal and defined as the least moisture in the coal that will give a relative humidity of 100%, or in other words, will behave as though free moisture were present.

Capacity moisture is of great importance in coal classification, and of lesser importance in ordinary analyses. Nevertheless in many analyses reported from these laboratories, the capacity moisture is given where this differs notably from the actual moisture found in the sample; as it is certain that free moisture will evaporate from the coal more easily than will inherent moisture, and therefore is less of a drawback.

It is of interest to note that far more samples have been received here showing excess moisture than have been received showing partial drying. In this report "typical moistures" are not intended to include free moisture.

GROSS AND NET CALORIFIC VALUES

When the coal is burned in a bomb calorimeter, as in the determination of its calorific value, the products of combustion are cooled to room temperature, and the steam is condensed to water and thus gives up its latent heat to the calorimeter. In the ordinary combustion of coal, on the contrary, the products of combustion enter the chimney at too high a temperature for the steam to have condensed, so that not only the sensible heat of the gases, but also the latent heat of the steam is lost. The loss of sensible heat can be minimized by combustion control and by the use of suitable equipment, so this loss can fairly be charged against the plant and its operation. The loss of latent heat, however, cannot be avoided in ordinary practice, so it is unfair to charge this loss against the plant. Two calorific values are therefore recognized:

Gross calorific values in which the products of combustion are assumed cooled to ordinary temperatures (60°F), and the steam condensed to water as in the calorimeter determination.

Net calorific values in which the products of combustion are assumed cooled to ordinary temperatures, but with the steam uncondensed. Net calorific values, in B.t.u. per pound, are calculated from gross calorific values, in the same units, by deducting 91.2

*E. Stansfield and K. C. Gilbart, Trans. A.I.M.M.E., Coal Division (1932), pp. 125-147.

B.t.u. per pound for each one per cent of hydrogen in the coal as fired. This figure allows for another slight correction which need not be explained here.

If two coals are compared, of equal gross calorific value, but one with low, and the other with high hydrogen content, it will be found that the former is distinctly the better fuel. Two coals of equal net calorific value, on the contrary, will be found to be nearly equal in fuel value regardless of their hydrogen content.

Gross calorific values are generally used in Canada and in the United States, but the net values give a better picture of the relative commercial values of different types of coal, and are often used in some other countries. The adoption of the net value has been delayed in America because its calculation requires the hydrogen content of the coal, and this is seldom known.

Gross calorific values are given in this report, unless the contrary is stated. The approximate deduction to be made for the coal of each area, or district, to give the net value, is generally given. The deduction ranges from about 2% to 9% of the gross heat value of Alberta coals.

MINERAL MATTER IN COAL AND ASH OF COAL

The mineral matter in a coal is not the same as the ash left when the coal is burned, either in composition or in weight. The relation between them varies; but, on an average, ten parts of mineral matter leaves only 9 parts of ash.

All ordinary analyses, proximate and ultimate, show the percentage of ash of the coal, not the percentage of mineral matter in the coal. This is standard procedure, well understood by all coal chemists, and the matter is quite immaterial to the ordinary coal consumer.

Whenever it is necessary to calculate an exact analysis of pure coal, as for example for purposes of coal classification, the matter is quite different, and it is necessary to convert the ash per cent of the coal to a mineral matter percentage. This change also involves a change in the volatile matter percentage. The relation between mineral matter and ash is discussed at greater length in Part V under "Coal as analyzed and as pure coal".

The slope of a mean line drawn through the points in the curve of Fig. 2 gives a measure of the ratio of mineral matter to ash, and this graphical method is regularly employed by the R.C.A. to determine this ratio. The equations given in the analytical section for calculating the modified calorific value of coal all contain a factor based on the relation of mineral matter to ash. This ratio has been found to vary with Alberta coals from 1.0 to 1.3 but the average value is slightly above 1.1.

Table 5

TABLE 22

Fusion Data for Ash of Alberta Coals

Area	District	Softening Temperature Low. °F	Softening Temperature High °F	Softening Interval °F	Flowing Interval °F	Samples Tested
Ardley		2030	2410	80	120	14
Big Valley		2190	2460	70	140	7
Brooks		2130	2370	70	160	3
Brule		+2600	....	....	......	1
Camrose		1980	2380	90	70	15
Carbon		1970	2400	70	140	22
Cascade	A	2550	+2770	....	......	3
	B	2140	+2770	120	150	11
Castor		2010	2360	70	80	20
Champion		1900	2180	50	50	8
Coalspur	A	2050	2170	40	130	7
	B	2090	2450	70	100	20
Crowsnest	A & C	2630	+2770	....	......	35
Drumheller		1850	2370	60	110	69
Edmonton		1970	2470	60	120	34
Gleichen		2010	2370	60	110	6
Halcourt	A	2460	2600	180	130	2
	B	2200	2460	100	160	4
Highwood		+2600	....	....	......	4
Lethbridge		2060	2420	80	140	23
Magrath		2190	2280	90	70	2
Milk River		1960	2200	90	190	6
Mountain Park		2280	+2700	140	130	21
Nordegg		2600	+2800	....	......	11
Pakowki		1920	2300	50	60	8
Pekisko		2150	2550	90	150	11
Pembina		2280	2460	70	110	12
Pincher	A	2330	+2600	80	170	4
Prairie Creek	A	2150	2340	80	100	6
	B	2100	2120	50	230	2
Redcliff		1880	2120	80	80	7
Saunders		2010	2260	60	80	12
Sexsmith		2070	....	60	70	1
Sheerness		1980	2320	50	70	17
Taber	A & B	2100	2490	60	90	11
	C	1870	2380	60	130	3
Tofield		2050	2270	50	60	7
Westlock		2050	2240	60	100	2
Wetaskiwin		2030	2420	90	100	3
Whitecourt		2180	....	90	190	1

Explanation of terms given on page 42.

Further information on analytical parameters of coal may be found in Francis (1961).

As mentioned above, "Capacity Moisture" is the only meaningful moisture determination for Plains coals. The "routine method" described above (weighing to equilibrium following exposure of the ground coal sample at 30° C in a dessicator with air held at 97.6% humidity by a saturated solution of potassium sulphate) followed by ash determination in a muffle furnace, is usually adequate to "characterize" a coal sample, i.e. to establish it rank closely enough for the requirements of a reconnaissance survey.

IV. GEOLOGY

In the Alberta Plains, two major stratigraphic intervals contain coal deposits. Firstly, very small amounts occur within the Lower Cretaceous Mannville Group, but since these strata outcrop only in northern Alberta, and include the McMurray oil sands, no further consideration is given them in this presentation.

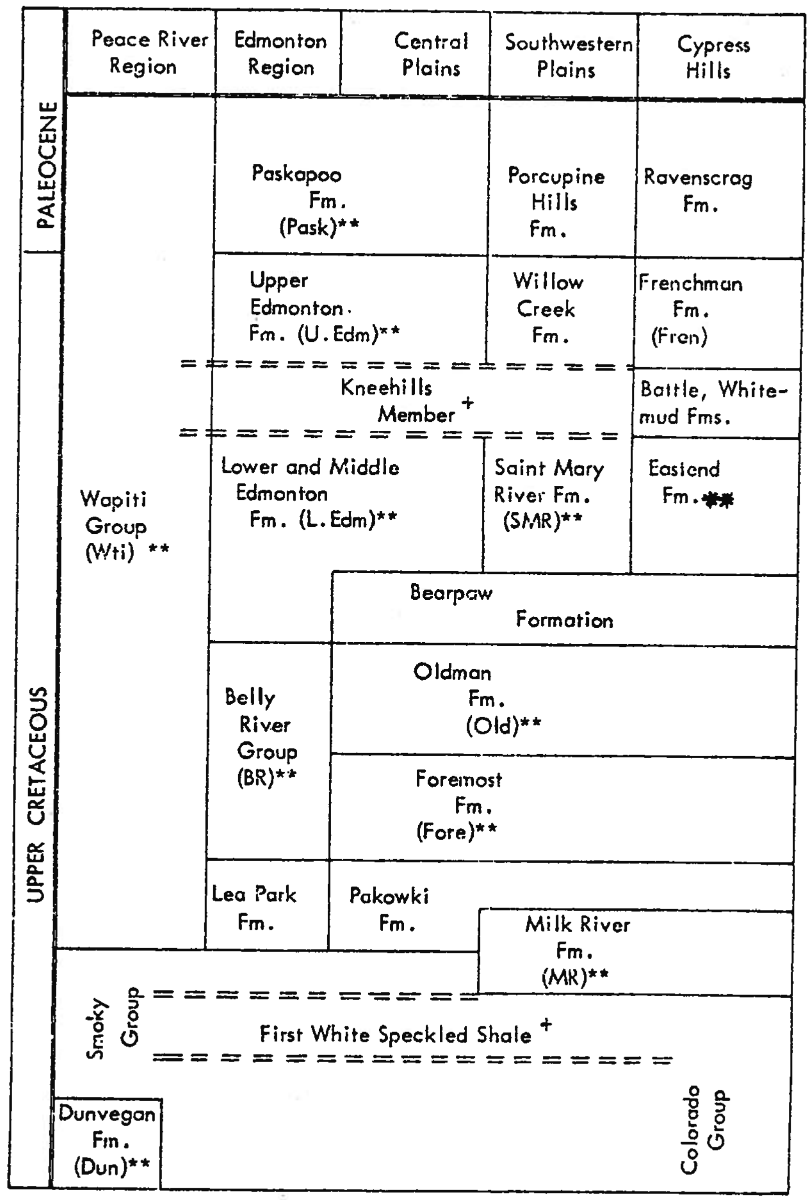
Much greater tonnages of coal exist within the Belly River Group, Edmonton Formation, and Paskapoo Formation of central and southern Alberta and the equivalent Wapiti Formation of the Peace River region which constitute a thick, mostly continental, coal-bearing and clastic Upper Cretaceous and Lower Tertiary succession, broken only in central Alberta where the marine Bearpaw Formation separates the Belly River Group from the Edmonton Formation. Distribution of these rock units is shown in Map A. See also stratigraphic diagram (Fig. 15).

Structure of the Alberta Plains consists of a flat monocline in which bed-rock strata dip very gently westward or southwestward (averaging about 15-20 feet per mile) so that progressively older formations are exposed at surface eastward. Thus the coal-bearing beds form a giant wedge (see section, Map A), with the oldest component strata lying at the surface in eastern Alberta (e.g., near Vermilion, about Tp. 50, R. 7, W. 4th Mer.) but at depths of 4000-6000 feet in the western Plains (e.g., near Rocky Mountain House, about Tp. 39, R. 7, W. 5th Mer.).

By far the largest tonnages of coal lie within the middle portion of this wedge, in strata generally called Edmonton Formation (see Allan and Sanderson, 1945). (Recently Carrigy, 1970, and Irish, 1970, have, with some logic, radically changed the nomenclature here, but in this presentation, the more familiar usage is followed.) Within this rock unit, two major coal-bearing intervals exist, and, midway between them, a minor one. The lower major interval is relatively thick (up to 600 feet) containing numerous well-marked coal seams and traceable from the Bow River east of Calgary, northward and northwestward almost to the Athabasca River (see Map A); it is referred to in this presentation as "Lower Edmonton Coals". The upper major interval is thinner (30-90 feet), consisting of a relatively compact mass of interlensing coal seams and coaly beds, and traceable from the Red Deer River near Drumheller northwestward to the Simonette River southeast of Grande Prairie (see Map A); this is referred to as the "Ardley Coal Zone". The minor coal-bearing interval, referred to as the "Carbon-Thompson Coal Zone", is quite discontinuous, occurring chiefly in the valley of the Red Deer River; it lies about 100-150 feet below the Ardley Coal Zone, and immediately below an extremely widespread and reliable bentonitic marker horizon usually referred to as the Kneehills Member.

4

Figure 15 Succession of Strata in the Alberta Plains



** Coal-bearing formation in the Alberta Plains
\+ Marker horizon

In southern Alberta, the Foremost Formation, forming the lower part of the Belly River Group, contains considerable quantities of coal, but most of this is so diffuse and erratically dispersed that it cannot be considered economically recoverable within the foreseeable future. However, at the top of the group, immediately below the Belly River–Bearpaw boundary, lies a coal zone consisting of a small number of well-marked coal seams, traceable with discontinuity from the Belly River south of Lethbridge to the lower Red Deer River east of Calgary (see Map A); it is referred to as the "Lethbridge Member".

There is a considerable body of information, mostly derived from oil and gas exploration, on the general disposition of the foregoing major coaly zones, but it is very incomplete and has not been adequately synthesized. In particular, details of coal distribution within coaly zones are, at present, not well understood: from outcrop and shallow occurrences, the percentage of coal within the zones is known to vary regionally, so that regions of maximum coaliness, constituting the exploitable coal fields, appear at a very rough estimate to occupy 10%–30% of the total area. Whether these coaly areas are circular or elongate or completely irregular in shape is, as yet, unknown.

V. UTILIZATION

Two major uses for Alberta Plains coals are immediately apparent: firing conventional steam-electric power plants; and "gasification", i.e., conversion of coal (in conventional surface plants) into "substitute natural gas" (SNG), equivalent in calorific value to natural gas. Beyond these uses is the possibility of producing such large-volume products as liquid fuels, carbonaceous absorbents or filter media, and argrobiological soil amendments (see Berkowitz, 1971); at the same time the possibility of large scale underground chemical conversion (gasification or liquid reaction) must not be discounted, although it will require several major technological breakthroughs to effect.

A. Steam Production

(Extract from Stansfield and Lang, 1944)

STEAM PRODUCTION AND BOILER TRIALS

A large percentage of the coal consumption of the world is coal burned in order to produce steam. Boiler trials are made in order to evaluate coals for the production of steam; but two types of these must be recognized.

(1) The operator of a boiler plant may run boiler trials on the different coals available for purchase, and thus find which coal is the best to buy for his plant. He is thus enabled to select a coal suited to the equipment installed, and the boiler trials satisfactorily meet his requirements.

(2) A government laboratory, or other testing plant, may endeavour to test a large number of coals in order to grade them according to merit for steam raising. Unfortunately, such a testing plant has seldom a wide range of testing equipment, and far too often the fact that coal M gave a higher evaporation than coal N does not prove that M was better than N, but only that M was better suited to the equipment and conditions of the test. Such boiler trials therefore may be entirely misleading, unless studied with a full appreciation of the difficulties and limitations under which the tests are made. The difficulties and limitations are probably less with pulverized coal trials than with hand fired or stoker trials.

A detailed report on a boiler trial may include as many as 80 items, and only by a study of such a report can the real significance of the trial be understood. The most frequently quoted value, however, is that termed "equivalent evaporation", or the pounds of water at 212°F converted to steam at 212°F per pound of coal fired. The efficiency of the boiler plant is also generally stated. This is the calculated heat required to convert the feed water evaporated into the steam thus produced, expressed as a percentage of the heat value of the coal burned to produce that steam.

The heat value of the coal, the efficiency of the boiler plant, and the equivalent evaporation are related by the following equation:

$$0.10306\,HK = 100\,E$$

where H = the heat value of the coal as fired, in B.t.u./pound
K = the efficiency of the boiler plant in per cent
E = the equivalent evaporation in pounds of water at 212°F converted to steam at 212°F.

This equation is based on the assumption that the latent heat of steam at 212°F is 970.3 B.t.u. per pound.

Either the gross or the net heat values can be employed, but with the net heat values higher boiler plant efficiencies will be obtained, and there will be smaller variation of efficiency between high and low hydrogen content coals.

Calculation can be avoided by the use of the alignment chart of Fig. 5. The heat value of the coal is shown on scale H on the left, the equivalent evaporation on scale E on the right, and the boiler plant efficiency on the sloping scale K. A straight line from a particular heat value on H to a particular evaporation on E will cut the sloping scale at the corresponding boiler plant efficiency. Or a straight line from a particular heat value on H, to a particular efficiency on K, if continued will cut the line at E at the corresponding equivalent evaporation. For example, a straight line drawn from a heat value of 14,000 B.t.u. through a plant efficiency of 70% will give an equivalent evaporation of 10.1 lbs.

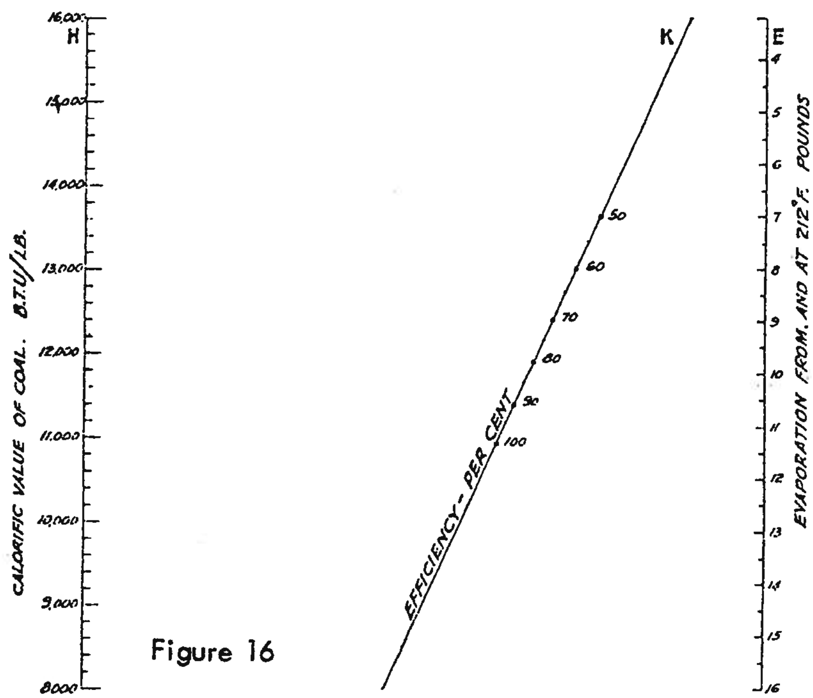


Fig. 5.—Nomogram—Boiler Efficiency and Equivalent Evaporation

The efficiency of a boiler plant depends far more on the equipment that on the coal, and high efficiency can be obtained with any ordinary coal and suitable equipment. It must be obvious, therefore ,that evaporations obtained with one coal in one set of boiler trials cannot be compared with those of another coal in another set of boiler trials to give the relative merits of the two coals.

A large number of references to steam production and to boiler trials with Alberta coals have been published. These show efficiencies ranging from 45% to 89%. The low efficiencies are with small boilers, without economizers, whilst the high efficiencies are with modern, high pressure plants, with pulverized coal firing, and with economizers to preheat the feed water, or the air for combustion, or both.

In view of all the above it has been decided to give references to such publications; but not to give any summary of the results reported.

It might be noted, however, that the reports cited include operating data on some large, modern boiler plants, and that these data show high efficiencies with both Alberta domestic and Alberta steam coals. Efficiencies as high as 80% are shown with domestic coal (Subbituminous B) in a stoker fired furnace, and as high as 89% with steam coal in a pulverized coal fired furnace.

The principal heat losses in a boiler plant are (1) radiation of heat from the outside of the boiler, (2) loss of incompletely burned coal through the grates or in the ashes, (3) loss of sensible heat in the flue gases, (4) loss of latent heat in the flue gases, and (5) loss of unburned material in the flue gases. The unburned material in the flue gases may include solid particles of coal and ash, called "fly ash"; solid particles of soot, vapours of tar, and combustible gases such as carbon monoxide, hydrogen and hydrocarbons.

The last four items in the above list are related to the character of the coal, and three of these losses can be reduced by the selection of equipment suited to the coal; but discussion of the means employed to reduce losses would be out of place in this report.

The following eight characteristics of any coal should be considered in relation to its use for the production of steam: (1) Total net heat value of the coal. (2) Distribution of heat value between the volatile and non-volatile fractions of the coal. This, it might be mentioned, is related to the percentages of volatile matter and fixed carbon in the coal. (3) Cleanliness of coal, as shown by the ash percentage. The dirtier is the coal, the more ash is there to be removed from the furnace and taken away. Also a high ash may involve increased loss of unburned fuel with the ash. (4) Clinkering properties of coal ash. This depends largely on the fusion temperature of the ash; in general a high fusion ash is preferred, but the reverse is sometimes the case. (5) Burning characteristics. Some coals burn much more freely than do others. Some burn with a short flame and others with a long flame (see 2 above), and some coals tend to cake or even to form coke in the fire bed. Some coals moreover tend to burn smokily and others to burn without smoke. However, all these types of coal can be burned without excessive losses in the flue gases if suitable equipment is provided. (6) Strength of coal. Some coals are strong and others friable. A friable coal is apt to result in the presence of a high percentage of fines in the coal as fired; on the other hand, if the coal is to be burned as pulverized coal extra power is required for pulverization if the coal is hard and strong. (7) Storage qualities. If the coal may require to be stored before being burned it is advisable to consider its storage properties, since some coals disintegrate rapidly when stored, unless protected from the weather. Also prolonged storage of most coals involves more or less risk of spontaneous combustion. (8) Ultimate analysis of coal: that is its carbon, hydrogen, oxygen, etc. content. Makers of boilers, before tendering on equipment to be supplied, commonly request the ultimate analysis of the coal expected to be burned. This assists them to specify the correct type of equipment. The ultimate analysis is also required for calculation of such combustion data as volume of air required per pound of coal.

Part V on combustion discusses further some of the above characteristics of the coal, and relates certain of them with the classification of the coal.

The following reports and articles refer to the use of Alberta coals for the production of steam:

Forty-One Steaming Tests, J. Blizard and E. S. Malloch, Mines Branch, Department of Mines, No. 496 (1920).

Investigations of Canadian Coals, B. F. Haanel and R. E. Gilmore, The Engineering Journal, XX (1937), p. 515.

The Burning of Low Rank Alberta Coals—The Steam Generating Plant. C. A. Robb. The Engineering Journal, XX (1937), pp. 555-564.

Experience in Burning Western Canadian Coals, E. W. Bull. The Engineering Journal, XX (1937), pp. 571-580.

B. Gasification

(Extract from Berkowitz, 1971)

III.

In terms of the coal tonnages required for it, the most important "other use" of coal in Western Canada is gasification – i.e. the conversion of coal into a "synthesis gas" (a mixture of CO and H_2) that can subsequently be methanated to provide a "synthetic" pipeline gas fully equivalent to natural gas, or converted into synthetic liquid fuels, chemicals or chemical intermediates by established (Fischer-Tropsch) hydrogenation.

Under active study and development since the 1930's, the primary gasification step involves a treatment of incandescent coal or coke with oxygen, steam and/or carbon dioxide, and yields a "synthesis gas" by reactions that can be formally written as

$$C + O_2 \rightarrow CO_2 \quad \ldots\ldots \quad (i)$$

$$H_2 + \tfrac{1}{2}O_2 \rightarrow H_2O \quad \ldots\ldots \quad (ii)$$

$$C + H_2O \rightarrow CO + H_2 \quad \ldots\ldots \quad (iii)$$

$$C + CO_2 \rightarrow 2\,CO \quad \ldots\ldots \quad (iv)$$

$$CO + H_2O \rightarrow CO_2 + H_2 \quad (v)$$

Reaction (i) is a sequential oxidation of carbon. (ii) arises from partial oxidation of volatile matter in coal. (iii) and (iv) describe gasification by steam and carbon dioxide. And (v) is the socalled water-gas "shift" reaction.

In a fixed-bed gasifier, in which coal is introduced countercurrent to the gas flow, formation and partial decomposition of volatile matter will, in addition, yield

$$C_mH_n \rightarrow \frac{n}{4}\,CH_4 + \frac{(m-n)}{4}\,C \quad \ldots\ldots \quad (vi)$$

and at elevated temperatures, auto-hydrogenation of volatile matter and some "reactive" carbon in coal will also produce methane by

$$C_mH_n + (2m-n)\,H_2/2 \rightarrow m\,CH_4 \quad \ldots\ldots \quad (vii)$$

$$C + 2\,H_2 \rightarrow CH_4 \quad \ldots\ldots \quad (viii)$$

Except for reactions (vi)-(viii) – which can evidently only occur when coal is gasified, but which are even then only of minor significance – this suite is remarkably insensitive to the nature of the solid reactant; and gasification therefore possesses an unrivalled flexibility. In practice, it is now possible to effectively gasify any coal or coke in fixed, agitated or fluidized beds at pressures up to 50 atm. and temperatures as high as 1800°C; to dispose of residual ash as a dry solid or a molten slag; and to vary the $CO:H_2$ ratio of the product "synthesis gas" by means of appropriate catalysts.

What can technically be achieved by gasification is illustrated in Figure 1 – a simplified flow sheet of the coal gasification plant operated by the South African Coal, Oil & Gas Corporation at Sasolburg, nr Johannesburg. The design capacity of the Lurgi pressure gasifiers is about 7500 Mcf/hr. at 360 psi. And products include the full range of liquid fuels elsewhere obtained from conventional oil refining, as well as a wide spectrum of industrial chemicals and chemical intermediates – all accruing from Fischer-Tropsch hydrogenation of "synthesis gas" under conditions determined by market requirements.

As an alternative to producing a "synthetic" pipeline gas via methanation of a CO + H_2 mixture, such a gas can also be obtained more directly by hydrogasification of coal. Originally conceived in the late 1930's, this process involves reacting a carbon source with hydrogen at temperatures in the order of 850°C (~1560°F) and pressures between 20 and 50 atm., and CH_4 yields are then generally proportional to the hydrogen partial pressure. Since the 1950's, hydrogasification of coal has been perfected by the U.S. Bureau of Mines and the Illinois Institute of Gas Technology; and a large pilot-plant developed from IGT's studies – from which it is expected to gain operating experience, performance data and scale-up criteria – is presently under construction near Chicago.

Extensive tests in a variety of small-scale plants and prototype reactors have established that over 90% of the organic carbon contained in a coal or coke can be gasified under appropriate conditions, and that correct matching of reactor to fuel will yield "synthesis gases" containing more than 80% $CO + H_2$. But there is still some uncertainty about costs. Based on \$5/t, \$3/t, \$7.50/t and \$0.01/kwh for coal, steam, oxygen and power respectively, cost estimates published some 10 years ago indicated that finished "synthesis gas" could be produced for 40-85 ¢/Mcf, and that each 1% return on investment would add 1-2 ¢/Mcf. A pipeline gas manufactured by subsequent methanation of the synthesis gas would, on this basis, cost 80-123 ¢/Mcf, with each \$1 deviation in coal costs altering the final gas costs by approximately 8 ¢/Mcf. However, since the early 1960's, advances in reactor design and improvements in process efficiency have evidently brought about substantial savings; and current development work in the USA is claimed to have achieved (or to be capable of achieving) costs in the range of 35-50 ¢/Mcf of fully finished "synthetic" pipeline gas (at ~950 btu/cu.ft.).

Given the present price and supply position of Alberta natural gas, a "synthetic" pipeline gas made via coal gasification would, of course, still be economically unattractive, even if the costs projected from the most recent American studies are, in fact, realized. But faced with increasing demands for gas - against which Alberta's resources are small and which, in the USA, are already creating visible shortages - coal gasification may well be seen as a means for stretching Western Canada's reserves.

What could conceivably hasten extensive gasification is, inter alia, progress in the development of large-scale generating systems in which "synthesis gas" is used to drive gas turbines*. Among the advantages claimed for such operation are relatively low plant investment costs, effective elimination of pollution problems, and the possibility of working with a variety of fuels with minimal down-time. A first 170 Mw commercial unit deploying this principle, and designed for quick response to peaking demands, is scheduled to go on stream at Lünen, W. Germany, in mid-1971.

* An alternative, now being studied in a 100 kw experimental plant by Westinghouse under contract to the U.S. Office of Coal Research, employs coal-generated "synthesis gas" to power fuel cells.

C. Storage

Low rank coals such as Alberta Plains coals, present considerable problems if they are to be held for any length of time between mining and utilization, either in storage or in transit. Stansfield and Lang (1944) offer the following notes.

RESEARCH COUNCIL OF ALBERTA 37

STORAGE OF COALS

Industrial concerns and power plants frequently store large quantities of coal in order to guard against stoppage of supplies from labour or transportation or other troubles. Seasonal fluctuations in the demand for coal for heating also necessitates storage by the operator or dealer; and even the householder may buy his coal in the summer and store for use in the winter. Coal tends to deteriorate in storage, and there are possibilities of serious loss from spontaneous combustion. The allied problems of storage and oxidation of coal are therefore of considerable economic importance. It can be definitely stated, however, that the problem of the storage of the different ranks of Alberta coal is the same as the problem of storage of the same ranks of coal elsewhere.

Coal does deteriorate in storage, to different extent with different ranks; but on the whole the deterioration is notably less than is commonly supposed, unless the coal is so badly stored that spontaneous combustion occurs. The loss in heat value is hard to measure, and will vary largely, but the U.S. Bureau of Mines suggest values not exceeding 1.2% for the first year with the bituminous coals they tested, and not exceeding 2 or 3% with the subbituminous coals. A coking coal does show a decrease in coking properties during storage and fresh coal should be used, if possible, for coke making. A complaint is sometimes made that stored coal is "dead" in the fire; but the actual depreciation in fuel value is probably slight. High moisture coals tend to dry out in storage, with consequent "slacking" or breaking down of the lumps. This will be discussed later under weathering.

Some of the principal factors involved in coal storage are outlined in the following section; but the problem is so complicated that it cannot be dealt with fully, and anyone without experience who needs to store considerable coal should consult more detailed reports.

Information Circular 7235 (1943) of the U.S. Bureau of Mines discusses the storage of coal at length, and gives seven satisfactory methods of storage.

Oxidation, Self Heating and Spontaneous Combustion.—All coals contain unstable compounds which are capable of absorbing oxygen from the air at ordinary atmospheric temperatures; but some coals contain more of these compounds than do others. This atmospheric oxidation is strictly a surface action; it may go on rapidly when the coal is freshly mined and slow down as the surface becomes oxidized; but go on with renewed activity whenever fresh surfaces are exposed by breakage. Such oxidation generates heat, and the rate of oxidation increases very rapidly as the temperature rises. If the heat generated is not carried away as fast as it is formed, the temperature of the coal rises, the rates of oxidation and of heat generation increase, and these may even result in open burning of the coal—"spontaneous combustion". Oxidation and self heating are almost inevitable in stored coal, but spontaneous combustion is less frequent. The more usual course is for the coal to gradually warm up and then cool off again. If the temperature rises to 120°F the pile should be carefully watched, and if it seems likely to pass 160°F serious trouble may be expected unless action is taken at once. It may be seen from the above that air provides the oxygen for the oxidation. If air could be excluded the coal would not heat. Also air will carry away the heat generated; so if there is a big flow of air the coal will oxidize but not heat. The dangerous situation is in between, with enough air to supply oxygen, but not enough to remove the heat.

The rate of oxidation and the danger of spontaneous combustion are dependent on the rank of the coal, its moisture content, presence of pyrite, the coal sizing, method of piling, size of pile, ventilation of pile, temperature of coal as piled, external sources of heat, etc. These factors, discussed below, are complex in action and it is often hard to foresee the combinations that will cause trouble.

Low rank coals oxidize more rapidly than do high rank coals, as shown later. The low rank, high moisture coals also tend to dry out and slack in storage thus producing fine coal with fresh surface for oxidation. Such coal is more difficult to store than coal which does not slack, and in general is stored under cover. Pyrites oxidize in moist air, but its effect is probably over emphasized. However, Alberta coal is notably low in pyrite content. The coal sizing is an important factor; with lump coal the surface exposed for oxidation is so small in relation to the weight that no trouble can be expected, with fine coal the conditions are reversed. The method of piling, size of pile and ventilation of pile are also important. Either little air, or ample ventilation is safe; the intermediate condition is dangerous. If in building a pile segregation of sizes occurs there may be ample ventilation through the larger sizes, and very little ventilation through the closely packed, fine coal; but in between these two zones there will almost inevitably be a danger zone. The larger, and, more especially, the higher the pile, the more certain there is to be a danger zone. The temperature of the coal as piled is another important factor; coal stored in the winter is less likely to give trouble than coal stored in summer. Again, if a pile is built in such a way that the advancing face is to the south, coal heated by the sun may be buried under a further load of coal and such a hot spot is extremely likely to give trouble. Care should be taken to avoid steam pipes, or other sources of heat such as wood, oily rags, etc., under or near coal.

Practical methods of storing coal can be divided into two groups, the first with exclusion or restriction of air, and the second with ample ventilation.

In the first of these the coal may be stored under water; or slack or fine coal stored on an impervious foundation, packed down layer by layer as the pile is built, and preferably with the sides, or the sides and top of the pile, capped with an air tight capping or covering.

In the second of these the coal should be stored on a well drained, open foundation such as a bed of cinders. With sized coals the natural air circulation will be ample if the lumps are not crushed during piling, and if the coal does not slack. With run-of-mine or fine coal this method is more difficult. The Canadian Pacific Railway, however, has for years stored run-of-mine coal successfully, in large piles, by contriving ventilation holes regularly and closely spaced over the whole pile, each hole extending from top to bottom of the pile. In small piles the natural ventilation will often suffice. Storage of domestic coal in a residence very rarely gives trouble; the quantity stored is seldom large, and sized coal is generally used.

The temperatures in a coal pile may be followed by inserting pointed rods, at intervals, from top to bottom of the pile, then lifting these from time to time, feeling their warmth and putting them back in fresh spots; or by inserting pipes, down which thermometers can be lowered; or by the use of automatic danger signals which can be purchased.

Tests have been made with a number of Alberta coals which show their relative oxidizability. In these tests* samples of the coals were ground continuously in an atmosphere of oxygen at 86°F for 120 hours in a sealed ball mill. The amount of oxygen absorbed, expressed as a percentage of the weight of pure, dry coal in the mill, is shown in the following table for coals from 17 areas. It must be noted that although the actual values have no commercial significance, as coal in practice is not ground finely in oxygen, they do show relative degrees of oxidizability. The high rank coals are the less susceptible to oxidation.

TABLE 7

Oxygen Absorption

Area	Number of Tests Made	Oxygen absorbed in 120 hours % by weight
Carbon	1	2.6
Coalspur	3	1.5
Crowsnest	4	0.4
Drumheller	4	2.7
Edmonton	10	3.1
Halcourt	1	1.8
Lethbridge	5	1.8
Milk River	1	2.1
Mountain Park	3	0.5
Nordegg	2	0.4
Pekisko	1	0.9
Prairie Creek	3	1.0
Redcliff	1	3.0
Saunders	1	1.9
Sheerness	3	3.2
Taber	1	2.4
Wetaskiwin	1	2.6

The amount of heat given out by the slow oxidation of coal is a matter of considerable interest. Tests made in this laboratory, for which however great accuracy is not claimed, showed that the heat given out, when expressed in terms of the oxygen absorbed, varied

*E. Stansfield, W. A. Lang and K. C. Gilbart. Trans. A.I.M.M.E., Coal Division (1934), pp. 243-254. Also R.C.A. Fifteenth Annual Report (1934), pp. 66-71.

little if at all with the rank of the coal. Fifty-two tests, on twelve different coals, oxidized at temperatures from 85° to 150°F, gave an average value of 102 B.t.u. per cubic foot of air measured at 32°F and 29.92 inches of mercury, on the assumption that all the oxygen in the air was absorbed. In Table 18, Part V, column 12 shows, for all the many coals studied, the amount of heat given out in burning; this again being expressed as B.t.u. per cubic foot of air. These values also vary little with rank, and the average value for all ranks is 107 B.t.u. These results show therefore, that for the same amount of oxygen involved, the heat given out by slow oxidation at temperatures below 150°F is approximately 95% of the heat given out in ordinary high temperature combustion.

Weathering and the Weathering Index.—As already stated, high moisture coals tend to lose moisture when exposed to the atmosphere, and the lumps then break up or slack. It is desirable to have a method for evaluating the weathering qualities of coals since those with notable slacking tendency should be stored under cover, or in closed bins. The weathering properties of coal moreover are used as a secondary factor for placing certain coals in the Canadian (A.S.T.M.) classification scheme.

A laboratory test, known as the accelerated weathering test, has therefore been devised for testing weathering characteristics. Small lumps of coal are subjected to a standardized cycle of air drying, immersion in water, and air drying; and the percentage by weight determined of the coal so broken down that it will pass through square holes of ¼″ side. This is called the weathering index. Coals with a weathering index of less than 5 are called non-weathering. That is they are good storage coals. The test is difficult to standardize exactly, and the results of one laboratory may differ from those of another.

Coals from sixteen different areas have been tested in these laboratories, and weathering indexes determined, varying from less than one to over ninety. Tests have also been run in the Fuel Research Laboratories in Ottawa. The results can be summarized by stating that coals in Groups I and II are non-weathering, that is good storage coals with weathering indexes seldom exceeding 1. Coals of Groups IV and V are weathering coals with high indexes; those of Group IV ranging from about 5 to 50 and those of Group V ranging from about 30 to 90.

Coals of Group III are closer to the boundary line. However, the great majority of the tests made in Edmonton with these coals gave indexes below five; and it seems probable that where the tests gave higher values the sample tested was not a fresh, unweathered coal. The coals of this group, that is from the Coalspur, Lethbridge, Prairie Creek and Saunders areas, are therefore classed definitely in this report as non-weathering.

iv

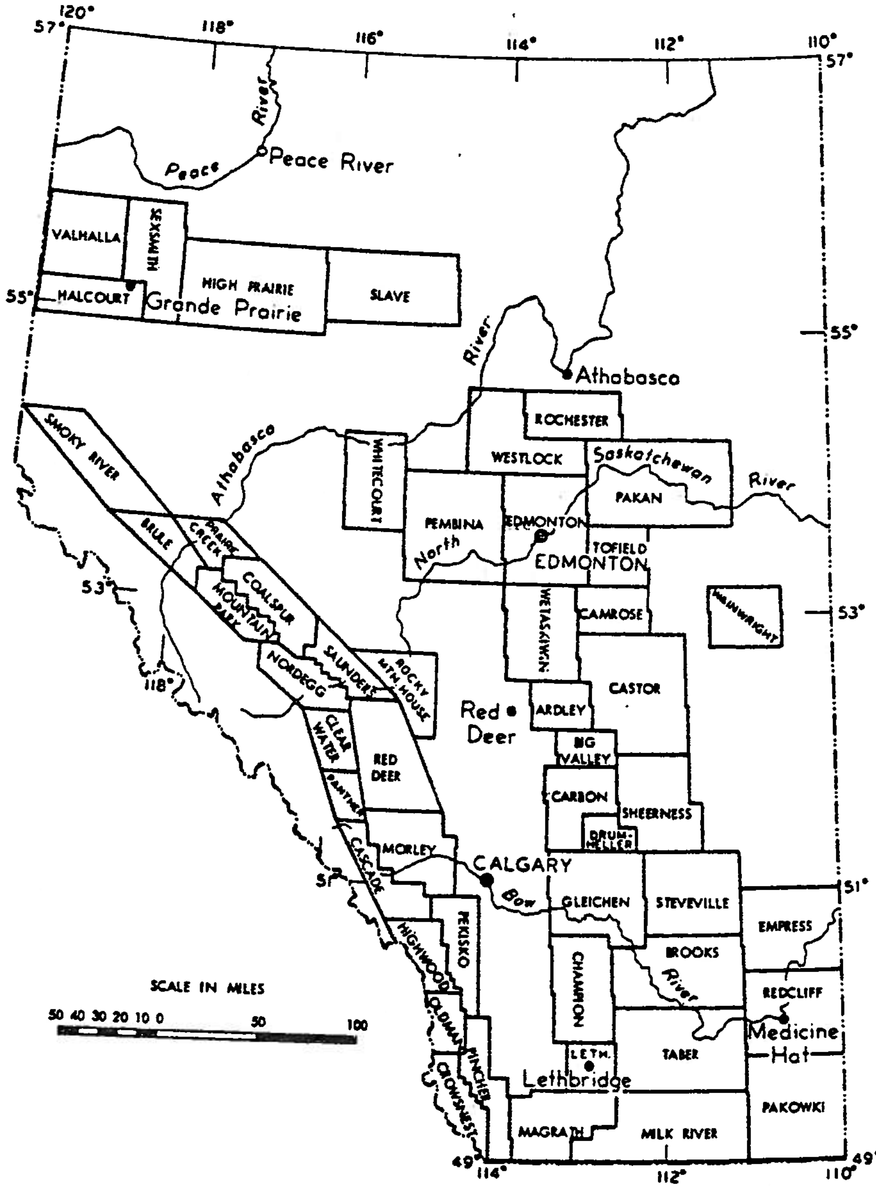


Figure 17 .Coal Areas of Alberta.

ill. O

VI. PLAINS AREAS

Research Council of Alberta Report 35 (Stansfield and Lang, 1944) treats the coals of Alberta on the basis of the old administrative "Alberta Coal Areas" (see figure 17) . Following are extracted discussions of all Plains Areas.

ARDLEY AREA

The mines produce an Alberta domestic coal—free burning and smokeless. According to Canadian classification the coal is Sub-bituminous B. Two seams are known and mined, both in the Edmonton horizon.

Eight mines (two stripping pits) were operated in 1943 and the output was 10,000 tons. The area is well served by the Canadian National and the Canadian Pacific railways. The largest producing mines are on a railway.

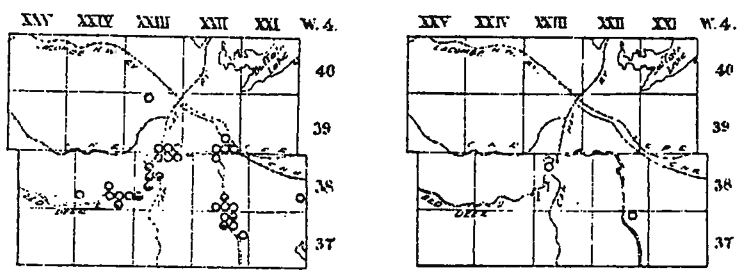
Volume Weight Relation

Solid coal as in seam

Percentage of Ash	8
Specific gravity	1.34
Tons per hundred cubic feet	4.20
Tons per acre foot	1,820

Map 13 shows the location of all recorded mines opened, and also indicates the mines from which samples have been obtained.

Map 14 shows the location of operating mines graded by output in 1943.



MAP 13 MAP 14

Scale: 20 miles to 1 inch. For symbols see page 93.

Figure 18

Typical Analyses

Proximate		Ultimate (with 19.8% moisture)	
Moisture	% 19.8	Carbon	% 55.3
Ash	% 8.2	Hydrogen	% 5.7
Volatile matter	% 28.0	Sulphur	% 0.3
Fixed carbon	% 44.0	Nitrogen	% 0.9
		Oxygen	% 29.6
		Ash	% 8.2

Fuel ratio (FC/VM), 1.55.

Calorific value, gross, in B.t.u. per lb., 9,260.

The net calorific value of this coal is approximately 520 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	$= 63.0 - 0.63(M + 1.26A)$
Volatile matter	$= 100 - (M + A + FC)$
Calorific value, B.t.u./lb.	$= 13{,}000 - 139(M + 1.10A)$

BIG VALLEY AREA

The mines produce an Alberta domestic coal—free burning and smokeless. According to Canadian classification the coal is Subbituminous B. At least three seams are known, all in the Edmonton horizon.

Four mines were operated in 1943 and the output was 13,000 tons. Two Canadian National Railway lines cross the area; but most of the mines are on the banks of the Red Deer River.

Volume Weight Relation

Solid coal as in seam

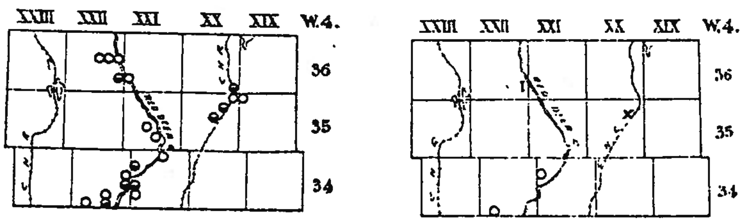
Percentage of Ash	5	10
Specific gravity	1.33	1.37
Tons per hundred cubic feet	4.15	4.25
Tons per acre foot	1,800	1,860

In addition to the typical and modified analyses given below reference has been made to coal from this area in the following sections of this report: fusibility of coal ash, solubility in alkalies, coal sizing, and smithy coal.

Map 15 shows the location of all recorded mines opened, and also indicates the mines from which samples have been obtained.

Map 16 shows the location of operating mines graded by output in 1943.

Because of wide differences in analyses of coals from separate points, the area has been subdivided into 2 districts wherein similar coals occur. The districts are given, by townships, below the maps.



MAP 15 MAP 16

Scale: 20 miles to 1 inch. For symbols see page 93.

Figure 19

District	Township	Range
A	34-36	XXI-XXII
B	34-36	XX

DISTRICT A

Canadian classification—Subbituminous B

Typical Analyses

Proximate		**Ultimate** (with 18.2% moisture)	
Moisture	% 18.2	Carbon	% 53.6
Ash	% 12.3	Hydrogen	% 5.5
Volatile matter	% 27.8	Sulphur	% 0.3
Fixed carbon	% 41.7	Nitrogen	% 0.9
		Oxygen	% 27.4
		Ash	% 12.3

Fuel ratio (FC/VM), 1.50.

Calorific value, gross, in B.t.u. per lb., 9,000.

The net calorific value of this coal is approximately 500 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	=	62.0 — 0.62(M+1.20A)
Volatile matter	=	100 — (M+A+FC)
Calorific value, B.t.u./lb.	=	13,400 — 134(M+1.20A)

DISTRICT B

Canadian classification—Subbituminous B

Typical Analyses

Proximate		Ultimate (with 21.8% moisture)	
Moisture	% 21.8	Carbon	% 50.05
Ash	% 10.6	Hydrogen	% 5.75
Volatile matter	% 28.4	Sulphur	% 0.2
Fixed carbon	% 39.2	Nitrogen	% 0.9
		Oxygen	% 32.5
		Ash	% 10.6

Fuel ratio (FC/VM), 1.40.

Calorific value, gross, in B.t.u. per lb., 8,550.

The net calorific value of this coal is approximately 520 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	=	58.0 — 0.58(M+1.00A)
Volatile matter	=	100 — (M+A+FC)
Calorific value, B.t.u./lb.	=	12,900 — 129(M+1.12A)

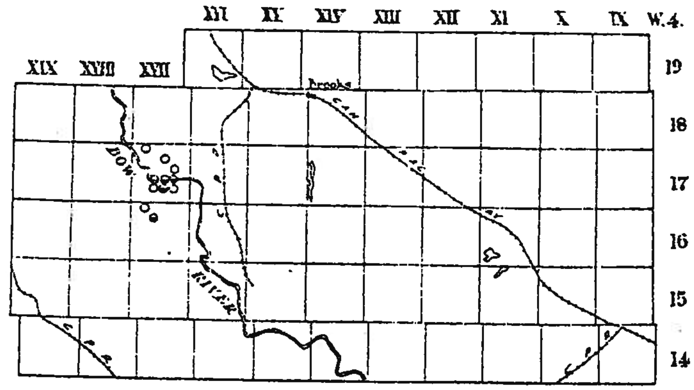
BROOKS AREA

The mines produce an Alberta domestic coal—free burning and smokeless. According to Canadian classification it is Subbituminous B.

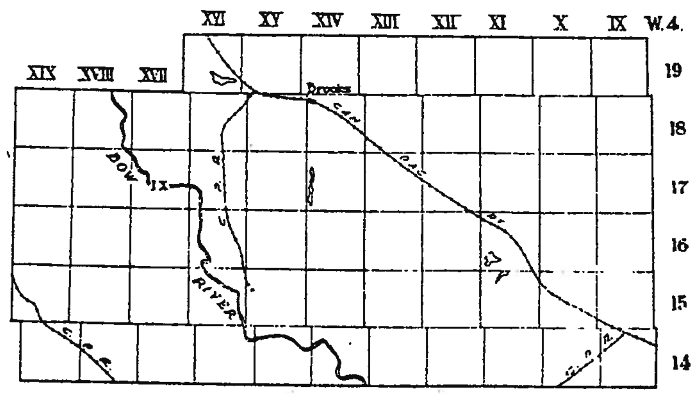
Two mines (one stripping pit) were operated in 1943 and the output was 30,000 tons. The area is served by the main line and branch lines of the Canadian Pacific Railway, but the mines opened have not been adjacent to a railway.

Map 17 shows the location of all recorded mines opened, and also indicates the mines from which samples have been obtained.

Map 18 shows the location of operating mines graded by output in 1943.



MAP 17



MAP 18

Scale: 20 miles to 1 inch. For symbols see page 93.

Figure 20

Typical Analyses

Proximate

Moisture	%	17.4
Ash	%	11.9
Volatile matter	%	31.1
Fixed carbon	%	39.6

Ultimate (with 17.4% moisture)

Carbon	%	54.65
Hydrogen	%	5.75
Sulphur	%	0.7
Nitrogen	%	1.2
Oxygen	%	25.8
Ash	%	11.9

Fuel ratio (FC/VM), 1.25.

Calorific value, gross, in B.t.u. per lb., 9,280.

The net calorific value of this coal is approximately 520 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	= 58.0 — 0.58(M+1.20A)
Volatile matter	= 100 — (M+A+FC)
Calorific value, B.t.u./lb.	= 13,400 — 134(M+1.12A)

CAMROSE AREA

The mines produce an Alberta domestic coal—free burning and smokeless. Two ranks of coal are mined, according to the Canadian classification; the principal output is Subbituminous C, but some Subbituminous B is also mined. Several seams are known, all in the Edmonton horizon.

Six mines (four stripping pits) were operated in 1943 and the output was 64,000 tons. The area is served by branches of both the Canadian National and the Canadian Pacific railways. Most of the mines are close to a railway.

Volume Weight Relation

Solid coal as in seam

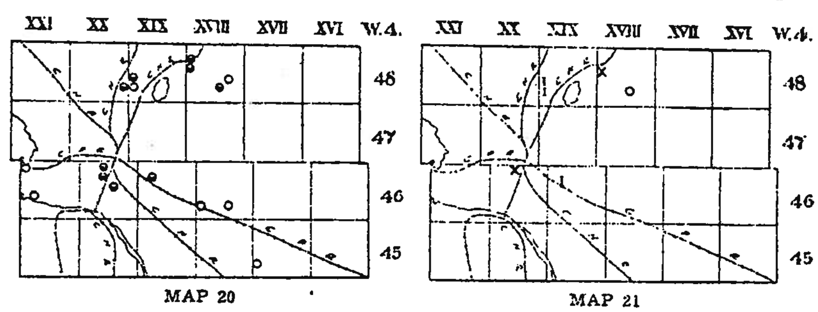
Percentage of Ash	5	10
Specific gravity	1.30	1.33
Tons per hundred cubic feet	4.05	4.15
Tons per acre foot	1,760	1,800

In addition to the typical and modified analyses given below reference has been made to coal from this area in the following sections of this report: fusibility of coal ash and coal sizing.

Map 20 shows the location of all recorded mines opened, and also indicates the mines from which samples have been obtained.

Map 21 shows the location of operating mines graded by output in 1943.

Because of wide differences in analyses of coals from separate points, the area has been subdivided into 3 districts wherein similar coals occur. The districts are given, by townships, below the maps.



Scale: 20 miles to 1 inch. For symbols see page 93.

Figure 21

District	Township	Range
A	46	XIX-XX
B	48	XIX-XX
C	48	XVIII

DISTRICT A

Canadian classification—Subbituminous C and also Subbituminous B

Typical Analyses

Proximate		Ultimate (with 25.2% moisture)	
Moisture	% 25.2	Carbon	% 52.4
Ash	% 5.2	Hydrogen	% 6.3
Volatile matter	% 29.2	Sulphur	% 0.3
Fixed carbon	% 40.4	Nitrogen	% 1.1
		Oxygen	% 34.7
		Ash	% 5.2

Fuel ratio (FC/VM), 1.40.

Calorific value, gross, in B.t.u. per lb, 9,080.

The net calorific value of this coal is approximately 570 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	=	59.0 — 0.59(M+1.22A)
Volatile matter	=	100 — (M+A+FC)
Calorific value, B.t.u./lb.	=	13,100 — 131(M+1.05A)

DISTRICT B

Canadian classification—Subbituminous C

Typical Analyses

Proximate			Ultimate (with 26.4% moisture)		
Moisture	%	26.4	Carbon	%	51.05
Ash	%	5.2	Hydrogen	%	6.35
Volatile matter	%	28.9	Sulphur	%	0.4
Fixed carbon	%	39.5	Nitrogen	%	1.0
			Oxygen	%	36.0
			Ash	%	5.2

Fuel ratio (FC/VM), 1.35.

Calorific value, gross, in B.t.u. per lb., 8,680.

The net calorific value of this coal is approximately 580 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	=	59.0 — 0.59(M+1.28A)
Volatile matter	=	100 — (M+A+FC)
Calorific value, B.t.u./lb.	=	12,800 — 128(M+1.13A)

DISTRICT C

This is the main producing district in this area.

Canadian classification—Subbituminous C

Typical Analyses

Proximate			Ultimate (with 28.4% moisture)		
Moisture	%	28.4	Carbon	%	50.25
Ash	%	4.5	Hydrogen	%	6.55
Volatile matter	%	28.7	Sulphur	%	0.4
Fixed carbon	%	38.4	Nitrogen	%	1.0
			Oxygen	%	37.3
			Ash	%	4.5

Fuel ratio (FC/VM), 1.35.

Calorific value, gross, in B.t.u. per lb., 8,540.

The net calorific value of this coal is approximately 600 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	=	58.0 — 0.58(M+1.18A)
Volatile matter	=	100 — (M+A+FC)
Calorific value, B.t.u./lb.	=	12,800 — 128(M+1.08A)

CARBON AREA

The mines produce an Alberta domestic coal—free burning and smokeless. Two ranks of coal are mined according to the Canadian classification, principally Subbituminous B, but also some Subbituminous A. Several seams are known, but production is principally from two seams. All are in the Edmonton horizon.

Thirteen mines (two stripping pits) were operated in 1943 and the output was 68,000 tons. The area is well served by the Canadian National and the Canadian Pacific railways; and most of the production is from mines on a railway.

Volume Weight Relation

Solid coal as in seam

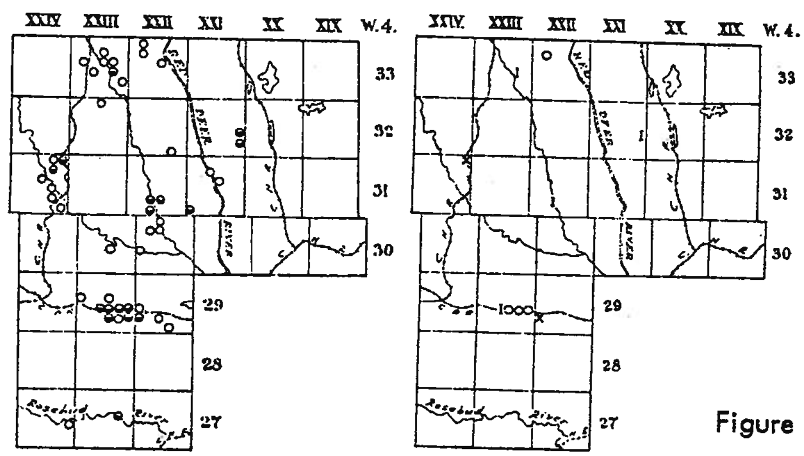
Percentage of Ash	5	10
Specific gravity	1.33	1.38
Tons per hundred cubic feet	4.15	4.30
Tons per acre foot	1,800	1,860

In addition to the typical and modified analyses given below reference has been made to coal from this area in the following sections of this report: storage (oxidation), solubility in alkalies and carbonization (L.T.C.).

Map 22 shows the location of all recorded mines opened, and also indicates the mines from which samples have been obtained.

Map 23 shows the location of operating mines graded by output in 1943.

Because of wide differences in analyses of coals from separate points, the area has been subdivided into 3 districts wherein similar coals occur. The districts are given, by townships, below the maps.



MAP 22 MAP 23

Figure 22

Scale: 20 miles to 1 inch. For symbols see page 93.

District	Township	Range
A	31-33	XXII-XXIV
B	31-32	XXI
C	29	XXII-XXIII

DISTRICT A

This is the principal producing district.
Canadian classification—Subbituminous B

Typical Analyses

Proximate		Ultimate (with 17.4% moisture)	
Moisture	% 17.4	Carbon	% 57.0
Ash	% 9.1	Hydrogen	% 5.6
Volatile matter	% 28.3	Sulphur	% 0.3
Fixed carbon	% 45.2	Nitrogen	% 0.9
		Oxygen	% 27.1
		Ash	% 9.1

Fuel ratio (FC/VM), 1.60.

Calorific value, gross, in B.t.u. per lb., 9,680.

The net calorific value of this coal is approximately 510 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon = 62.0 — 0.62(M+1.06A)
Volatile matter = 100 — (M+A+FC)
Calorific value, B.t.u./lb. = 13,400 — 134(M+1.14A)

DISTRICT B

Canadian classification—Subbituminous B

Typical Analyses

Proximate		Ultimate (with 19.3% moisture)	
Moisture	% 19.3	Carbon	% 55.5
Ash	% 8.1	Hydrogen	% 5.9
Volatile matter	% 29.6	Sulphur	% 0.3
Fixed carbon	% 43.0	Nitrogen	% 1.1
		Oxygen	% 29.1
		Ash	% 8.1

Fuel ratio (FC/VM), 1.45.

Calorific value, gross, in B.t.u. per lb., 9,380.

The net calorific value of this coal is approximately 540 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon = 61.0 — 0.61(M+1.26A)
Volatile matter = 100 — (M+A+FC)
Calorific value, B.t.u./lb. = 13,100 — 131(M+1.13A)

DISTRICT C

Canadian classification—the coal in this district is on the border line between Subbituminous A and Subbituminous B

Typical Analyses

Proximate		Ultimate (with 16.5% moisture)	
Moisture %	16.5	Carbon %	57.8
Ash %	8.8	Hydrogen %	5.7
Volatile matter %	31.1	Sulphur %	0.3
Fixed carbon %	43.6	Nitrogen %	1.2
		Oxygen %	26.2
		Ash %	8.8

Fuel ratio (FC/VM), 1.40.

Calorific value, gross, in B.t.u. per lb., 9,940.

The net calorific value of this coal is approximately 520 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	=	60.0 — 0.60(M+1.24A)
Volatile matter	=	100 — (M+A+FC)
Calorific value, B.t.u./lb.	=	13,500 — 135(M+1.13A)

CASTOR AREA

The mines produce an Alberta domestic coal—free burning and smokeless. Two ranks of coal are mined, according to the Canadian classification; the principal output is Subbituminous C, but some Subbituminous B is also mined. Several seams are known and mined, all in the Edmonton horizon.

Twenty-eight mines (three stripping pits) were operated in 1943 and the output was 60,000 tons. The area is well served by both the Canadian National and the Canadian Pacific railways, but many of the mines are on the banks of the Battle River.

Volume Weight Relation

Solid coal as in seam

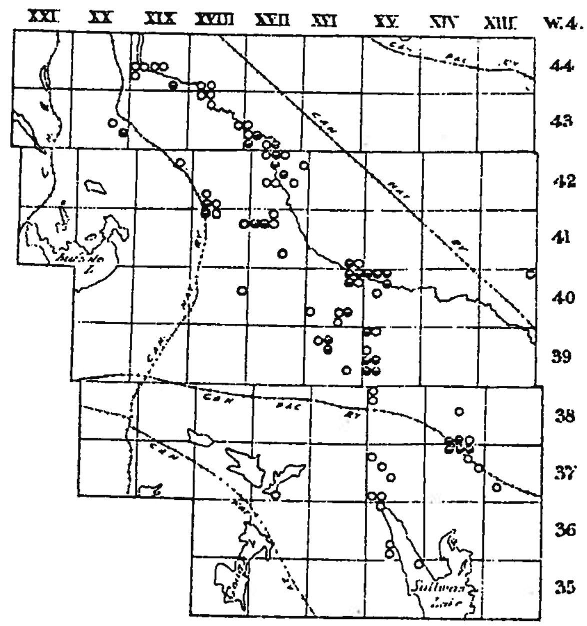
Percentage of Ash	5	10	15
Specific gravity	1.30	1.34	1.39
Tons per hundred cubic feet	4.05	4.20	4.30
Tons per acre foot	1,760	1,820	1,880

In addition to the typical and modified analyses given below reference has been made to coal from this area in the following sections of this report: solubility in alkalies, carbonization (L.T.C.).

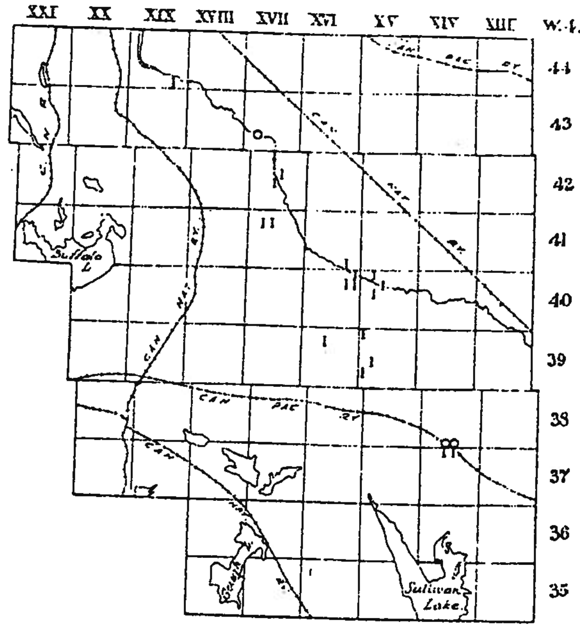
Map 26 shows the location of all recorded mines opened, and also indicates the mines from which samples have been obtained.

Map 27 shows the location of operating mines graded by output in 1943.

Because of wide differences in analyses of coals from separate points, the area has been subdivided into 3 districts wherein similar coals occur. The districts are given, by townships, below the maps.



MAP 26



MAP 27

Scale: 20 miles to 1 inch. For symbols see page 93.

Figure 23 (cont.)

District	Township	Range
A	41-44	XVII-XX
B	39-41	XV-XVI
C	37-38	XIV

DISTRICT A

Canadian classification—Subbituminous B and Subbituminous C

Typical Analyses

Proximate		Ultimate (with 25.2% moisture)	
Moisture	% 25.2	Carbon	% 50.9
Ash	% 6.7	Hydrogen	% 6.2
Volatile matter	% 29.0	Sulphur	% 0.4
Fixed carbon	% 39.1	Nitrogen	% 1.0
		Oxygen	% 34.8
		Ash	% 6.7

Fuel ratio (FC/VM), 1.35.

Calorific value, gross, in B.t.u. per lb., 8,710.

The net calorific value of this coal is approximately 570 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon $= 59.0 - 0.59(M+1.26A)$

Volatile matter $= 100 - (M+A+FC)$

Calorific value, B.t.u./lb. $= 12,800 - 128(M+1.00A)$

DISTRICT B

This is the main producing district.
Canadian classification—Subbituminous C

Typical Analyses

Proximate		Ultimate (with 26.4% moisture)	
Moisture	% 26.4	Carbon	% 50.25
Ash	% 6.3	Hydrogen	% 6.35
Volatile matter	% 29.0	Sulphur	% 0.4
Fixed carbon	% 38.3	Nitrogen	% 0.9
		Oxygen	% 35.8
		Ash	% 6.3

Fuel ratio (FC/VM), 1.30.

Calorific value, gross, in B.t.u. per lb., 8,550.

The net calorific value of this coal is approximately 580 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon = $58.0 - 0.58(M+1.22A)$
Volatile matter = $100 - (M+A+FC)$
Calorific value, B.t.u./lb. = $12{,}900 - 129(M+1.17A)$

DISTRICT C

Canadian classification—Subbituminous C

Typical Analyses

Proximate		Ultimate (with 29.5% moisture)	
Moisture	% 29.5	Carbon	% 47.0
Ash	% 6.2	Hydrogen	% 6.5
Volatile matter	% 28.6	Sulphur	% 0.4
Fixed carbon	% 35.7	Nitrogen	% 0.9
		Oxygen	% 39.0
		Ash	% 6.2

Fuel ratio (FC/VM), 1.25.

Calorific value, gross, in B.t.u. per lb., 7,980.

The net calorific value of this coal is approximately 590 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon = $57.0 - 0.57(M+1.28A)$
Volatile matter = $100 - (M+A+FC)$
Calorific value, B.t.u./lb. = $12{,}500 - 125(M+1.07A)$

CHAMPION AREA

The mines produce an Alberta domestic coal—free burning and smokeless. Two ranks of coal are mined according to the Canadian classification, Subbituminous A and also Subbituminous B. Several seams are known, all in the Edmonton horizon.

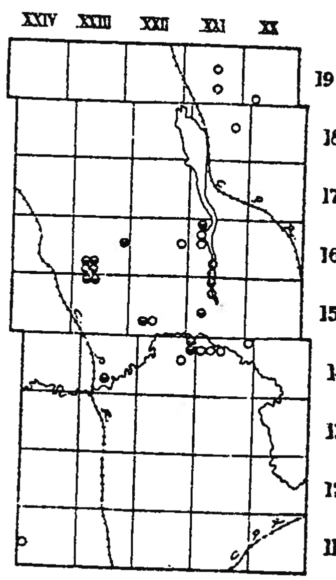
Four mines were operated in 1943 and the output was 12,000 tons. The area is served by three branches of the Canadian Pacific Railway, but none of the mines is on a railway.

In addition to the typical and modified analyses given below reference has been made to coal from this area in the following sections of this report: solubility in organic solvents, solubility in alkalies.

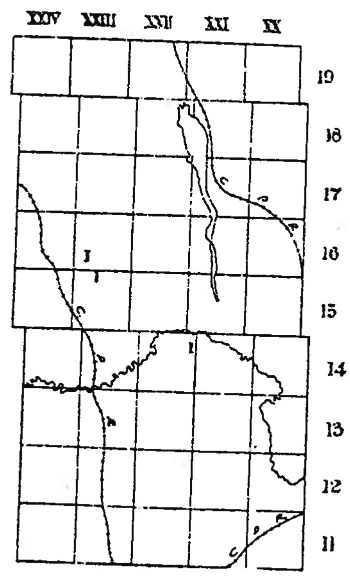
Map 28 shows the location of all recorded mines opened, and also indicates the mines from which samples have been obtained.

Map 29 shows the location of operating mines graded by output in 1943.

Because of wide differences in analyses of coals from separate points, the area has been subdivided into 3 districts wherein similar coals occur. The districts are given, by townships, below the maps.



MAP 28



MAP 29

Scale: 20 miles to 1 inch. For symbols see page 93.

Figure 24

District	Township	Range
A	14-16	XXIII
B	14-15	XXI-XXII
C	16	XXI

DISTRICT A

This is the largest producting district in the area.
Canadian classification—Subbituminous A

Volume Weight Relation

Solid coal as in seam

Percentage of Ash	5	10	15
Specific gravity	1.33	1.41	1.48
Tons per hundred cubic feet	4.15	4.40	4.60
Tons per acre foot	1,800	1,900	2,000

Typical Analyses

Proximate		Ultimate (with 12.7% moisture)	
Moisture	% 12.7	Carbon	% 61.5
Ash	% 7.4	Hydrogen	% 5.6
Volatile matter	% 34.9	Sulphur	% 0.5
Fixed carbon	% 45.0	Nitrogen	% 1.3
		Oxygen	% 23.7
		Ash	% 7.4

Fuel ratio, (FC/VM), 1.30.

Calorific value, gross, B.t.u. per lb., 10,690.

The net calorific value of this coal is approximately 510 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	= 57.0 — 0.57(M+1.16A)
Volatile matter	= 100 — (M+A+FC)
Calorific value, B.t.u./lb.	= 13,400 — 134(M+1.04A)

DISTRICT B

Canadian classification—Subbituminous A

Volume Weight Relation

Solid coal as in seam

Percentage of Ash	5	10	15
Specific gravity	1.35	1.40	1.45
Tons per hundred cubic feet	4.20	4.35	4.50
Tons per acre foot	1,840	1,900	1,960

Typical Analyses

Proximate		Ultimate (with 14.9% moisture)	
Moisture	% 14.9	Carbon	% 60.2
Ash	% 7.1	Hydrogen	% 5.6
Volatile matter	% 31.9	Sulphur	% 0.9
Fixed carbon	% 46.1	Nitrogen	% 1.4
		Oxygen	% 24.8
		Ash	% 7.1

Fuel ratio (VC VM), 1.45.

Calorific value, gross, in B.t.u. per lb., 10,320.

The net calorific value of this coal is approximately 510 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	=	60.0 — 0.60 (M+1.18A)
Volatile matter	=	100 — (M+A+FC)
Calorific value, B.t.u./lb.	=	13,300 — 133 (M+1.06A)

DISTRICT C

Canadian classification—Subbituminous B

Typical Analysis
Proximate

Moisture	%	17.3
Ash	%	8.3
Volatile matter	%	32.1
Fixed carbon	%	42.3

Fuel ratio (FC/VM), 1.3.

Calorific value, gross, in B.t.u. per lb., 9,830.

DRUMHELLER AREA

The mines produce an Alberta domestic coal—free burning and smokeless. This is by far the most important area for the production of such coal, both for home and outside markets. According to the Canadian classification the coal is Subbituminous B. Numerous seams are known, all in the Edmonton horizon, and five seams have been mined. A full description of this area can be found in Research Council of Alberta Report 4 (1921) and also in Report 34 (1943), part V, page 188.

Twenty-seven mines were operated in 1943 and the output was 1,839,000 tons. The area is well served by the Canadian Pacific and Canadian National railways. The mines are adjacent to a railway, and a considerable portion of the market for this coal is outside the Province.

Volume Weight Relation

Solid coal as in seam

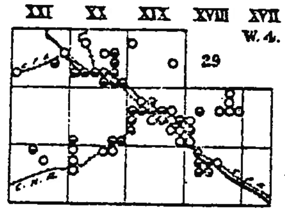
Percentage of Ash	5	10	15
Specific gravity	1.32	1.36	1.40
Tons per hundred cubic feet	4.10	4.25	4.35
Tons per acre foot	1,800	1,840	1,900

In addition to the typical and modified analyses given below reference has been made to coal from this area in the following sections of this report: storage (oxidation), pulverizability and grindability, fusibility of coal ash, solubility in organic solvents, solubility in alkalies, coal sizing and carbonization (L.T.C.).

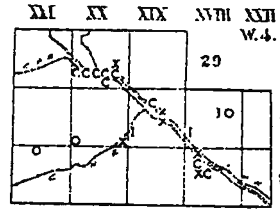
Map 34 shows the location of all recorded mines opened, and also indicates the mines from which samples have been obtained.

Map 35 shows the location of operating mines graded by output in 1943.

Because of wide differences in analyses of coals from separate points, the area has been subdivided into 3 districts wherein similar coals occur. The districts are given, by townships, below the maps.



MAP 34



MAP 35

Scale: 20 miles to 1 inch. For symbols see page 93.

Figure 25

District	Seam	Township	Range
A_1	1	29	XX-XXI
A_7	5 & 7	29	XX-XXI
B_1	1	28	XVIII-XX
		27	XXI
B_2	2	28	XVIII-XX
		27	XXI
C	......	27	XVIII

DISTRICT A—Seam 1 or Lower Seam

Canadian classification—Subbituminous B

Typical Analyses

Proximate		Ultimate (with 18.0% moisture)	
Moisture	% 18.0	Carbon	% 57.6
Ash	% 6.6	Hydrogen	% 5.7
Volatile matter	% 31.2	Sulphur	% 0.4
Fixed carbon	% 44.2	Nitrogen	% 1.2
		Oxygen	% 28.5
		Ash	% 6.6

Fuel ratio (FC/VM), 1.40.

Calorific value, gross, B.t.u. per lb., 10,020.

The net calorific value of this coal is approximately 520 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	=	$60.0 - 0.60(M + 1.26A)$
Volatile matter	=	$100 - (M + A + FC)$
Calorific value, B.t.u./lb.	=	$13{,}400 - 134(M + 1.10A)$

DISTRICT A—Seams 5 and 7 or Upper Seams

Canadian classification—Subbituminous B

Typical Analyses

Proximate		Ultimate (with 18.8% moisture)	
Moisture	% 18.8	Carbon	% 57.1
Ash	% 6.1	Hydrogen	% 5.8
Volatile matter	% 30.3	Sulphur	% 0.4
Fixed carbon	% 44.8	Nitrogen	% 1.2
		Oxygen	% 29.4
		Ash	% 6.1

Fuel ratio (FC/VM), 1.50.

Calorific value, gross, in B.t.u. per lb., 9,870.

The net calorific value of this coal is approximately 530 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	=	60.0 — 0.60(M+1.08A)
Volatile matter	=	100 — (M+A+FC)
Calorific value, B.t.u./lb.	=	13,400 — 134(M+1.24A)

DISTRICT B—Seam 1 or Lower Seam

Canadian classification—Subbituminous B

Typical Analyses

Proximate			Ultimate (with 18.8% moisture)		
Moisture	%	18.8	Carbon	%	56.7
Ash	%	6.9	Hydrogen	%	5.9
Volatile matter	%	31.3	Sulphur	%	0.5
Fixed carbon	%	43.0	Nitrogen	%	1.3
			Oxygen	%	28.7
			Ash	%	6.9

Fuel ratio (FC/VM), 1.35.

Calorific value, gross, in B.t.u. per lb., 9,780.

The net calorific value of this coal is approximately 540 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	=	59.0 — 0.59(M+1.20A)
Volatile matter	=	100 — (M+A+FC)
Calorific value, B.t.u./lb.	=	13,300 — 133(M+1.11A)

DISTRICT B—Seam 2 or Upper Seam

Canadian classification—Subbituminous B

Typical Analyses

Proximate			Ultimate (with 19.6% moisture)		
Moisture	%	19.6	Carbon	%	56.7
Ash	%	6.0	Hydrogen	%	5.9
Volatile matter	%	30.2	Sulphur	%	0.4
Fixed carbon	%	44.2	Nitrogen	%	1.2
			Oxygen	%	29.8
			Ash	%	6.0

Fuel ratio (FC/VM), 1.45.

Calorific value, gross, B.t.u. per lb., 9,730.

The net calorific value of this coal is approximately 540 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	$= 60.0 - 0.60(M+1.12A)$
Volatile matter	$= 100 - (M+A+FC)$
Calorific value, B.t.u./lb.	$= 13{,}300 - 133(M+1.20A)$

DISTRICT C

Canadian classification—Subbituminous B

Typical Analyses

Proximate			Ultimate (with 20.2% moisture)		
Moisture	%	20.2	Carbon	%	54.5
Ash	%	7.6	Hydrogen	%	5.9
Volatile matter	%	30.1	Sulphur	%	0.5
Fixed carbon	%	42.1	Nitrogen	%	1.2
			Oxygen	%	30.3
			Ash	%	7.6

Fuel ratio (FC/VM), 1.40.

Calorific value, gross, in B.t.u. per lb., 9,280.

The net calorific value of this coal is approximately 540 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	$= 60.0 - 0.60(M+1.28A)$
Volatile matter	$= 100 - (M+A+FC)$
Calorific value, B.t.u./lb.	$= 13{,}100 - 131(M+1.18A)$

EDMONTON AREA

The mines in this area produce an Alberta domestic coal; but the coal is also largely used for power production. It is free burning and smokeless. Two ranks of coal are mined according to the Canadian classification—Subbituminous B and Subbituminous C. Ten seams are known, all of them in the Edmonton horizon.

Twenty-nine mines were operated in 1943 and the output was 457,000 tons. The area is served by the Canadian National, the Canadian Pacific and the Northern Alberta railways. The principal producing mines are adjacent to a railway.

Volume Weight Relation

Solid coal as in seam

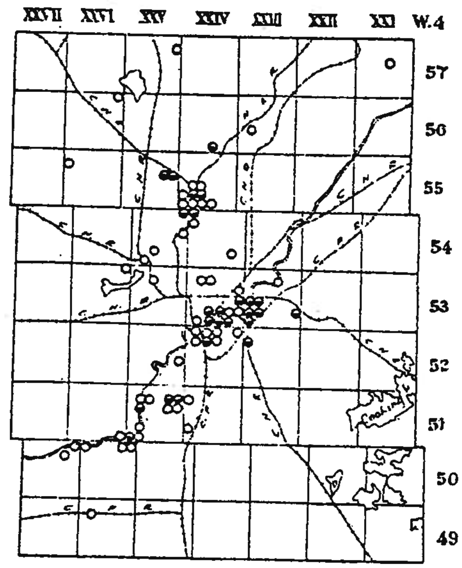
Percentage of Ash	5	10	15
Specific gravity	1.31	1.35	1.38
Tons per hundred cubic feet	4.10	4.20	4.30
Tons per acre foot	1,780	1,820	1,880

In addition to the typical and modified analyses given below reference has been made to coal from this area in the following sections of this report: storage (oxidation), fusibility of coal ash, solubility in organic solvents, coal sizing, and carbonization (L.T.C.).

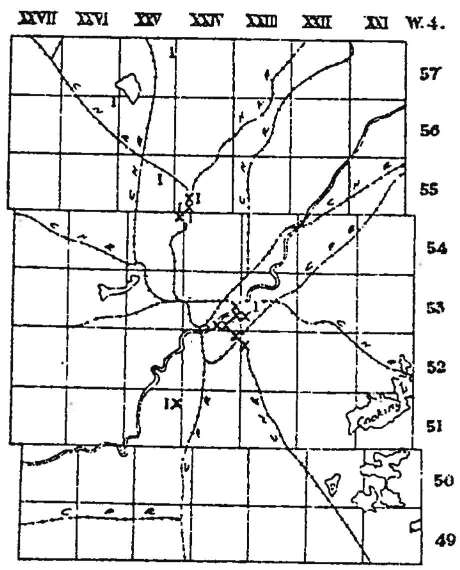
Map 36 shows the location of all recorded mines opened, and also indicates the mines from which samples have been obtained.

Map 37 shows the location of operating mines graded by output in 1943.

Because of wide differences in analyses of coals from separate points, the area has been subdivided into 3 districts wherein similar coals occur. The districts are given, by townships, below the maps.



MAP 36



MAP 37

Scale: 20 miles to 1 inch. For symbols see page 93.

Figure 26

District	Township	Range
A	54-56	XXIV-XXV
B	52-53	XXIII-XXIV
C	50-51	XXV-XXVI

DISTRICT A

Canadian classification—Subbituminous C and also Subbituminous B

Typical Analyses

Proximate		Ultimate (with 25.3% moisture)	
Moisture	% 25.3	Carbon	% 50.25
Ash	% 7.1	Hydrogen	% 6.15
Volatile matter	% 28.6	Sulphur	% 0.3
Fixed carbon	% 39.0	Nitrogen	% 1.0
		Oxygen	% 35.2
		Ash	% 7.1

Fuel ratio (FC/VM), 1.35.

Calorific value, gross, in B.t.u. per lb., 8,640.

The net calorific value of this coal is approximately 560 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon = 60.0 — 0.60(M+1.36A)
Volatile matter = 100 — (M+A+FC)
Calorific value, B.t.u./lb. = 12,800 — 128(M+1.02A)

DISTRICT B

This is the principal producing district in the area.

Canadian classification—Subbituminous B and Subbituminous C

Typical Analyses

Proximate		Ultimate (with 25.0% moisture)	
Moisture	% 25.0	Carbon	% 51.6
Ash	% 6.2	Hydrogen	% 6.2
Volatile matter	% 28.4	Sulphur	% 0.3
Fixed carbon	% 40.4	Nitrogen	% 1.0
		Oxygen	% 34.7
		Ash	% 6.2

Fuel ratio (FC/VM), 1.40.

Calorific value, gross, in B.t.u. per lb., 8,860.

The net calorific value of this coal is approximately 570 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon = 60.0 — 0.60(M+1.24A)
Volatile matter = 100 — (M+A+FC)
Calorific value, B.t.u./lb. = 12,900 — 129(M+1.02A)

DISTRICT C

The mines in this district are not as close to a railway as those in the other two districts.

Canadian classification—Subbituminous B

Typical Analyses

Proximate			Ultimate (with 23.3% moisture)		
Moisture	%	23.3	Carbon	%	53.5
Ash	%	6.5	Hydrogen	%	6.1
Volatile matter	%	28.5	Sulphur	%	0.3
Fixed carbon	%	41.7	Nitrogen	%	1.1
			Oxygen	%	32.5
			Ash	%	6.5

Fuel ratio (FC/VM), 1.45.

Calorific value, gross, in B.t.u. per lb., 9,160.

The net calorific value of this coal is approximately 560 B.t.u. per lb. lower than the gross value.

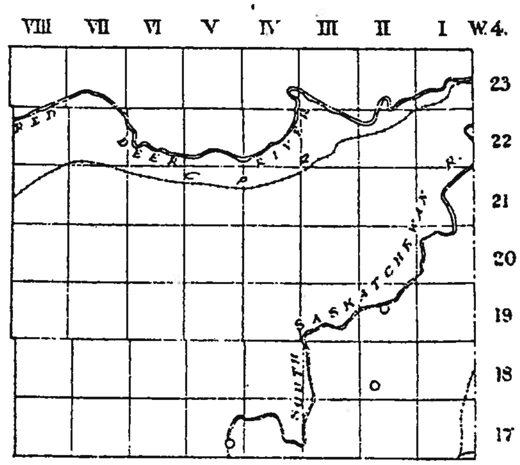
Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	=	60.0 — 0.60(M+1.10A)
Volatile matter	=	100 — (M+A+FC)
Calorific value, B.t.u./lb.	=	13,200 — 132(M+1.12A)

EMPRESS AREA

Map 38 shows the location of three recorded mines opened. No samples have been obtained.



MAP 38

Scale: 20 miles to 1 inch. For symbols see page 93.

Figure 27

GLEICHEN AREA

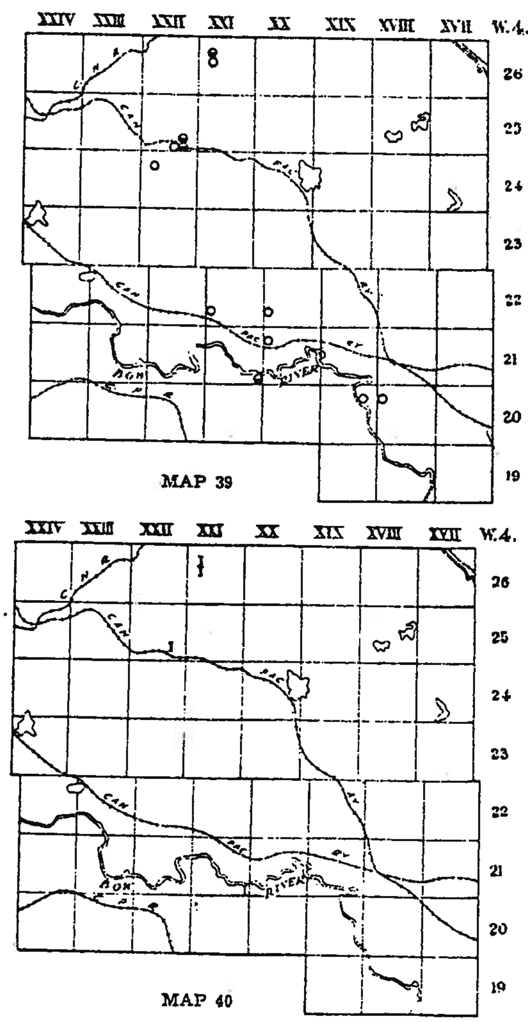
The mines produce an Alberta domestic coal, free burning and smokeless. According to the Canadian classification the coal is Subbituminous B. Three seams are known, all in the Edmonton horizon.

Five mines were operated in 1943 and the output was 21,000 tons. The area is served by the main line, and several branch lines, of the Canadian Pacific Railway, and one branch line of the Canadian National Railway.

In addition to the typical and modified analyses given below reference has been made to coal from this area in the following section of this report: solubility in organic solvents.

Map 39 shows the location of all recorded mines opened, and also indicates the mines from which samples have been obtained.

Map 40 shows the location of operating mines graded by output in 1943.



Scale: 20 miles to 1 inch. For symbols see page 93.

Figure 28

Typical Analyses

Proximate		Ultimate (with 17.6% moisture)	
Moisture	% 17.6	Carbon	% 55.25
Ash	% 9.5	Hydrogen	% 5.75
Volatile matter	% 31.0	Sulphur	% 0.3
Fixed carbon	% 41.9	Nitrogen	% 1.1
		Oxygen	% 28.1
		Ash	% 9.5

Fuel ratio (FC/VM), 1.35.

Calorific value, gross, in B.t.u. per lb., 9,570.

The net calorific value of this coal is approximately 520 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	=	61.0 — 0.61 (M+1.44A)
Volatile matter	=	100 — (M+A+FC)
Calorific value, B.t.u./lb.	=	13,400 — 134 (M+1.16A)

HALCOURT AREA

The coal has so far been developed for the domestic market, but it could also be used for power production. The coal is an Alberta domestic; it is free burning, weather resistant and only slightly smoky. Two ranks of coal are mined, according to the Canadian classification—High Volatile C Bituminous from the west and Sub-bituminous B from the east of the area.

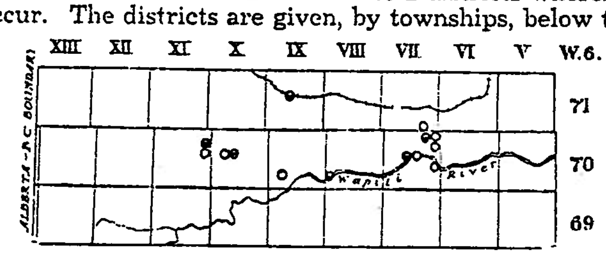
Several seams are known, but no thick seam has yet been found. These seams are all in the Belly River horizon. Five mines (two stripping pits) were operated in 1943 and the output was 1,900 tons. The Northern Alberta Railway Co. serves this area, but the operating mines are not on the railway.

In addition to the typical and modified analyses given below reference has been made to coal from this area in the following section of this report: storage (oxidation).

Map 41 shows the location of all recorded mines opened, and also indicates the mines from which samples have been obtained.

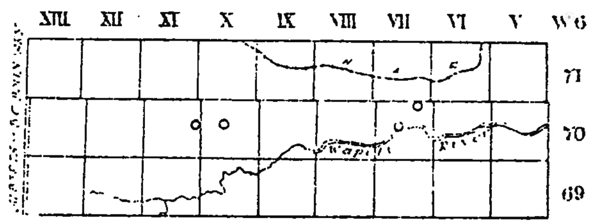
Map 42 shows the location of operating mines graded by output in 1943.

Because of wide differences in analyses of coals from separate points, the area has been subdivided into 2 districts wherein similar coals occur. The districts are given, by townships, below the maps.



MAP 41

Figure 29



MAP 42

Scale: 20 miles to 1 inch. For symbols see page 93.

Figure 29 (cont.)

District	Township	Range
A	70	VIII, X-XI
B	71	IX
	70	VII

DISTRICT A

Canadian classification—High Volatile C Bituminous

Typical Analyses

Proximate		Ultimate (with 13.0% moisture)	
Moisture	% 13.0	Carbon	% 64.1
Ash	% 7.0	Hydrogen	% 5.8
Volatile matter	% 32.9	Sulphur	% 0.4
Fixed carbon	% 47.1	Nitrogen	% 1.4
		Oxygen	% 21.3
		Ash	% 7.0

Fuel ratio (FC/VM), 1.45.

Calorific value, gross, in B.t.u. per lb., 11,290.

The net calorific value of this coal is approximately 530 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	=	59.0 — 0.59(M+1.04A)
Volatile matter	=	100 -- (M+A+FC)
Calorific value, B.t.u./lb.	=	14,100 — 141(M+1.00A)

DISTRICT B

Canadian classification—Subbituminous B

Volume Weight Relation

Solid coal as in seam

Percentage of Ash	5	10	15
Specific gravity	1.31	1.35	1.39
Tons per hundred cubic feet	4.10	4.20	4.35
Tons per acre foot	1,780	1,840	1,880

Typical Analyses

Proximate		Ultimate (with 15.5% moisture)	
Moisture	% 15.5	Carbon	% 60.6
Ash	% 8.5	Hydrogen	% 5.8
Volatile matter	% 30.7	Sulphur	% 0.4
Fixed carbon	% 45.3	Nitrogen	% 1.3
		Oxygen	% 23.4
		Ash	% 8.5

Fuel ratio (FC/VM), 1.50.

Calorific value, gross, in B.t.u. per lb., 10,600.

The net calorific value of this coal is approximately 530 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	=	60.0 — 0.60(M+1.06A)
Volatile matter	=	100 — (M+A+FC)
Calorific value, B.t.u./lb.	=	14,000 — 140(M+1.04A)

HIGH PRAIRIE AREA

Report 35 does not give any data for the two insignificant mines operated in the 1940's in Tp. 72, R. 20, W. 5th Mer. Both exploited the same three-foot seam of coal in Belly River equivalent strata.

LETHBRIDGE AREA

The coal is an Alberta domestic coal, but it is similar to the coals of certain other areas that have been regarded as Subbituminous. It is free burning, weather resistant and slightly smoky. This coal is widely used for domestic heating and for power production. According to the Canadian classification it is High Volatile C Bituminous.

Several seams are known, but only one seam is extensively worked. All seams are in the Belly River horizon. Nine mines were operated in 1943 and the output was 579,000 tons. The area has good railway facilities. These include the Crowsnest line, and several branch lines of the Canadian Pacific Railway. This area ships a large tonnage of coal outside the Province.

Volume Weight Relation

Solid coal as in seam

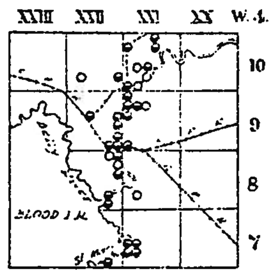
Percentage of Ash	5	10	15
Specific gravity	1.33	1.37	1.41
Tons per hundred cubic feet	4.15	4.25	4.40
Tons per acre foot	1,800	1,860	1,920

In addition to the typical and modified analyses given below reference has been made to coal from this area in the following sections of this report: storage (oxidation), fusibility of coal ash, solubility in organic solvents, solubility in alkalies, microstructure and spores, and coal sizing.

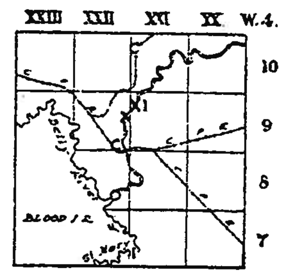
Map 44 shows the location of all recorded mines opened, and also indicates the mines from which samples have been obtained.

Map 45 shows the location of operating mines graded by output in 1943.

Because of wide differences in analyses of coals from separate points, the area has been subdivided into 3 districts wherein similar coals occur. The districts are given, by townships, below the maps.



MAP 44



MAP 45

Figure 30

Scale: 20 miles to 1 inch. For symbols see page 93.

District	Township	Range
A	9	XXI
	10	XXI-XXII
B	8-9	XXII
C	7	XXI-XXII

DISTRICT A

This is the main production district in the area.
Canadian classification—High Volatile C Bituminous

Typical Analyses

Proximate		Ultimate (with 11.7% moisture)	
Moisture %	11.7	Carbon %	61.3
Ash %	9.7	Hydrogen %	5.5
Volatile matter %	33.6	Sulphur %	0.6
Fixed carbon %	45.0	Nitrogen %	1.5
		Oxygen %	21.4
		Ash %	9.7

Fuel ratio (FC/VM), 1.35.

Calorific value, gross, in B.t.u. per lb., 10,680.

The net calorific value of this coal is approximately 500 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	=	59.0 — 0.59(M+1.24A)
Volatile matter	=	100 — (M+A+FC)
Calorific value, B.t.u./lb.	=	13,800 — 138(M+1.12A)

DISTRICT B

This is also a large production district.

Canadian classification—High Volatile C Bituminous

Typical Analyses

Proximate		Ultimate (with 10.7% moisture)	
Moisture	% 10.7	Carbon	% 62.55
Ash	% 9.8	Hydrogen	% 5.55
Volatile matter	% 34.7	Sulphur	% 0.5
Fixed carbon	% 44.8	Nitrogen	% 1.5
		Oxygen	% 20.1
		Ash	% 9.8

Fuel ratio (FC/VM), 1.30.

Calorific value, gross, in B.t.u. per lb., 10,960.

The net calorific value of this coal is approximately 510 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	=	59.0 — 0.59(M+1.36A)
Volatile matter	=	100 — (M+A+FC)
Calorific value, B.t.u./lb.	=	14,100 — 141(M+1.18A)

DISTRICT C

Canadian classification—High Volatile C Bituminous

Typical Analyses

Proximate		Ultimate (with 10.5% moisture)	
Moisture	% 10.5	Carbon	% 60.1
Ash	% 13.0	Hydrogen	% 5.4
Volatile matter	% 34.9	Sulphur	% 0.7
Fixed carbon	% 41.6	Nitrogen	% 1.3
		Oxygen	% 19.5
		Ash	% 13.0

Fuel ratio (FC/VM), 1.20.

Calorific value, gross, in B.t.u. per lb., 10,620.

The net calorific value of this coal is approximately 490 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	=	57.0 — 0.57(M+1.28A)
Volatile matter	=	100 — (M+A+FC)
Calorific value, B.t.u./lb.	=	14,000 — 140(M+1.05A)

MAGRATH AREA

Magrath area lies partly in the Plains region and partly in the Foothills. Data given in Report 35 pertain only to the Foothills portion and are therefore not reproduced here.

MILK RIVER AREA

The mines produce an Alberta domestic coal. It is free burning but slightly smoky. Two ranks of coal are mined, according to the Canadian classification, Subbituminous A and Subbituminous B.

Several thin seams occur. All seams are in the Belly River horizon. Two mines were operated (one a stripping pit) in 1943 and the output was 2,600 tons. This area is served by two branch lines of the Canadian Pacific Railway, but the operating mines are distant from the railway.

Volume Weight Relation

Solid coal as in seam

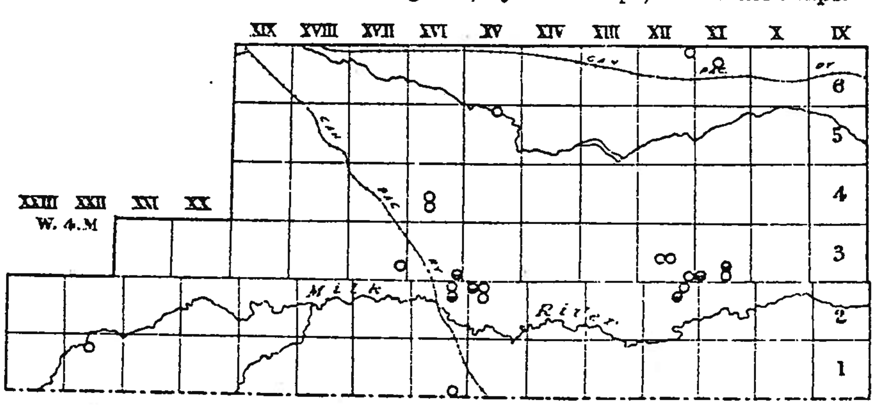
Percentage of Ash	5	10	15
Specific gravity	1.33	1.37	1.42
Tons per hundred cubic feet	4.15	4.25	4.40
Tons per acre foot	1,800	1,860	1,920

In addition to the typical and modified analyses given below reference has been made to coal from this area in the following section of this report: storage (oxidation).

Map 47 shows the location of all recorded mines opened, and also indicates the mines from which samples have been obtained.

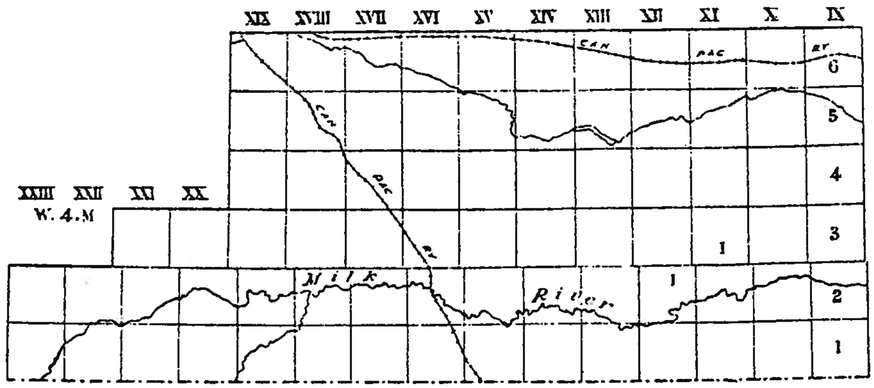
Map 48 shows the location of operating mines graded by output in 1943.

Because of wide differences in analyses of coals from separate points, the area has been subdivided into 2 districts wherein similar coals occur. The districts are given, by townships, below the maps.



MAP 47

Figure 31



MAP 48

Scale: 20 miles to 1 inch. For symbols see page 93.

Figure 31 (cont.)

District	Township	Range
A	2-3	XV-XVI
B	2-3	XI-XII

DISTRICT A

No mines listed as operating in this district.
Canadian classification—Subbituminous A

Typical Analyses

Proximate		Ultimate (with 14.0% moisture)	
Moisture	% 14.0	Carbon	% 57.25
Ash	% 12.0	Hydrogen	% 5.35
Volatile matter	% 30.2	Sulphur	% 0.9
Fixed carbon	% 43.8	Nitrogen	% 1.4
		Oxygen	% 23.1
		Ash	% 12.0

Fuel ratio (FC/VM), 1.45.

Calorific value, gross, in B.t.u. per lb., 10,000.

The net calorific value of this coal is approximately 490 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	$= 61.0 - 0.61(M+1.18A)$
Volatile matter	$= 100 - (M+A+FC)$
Calorific value, B.t.u./lb.	$= 13{,}700 - 137(M+1.08A)$

DISTRICT B

All coal mined in 1943 was from this district.
Canadian classification—Subbituminous B

Typical Analyses

Proximate		Ultimate (with 19.8% moisture)	
Moisture	% 19.8	Carbon	% 55.3
Ash	% 8.8	Hydrogen	% 5.8
Volatile matter	% 29.3	Sulphur	% 0.7
Fixed carbon	% 42.1	Nitrogen	% 1.1
		Oxygen	% 28.3
		Ash	% 8.8

Fuel ratio (FC/VM), 1.45.

Calorific value, gross, in B.t.u. per lb., 9,420.

The net calorific value of this coal is approximately 530 B.t.u. per lb. lower than the gross value.

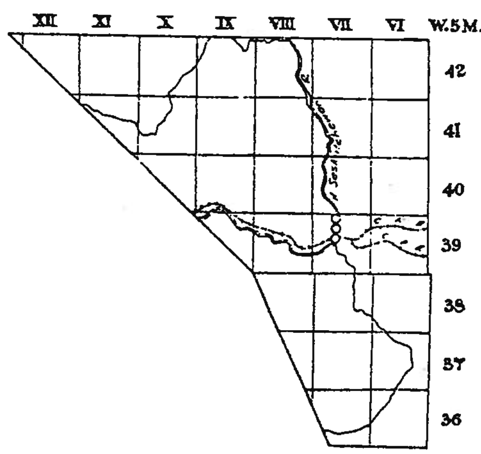
Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	=	59.0 — 0.59(M+1.00A)
Volatile matter	=	100 — (M+A+FC)
Calorific value, B.t.u./lb.	=	13,500 — 135(M+1.18A)

MOUNTAIN HOUSE AREA

Map No. 50 shows the location of three recorded mines opened. No samples have been obtained.



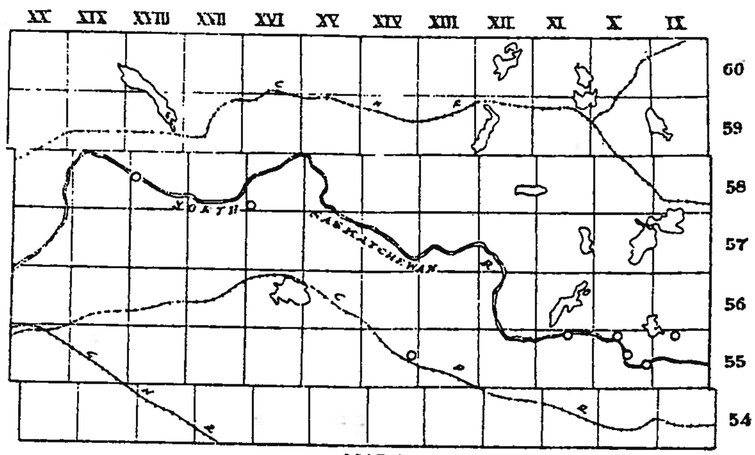
MAP 50

Scale: 20 miles to 1 inch. For symbols see page 93.

Figure 32

PAKAN AREA

Map 56 shows the location of all recorded mines opened. No samples have been obtained.



MAP 56

Scale: 20 miles to 1 inch. For symbols see page 93.

Figure 33

PAKOWKI AREA

The coal mined is an Alberta domestic coal. It is a free burning, smokeless coal, used locally for domestic heating. Two ranks of coal are mined according to the Canadian classification, Subbituminous C and Lignite.

Several seams are known, most of them in the Belly River horizon. One seam in the Cypress Hills, in the N.E. corner of the area, however, is in the Edmonton horizon. Three mines were operated in 1943 and the output was less than 500 tons. A branch line of the Canadian Pacific Railway crosses the area, but the mines opened have been distant from the railway.

Volume Weight Relation

Solid coal as in seam

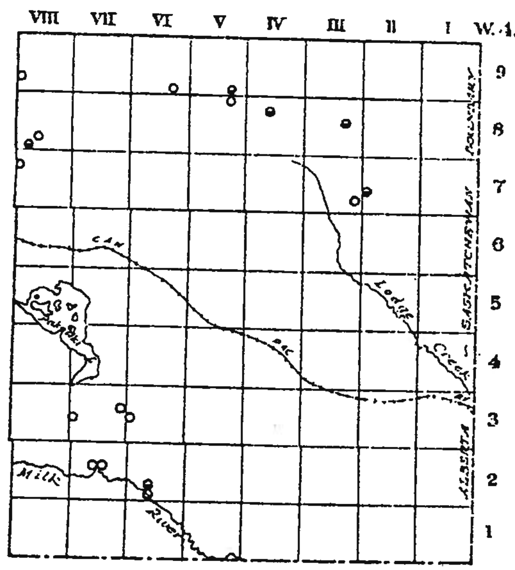
Percentage of Ash	5	10
Specific gravity	1.31	1.35
Tons per hundred cubic feet	4.05	4.20
Tons per acre foot	1,780	1,820

In addition to the typical and modified analyses given below reference has been made to coal from this area in the following sections of this report: solubility in organic solvents, solubility in alkalies.

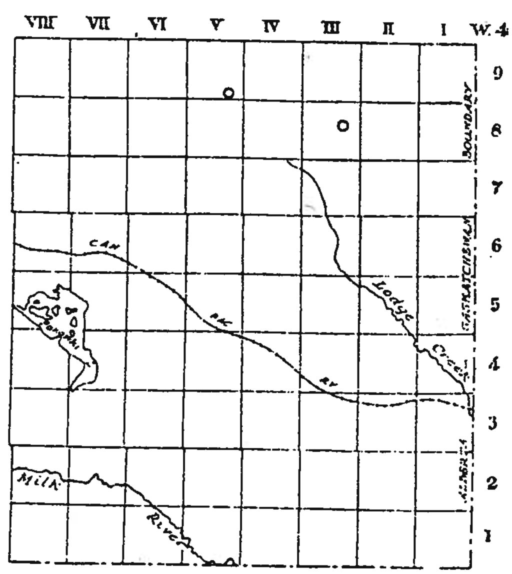
Map 57 shows the location of all recorded mines opened, and also indicates the mines from which samples have been obtained.

Map 58 shows the location of operating mines graded by output in 1943.

Because of wide differences in analyses of coals from separate points, the area has been subdivided into 3 districts wherein similar coals occur. The districts are given, by townships, below the maps.



MAP 57



MAP 58

Scale: 20 miles to 1 inch. For symbols see page 93.

Figure 34

District	Township	Range
A	8	VIII
	2	VI
B	9	V
	8	IV
C	8	III
	7	II

DISTRICT A

Canadian classification—Subbituminous C

Typical Analyses

Proximate			Ultimate (with 24.5% moisture)		
Moisture	%	24.5	Carbon	%	49.8
Ash	%	9.1	Hydrogen	%	6.0
Volatile matter	%	28.9	Sulphur	%	0.7
Fixed carbon	%	37.5	Nitrogen	%	1.0
			Oxygen	%	33.4
			Ash	%	9.1

Fuel ratio (FC/VM), 1.30.

Calorific value, gross, in B.t.u. per lb., 8,440.

The net calorific value of this coal is approximately 550 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	=	$57.0 - 0.57(M+1.07A)$
Volatile matter	=	$100 - (M+A+FC)$
Calorific value, B.t.u./lb.	=	$12{,}700 - 127(M+1.00A)$

DISTRICT B

Canadian classification—Subbituminous C and Lignite

Typical Analyses

Proximate			Ultimate (with 29.1% moisture)		
Moisture	%	29.1	Carbon	%	43.6
Ash	%	8.5	Hydrogen	%	6.2
Volatile matter	%	29.6	Sulphur	%	0.4
Fixed carbon	%	32.8	Nitrogen	%	0.8
			Oxygen	%	40.5
			Ash	%	8.5

Fuel ratio (FC/VM), 1.10.

Calorific value, gross, in B.t.u. per lb., 7,320.

The net calorific value of this coal is approximately 570 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	=	$54.0 - 0.54(M+1.20A)$
Volatile matter	=	$100 - (M+A+FC)$
Calorific value, B.t.u./lb.	=	$12{,}400 - 124(M+1.40A)$

DISTRICT C

Canadian classification—Lignite

Typical Analyses

Proximate		Ultimate (with 33.6% moisture)	
Moisture	% 33.6	Carbon	% 40.8
Ash	% 8.3	Hydrogen	% 6.7
Volatile matter	% 28.4	Sulphur	% 0.2
Fixed carbon	% 29.7	Nitrogen	% 0.6
		Oxygen	% 43.4
		Ash	% 8.3

Fuel ratio (FC/VM), 1.05.

Calorific value, gross, in B.t.u. per lb., 6,870.

The net calorific value of this coal is approximately 610 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	=	53.0 — 0.53(M+1.26A)
Volatile matter	=	100 — (M+A+FC)
Calorific value, B.t.u./lb.	=	11,900 — 119(M+1.04A)

PEMBINA AREA

The mines produce an Alberta domestic coal; it is free burning and smokeless. According to the Canadian classification the coal is Subbituminous B. Two or more seams have been mined, all in the Edmonton horizon.

Six mines (two stripping pits) were operated in 1943 and the output was 54,000 tons. The area is crossed by three Canadian National railway lines. The principal production is on the main line of the C.N.R.

Volume Weight Relation

Solid coal as in seam

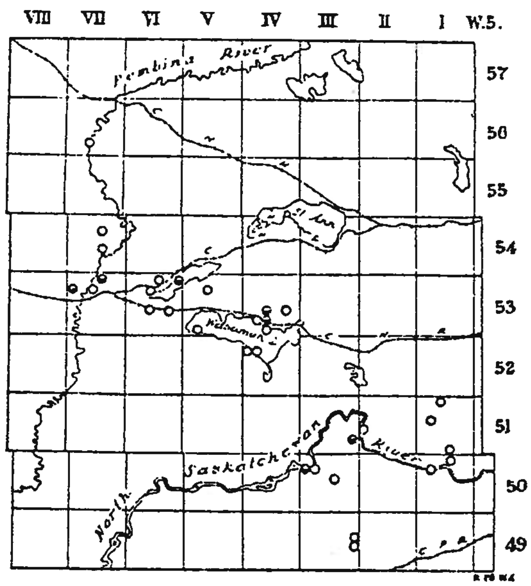
Percentage of Ash	5	10	15
Specific gravity	1.34	1.39	1.44
Tons per hundred cubic feet	4.15	4.30	4.45
Tons per acre foot	1,820	1,900	1,960

In addition to the typical and modified analyses given below reference has been made to coal from this area in the following section of this report: coal sizing.

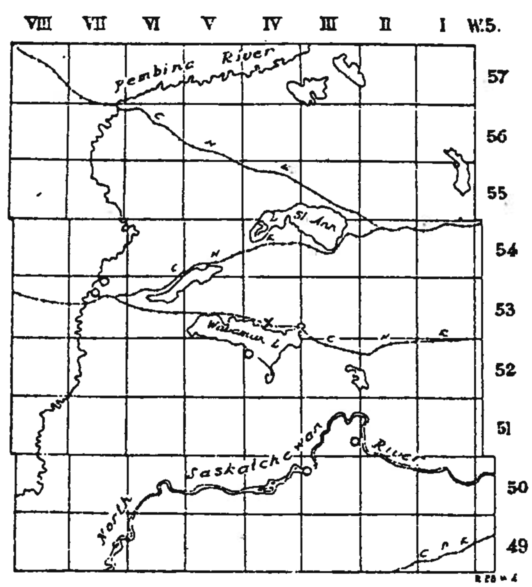
Map 61 shows the location of all recorded mines opened, and also indicates the mines from which samples have been obtained.

Map 62 shows the location of operating mines graded by output in 1943.

Because of wide differences in analyses of coals from separate points, the area has been subdivided into 3 districts wherein similar coals occur. The districts are given, by townships, below the maps.



MAP 61



MAP 62

Scale: 20 miles to 1 inch. For symbols see page 93.

Figure 35

District	Township	Range
A	53	VII
B	53	IV
C	50-51	III

DISTRICT A

Canadian classification—Subbituminous B

Typical Analyses

Proximate		Ultimate (with 19.3% moisture)	
Moisture	% 19.3	Carbon	% 53.8
Ash	% 10.3	Hydrogen	% 5.4
Volatile matter	% 26.7	Sulphur	% 0.2
Fixed carbon	% 43.7	Nitrogen	% 0.8
		Oxygen	% 29.5
		Ash	% 10.3

Fuel ratio (FC/VM), 1.65.

Calorific value, gross, in B.t.u. per lb., 9,070.

The net calorific value of this coal is approximately 490 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	=	63.0 — 0.63(M+1.10A)
Volatile matter	=	100 — (M+A+FC)
Calorific value, B.t.u./lb.	=	13,000 — 130(M+1.06A)

DISTRICT B

This is now the main producing district.

Canadian classification—Subbituminous B

Typical Analyses

Proximate		Ultimate (with 21.4% moisture)	
Moisture	% 21.4	Carbon	% 53.0
Ash	% 8.0	Hydrogen	% 5.7
Volatile matter	% 28.3	Sulphur	% 0.8
Fixed carbon	% 42.3	Nitrogen	% 0.7
		Oxygen	% 31.8
		Ash	% 8.0

Fuel ratio (FC/VM), 1.50.

Calorific value, gross, in B.t.u. per lb., 8,920.

The net calorific value of this coal is approximately 520 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	=	62.0 — 0.62(M+1.30A)
Volatile matter	=	100 — (M+A+FC)
Calorific value, B.t.u./lb.	=	12,900 — 129(M+1.18A)

DISTRICT C

This district is remote from a railway.
Canadian classification—Subbituminous B

Only two samples tested; an average analysis follows:

Proximate

Moisture	%	20.5
Ash	%	6.3
Volatile matter	%	28.7
Fixed carbon	%	44.5

Fuel ratio (FC/VM), 1.55.

Calorific value, gross, in B.t.u. per lb., 9,500.

REDCLIFF AREA

The mines produce Alberta domestic coal, free burning and smokeless. According to the Canadian classification it is Subbituminous C coal.

The coal is mined from one seam in the Belly River horizon. Two mines were operated in 1943 and the output was 28,000 tons. The main line of the Canadian Pacific Railway crosses this area, and both mines are adjacent to the railway.

Volume Weight Relation

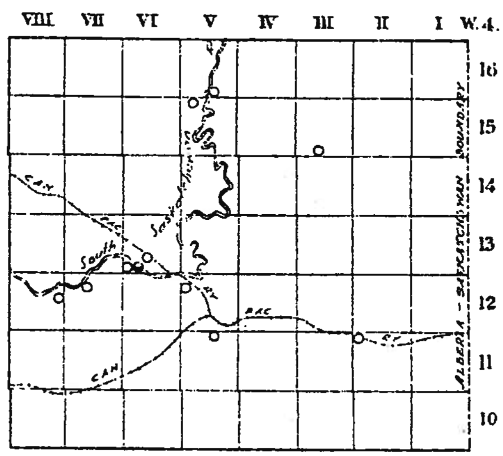
Solid coal as in seam

Percentage of Ash	5
Specific gravity	1.32
Tons per hundred cubic feet	4.10
Tons per acre foot	1,780

In addition to the typical and modified analyses given below reference has been made to coal from this area in the following sections of this report: storage (oxidation), and solubility in alkalies.

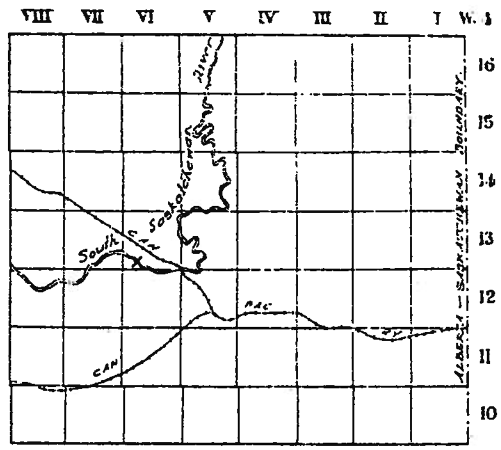
Map 67 shows the location of all recorded mines opened, and also indicates the mines from which samples have been obtained.

Map 68 shows the location of operating mines graded by output in 1943.



MAP 67

Figure 36



MAP 68

Scale: 20 miles to 1 inch. For symbols see page 93.

Figure 36 (cont.)

Typical Analyses

Proximate			Ultimate (with 25.8% moisture)		
Moisture	%	25.8	Carbon	%	50.5
Ash	%	7.0	Hydrogen	%	6.2
Volatile matter	%	27.8	Sulphur	%	0.5
Fixed carbon	%	39.4	Nitrogen	%	0.9
			Oxygen	%	34.9
			Ash	%	7.0

Fuel ratio (FC/VM), 1.40.

Calorific value, gross, in B.t.u. per lb., 8,540.

The net calorific value of this coal is approximately 570 B.t.u. per lb. lower than the gross value.

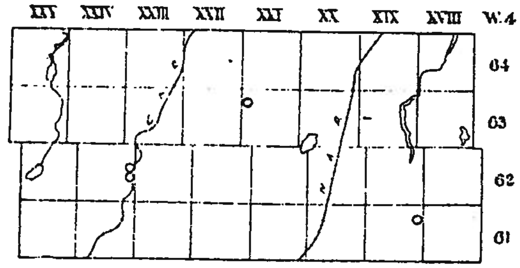
Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon = 59.0 — 0.59(M+1.06A)
Volatile matter = 100 — (M+A+FC)
Calorific value, B.t.u./lb. = 12,900 — 129(M+1.14A)

ROCHESTER AREA

Map 70 shows the location of four recorded mines opened. No samples have been obtained.



MAP 70

Scale: 20 miles to 1 inch. For symbols see page 93.

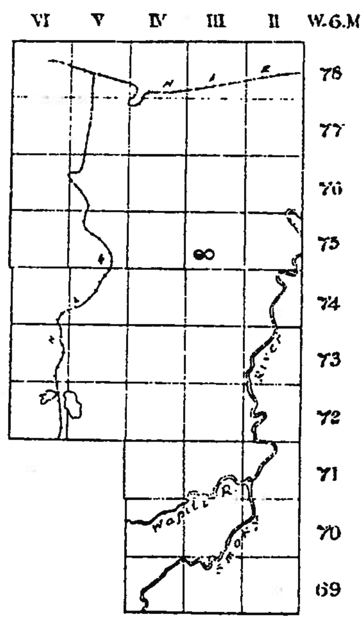
Figure 37

SEXSMITH AREA

The coal is an Alberta domestic coal; free burning and smokeless. According to the Canadian classification it is Subbituminous C. Seams are known, in both the Belly River and Edmonton horizons, but all are thin.

No mines were operated in 1943. Branches of the Northern Alberta Railway serve the area.

Map 73 shows the location of all recorded mines opened, and also indicates the mines from which samples have been obtained.



MAP 73

Scale: 20 miles to 1 inch. For symbols see page 93.

Figure 38

Typical Analysis

Proximate

Moisture	%	29.6
Ash	%	6.9
Volatile matter	%	27.2
Fixed carbon	%	36.3

Fuel ratio (FC/VM), 1.3.

Calorific value, gross, in B.t.u. per lb., 8,090.

SHEERNESS AREA

The mines produce an Alberta domestic coal, free burning and smokeless. According to the Canadian classification the coal is Subbituminous C. Several seams are known, all in the Edmonton horizon. A description of this field can be found in Report 33, Research Council of Alberta (1935), p. 31.

Eight mines (seven stripping pits) were operated in 1943 and the output was 59,000 tons. The area is served by branches of the Canadian National Railway and the largest producing mines are on a railway. A considerable portion of the market for this coal is outside the Province.

Volume Weight Relation

Solid coal as in seam

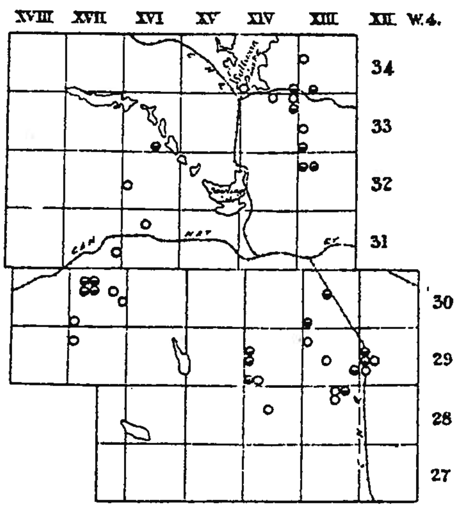
Percentage of Ash	5	10	15
Specific gravity	1.31	1.36	1.38
Tons per hundred cubic feet	4.10	4.25	4.30
Tons per acre foot	1,780	1,840	1,880

In addition to the typical and modified analyses given below reference has been made to coal from this area in the following sections of this report: storage (oxidation), fusibility of coal ash, solubility in organic solvents, solubility in alkalies, and carbonization (L.T.C.).

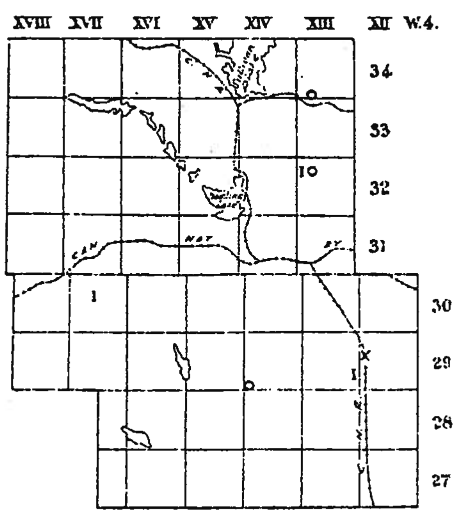
Map 74 shows the location of all recorded mines opened, and also indicates the mines from which samples have been obtained.

Map 75 shows the location of operating mines graded by output in 1943.

Because of wide differences in analyses of coals from separate points, the area has been subdivided into 5 districts wherein similar coals occur. The districts are given, by townships, below the maps.



MAP 74



MAP 75

Scale: 20 miles to 1 inch. For symbols see page 93.

Figure 39

District	Township	Range
A	33	XVI
B	32-34	XIII-XIV
C	30	XVII
D	29	XIV
E	28-30	XII-XIII

DISTRICT A

No mines operated in 1943.
Canadian classification—Subbituminous C

Typical Analysis

Proximate

Moisture	%	25.9
Ash	%	7.4
Volatile matter	%	27.4
Fixed carbon	%	39.3

Fuel ratio (FC/VM), 1.45.
Calorific value, gross, in B.t.u. per lb., 8,150.

DISTRICT B

Canadian classification—Subbituminous C

Typical Analyses

Proximate			Ultimate (with 28.8% moisture)		
Moisture	%	28.8	Carbon	%	45.6
Ash	%	8.2	Hydrogen	%	6.4
Volatile matter	%	28.0	Sulphur	%	0.4
Fixed carbon	%	35.0	Nitrogen	%	0.9
			Oxygen	%	38.5
			Ash	%	8.2

Fuel ratio (FC/VM), 1.25.
Calorific value, gross, in B.t.u. per lb., 7,730.
The net calorific value of this coal is approximately 580 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	=	57.0 — 0.57(M+1.20A)
Volatile matter	=	100 — (M+A+FC)
Calorific value, B.t.u./lb.	=	12,500 — 125(M+1.14A)

DISTRICT C

Canadian classification—Subbituminous C

Typical Analyses

Proximate			Ultimate (with 24.3% moisture)		
Moisture	%	24.3	Carbon	%	49.95
Ash	%	8.7	Hydrogen	%	5.95
Volatile matter	%	27.6	Sulphur	%	0.3
Fixed carbon	%	39.4	Nitrogen	%	0.8
			Oxygen	%	34.3
			Ash	%	8.7

Fuel ratio (FC/VM), 1.45.
Calorific value, gross, in B.t.u. per lb., 8,370.
The net calorific value of this coal is approximately 540 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	= 61.0 — 0.61 (M+1.28A)
Volatile matter	= 100 — (M+A+FC)
Calorific value, B.t.u./lb.	= 12,500 — 125 (M+1.00A)

DISTRICT D

Canadian classification—Subbituminous C

Typical Analyses

Proximate		Ultimate (with 25.4% moisture)	
Moisture	% 25.4	Carbon	% 51.2
Ash	% 6.0	Hydrogen	% 6.3
Volatile matter	% 29.3	Sulphur	% 0.5
Fixed carbon	% 39.3	Nitrogen	% 1.0
		Oxygen	% 35.0
		Ash	% 6.0

Fuel ratio (FC/VM), 1.35.

Calorific value, gross, in B.t.u. per lb., 8,720.

The net calorific value of this coal is approximately 570 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	= 58.0 — 0.58 (M+1.14A)
Volatile matter	= 100 — (M+A+FC)
Calorific value, B.t.u./lb.	= 12,700 — 127 (M+1.00A)

DISTRICT E

This is the principal producing district in the area.

Canadian classification—Subbituminous C

Typical Analyses

Proximate		Ultimate (with 27.5% moisture)	
Moisture	% 27.5	Carbon	% 49.0
Ash	% 5.9	Hydrogen	% 6.3
Volatile matter	% 28.8	Sulphur	% 0.4
Fixed carbon	% 37.8	Nitrogen	% 0.9
		Oxygen	% 37.5
		Ash	% 5.9

Fuel ratio (FC/VM), 1.30.

Calorific value, gross, in B.t.u. per lb., 8,180.

The net calorific value of this coal is approximately 570 B.t.u. per lb. lower than the gross value.

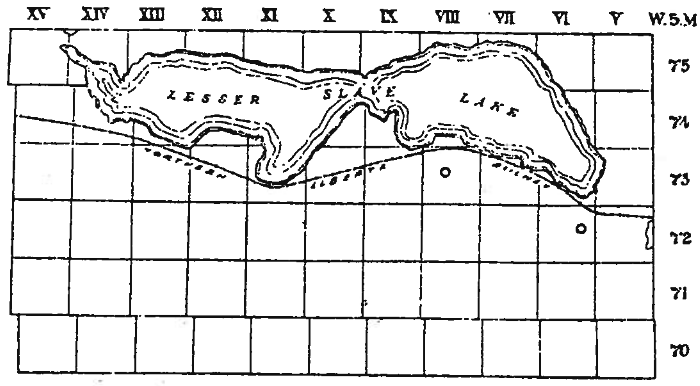
Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	= 57.0 — 0.57 (M+1.04A)
Volatile matter	= 100 — (M+A+FC)
Calorific value, B.t.u./lb.	= 12,600 — 126 (M+1.04A)

SLAVE AREA

Map 76 shows the location of two recorded mines opened. No samples have been obtained.



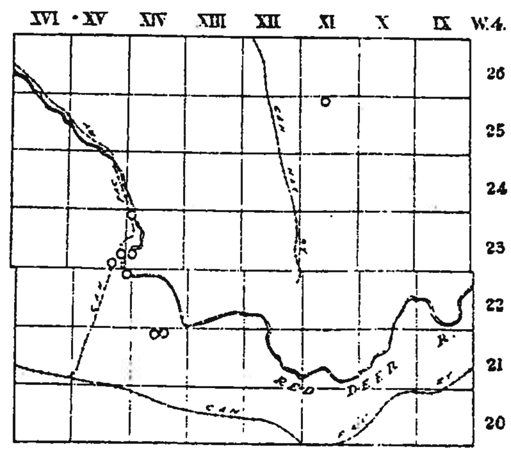
MAP 76

Scale: 20 miles to 1 inch. For symbols see page 93.

Figure 40

STEVEVILLE AREA

Map 77 shows the location of all recorded mines opened. No samples have been obtained.



MAP 77

Scale: 20 miles to 1 inch. For symbols see page 93.

Figure 41

TABER AREA

The mines produce an Alberta domestic coal. It is free burning and smokeless. Two ranks of coal are mined according to the Canadian classification, Subbituminous A and Subbituminous B.

Numerous seams of coal occur, all in the Belly River horizon.

Seven mines (four stripping pits) were operated in 1943 and the output was 21.000 tons. The area is well served by the Canadian Pacific Railway.

Volume Weight Relation

Solid coal as in seam

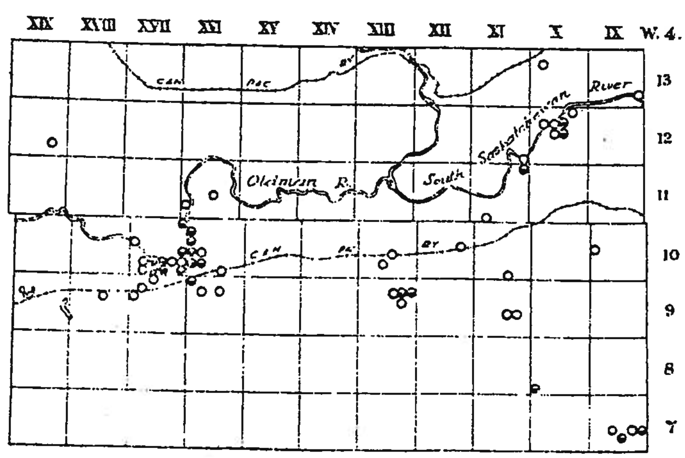
Percentage of Ash	5	10	15
Specific gravity	1.33	1.37	1.42
Tons per hundred cubic feet	4.15	4.25	4.40
Tons per acre foot	1,800	1,860	1,920

In addition to the typical and modified analyses given below reference has been made to coal from this area in the following sections of this report: storage (oxidation), solubility in alkalies, and carbonization (L.T.C.).

Map 78 shows the location of all recorded mines opened, and also indicates the mines from which samples have been obtained.

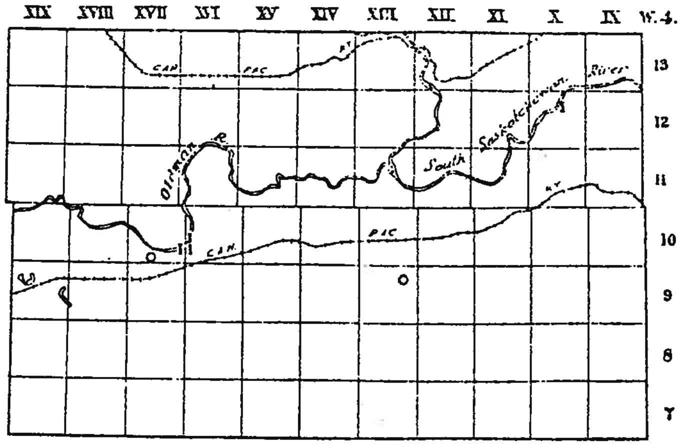
Map 79 shows the location of operating mines graded by output in 1943.

Because of wide differences in analyses of coals from separate points, the area has been subdivided into 4 districts wherein similar coals occur. The districts are given, by townships, below the maps.



MAP 78

Figure 42



MAP 79

Scale: 20 miles to 1 inch. For symbols see page 93.

Figure 42 (cont.)

District	Township	Range
A	9-10	XVI-XVIII
B	9	XIII
C	11	XI
	12	X
D	8	X
	7	IX

DISTRICT A

This was the main producing district in 1943.
Canadian classification—Subbituminous A

Typical Analyses

Proximate		Ultimate (with 15.3% moisture)	
Moisture	% 15.3	Carbon	% 56.8
Ash	% 10.2	Hydrogen	% 5.6
Volatile matter	% 31.5	Sulphur	% 1.2
Fixed carbon	% 43.0	Nitrogen	% 1.4
		Oxygen	% 24.8
		Ash	% 10.2

Fuel ratio (FC/VM), 1.35.

Calorific value, gross, in B.t.u. per lb., 9,580.

The net calorific value of this coal is approximately 510 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon = 59.0 — 0.59(M+1.16A)
Volatile matter = 100 — (M+A+FC)
Calorific value, B.t.u./lb. = 13,600 — 136(M+1.08A)

DISTRICT B

Canadian classification—Subbituminous B

Typical Analyses

Proximate		Ultimate (with 18.5% moisture)	
Moisture	% 18.5	Carbon	% 54.6
Ash	% 9.4	Hydrogen	% 5.8
Volatile matter	% 30.8	Sulphur	% 1.1
Fixed carbon	% 41.3	Nitrogen	% 1.1
		Oxygen	% 28.0
		Ash	% 9.4

Fuel ratio (FC/VM), 1.35.

Calorific value, gross, in B.t.u. per lb., 9,440.

The net calorific value of this coal is approximately 530 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	= 58.0 — 0.58(M+1.09A)
Volatile matter	= 100 — (M+A+FC)
Calorific value, B.t.u./lb.	= 13,300 — 133(M+1.12A)

DISTRICT C

Canadian classification—Subbituminous B

Typical Analyses

Proximate		Ultimate (with 22.5% moisture)	
Moisture	% 22.5	Carbon	% 53.35
Ash	% 7.4	Hydrogen	% 5.95
Volatile matter	% 28.7	Sulphur	% 0.6
Fixed carbon	% 41.4	Nitrogen	% 1.0
		Oxygen	% 31.7
		Ash	% 7.4

Fuel ratio (FC/VM), 1.45.

Calorific value, gross, in B.t.u. per lb., 9,060.

The net calorific value of this coal is approximately 540 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	= 59.0 — 0.59(M+1.00A)
Volatile matter	= 100 — (M+A+FC)
Calorific value, B.t.u./lb.	= 13,200 — 132(M+1.20A)

DISTRICT D

No operating mines listed.

Canadian classification—Subbituminous B

Typical Analysis

Proximate

Moisture	% 22.5
Ash	% 10.1
Volatile matter	% 29.5
Fixed carbon	% 37.9

Fuel ratio (FC/VM), 1.30.

Calorific value, gross, in B.t.u. per lb., 8,700.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	= 57.0 — 0.57(M+1.10A)
Volatile matter	= 100 — (M+A+FC)
Calorific value, B.t.u./lb.	= 13,100 — 131(M+1.10A)

TOFIELD AREA

The mines produce an Alberta domestic coal, free burning and smokeless. According to the Canadian classification the coal is Subbituminous C. Several seams are known, all in the Edmonton horizon, but only the top seam is mined.

Four mines (two stripping pits) were operated in 1943 and the output was 85,000 tons. The area is served by several lines of the Canadian National Railway, and the mines are adjacent to a railway. A considerable portion of the market for this coal is outside the Province.

Volume Weight Relation

Solid coal as in seam

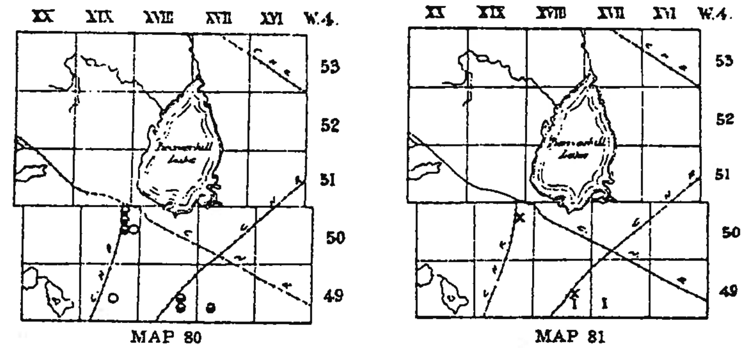
Percentage of Ash	5
Specific gravity	1.30
Tons per hundred cubic feet	4.05
Tons per acre foot	1,760

In addition to the typical and modified analyses given below reference has been made to coal from this area in the following sections of this report: fusibility of coal ash, coal sizing, and carbonization (L.T.C.).

Map 80 shows the location of all recorded mines opened, and also indicates the mines from which samples have been obtained.

Map 81 shows the location of operating mines graded by output in 1943.

Because of wide differences in analyses of coals from separate points, the area has been subdivided into 2 districts wherein similar coals occur. The districts are given, by townships, below the maps.



Scale: 20 miles to 1 inch. For symbols see page 93.

Figure 43

District	Township	Range
A	50	XIX
B	49	XVII-XVIII

DISTRICT A

This is the main producing district in the area.
Canadian classification—Subbituminous C

Typical Analyses

Proximate		Ultimate (with 28.1% moisture)	
Moisture	% 28.1	Carbon	% 49.6
Ash	% 5.4	Hydrogen	% 6.4
Volatile matter	% 28.0	Sulphur	% 0.4
Fixed carbon	% 38.5	Nitrogen	% 0.9
		Oxygen	% 37.3
		Ash	% 5.4

Fuel ratio (FC/VM), 1.40.
Calorific value, gross, in B.t.u. per lb., 8,520.
The net calorific value of this coal is approximately 580 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

Fixed carbon	=	58.0 — 0.58(M+1.04A)
Volatile matter	=	100 — (M+A+FC)
Calorific value, B.t.u./lb.	=	12,700 — 127(M+1.00A)

DISTRICT B

Canadian classification—Subbituminous C

Typical Analyses

Proximate		Ultimate (with 28.4% moisture)	
Moisture	% 28.4	Carbon	% 47.3
Ash	% 7.5	Hydrogen	% 6.3
Volatile matter	% 27.9	Sulphur	% 0.6
Fixed carbon	% 36.2	Nitrogen	% 0.9
		Oxygen	% 37.4
		Ash	% 7.5

Fuel ratio (FC/VM), 1.30.
Calorific value, gross, in B.t.u. per lb., 8,070.
The net calorific value of this coal is approximately 570 B.t.u. per lb. lower than the gross value.

Modified Proximate Analysis

The following equations are provided to enable operators to tender on coals with moisture or ash differing from those of the typical analysis. See page 28 for method of use.

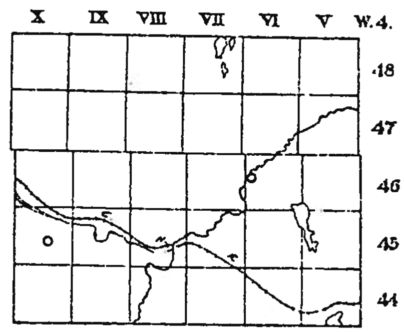
Fixed carbon	=	57.0 — 0.57(M+1.07A)
Volatile matter	=	100 — (M+A+FC)
Calorific value, B.t.u./lb.	=	12,700 — 127(M+1.07A)

VALHALLA AREA

No mines have ever been opened in this area, nor has any coal been reported.

WAINWRIGHT AREA

Map 82 shows the location of two recorded mines opened. No samples have been obtained.



MAP 82

Scale: 20 miles to 1 inch. For symbols see page 93. Figure 44

WESTLOCK AREA

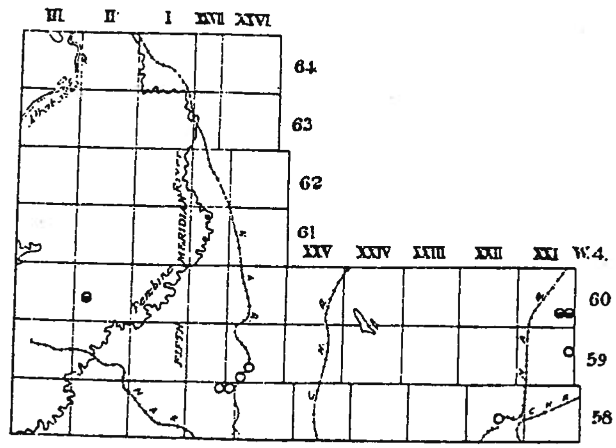
The coal is an Alberta domestic coal, free burning and smokeless. According to the Canadian classification it is Subbituminous C. Seams are known in both the Belly River and Edmonton horizons, but production has been from the former only.

Two mines, both stripping pits, were operated in 1943 and the output was 7,000 tons. The area is well served by the Northern Alberta and the Canadian National railways.

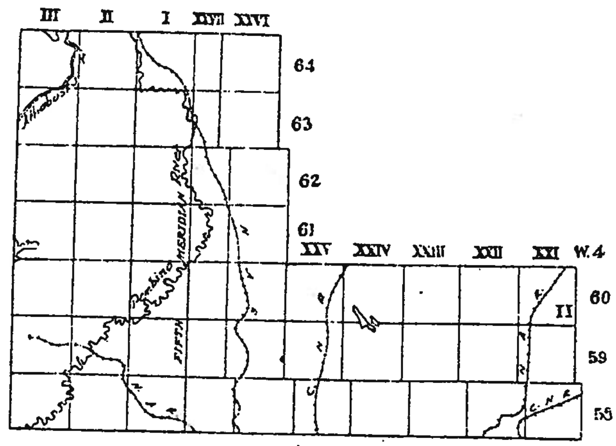
Map 83 shows the location of all recorded mines opened, and also indicates the mines from which samples have been obtained.

Map 84 shows the location of operating mines graded by output in 1943.

Because of wide differences in analyses of coals from separate points, the area has been subdivided into 2 districts wherein similar coals occur. The districts are given, by townships, below the maps.



MAP 83



MAP 84

Scale: 20 miles to 1 inch. For symbols see page 93.

Figure 45

District	Township	Range	Meridian
A	60	II	W 5
B	60	XXI	W 4

DISTRICT A

Canadian classification—Subbituminous C

Typical Analysis

Proximate

Moisture	%	26.5
Ash	%	4.6
Volatile matter	%	29.7
Fixed carbon	%	39.2

Fuel ratio (FC/VM), 1.3.

Calorific value, gross, in B.t.u. per lb., 8,730.

DISTRICT B

Canadian classification—Subbituminous C

Typical Analyses

Proximate		Ultimate (with 31.3% moisture)	
Moisture	% 31.3	Carbon	% 45.9
Ash	% 7.0	Hydrogen	% 6.6
Volatile matter	% 26.9	Sulphur	% 0.4
Fixed carbon	% 34.8	Nitrogen	% 0.9
		Oxygen	% 39.2
		Ash	% 7.0

Fuel ratio (FC/VM), 1.3.

Calorific value, gross, in B.t.u. per lb., 7,730.

The net calorific value of this coal is approximately 600 B.t.u. per lb. lower than the gross value.

WETASKIWIN AREA

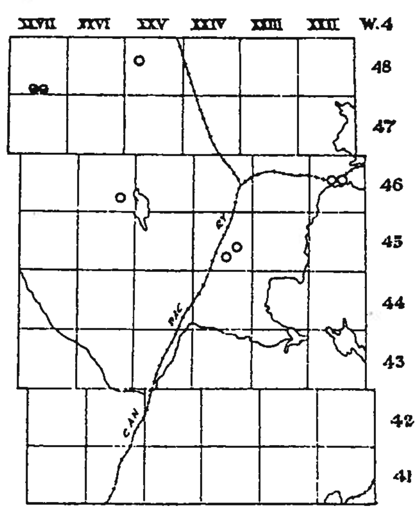
The mines produce an Alberta domestic coal, free burning and smokeless. According to the Canadian classification the coal is Subbituminous B. A number of seams are known, all in the Edmonton horizon.

One mine was operated in 1943 and the output was 3,000 tons. The area is crossed by two branches of the Canadian Pacific Railway. The mines are not on a railway.

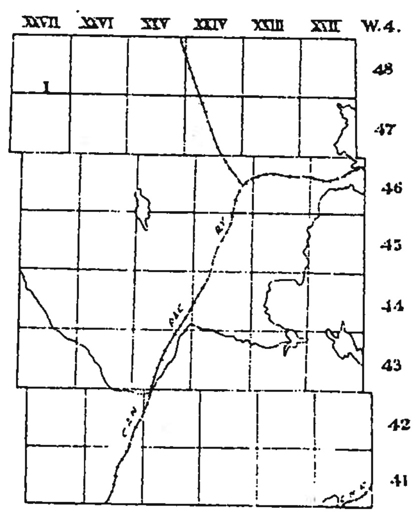
In addition to the typical analyses given below reference has been made to coal from this area in the following section of this report: storage (oxidation).

Map 85 shows the location of all recorded mines opened, and also indicates the mines from which samples have been obtained.

Map 86 shows the location of the operating mine graded by output in 1943.



MAP 85



MAP 86

Scale: 20 miles to 1 inch. For symbols see page 93.

Figure 46

Typical Analyses

Proximate			Ultimate (with 20.0% moisture)		
Moisture	%	20.0	Carbon	%	55.8
Ash	%	7.6	Hydrogen	%	5.8
Volatile matter	%	28.0	Sulphur	%	0.2
Fixed carbon	%	44.4	Nitrogen	%	0.8
			Oxygen	%	29.8
			Ash	%	7.6

Fuel ratio (FC/VM), 1.60.

Calorific value, gross, in B.t.u. per lb., 9,520.

The net calorific value of this coal is approximately 530 B.t.u. per lb. lower than the gross value.

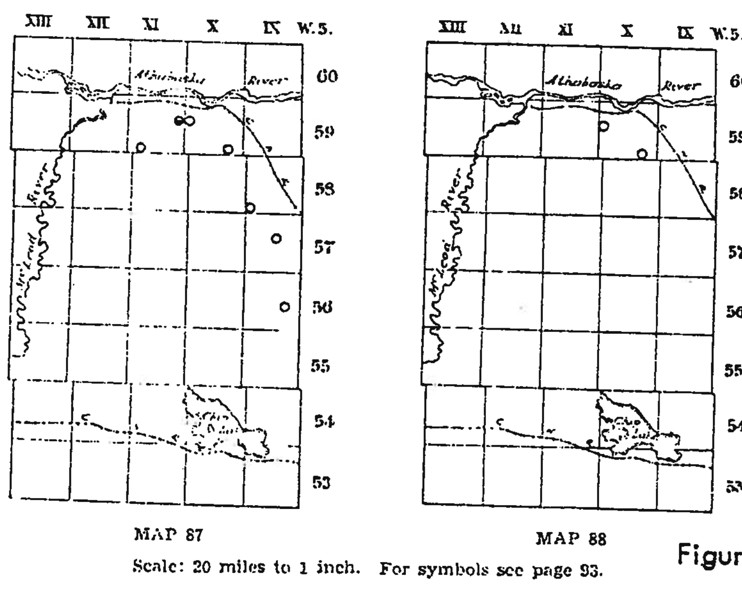
WHITECOURT AREA

The mines produce an Alberta domestic coal, free burning and smokeless. According to the Canadian classification the coal is Subbituminous B. The seams are all in the Edmonton horizon.

Two mines, both stripping pits, were operated in 1943 and the output was less than 200 tons. The area is crossed by the main and one branch line of the Canadian National Railway.

Map 87 shows the location of all recorded mines opened, and also indicates the mines from which a sample has been obtained.

Map 88 shows the location of operating mines graded by output in 1943.



MAP 87 MAP 88

Scale: 20 miles to 1 inch. For symbols see page 93.

Figure 47

Typical Analyses

Proximate		Ultimate (with 22.6% moisture)	
Moisture	% 22.6	Carbon	% 52.6
Ash	% 12.2	Hydrogen	% 5.7
Volatile matter	% 24.8	Sulphur	% 0.3
Fixed carbon	% 40.4	Nitrogen	% 0.8
		Oxygen	% 28.4
		Ash	% 12.2

Fuel ratio (FC/VM), 1.6.

Calorific value, gross, in B.t.u. per lb., 8,070.

The net calorific value of this coal is approximately 520 B.t.u. per lb. lower than the gross value.

VII. PLAINS MINES

Following are extracted particulars of all mines for which analyses are given in Research Council of Alberta Report 64-3 (Campbell, 1964) with, as preface, the glossary. Mine locations are shown approximately in Maps A and B.

GLOSSARY AND EXPLANATION OF ABBREVIATIONS

A. - ash; the non-combustible portion of a coal, expressed as percentage of total weight at capacity moisture.

bone or blackjack - miners' terms for silicified or calcified coal.

BR - Belly River Group or Formation.

capacity moisture - the moisture content of a coal after equilibriation of coal in an atmosphere at 100 percent relative humidity. (Capacity moisture does not include free surface moisture due, for example, to retention of rain or snow.)

C.Co - coal company.

Dun - Dunvegan Formation.

Edm - Edmonton Formation.

F.C. - fixed carbon; the non-volatile but combustible portion of a coal expressed as percentage of total weight at capacity moisture.

Fore - Foremost Formation.

Fren - Frenchman Formation.

G.BTU - gross calorific value; the heat content of a coal (including the latent heat of condensation of the water produced by combustion) expressed in British Thermal Units per pound of coal at capacity moisture.

H_2O - capacity moisture content of a coal expressed as percentage of total weight at capacity moisture.

L.Edm- lower and middle parts of the Edmonton Formation, below the Kneehills member.

Lsd. - legal subdivision in the Land Survey system.

Mer. - principal meridian in the Land Survey system.

MR - Milk River Formation.

Old - Oldman Formation.

6

Pask - Paskapoo Formation.

Prod. Fm.- rock unit from which coal is extracted.

proximate analysis - a system of coal analysis, including determinations of moisture, ash, volatile matter and fixed carbon, all of which are empirical evaluations not representing actual specific constituents of the coal. Proximate analysis does, however, give a valid measure of the quality of a coal.

R. - range in the Land Survey system.

s - strip mine.

Sec. - section, a parcel of land one mile square, in the Land Survey system.

SMR - St. Mary River Formation.

ss. - sandstone.

Tp. - township in the Land Survey system.

U.Edm - upper part of the Edmonton Formation, above the Kneehills member.

u/g - underground mine.

V.M. - volatile matter; that portion of a coal, other than moisture, which is lost from the coal on heating to 950°C. (1742°F.) in the absence of air.

Wti - Wapiti Formation.

GEOGRAPHICAL LISTING, COAL MINES, PLAINS OF ALBERTA

Lsd. or 1/4	Location Sec.	Tp.	R.	Mer.	Mine No.	Mine Type	Life Span	Last Operator	Coal Area	Seam Elevation	Cover (feet)	Seam (feet)	Prod. Fm.	Logs(feet); Analyses; Notes
7,8, 9,10	10	3	11	4	1301	u/g	1929-53	Taylor	Milk River	3190	50-65	4.3	Fore	- Bl. sh. 2; ss 3.5; coal 1.5; bone .5; coal 2.3; blue rock. H_2O 18.8; A. 11.7; V.M. 27.5; F.C. 42; G.BTU 8,960.
2,3,7	7	7	21	4	56	u/g	1902-54	Razzolini & Bridarolli	Lethbridge				Old	- H_2O 11.5; A. 17.7; V.M. 29.4; F.C. 41.4; G.BTU 9,740. See also Lsd. 14-6-7-21-4.
3,4	7	7	21	4	1602	u/g	1943-49	Vulcan Mining & Con.	Lethbridge		75-125		Old	- Bottom seam: shale; coal 3.2; shale. H_2O 11.1; A. 20; V.M. 30.6; F.C. 38.3; G.BTU 9,400.
8,9	7	7	21	4	1086	u/g	1923-63	Steve's Mine	Lethbridge		20-155	3	Old	- Shale; coal .5; bone .3; coal 1.8; clay .2; bone .3; coal .7; bone .2; shale. H_2O 11.8; A. 24.1; V.M. 27.8; F.C. 36.3; G.BTU 8,700. See also Lsd. 5,12 Sec.8-7-21-4.
5,12	8	7	21	4	1086	u/g	1923-63	Steve's Mine	Lethbridge				Old	- H_2O 11.8; A. 24.1; V.M. 27.8; F.C. 36.3; G.BTU 8,700. See also Lsd. 8,9 Sec.7-7-21-4.
2	18	7	21	4	1685	s	1948-57	M&M Coal Mine	Lethbridge		15-24		Old	- Bone .5; coal .5; coal 1.5; bone .3; coal 4; shale 6; coal 3. H_2O 12.5; A. 17; V.M. 30.7; F.C. 39.8; G.BTU 9,650.
7,10	23	8	3	4	1318	u/g	1930-55	Raeder	Pakowki	4070-4073	23-36		Fren	- Shale or coal; coal .8; parting; coal 2; parting .2; coal 1; parting; coal 1.6; shale. H_2O 32.8; A. 8; V.M. 29.5; F.C. 29.7; G.BTU 7,150.
15	2	8	22	4	889	u/g	1921-55	Rollingson & Son	Lethbridge				Old	- Shale; bone 1; coal 2.7; shale. H_2O 12.1; A. 11.3; V.M. 31.2; F.C. 45.4; G.BTU 10,460.
2,7	11	8	22	4	738	u/g;s	1918-60	Wakusich C.Mine	Lethbridge	2790	18-100	1.8	Old	- Coal .3; clay & bone .8; coal 1.8; shale .8. H_2O 11.6; A. 13.1; V.M. 31.3; F.C. 44; G.BTU 10,380.
6,11	2	9	5	4	602	u/g	1915-46	Vogel&Rosenfelter	Pakowki	3441-3460	10-120	5.5-6	Eastend	- Coal .3; parting; coal 2.3; parting; coal .6; parting; coal 1.7. H_2O 29.4; A. 9; V.M. 29.8; F.C. 31.8; G.BTU 7,400.
4,5	25	9	13	4	1705	u/g	1949-54	Neufeld	Taber		25-50	4.2	Fore	- Blue shale; coal 2; rock 1; coal 1.5. H_2O 17.9; A. 5.7; V.M. 33.2; F.C. 43.6; G.BTU 10,090.
2,3,4	26	9	13	4	1334	s	1930-57	Continental C.Corp.	Taber				Fore	- H_2O 18.3; A. 9.5; V.M. 30.1; F.C. 42.1; G.BTU 9,540. See also Lsd. 13,14,15 Sec. 23-9-13-4.

GEOGRAPHICAL LISTING, COAL MINES, PLAINS OF ALBERTA

Lsd. or 1/4	Location Sec.	Tp.	R.	Mer.	Mine No.	Mine Type	Life Span	Last Operator	Coal Area	Seam Elevation	Cover (feet)	Seam (feet)	Prod. Fm.	Logs(feet); Analyses; Notes
1,2,3, 4,5,6, 7,10,11, 12,13, 14,15	2	9	22	4	1464	u/g	1934-57	Leth.Coll.Ltd.	Lethbridge	2629.38	359		Old	- H_2O 10.6; A. 12; V.M. 31.7; F.C. 45.7; G.BTU 10,640. See also Lsd. 7,9,10,11,13,14,15,16 Sec. 34-8-22-4; Lsd. 5,6,10,11,12,13, 14,15,16 Sec. 35-8-22-4; Lsd. 1,2,3,4,6, 7,10,11 Sec. 3-9-22-4; Lsd. 1,2,3,7,8 Sec. 10-9-22-4; Lsd. 2,3,4,5,6,7 Sec. 11-9-22-4.
1,2,3, 4,6,7, 10,11	3	9	22	4	1464	u/g	1934-57	Leth.Coll.Ltd.	Lethbridge	2624	384		Old	- H_2O 10.6; A. 12; V.M. 31.7; F.C. 45.7; G.BTU 10,640. See also Lsd. 7,9,10,11,13,14,15,16 Sec. 34-8-22-4; Lsd. 5,6,10,11,12,13,14, 15,16 Sec. 35-8-22-4; Lsd. 1,2,3,4,5,6,7, 10,11,12,13,14,15 Sec. 2-9-22-4; Lsd. 1, 2,3,7,8 Sec. 10-9-22-4; Lsd. 2,3,4,5,6,7 Sec. 11-9-22-4.
5,6, 11,12	24	9	22	4	1581	u/g	1941-56	Hamilton C.Co	Lethbridge	2447-2453	228-233		Old	- Coal .8; slate 1; coal 1.5; clay .2; coal 2.5; bone .8. H_2O 10.7; A. 9.8; V.M. 33.3; F.C. 46.2; G.BTU 10,970.
1,2, 7,8	18	10	16	4	1536	u/g	1938-54	Oliver C.Mines	Taber		90	3.7	Fore	- Ss; coal 3.7; shale. H_2O 15.3; A. 7.6; V.M. 32; F.C. 45.1; G.BTU 10,430.
1,8	19	10	16	4	228	u/g	1910-54	Malo	Taber		150-200	3.3	Fore	- Shale .4; bone & coal .6; shale .4; coal 3.3; fire clay. H_2O 16.2; A. 11; V.M. 29.4; F.C. 43.4; G.BTU 9,660. See also Lsd. 4,5 Sec. 20-10-16-4.
2,3,6, 7,11, 12,13	30	10	16	4	1609	s	1943-49	South.Alta.C.Co	Taber				Fore	- H_2O 15.9; A. 9.4; V.M. 30.3; F.C. 44.4; G.BTU 10,020. See also Lsd. 15 Sec. 19-10-16-4.
2,3,4, 5,6,7, 8,9,10	12	10	17	4	1604	s	1943---	Alta.Coal Sales	Taber				Fore	- H_2O 14.8; A. 14.3; V.M. 29.9; F.C. 41; G.BTU 9,530. See also Lsd. 5,12,13,14 Sec. 1-10-17-4; Lsd. 9,16 Sec. 2-10-17-4; Lsd. 1,8 Sec. 11-10-17-4.
3,4,5	29	10	21	4	1263	u/g	1927---	Leth.Coll.Ltd.	Lethbridge				Old	- H_2O 12; A. 9.2; V.M. 32.8; F.C. 46; G.BTU 10,690. See also Lsd. 9,10,11,12,13,14,15,16 Sec. 19-10-21-4; Lsd. 1,2,3,4,5,6,7,8,9, 10,15,16 Sec. 30-10-21-4; Lsd. 9,10,15, 16 Sec. 24-10-22-4; Lsd. 1,2,7,8,9,10, 11,14,15,16 Sec. 25-10-22-4.

GEOGRAPHICAL LISTING, COAL MINES, PLAINS OF ALBERTA

Lsd. or 1/4	Location Sec.	Tp.	R.	Mer.	Mine No.	Mine Type	Life Span	Last Operator	Coal Area	Seam Elevation	Cover (feet)	Seam (feet)	Prod. Fm.	Logs(feet); Analyses; Notes
5	22	12	10	4	1741	s	1955-59	Katcher	Taber		20-45	4.5	Fore	- Soft shale; bone .5-.8; coal 4.5; bone .3; coal 1. H2O 23.2; A. 8.3; V.M. 27.9; F.C. 40.6; G.BTU 8,940.
3,7	27	12	10	4	672	u/g	1916-55	Boughton&Sons	Taber				Fore	- H_2O 24.2; A. 9.6; V.M. 27.1; F.C. 39.1; G.BTU 8,420. See also Lsd. 14 Sec. 22-12-10-4.
7	28	12	10	4	838	u/g	1919-58	Smith	Taber	2350	100-150	5.8	Fore	- Ss; coal 5.8; shale. H_2O 22.6; A. 9.2; V.M. 26.5; F.C. 41.7; G.BTU 8,640.
1,2	6	13	6	4	772	u/g	1918---	Ajax C.Co	Redcliff				Fore	- H_2O 25.6; A. 6.4; V.M. 27.2; F.C. 40.8; G.BTU 8,590. See also Lsd. 3,4 Sec. 5-13-6-4; Lsd. 16 Sec. 31-12-6-4; Lsd. 13,14,15 Sec. 32-12-6-4.
1,2,8	3	14	13	4	1672	s	1948---	Coral Coals Ltd.	Brooks	.	45		Fore	- Shale rock; coal 7. H_2O 20.2; A. 7.1; V.M. 28.3; F.C. 44.4; G.BTU 9,490.
7,8,9, 10,16	8	15	22	4	136	u/g	1907-55	Rhodes	Champion	3120			L.Edm	- Shale .5; coal 3; clay .5. H_2O 14.4; A. 9.4; V.M. 30.5; F.C. 45.7; G.BTU 9,970.
13,15, 16	33	15	23	4	1509	u/g	1937---	Champion C.Co	Champion	3137	65	3.6	L.Edm	- Soapstone; coal 3.6; bone; clay. H_2O 13.7; A. 12.8; V.M. 30.7; F.C. 42.8; G.BTU 9,710.
2,3	4	16	23	4	1137	u/g	1924---	Cottoni	Champion		60-90	3.8	L.Edm	- Ss; clay; coal .5; coal 3.5; bone .2; coal .3; fire clay; ss. H_2O 13.7; A. 14.5; V.M. 30.1; F.C. 41.7; G.BTU 9,540.
9,10	8	16	23	4	1565	u/g	1939-53	Popovich	Champion		85-105	3.3	L.Edm	- Clay; soft coal .3; coal 3; bone .3; clay. H_2O 10.9; A. 19.1; V.M. 32.3; F.C. 37.7; G.BTU 9,470.
8,9	16	17	17	4	1404	s	1932---	Kleenbirn Coll.	Brooks				Old	- H_2O 18.6; A. 11.1; V.M. 29.9; F.C. 40.4; G.BTU 9,270. See also Lsd. 8 Sec. 22-17-17-4; Lsd. 4,5 Sec. 23-17-17-4; Lsd. 5,6,7,8,9,10,11,12 Sec. 15-17-17-4; Lsd. 5 Sec. 14-17-17-4.
1	12	21	21	4	72A 72B 72C		1902-55	Blackfoot Indians	Gleichen				L.Edm	- H_2O 17.7; A. 10.5; V.M. 29.9; F.C. 41.9; G.BTU 9,060. See also Lsd. 12,16 Sec. 33-20-19-4.
5,6, 12	11	25	22	4	1265	u/g	1927-52	Costello & Sons	Gleichen		79	5.6	L.Edm	- Clay; coal .5-1; bone .5; bentonite .5; shaly clay .8; coal 3.8; clay. H_2O 16.8; A. 10.1; V.M. 31.2; F.C. 41.9; G.BTU 9,480.

GEOGRAPHICAL LISTING, COAL MINES, PLAINS OF ALBERTA

Lsd. or 1/4	Location Sec.	Tp.	R.	Mer.	Mine No.	Mine Type	Life Span	Last Operator	Coal Area	Seam Elevation	Cover (feet)	Seam (feet)	Prod. Fm.	Logs(feet); Analyses; Notes
14,15	20	26	21	4	1521	u/g	1937---	Lucky Strike Mine	Gleichen		0-100	3.5	L.Edm	- H_2O 18; A. 7.4; V.M. 30.8; F.C. 43.8; G.BTU 9,720.
3,6,7	29	26	21	4	1431	u/g	1933---	Consumers' Mine	Gleichen		18-80	2.7	L.Edm	- H_2O 18.4, A. 8.1; V.M. 30.9; F.C. 42.6; G.BTU 9,500.
8,9, 10,11, 14,15,16	18	27	18	4	1484	u/g	1935-56	Century Coals	Drumheller				L.Edm	- H_2O 20; A. 5.9; V.M. 29.9; F.C. 44.2; G.BTU 9,470. See also Lsd. 11,12,13,14,15 Sec. 17-27-18-4; Lsd. 1,2,3,7,8,9 Sec. 19-27-18-4; Lsd. 2,3,4,5,6,7,8,9,10,11,12,14,15,16 Sec. 20-27-18-4; Lsd. 12,13 Sec. 21-27-18-4.
4,5,6, 7,9,10, 11,12,13, 14,15,16	19	27	18	4	1491	u/g	1936-59	Murray Coll.	Drumheller	2358.73	0-400		L.Edm	- Shale; coal 5.2; sandy shale. H_2O 19.1; A. 9.1; V.M. 29.8; F.C. 42; G.BTU 9,260. See also Lsd. 13,14 Sec. 20-27-18-4; Lsd. 1,2,3,4,5,6,7,11,12 Sec. 29-27-18-4; Lsd. 1,2,3,6,7,8,9 Sec. 30-27-18-4; Lsd. 9,10 Sec. 24-27-19-4.
1	20	27	18	4	1573	u/g	1940---	Amalgamated C.	Drumheller				L.Edm	- H_2O 19.6; A. 6.6; V.M. 29.7; F.C. 44.1; G.BTU 9,350. See also Lsd. 2,3,4,5,6,7,8,9,10,11,12, 14,15,16 Sec. 17-27-18-4; Lsd. 1,2 Sec. 20-28-18-4.
7,8, 9,10, 11,12	33	27	18	4	1299	u/g	1929-52	Sask.Fed.Co-ops	Drumheller				L.Edm	- H_2O 20.8; A. 9.9; V.M. 29; F.C. 40.3; G.BTU 8,900. See also Lsd. 1,2,7,8 Sec. 32-27-18-4.
3	5	28	18	4	728	u/g	1918-51	Maple Leaf Coal	Drumheller				L.Edm	- H_2O 20; A. 8.5; V.M. 29.2; F.C. 42.3; G.BTU 9,160. See also Lsd. 1,2,7,8,9,10,11,13,14,15, 16 Sec. 32-27-18-4; Lsd. 12,13 Sec. 33-27-18-4.
9,10	22	28	18	4	1599	u/g;s	1943---	Chambers	Drumheller	2600	200	3-4	L.Edm	- Coal 2; bone .2; coal 1.8; bone .5. H_2O 21; A. 8.4; V.M. 28.8; F.C. 41.8; G.BTU 9,030.
10	22	28	18	4	1515	u/g	1937-52	Empress Coal	Drumheller		200	4	L.Edm	- Coal 2; bone .2; coal 1.8; bone .5. H_2O 21; A. 9.3; V.M. 27.4; F.C. 42.3; G.BTU 8,990.

GEOGRAPHICAL LISTING, COAL MINES, PLAINS OF ALBERTA

Lsd. or 1/4	Location Sec.	Tp.	R.	Mer.	Mine No.	Mine Type	Life Span	Last Operator	Coal Area	Seam Elevation	Cover (feet)	Seam (feet)	Prod. Fm.	Logs(feet); Analyses; Notes
2,7	23	28	18	4	1725	u/g;s	1952-57	Ostrowski	Drumheller	2440			L.Edm	- Coal 1.6; clay .1; coal 1.7. H_2O 22.3; A. 6.2; V.M. 28.1; F.C. 43.4; G.BTU 9,170.
5,6, 7,10, 11,12	8	28	19	4	1570	u/g	1940-57	Wayne C.Co	Drumheller				L.Edm	- H_2O 18.7; A. 8.8; V.M. 29.8; F.C. 42.7; G.BTU 9,420. See also Lsd. 8,9 Sec. 7-28-19-4.
15,16	16	28	19	4	1666	s	1947---	Subway Coal	Drumheller		10-40	4-6	L.Edm	- Clay; coal 2; clay .8; bone & bony coal 1.5; coal 2; clay. H_2O 19.6; A. 8.1; V.M. 30.2; F.C. 42.1; G.BTU 9,390. See also Lsd. 1,2 Sec. 21-28-19-4.
3	18	28	19	4	1660	u/g	1947-49	Heckler	Drumheller			2.5	L.Edm	- H_2O 18; A. 5.6; V.M. 31.1; F.C. 45.3; G.BTU 10,110.
13,14	18	28	19	4	1669	u/g	1948-56	Joy Coal	Drumheller	2277	275	3.5	L.Edm	- H_2O 19.9; A. 6.3; V.M. 29.4; F.C. 44.4; G.BTU 9,640.
13	20	28	19	4	1436	u/g	1933-52	Royalty Mine	Drumheller				L.Edm	- H_2O 19.7; A. 6.7; V.M. 29.5; F.C. 44.1; G.BTU 9,560. See also Lsd. 16 Sec. 19-28-19-4.
3,4, 5,6	23	28	19	4	1511	u/g;s	1937-56	Aetna Coals	Drumheller				L.Edm	- H_2O 18.7; A. 7.2; V.M. 30.7; F.C. 43.4; G.BTU 9,690. See also Lsd. 1,8 Sec. 22-28-19-4.
1,8, 9,16	28	28	19	4	436	u/g	1914-57	Star C.Mines	Drumheller				L.Edm	- H_2O 20; A. 5.7; V.M. 30.5; F.C. 43.8; G.BTU 9,590. See also Lsd. 4,5,6,10,11,12,14,15,16 Sec. 27-28-19-4; Lsd. 1,2,3,6,7,8 Sec. 34-38-19-4; Lsd. 3,4,5,6,11,12,13,14, 15 Sec. 35-28-19-4; Lsd. 2,3,4,5,6,7 Sec. 2-29-19-4.
All of	33	28	19	4	346	u/g	1912-52	Rosedale Coll.	Drumheller				L.Edm	- H_2O 20.6; A. 8.1; V.M. 28.7; F.C. 42.6; G.BTU 9,160. See also Lsd. 13 Sec. 27-28-19-4; Lsd. 13, 14,15,16 Sec. 28-28-19-4; Lsd. 16 Sec. 29-28-19-4; Lsd. 1,8,9,16 Sec. 32-28-19-4; Lsd. 3,4,5,6,7,12,13 Sec. 34-28-19-4; Lsd. 4,5,6,12 Sec. 3-29-19-4; Lsd. 1,2,3,4,5,8 Sec. 4-29-19-4; Lsd. 1, 8 Sec. 5-29-19-4.
3,4, 5,6	19	29	12	4	1432	s	1933-52	Sheerness C.Co	Sheerness				L.Edm	- H_2O 27.4; A. 7.1; V.M. 28.5; F.C. 37; G.BTU 8,220. See also Lsd. 13,14 Sec. 18-29-12-4.

GEOGRAPHICAL LISTING, COAL MINES, PLAINS OF ALBERTA

Lsd. or 1/4	Location Sec.	Tp.	R.	Mer.	Mine No.	Mine Type	Life Span	Last Operator	Coal Area	Seam Elevation	Cover (feet)	Seam (feet)	Prod. Fm.	Logs(feet); Analyses; Notes
16	12	29	13	4	1597	s	1943-57	Bordula C.Co	Sheerness				L.Edm	- H_2O 28; A. 5.1; V.M. 28.6; F.C. 38.3; G.BTU 8,370. See also Lsd. 12 Sec. 7-29-12-4.
3,4,5, 6,7,9, 10,11	13	29	13	4	443	s	1915---	Great West C.Co	Sheerness		10-30	5-6	L.Edm	- Soil & drift 10-30; soft coal 2; shale .8; bone 1.5; coal 5-6; ss. H_2O 27; A. 5.7; V.M. 28.3; F.C. 39; G.BTU 8,240. See also Lsd. 1,7,8 Sec. 14-29-13-4.
3	17	29	19	4	1668	s	1948-63	Leonhardt	Drumheller		12-20	2	L.Edm	- H_2O 21.1; A. 4.8; V.M. 30.7; F.C. 43.4; G.BTU 9,590.
5,6	1	29	20	4	1700	s	1949-51	McLeod&Paxton	Drumheller				L.Edm	- Shale 6; ss 2; coal 4; shale & ss 18; coal 2; shale 3; coal 2; shale 9; ss .5; coal 13; shale & ss 23; coal & bone 7.5; shale 9.5; coal - trace. H_2O 22.8; A. 5.1; V.M. 28.7; F.C. 43.4; G.BTU 8,790.
2,3,4, 5,6,7, 9,10,11, 12,13,14	3	29	20	4	620	u/g	1915-50	Newcastle Coll.	Drumheller				L.Edm	- H_2O 17; A. 6.2; V.M. 31.8; F.C. 45; G.BTU 9,870. See also Lsd. 16 Sec. 33-28-20-4; Lsd. 'i, 12,13,14 Sec. 34-28-20-4; Lsd. 1,8 Se . 4-29-20-4; Lsd. 4 Sec. 10-29-20-4.
16	3	29	20	4	1726	s	1952-55	Ochatzchen & Partners	Drumheller				L.Edm	- Coal 2.5; bone .3; coal 2. H_2O 19.7; A. 4.8; V.M. 29.2; F.C. 46.3; G.BTU 9,740.
2,3,5, 6,7,9, 10,11,12, 13,14,15, 16	5	29	20	4	422	u/g	1914-56	Century Coal	Drumheller	2082.28			L.Edm	- Shale; coal 1.5; clay .2; coal 4; clay & bone. H_2O 17.7; A. 7; V.M. 30.8; F.C. 44.5; G.BTU 9,920. See also Lsd. 4 Sec. 9-29-20-4.
11,12, 13,14	9	29	20	4	367	u/g	1912-59	Midland Coal	Drumheller				L.Edm	- H_2O 19; A. 5.4; V.M. 30.6; F.C. 45; G.BTU 9,990. See also Lsd. 15,16 Sec. 8-29-20-4; Lsd. 3,4,12,13,14,15 Sec. 16-29-20-4; Lsd. 1,2,3,4,5,6,7,8,9,10,11,16 Sec. 17-29-20-4; Lsd. 2,3,4,5,6 Sec. 21-29-20-4.
11,14, 15	10	29	20	4	1258	u/g	1927-58	Brilliant C.Co	Drumheller	2150	35-125	2-6	L.Edm	- H_2O 18.6; A. 9.8; V.M. 29.6; F.C. 42; G.BTU 9,310. See also Lsd. 2,3,5,6,7,10,11,12,13,14, 15 Sec. 15-29-20-4; Lsd. 8,9 Sec. 16-29-20-4; Lsd. 2,3,4,6,7 Sec. 22-29-20-4.

GEOGRAPHICAL LISTING, COAL MINES, PLAINS OF ALBERTA

Lsd. or 1/4	Location Sec.	Tp.	R.	Mer.	Mine No.	Mine Type	Life Span	Last Operator	Coal Area	Seam Elevation	Cover (feet)	Seam (feet)	Prod. Fm.	Logs(feet); Analyses; Notes
13	11	29	20	4	1421	u/g	1933-62	Federated Co-ops	Drumheller				L.Edm	H_2O 19.3; A. 10.4; V.M. 29.1; F.C. 41.2 G.BTU 9,160. See also Lsd. 16 Sec. 10-29-20-4; Lsd. 12,13 Sec. 13-29-20-4; All of Sec. 14-29-20-4; Lsd. 1,8,9 Sec. 15-29-20-4; Lsd. 1,2,3,6,7,8 Sec. 23-29-20-4; Lsd. 4 Sec. 24-29-20-4.
7,8, 9,10	14	29	20	4	1520	u/g	1937-54	Minute C.Co	Drumheller				L.Edm	Soft shale; coal 2; bone 1; coal 2; shale. H_2O 19.1; A. 10.6; V.M. 29.1; F.C. 41.2; G.BTU 9,100.
9	22	29	20	4	1655	u/g	1947---	Wakaruk & Partners	Drumheller				L.Edm	Shale; coal 2; clay 5; coal 2.5; shale. H_2O 19.8; A. 8.4; V.M. 29.6; F.C. 42.2; G.BTU 9,370.
1,2,3, 4,5,6, 7,8,9, 10,11,12, 13,14,15	12	29	21	4	402	u/g	1913-61	Red Deer Valley C.	Drumheller				L.Edm	H_2O 17.1; A. 9.4; V.M. 29.5; F.C. 44; G.BTU 9,580. See also Lsd. 2,3,4,5,6,7,8,9,10,11,12, 13,14,15,16 Sec. 6-29-20-4; Lsd. 1,2,3, 4,5,6,7,8,9,10,11,12,16 Sec. 7-29-20-4; Lsd. 5,12,13 Sec. 8-29-20-4; Lsd. 13, 14,15,16 Sec. 1-29-21-4; Lsd. 8,9 Sec. 11-29-21-4.
7,10, 11,12	7	29	22	4	1060	u/g	1922-56	East Carbon C.Co	Carbon	2600	200	4.2	L.Edm	Shaly clay; coal 4; bone .2; coal .2; shaly clay. H_2O 16; A. 11.8; V.M. 29.3; F.C. 42.9; G.BTU 9,470. See also Lsd. 9 Sec. 12-29-23-4.
3,6	14	29	23	4	53	u/g	1898---	Fox	Carbon	2560	10-150	4	L.Edm	Soft ss; soapstone 1.5; coal 4; clay. H_2O 16.5; A. 8.4; V.M. 31.2; F.C. 43.9; G.BTU 9,960. See also Lsd. 13,14,15 Sec. 11-29-23-4.
10	21	30	17	4	1553	u/g	1939-56	Masciangelo & Partners	Sheerness	3100	20-100	3.1	U.Edm	Clay; coal .7; clay .[illegible]; coal 2.2; clay. H_2O 23.1; A. 8.2; V.M. 27.7; F.C. 41; G.BTU 8,680.
16	21	31	21	4	1719	s	1950-53	Notland	Carbon		8	2.5	L.Edm	Clay & ss 8; coal 2.5. H_2O 22.9; A. 6.6; V.M. 28.9; F.C. 41.6; G.BTU 8,320.
9,10, 15,16	4	31	22	4	194	u/g;s	1909---	Nottal Bros.	Carbon		12-25	4.5	L.Edm	Ss; coal 4.5. H_2O 17.6; A. 7.3; V.M. 30.1; F.C. 45; G.BTU 9,900. See also Lsd. 1,2,7,9,10 Sec. 9-31-22-4.
	9	31	22	4	1499		1936	Nottal Bros.	Carbon				L.Edm	H_2O 17.9; A. 7; V.M. 30.4; F.C. 44.7; G.BTU 9,940. Consol. with Mine #194.
1,2,3, 6,7,8	36	31	24	4	384	u/g	1913-53	Inland C.Co	Carbon				U.Edm	H_2O 17.4; A. 11.3; V.M. 26.7; F.C. 44.6; G.BTU 9,300. See also Lsd. 10,11,14,15,16 Sec. 25-31-24-4.

GEOGRAPHICAL LISTING, COAL MINES, PLAINS OF ALBERTA

Lsd. or 1/4	Location Sec.	Tp.	R.	Mer.	Mine No.	Mine Type	Life Span	Last Operator	Coal Area	Seam Elevation	Cover (feet)	Seam (feet)	Prod. Fm.	Logs(feet); Analyses; Notes
7,8,9	14	33	23	4	1283	u/g	1928---	Halbert Bros.	Carbon	2730	30-80	5.8	U.Edm	- Clay; coal .5; coal 1.5; clay .2; coal 3; clay .5; clay. H_2O 18.2; A. 11; V.M. 26.7; F.C. 44.1; G.BTU 9,170.
9,10, 15,16	14	33	23	4	710	u/g	1917-61	East Trochu C.Co	Carbon	2750	80	6	U.Edm	- Clay; coal 2.5; bone .2; coal 3; clay .5; coal .5; clay. H_2O 17.8; A. 8.6; V.M. 29.1; F.C. 44.5; G.BTU 9,660.
15	14	33	23	4	921	u/g	1921---	Reissig	Carbon	2730	up to 100	4.8	U.Edm	- Soft ss; coal .5; coal 1; clay .2; coal 3; clay .7. H_2O 17.8; A. 9.2; V.M. 27.8; F.C. 45.2; G.BTU 9,510. See also Lsd. 2 Sec. 23-33-23-4.
1	9	35	20	4	1708	s	1949-54	Grant	Big Valley		13	1.5-2	L.Edm	- Gravel 11; shale 2; coal 1.5-2; grey clay. H_2O 21.8; A. 8; V.M. 31.1; F.C. 3[illegible].1; G.BTU 8,990.
12,13	36	35	20	4	864	u/g;s	1920-56	Big Valley Coll.	Big Valley				L.Edm	- H_2O 18.7; A. 14.4; V.M. 28.1; F.C. 38.8; G.BTU 8,280. See also Lsd. 1,8 Sec. 35-35-20-4; Lsd. 15,16 Sec. 26-35-20-4.
2,7	13	36	22	4	1661	u/g;s	1947-58	Anderson, Stiffensen&Hunter	Big Valley		30-50		L.Edm	- U/G mine: clay & glacial drift 50+; ss 3; coal 5. H_2O 17.3; A. 17; V.M. 27.6; F.C. 38.1; G.BTU 8,400.
9,16	33	37	14	4	902	u/g	1921---	Remillard	Castor	2650	66	5.5	L.Edm	- Stony clay; coal 5.5; ss. H_2O 26.5; A. 9.7; V.M. 27.8; F.C. 36; G.BTU 7,780.
11,12, 13,14	34	37	14	4	1417	u/g;s	1933-45	Easton	Castor	2666	30	5.2	L.Edm	- Clay; coal .5; coal 1.2; bone .3; coal 1.7; bone .5; clay. H_2O 25.4; A. 8; V.M. 29.8; F.C. 36.8; G.BTU 8,020.
5	35	37	22	4	1586	u/g	1942-49	Kehl&McGladrie	Ardley		50	5.2	L.Edm	- Ss; bone .2; coal 3; clay .2; coal 1.7; clay. H_2O 20.4; A. 12.9; V.M. 26.4; F.C. 40.3; G.BTU 8,440.
2,3, 5,6	3	38	14	4	1343	s	1930-53	Haden	Castor		6-12	3.5-6	L.Edm	- Clay; poor coal 2.5; coal 1.2; clay .2; coal 2.2; bone .5; clay. H_2O 25.2; A. 9; V.M. 29; F.C. 36.8; G.BTU 7,990.
2,3, 4,5,6	3	38	14	4	1608	s	1943-50	Castor C.& Constr'n Co	Castor		6-12	3.5-6	L.Edm	- H_2O 29.2; A. 9.4; V.M. 27.9; F.C. 33.5; G.BTU 7,420.
13,14	10	38	22	4	969	u/g;s	1921-52	Schnepf	Ardley		11-60		L.Edm	- Ss; coal 1.2; clay .4; coal 2.2; clay. H_2O 19.6; A. 8.8; V.M. 30; F.C. 41.6; G.BTU 9,070.
13	8	38	23	4	1675	s	1948-53	Lynass	Ardley		15-20	5.5	U.Edm	- Clay & shale 15-20; coal 4; clay .2; coal 1.2; clay. H_2O 19.8; A. 6.6; V.M. 28.4; F.C. 45.2; G.BTU 9,480. See also Lsd. 16 Sec. 7-38-23-4; Lsd. 4 Sec. 17-38-23-4.

GEOGRAPHICAL LISTING, COAL MINES, PLAINS OF ALBERTA

Lsd. or 1/4	Location Sec.	Tp.	R.	Mer.	Mine No.	Mine Type	Life Span	Last Operator	Coal Area	Seam Elevation	Cover (feet)	Seam (feet)	Prod. Fm.	Logs(feet); Analyses; Notes
5,11, 12,13	17	38	23	4	255	u/g;s	1910---	Straub	Ardley	2575	51	6.2	U.Edm	Soil 10; gravel 1; sandy clay 5; soft sand-rock 8; blue clay 4; coal & earth bands 4; coal 4; bone .7; coal 1.5; shale. H_2O 18; A. 7.5; V.M. 28.5; F.C. 46; G.BTU 9,360. See also Mine #1320.
10	20	38	23	4	1613	s	1943-55	Armstrong Constr'n	Ardley		25+	5.5	U.Edm	Sandy clay 25+; coal 3.7; bone .3; coal 1.5; shaly clay. H_2O 19.7; A. 8.8; V.M. 27.9; F.C. 43.6; G.BTU 10,000.
3,4,5, 6,9,10, 11,15,16	33	38	23	4	809	u/g;s	1919---	Mann	Ardley		21-80		U.Edm	Soil 7; gravel 1.2; shale 6; iron nodules 1; shale 3.9; iron nodules .8; shale 6; ss 1.2; shale 4; shaly clay 10; coal, ss, slate 1.5; coal 4.5; bone .2; coal 1.3; bone, soft clay 3.4; coal 1.5; clay .5; coal 1.3; sandrock. See also Lsd. 2,3,4 Sec. 2-39-23-4. H_2O 19.6; A. 5.6; V.M. 27.9; F.C. 46.9; G.BTU 9,490.
12	35	38	23	4	1605	s	1943-48	Myers&Munro	Ardley		25	4.5	U.Edm	Gravel & sandy clay 25; clay 2-3; bone 1; coal 3.5; clay .3; coal 1.5. H_2O 19.8; A. 7.2; V.M. 28.8; F.C. 44.2; G.BTU 9,290.
11,12	8	39	15	4	1237	u/g	1926-54	Davis & Doan	Castor	2500	85	7	L.Edm	Soft ss; coal .2; clay .3; coal .8; clay .2; coal 4.2; clay. H_2O 24.9; A. 11.2; V.M. 27.3; F.C. 36.6; G.BTU 8,020.
4	17	39	15	4	1062	u/g	1922-57	Strader	Castor	2500		5.5	L.Edm	H_2O 25.2; A. 13.3; V.M. 26.7; F.C. 34.8; G.BTU 7,560.
11,12	32	39	15	4	1634	u/g;s	1945-54	Wiltse	Castor	2420	30	5	L.Edm.	Clay; coal 3.9; clay .1; coal 1; clay. H_2O 26.1; A. 9.9; V.M. 28.4; F.C. 35.6; G.BTU 8,040.
6,11	28	39	16	4	291	u/g;s	1911---	Chiswick	Castor	2500	10-25	4	L.Edm	Clay; bone .2; coal 4; shaly clay. H_2O 25.6; A. 5.3; V.M. 29.7; F.C. 39.4; G.BTU 8,370.
11	19	40	15	4	1691	s	1949-52	Shannon&Lang	Castor		16	6	L.Edm	Clay; coal 2.5; bone .3; coal 4.2; clay. H_2O 23.9; A. 7.9; V.M. 27.6; F.C. 40.6; G.BTU 8,670.
1,2,3, 6,7,8, 9,10,11, 12,13	20	40	15	4	1046	s	1922---	Battle River C.Co	Castor		20-60	6.5	L.Edm	H_2O 26.4; A. 4.1; V.M. 30.1; F.C. 39.4; G.BTU 8,750. See also Lsd. 5 Sec. 21-40-15-4; Lsd. 10, 15,16 Sec. 19-40-15-4; Lsd. 2,7,11 Sec. 25-40-16-4; Lsd. 1 Sec. 30-40-15-4; Lsd. 14,15,16 Sec. 24-40-15-4.

GEOGRAPHICAL LISTING, COAL MINES, PLAINS OF ALBERTA

Lsd. or 1/4	Location Sec.	Location Tp.	R.	Mer.	Mine No.	Mine Type	Life Span	Last Operator	Coal Area	Seam Elevation	Cover (feet)	Seam (feet)	Prod. Fm.	Logs(feet); Analyses; Notes
1,8	32	40	15	4	953	u/g;s	1921-50	Wiltse, Cordell & Pilsworth	Castor	2316	28	6.7	L.Edm	- Blue clay; coal 4.8; clay .2; coal 1.7; ss. H_2O 25.9; A. 6.7; V.M. 29.3; F.C. 38.1; G.BTU 8,640.
3	32	40	15	4	1650	s	1946-54	Lynass	Castor		25	6.7	L.Edm	- Clay 25; coal 4.8; clay .2; coal 1.7. H_2O 24.9; A. 8.3; V.M. 30.1; F.C. 36.7; G.BTU 8,450. See also Lsd. 14 Sec. 29-40-15-4.
7	32	40	15	4	1697	u/g	1949-53	Muyers & Sons	Castor		28	8	L.Edm	- Clay; coal 2; coal 6; clay. H_2O 24.3; A. 7.4; V.M. 30.4; F.C. 37.9; G.BTU 8,720.
13	25	40	16	4	1232	u/g	1926-54	Ainsworth	Castor	2292	20	7	L.Edm	- Clay; bony coal 1.8; coal 3; bone .2; coal 2; clay. H_2O 25.8; A. 5.7; V.M. 29.3; F.C. 39.2; G.BTU 8,670.
14	25	40	16	4	1642	u/g	1946-51	Bradley & O'Brien	Castor	2294	50+	6.2	L.Edm	- Clay; coal .2; coal 6; clay. H_2O 25.9; A. 5; V.M. 29.8; F.C. 39.3; G.BTU 8,890.
16	26	40	16	4	1614	s	1943---	Stettler C.Co	Castor		45	7.1	L.Edm	- Clay; coal 7; clay .1; shaly clay. H_2O 26.1; A. 7.1; V.M. 28.9; F.C. 37.9; G.BTU 8,550. See also Lsd. 11,12 Sec. 25-40-16-4.
9,13, 14,15, 16	36	40	16	4	1578	s	1941---	Forestburg Coll.	Castor				L.Edm	- H_2O 25.6; A. 5.6; V.M. 29.8; F.C. 39; G.BTU 8,710. See also Lsd. 16 Sec. 35-40-16-4; Lsd. 1,2, 7,8,9,16 Sec. 2-41-16-4; Lsd. 1,2,3,4,5, 6,7,8 Sec. 1-41-16-4.
1	2	41	16	4	1677	s	1948---	Luscar C.Co	Castor				L.Edm	- Consol. with Mine #1578. H_2O 26.5; A. 5.4; V.M. 29.5; F.C. 38.6; G.BTU 8,650.
4,5	28	41	17	4	1572	u/g	1940-53	Jones	Castor	2300	22-32		L.Edm	- H_2O 24.7; A. 7.7; V.M. 28.3; F.C. '9.3; G.BTU 8,610.
10	29	41	17	4	1248	u/g	1926---	Gerla & Runge	Castor	2308	100	5.7	L.Edm	- Ss; coal .2; clay .2; coal .5; clay .2; coal 3; bone .2; coal 1.5; clay. H_2O 24.8; A. 6; V.M. 28.7; F.C. 40.5; G.BTU 8,750. Mine #1. See also Mines # 2 and 3.
12,13	16	42	17	4	1441	u/g	1933-54	Marshall	Castor	2263	130	10.8	L.Edm	- Clay; coal 2.5; clay .3; coal 3.1; bone 1.2; coal 3.1; bone 1.2; coal 3.8; clay. H_2O 24.3; A. 8; V.M. 28.6; F.C. 39.1; G.BTU 8,610. See also Lsd. 9 Sec. 17-42-17-4.
8	21	42	17	4	1689	u/g	1949-57	MacPherson&Schatz	Castor	2330	50-100	7.2	L.Edm	- Clay; bone & coal 1.5; coal, bone & clay 1.4; coal 1; bone .3; coal 1.3; clay .2; coal 1.5. H_2O 25; A. 8; V.M. 28.6; F.C. 38.4; G.BTU 8,490.

GEOGRAPHICAL LISTING, COAL MINES, PLAINS OF ALBERTA

Lsd. or 1/4	Location Sec.	Tp.	R.	Mer.	Mine No.	Mine Type	Life Span	Last Operator	Coal Area	Seam Elevation	Cover (feet)	Seam (feet)	Prod. Fm.	Logs(feet); Analyses; Notes
5,6	22	42	17	4	1587	u/g	1942---	Mills	Castor	2300	70	6.8	L.Edm	- Bone 1; coal 1.6; bone .45; coal .3; clay 1.4; coal 2.5; clay .2; coal 1.2. H_2O 25.5; A. 7.7. V.M. 27.6; F.C. 39.2; G.BTU 8,580.
13	22	42	17	4	615	u/g		Komperdo&Partners	Castor	2302	95	6	L.Edm	- Clay 1; bone .3; coal .8; clay .1; coal 2.5; clay .2; coal 1; ss. H_2O 23.1; A. 12; V.M. 29.4; F.C. 35.5; G.BTU 8,310.
4	27	42	17	4	1702	u/g	1949-58	Dolanz&Strickland	Castor	2385	85	5.2	L.Edm	- Clay; coal 5; clay. H_2O 25.9; A.7.7; V.M. 28; F.C. 39.4; G.BTU 8,550.
9,15, 16	28	42	17	4	251	u/g	1910-57	Tyrlik	Castor	2332	70	4.9	L.Edm	- Ss; shaly clay .2; coal 1.5; bone .8; coal 2; shaly clay. H_2O 26.3; A. 5.5; V.M. 28.4; F.C. 39.8; G.BTU 8,650.
16	29	42	17	4	1718	u/g;s	1950-57	Centennial C.Co	Castor		10-25	10.5	L.Edm	- Clay & shale; dirty coal .8; bone .7; coal 4.5; mixture 1.5; coal 3. H_2O 24.8; A. 5.9; V.M. 29.3; F.C. 40; G.BTU 8,540.
1	33	42	17	4	911	u/g	1921	Strickland	Castor	2340	20-50	4.5	L.Edm	- Clay; coal 1.8; bone .2; clay .3; bone .2; coal 2; shaly clay. H_2O 24.5; A. 8.3; V.M. 28.4; F.C. 38.8; G.BTU 8,580. See also Lsd. 4 Sec. 34-42-17-4.
8	7	43	17	4	1674	u/g	1948-50	Wisla	Castor	2345	80-150	4.2	L.Edm	- Clay; coal 3.5; coal & bone .8; clay. H_2O 26; A. 4.6; V.M. 29.7; F.C. 39.7; G.BTU 8,990.
1,2	8	43	17	4	1713	u/g	1950-57	Wisla Bros.	Castor	2335	30-100	4.8	L.Edm	- Clay; rock 1-1.5; coal; bone .7-1.5; coal .5. H_2O 25.6; A. 4.1; V.M. 29.6; F.C. 40.7; G.BTU 9,180.
6,11	2	44	19	4	1435	u/g	1933-57	Olson	Castor	2375	75	4.7	L.Edm	- Soft sandrock; shaly clay 1.5; coal 2.3; bone .3; coal 2; bone .4; clay. H_2O 26.1; A. 8.4; V.M. 27.6; F.C. 37.9; G.BTU 8,270.
2,3, 6,7	20	46	19	4	1603	s	1943---	Camrose Coll.	Camrose		14-24	3.5-5	L.Edm	- Clay; coal 3.5-5; shaly clay. H_2O 26.2; A. 4.9; V.M. 28.7; F.C. 40.2; G.BTU 8,850. See also Lsd. 14,15 Sec. 17-46-19-4.
3,6	14	48	18	4	724	s	1917---	Bumstad	Camrose			5.8	L.Edm	- Clay 10-18; coal 1.2; clay .1; coal 4.5; shaly clay. H_2O 29.1; A. 3.9; V.M. 28.1; F.C. 38.9; G.BTU 8,370.
7,8, 9,10	30	48	18	4	1055	s	1922-59	Fergstad	Camrose		16	6.	L.Edm	- H_2O 28; A. 4.9; V.M. 28; F.C. 39.1; G.BTU 8,420.

GEOGRAPHICAL LISTING, COAL MINES, PLAINS OF ALBERTA

Lsd. or 1/4	Location Sec.	Tp.	R.	Mer.	Mine No.	Mine Type	Life Span	Last Operator	Coal Area	Seam Elevation	Cover (feet)	Seam (feet)	Prod. Fm.	Logs(feet); Analyses; Notes
8,9	7	48	19	4	1524	s	1937-58	Shute & Partners	Camrose		6-9	3	L.Edm	H_2O 28.6; A. 4; V.M. 28.8; F.C. 38.6; G.BTU 8,320.
3	18	48	19	4	241	s	1910-54	Proskou	Camrose		8-12	6.8	L.Edm	Clay 6-12; coal 3.6; clay .1; coal 3.2; shaly clay. H_2O 24.5; A. 12.4; V.M. 27.5; F.C. 35.6; G.BTU 7,850.
11,12	20	48	25	4	1743	s	1956---	Blue Bird C.Co	Wetaskiwin		15-30	3.9	L.Edm	Clay & sandy shale; coal .5; clay .4; coal 2.3; clay .2; coal .5; clay. H_2O 21.4; A. 9.2; V.M. 27.6; F.C. 41.8; G.BTU 9,230.
7	3	48	27	4	1534	u/g	1938-55	Gill	Wetaskiwin	2584.7			U.Edm	Coal & shale; poor coal 1; clay .8; coal .7; clay .3; coal 4; bony clay. H_2O 21; A. 10.8; V.M. 26.9; F.C. 41.3; G.BTU 8,900.
8	8	49	17	4	1206	u/g;s	1925-62	Ryley C.Co	Tofield	2350	14	8.15	L.Edm	Coal; coal .8; clay .1; coal 2.2; clay .15; coal 3; shale. H_2O 29.3; A. 5.9; V.M. 27.8; F.C. 37; G.BTU 8,170.
5,12	9	49	17	4	1624	u/g;s	1945---	Tyalta C.Co	Tofield	2355	20	9.8	L.Edm	Clay; coal 3.6; coal 2; clay .2; coal 4; clay. H_2O 30.7; A. 6; V.M. 27.5; F.C. 35.8; G.BTU 7,920.
10,11, 12,13, 14,15	11	49	18	4	1107	u/g;s	1923---	Black Nugget C.Co	Tofield	2300	9-28	5.5-6.5	L.Edm	Strip mine: clay; coal 5.5; shaly clay. H_2O 29.2; A. 7.8; V.M. 26; F.C. 37; G.BTU 8,010.
1,2, 3,6,11	14	49	18	4	215	u/g;s	1909---	Jet Constr'n Ltd.	Tofield		13-23	5-6.5	L.Edm	Clay 15-23; coal 5-6.5; shaly clay. H_2O 28.7; A. 7.4; V.M. 27.4; F.C. 36.5; G.BTU 8,040.
12	20	49	2	5	1712	s	1950-56	Fodor & Fodor	Pembina		25	3.5	U.Edm	Clay 25; coal 3.5. H_2O 22.9; A. 6.6; V.M. 29; F.C. 41.5; G.BTU 9,160.
6,11, 16	13	49	3	5	1644	s	1946-58	Strawberry Creek C.Co	Pembina		20-50	3.2	U.Edm	Clay; ss; coal 3.2; clay. H_2O 18.6; A. 7.7; V.M. 27.6; F.C. 46.1; G.BTU 9,670.
12,14	13	49	3	5	1670	s	1948---	Warburg C.Co	Pembina		15-35	3.5	U.Edm	Clay; sandrock .7; shale 2.5; ss 3; coal 3.5; clay. H_2O 18.4; A. 7.7; V.M. 29.5; F.C. 44.4; G.BTU 9,660. See also Lsd. 1,2 Sec. 24-49-3-5.
9	23	49	7	5	1649	u/g	1946-48	Schon	Pembina			13	U.Edm	H_2O 19.2; A. 14.2; V.M. 26.7; F.C. 39.9; G.BTU 8,180.
6,7,8, 9,10,11, 12,16	26	50	19	4	252	s	1910-57	Tofield C.Co	Tofield		7-27	5-7	L.Edm	Loam 1.5; clay 7-27; coal 5-7. H_2O 27.2; A. 6.4; V.M. 28.1; F.C. 38.3; G.BTU 8,460.
NW	18	50	3	5	1701	s	1949-51	Gailey & Son	Pembina			18	U.Edm	H_2O 18.3; A. 16; V.M. 25.9; F.C. 39.8; G.BTU 8,260.

GEOGRAPHICAL LISTING, COAL MINES, PLAINS OF ALBERTA

Lsd. or 1/4	Location Sec.	Tp.	R.	Mer.	Mine No.	Mine Type	Life Span	Last Operator	Coal Area	Seam Elevation	Cover (feet)	Seam (feet)	Prod. Fm.	Logs(feet); Analyses; Notes
9	15	50	4	5	1687	s	1948-53	Sturns	Pembina			8	U.Edm	H_2O 18; A. 7.2; V.M. 28.4; F.C. 46.4; G.BTU 9,310.
13	5	51	25	4	720	u/g	1917---	Rudolph Mine	Edmonton	2046		5	L.Edm	Sandy clay; bone .5; coal 4.7; clay. H_2O 18.8; A. 5.9; V.M. 28.9; F.C. 46.4; G.BTU 9,900.
5,16	23	51	25	4	1628	u/g	1945-54	Blue Point Mine	Edmonton	2070		4-4.5	L.Edm	H_2O 22.8; A. 6.2; V.M. 28.8; F.C. 42.2; G.BTU 9,200.
3,4,5	25	51	25	4	1419	u/g;s	1933-54	Pine Creek Coll.	Edmonton	2089	up to 110	4.5	L.Edm	Clay; coal 2.2; clay .1; coal 2.1; clay. H_2O 24.1; A. 6; V.M. 28.5; F.C. 41.4; G.BTU 8,990.
7,10, 11	25	51	25	4	1560	u/g	1939-54	Nimko	Edmonton	2120	45-125		L.Edm	#1 Mine; clay; coal 1.8; clay .2; coal 2.3; clay. H_2O 24.3; A. 10.8; V.M. 27.2; F.C. 37.7; G.BTU 8,250.
12	25	51	25	4	1646	s	1946-48	Mucha	Edmonton				L.Edm	Clay; coal 2; clay .2; coal 2; clay. H_2O 23.9; A. 6.6; V.M. 28.9; F.C. 40.6; G.BTU 9,060.
13,14	25	51	25	4	29	u/g	1897-1948	Waypowich & Senechto	Edmonton	2135	24-75		L.Edm	H_2O 22.3; A. 6.2; V.M. 29.4; F.C. 42.1; G.BTU 9,360.
9,16	26	51	25	4	1641	u/g	1946-58	Horkulak	Edmonton		82		L.Edm	Clay; coal 2.3; clay .2; coal 2.2; clay. H_2O 23.4; A. 4.2; V.M. 30.6; F.C. 41.8; G.BTU 9,470.
3,4, 5,6	13	52	25	4	1727	u/g	1952---	Whitemud Creek C.Co	Edmonton	2004.3	50-165		L.Edm	Clay; coal 6-8; clay. H_2O 22.5; A. 7.4; V.M. 28.4; F.C. 41.7; G.BTU 9,120.
8	30	52	4	5	1592	s	1943-61	Mt. Royal Coll.	Pembina				U.Edm	H_2O 20; A. 7.3; V.M. 29.9; F.C. 42.8; G.BTU 9,080. See also Lsd. 4,5 Sec. 29-52-4-5.
5	33	52	5	5	1683	s	1948-51	Continental Coll.	Pembina		8-50	8	U.Edm	Clay 4-6; mushy coal 4; friable coal 5.5; shaly clay .8; coal ? H_2O 18.5; A. 11; V.M. 28.4; F.C. 42.1; G.BTU 8,770.
9	2	53	21	4	1632	s	1945-55	MacLachlan	Edmonton		0-45		L.Edm	Coal 1.3; clay .05; coal 3.2; parting; coal 2.4; clay 2.2; coal 2.5. H_2O 28.4; A. 8.1; V.M. 29.7; F.C. 33.8; G.BTU 7,770.
1,2, 7,8	7	53	23	4	99	u/g	1903-52	Great West C.Co	Edmonton				L.Edm	H_2O 25.2; A. 7.9; V.M. 27.1; F.C. 39.8; G.BTU 8,570. See also Lsd. 5,6,11,12,13,14 Sec. 5-53-23-4; Lsd. 1,2,3,6,7,8,9,10,11,15,16 Sec. 6-53-23-4; Lsd. 3,4,5,6 Sec. 8-53-23-4.
1,2,3, 4,6,7	13	53	24	4	1366	u/g	1931-51	Beverly C.Ltd	Edmonton			3.1-4.5	L.Edm	H_2O 24.1; A. 7.3; V.M. 28.3; F.C. 40.3; G.BTU 8,740. See also Lsd. 14 Sec. 12-53-24-4.

GEOGRAPHICAL LISTING, COAL MINES, PLAINS OF ALBERTA

Lsd. or 1/4	Location Sec.	Tp.	R.	Mer.	Mine No.	Mine Type	Life Span	Last Operator	Coal Area	Seam Elevation	Cover (feet)	Seam (feet)	Prod. Fm.	Logs(feet); Analyses: Notes
R.L.29, 31,33		53	24	4	1357	u/g	1931-51	Red Hot C.Co	Edmonton	2033.2	58		L.Edm	Coal .5-1.8; bone .3-.6; clay 2.1-2.7; coal 1.7-2.3. H_2O 24.2; A. 6.4; V.M. 28.8; F.C. 40.6; G.BTU 8,950.
1,2,3, 4,5,6	15	53	4	5	419	u/g;s	1913-63	Alberta C.Co	Pembina				U.Edm	H_2O 21; A. 8.1; V.M. 28.1; F.C. 42.8; G.BTU 8,760. See also Lsd. 15,16 Sec. 9-53-4-5; Lsd. 13 Sec. 10-53-4-5; Lsd. 1,2,7,8 Sec. 16-53-4-5.
1	15	53	4	5	1645	s	1936-53	Alta.South.C.Co	Pembina				U.Edm	H_2O 20.5; A. 10.7; V.M. 27.7; F.C. 41.1; G.BTU 8,670. See Mine #419.
1	31	53	5	5	1630	s	1945-46	Lake Isle Mine	Pembina		0-20	9	U.Edm	H_2O 26.7; A. 9; V.M. 26.1; F.C. 38.2; G.BTU 7,600.
12	34	53	7	5	1495	u/g;s	1936-54	Pembina Peerless C.Co	Pembina	2265.7	0-25		U.Edm	Clay; coal 1.5; clay .2; coal 5.4; clay 1; coal .4; clay. H_2O 20.3; A. 8.6; V.M. 25.8; F.C. 45.3; G.BTU 9,080.
3,4	31	54	24	4	1098	u/g	1923-54	Vitaly	Edmonton	2209	85		L.Edm	Clay; coal 4.7; clay .3; bone .2; coal 1; clay. H_2O 24.9; A. 10.3; V.M. 27.4; F.C. 37.4; G.BTU 8,200.
4	36	54	25	4	1626	u/g	1945---	Star Key Mines	Edmonton				L.Edm	H_2O 24.9; A. 8.7; V.M. 28; F.C. 38.4; G.BTU 8,500. See also Lsd. 1,2,7,8,9 Sec. 35-54-25-4.
5,6	36	54	25	4	1316	u/g	1929-57	Samis Coll.	Edmonton	2209	48		L.Edm	Clay; shaly coal 3; coal 3; coal 6.2; clay .1; coal 1.5; clay .1; bone & clay 4; coal 3; clay. H_2O 25.8; A. 9.3; V.M. 26.8; F.C. 38.1; G.BTU 8,280.
11,12, 13,14	36	54	25	4	1266	u/g	1927---	Black Gem C.Co	Edmonton				L.Edm	H_2O 24.8; A. 2.9; V.M. 30.1; F.C. 42.2; G.BTU 9,330. See also Lsd. 9,16 Sec. 35-54-25-4.
12	3	54	7	5	1739	s	1954---	Ostertag	Pembina				U.Edm	Coal & clay bands 1.5; coal 4. H_2O 19.8; A. 10.7; V.M. 26.6; F.C. 42.9; G.BTU 8,940. See also Lsd. 6,11 Sec. 10-54-7-5.
9,16	10	54	7	5	1657	u/g	1947-57	Rhodes & Son	Pembina	2400	0-100		U.Edm	Bone; coal 4; clay .3-.7; coal .3-.6; clay. H_2O 20.8; A. 4.2; V.M. 27.7; F.C. 47.3; G.BTU 9,710.
3,4	6	55	24	4	1496	u/g	1936-53	Gwilliam&Samis	Edmonton		60		L.Edm	H_2O 24; A. 10.5; V.M. 28.1; F.C. 37.4; G.BTU 8,270.

GEOGRAPHICAL LISTING, COAL MINES, PLAINS OF ALBERTA

Lsd. or 1/4	Location Sec.	Tp.	R.	Mer.	Mine No.	Mine Type	Life Span	Last Operator	Coal Area	Seam Elevation	Cover (feet)	Seam (feet)	Prod. Fm.	Logs(feet); Analyses; Notes
3,4, 5,6	8	55	24	4	1463	u/g	1934-56	Riverdale C.Ltd	Edmonton		75	5	L.Edm	- Clay; coal .1; clay .5; coal 3.8; bone .4; coal .8; shaly clay. H_2O 25.4; A. 6.7; V.M. 28.2; F.C. 39.7; G.BTU 8,750.
7,9, 10,14, 15,16	8	55	24	4	428	u/g	1914-51	Banner C.Ltd	Edmonton	2080	174	4.5	L.Edm	- Ss; clay; coal 4.5; clay. H_2O 24.7; A. 9.2; V.M. 27.2; F.C. 38.9; G.BTU 8,440.
2	17	55	24	4	1627	u/g;s	1945-54	Beverly Ltd	Edmonton			5-6	L.Edm	- H_2O 25.3; A. 6.6; V.M. 28.5; F.C. 39.6; G.BTU 8,730.
3,4,6, 10,15	24	55	25	4	129	u/g;s	1907-60	Sundance Mines	Edmonton		20-40	7-10	L.Edm	- H_2O 25.6; A. 5.7; V.M. 28.8; F.C. 39.9; G.BTU 8,620.
1,2	32	55	25	4	1635	u/g	1945-57	Morinville Coll.	Edmonton	2243	51		L.Edm	- Clay; coal 3; clay .2; coal 2.9; bone; clay. H_2O 25.7; A. 6.8; V.M. 28.4; F.C. 39.1; G.BTU 8,630.
2,7	36	56	26	4	1582	s	1941---	Egg Lake C.Co	Edmonton		15-20	6.5	L.Edm	- H_2O 25; A. 6.2; V.M. 29.3; F.C. 39.5; G.BTU 8,550.
2,7	36	56	26	4	1696	s	1949-58	Morinville Contr's	Edmonton		13-15	6.5	L.Edm	- H_2O 26.9; A. 8.8; V.M. 28.7; F.C. 35.6; G.BTU 8,010.
14	26	57	25	4	1636	s	1945-51	St.Martin	Edmonton		8-10	5	L.Edm	- H_2O 32.8; A. 10.4; V.M. 27.1; F.C. 29.7; G.BTU 6,390.
16	35	58	27	4	1523	s	1937---	Picardville C.Co	Westlock		24	6	L.Edm	- Clay 24; coal 2.5; bone .5; coal 3; shaly clay 10; coal 5; shaly clay. H_2O 27.1; A. 6.8; V.M. 28.1; F.C. 38; G.BTU 8,430.
9	20	59	8	5	1735	s	1953-55	Collins	No Area		12	3	U.Edm	- Clay & shale 12; coal 3. H_2O 29; A. 8.1; V.M. 25.3; F.C. 37.6; G.BTU 7,420.
1	31	59	10	5	1612	u/g	1943-51	Pritchard	Whitecourt		20-80	3.5	L.Edm	- Soft ss; clay; coal 1; clay .5; coal 2; clay. H_2O 20.5; A. 7.6; V.M. 31; F.C. 40.9; G.BTU 9,450.
16	24	59	11	5	1569	s	1940-62	Watson	Whitecourt		10-50	7.8	L.Edm	- Clay; ss 1.5; slaty coal 1.2; clay .5; coal 1.5; clay .5; coal 3.5; clay. H_2O 20.8; A. 9.9; V.M. 25.9; F.C. 43.4; G.BTU 9,000.
1	11	60	21	4	1562	u/g;s	1939---	North Point C.Co	Westlock				Old	- H_2O 31; A. 4.8; V.M. 27.6; F.C. 36.6; G.BTU 7,960. See also Lsd. 16 Sec. 2-60-21-4.
12,13	12	60	21	4	1517	u/g;s	1937---	Thorhild C.Co	Westlock		13-20	7.3	Old	- Bone .5; coal 2; bone .6; coal 2.2; bone .5; coal 1.5; clay. H_2O 29.6; A. 6.2; V.M. 27.5; F.C. 36.7; G.BTU 7,980.
2	2	60	9	5	1681	u/g	1948-54	Hughes	Whitecourt			3.5	L.Edm	- H_2O 20.1; A. 15.9; V.M. 26.5; F.C. 37.5; G.BTU 8,320.
NE	2	68	10	6	1616	s	1943-56	Pinto Creek Coal	No Area		5-30		Wti	- Coal 3.3-3.7; clay .3; coal 1.8. H_2O 11.2; A. 13.7; V.M. 30.5; F.C. 44.6; G.BTU 10,600.

GEOGRAPHICAL LISTING, COAL MINES, PLAINS OF ALBERTA

Lsd. or 1/4	Location Sec.	Tp.	R.	Mer.	Mine No.	Mine Type	Life Span	Last Operator	Coal Area	Seam Elevation	Cover (feet)	Seam (feet)	Prod. Fm.	Logs(feet); Analyses; Notes
15	35	70	7	6	651	u/g	1916-57	Gibney	Halcourt	2198.8	40-86	3.6	Wti	- Ss; coal .3; bone .5; coal 2; bone .2; coal .5; clay. H_2O 17.5; A. 7.4; V.M. 28.6; F.C. 46.5; G.BTU 10,330.
3,6	21	70	10	6	1704	s	1949-57	Romaniuk	Halcourt		10-18	1.7-1.8	Wti	- H_2O 12.6; A. 7.2; V.M. 33.7; F.C. 46.5; G.BTU 11,340.
14	24	70	11	6	1588	s	1942---	Dahl & Cage	Halcourt	2100	15+	2.2-3	Wti	- #1 Mine: shale; coal 2.2; shale. H_2O 12,2; A. 5.4; V.M. 34; F.C. 48.4; G.BTU 11,590. See also Lsd. 3 Sec. 25-70-11-4.
5,12	22	73	8	5	1682	s	1948-51	Pearson	Slave			5	Wti	- H_2O 35.2; A. 6.2; V.M. 27; F.C. 31.6; G.BTU 7,020.
NE	24	74	5	5	1730	s	1952-53	Norris	Slave			6	Wti	- H_2O 31; A. 3.5; V.M. 27.8; F.C. 37.7; G.BTU 7,870.

VIII. COAL "FIELDS"

Large numbers of coal mines have operated in Alberta, mostly clustered in recognizable "fields" (see foregoing extracts) which usually contain some coal deposits lying close enough to the surface to be recovered by strip-mining methods. Eighteen major "fields" whose locations are shown in Map B, are listed below. Tonnage estimates are not given, since these are almost entirely dependant on engineering criteria not discussed here (but see Latour and Christmas, 1970, for a recent tonnage estimate); however, speculation on abundance of coal in "fields" is indicated by size of enclosing circles in Map B.

1. Thelma-Elkwater Field

- Upper Cretaceous coals (Eastend Formation)
- Rank Lignite A
- Seams 5 - 10 feet thick
- Deposits probably recoverable only by underground mining
- Active mining 1917-1955
- Total tonnages here are probably very large but underground mining for Lignite can scarcely be an economically attractive operation within the foreseeable future.

2. Lethbridge Field

- Upper Cretaceous coals (Lethbridge Member of Oldman Formation)
- Rank HighVolatile C Bituminous
- Seams 4 - 6 feet thick
- Deposits recoverable only by underground mining
- Active mining 1873-1962
- Large tonnages of good quality, high-rank coal still remain to be recovered by underground mining methods.

3. Medicine Hat Field

- Upper Cretaceous coals (Foremost Formation)
- Rank Subbituminous C
- Seams to 6 feet thick
- Deposits recoverable only by underground mining
- Active mining 1898-1967

3. Medicine Hat Field (continued)

- The Foremost Formation here still contains considerable tonnages of unexploited coal, but rank is low, seams are impersistent, anastomosing and split by numerous dirt partings, while overburden everywhere is too great to allow economical stripping.

4. Bow City-Brooks Field

- Upper Cretaceous coals (Lethbridge Member of Oldman Formation)
- Rank Subbituminous B
- Seams to 6 feet thick
- Many deposits strippable
- Active mining continuous since 1909
- An economically attractive stripping area; seam extension into underground mineable areas unknown but possibly great.

5. Bassano Field

- Upper Cretaceous coals (Lower Edmonton Formation)
- Rank Subbituminous B
- Seams to 12 feet thick
- Deposits recoverable only by underground mining
- Active mining 1902-1955
- Thick seams with dirt partings outcropping on the Blackfoot Indian Reserve, may have extensions into underground-mineable areas.

6. Drumheller Field

- Upper Cretaceous coals (Lower Edmonton Formation)
- Rank Subbituminous B
- Seams to 12 feet thick
- Most deposits recoverable only by underground mining
- Active mining continuous since 1911
- Very large reserves of clean coal in thick seams known in this area; one of the better Alberta fields, although down-dip limits unknown.

7. Sheerness Field

- Upper Cretaceous coals (Lower Edmonton Formation)
- Rank Subbituminous C
- Seams to 12 feet thick
- All deposits strippable
- Active mining continuous since 1912
- Large but strictly delimited coal body, with very thin cover; an economically attractive field in spite of low rank and extensive oxidation; no extensions possible.

8. Three Hills-Scollard Fields

- Upper Cretaceous-Lower Tertiary coals (Ardley Coal Zone, Edmonton Formation)
- Rank Subbituminous B
- Seams to 7 feet thick
- Many deposits strippable
- Active mining began 1906
- Considerable tonnages strippable in scattered fields along outcrop zone; very great tonnages probably available for underground mining in down-dip extension.

9. Ardley Fields

- Upper Cretaceous-Lower Tertiary coals (Ardley Coal Zone, Edmonton Formation)
- Rank Subbituminous B
- Seams to 6 feet thick in zone to 28 feet thick
- Many deposits strippable
- Active mining began about 1900
- Considerable tonnages strippable under heavy overburden at the outcrop zone; considerably greater tonnages probably available for underground mining in down-dip extension.

10. Battle River Fields

- Upper Cretaceous coals (Lower Edmonton Formation)
- Rank Subbituminous C
- Seams to 8 feet thick
- Large deposits strippable
- Active mining continuous since 1910
- Widely scattered lenses of strippable low-rank coal, some of enormous size, including the second most productive field in Alberta Plains at present time; extension down-dip unknown.

11. Tofield-Dodds Field

- Upper Cretaceous coals (Lower Edmonton Formation)
- Rank Subbituminous C
- Seams to 8 feet thick
- Most known deposits strippable
- Active mining continuous since 1907
- Widely scattered lenses of strippable, low-rank coal, some glacially distorted; extension down-dip unknown.

12. Edmonton Fields

- Upper Cretaceous coals (Lower Edmonton Formation)
- Rank Subbituminous B and Subbituminous C
- Seams to 8 feet thick
- Some deposits strippable
- Active mining continuous since 1870's
- Large reserves of clean coal in thick seams known in this area; one of the oldest and best-known fields, but down-dip limits unknown; urbanization probably limits development.

13. Wabamun Fields

- Upper Cretaceous-Lower Tertiary coals (Ardley Coal Zone, Edmonton Formation)
- Rank Subbituminous B
- Seams to 9 feet thick in zones to 30 feet thick
- Many deposits strippable
- Active mining continuous since 1910
- Within 30 miles from Genessee to Evansburg, some 5 glacially disturbed, more or less merging coal bodies, which, in aggregate, contain the largest tonnage of strippable coal in Alberta; at present include the most productive coal field in the Plains region; considerable tonnages probably available for underground mining in extension down-dip.

14. Whitecourt-Swan Hills Fields

- Upper Cretaceous-Lower Tertiary coals (Ardley Coal Zone, Edmonton Formation, and older)
- Rank Subbituminous B, Subbituminous C and Lignite A
- Seams to 8 feet thick and zones to 25 feet thick
- Limited mining around periphery 1923-1962
- Probably large deposits scattered through large unpopulated area, terrain very rough; slumping and glacial deformation of near-surface bedrock extreme; possibly small strippable coal bodies might be expected along east face of Swan Hills (Tp. 63-70, R. 7-9, W. 5th Mer.), but elsewhere, only underground mining will be possible.

15. Fox Creek Fields

- Upper Cretaceous-Lower Tertiary coals (Ardley Coal Zone, Edmonton Formation)
- Rank Subbituminous B, Subbituminous C
- Seams to 10 feet thick in zones to 50 feet thick
- Many deposits strippable
- No active mining
- Large deposits in unpopulated area; numerous dirt partings; glacial deformation of near-surface bedrock extreme but terrain gentle so that large tonnages available for stripping; considerable tonnages known to be available for underground mining in down-dip extension.

16. Simonette Field

- Upper Cretaceous-Lower Tertiary coals (Ardley Coal Zone, Edmonton Formation)
- Rank unknown, probably Subbituminous B
- No active mining
- Thick seams known from outcrop and subsurface in middle valley of Simonette River; probably an upper split of Ardley Coal Zone; underground mining will probably be preferred because of surface disturbance and heavy overburden.

17. Smoky-Cutbank Fields

- Upper Cretaceous-Lower Tertiary coals (Ardley Coal Zone, Edmonton Formation, and younger)
- Rank Subbituminous A, Subbituminous B
- Single seams to 5 feet and coaly zones to 15 feet
- One small strip pit operated for very short period
- Possibly large tonnages of coal in unpopulated area, but massive slumping in extremely rough terrain and considerable glacial deformation of bedrock makes economical strip-mining highly improbable; slumping and possible tectonic faulting put stratigraphy in doubt.

18. Halcourt Field

- Upper Cretaceous coals (Belly River Group equivalent)
- Rank High Volatile C Bituminous, Subbituminous A, Subbituminous B
- Seams to 5 feet, mostly about 2 feet
- Almost no deposits strippable
- Active mining 1916-1957
- Probably only one seam or closely related group of seams; in spite of high rank and low ash, this field cannot be economically attractive because of thin seams and heavy overburden.

IX. CONCLUSIONS AND RECOMMENDATIONS

1. It is believed that, in populated regions of the Alberta Plains, all major near-surface coal bodies have long since been discovered, chiefly through enterprise of the first settlers whose prime needs were water and fuel. Recent endeavours of both governmental and private survey organizations, summarized in figure 48, have pretty well elucidated the near-surface strippable coal reserves of the Plains.

2. It is believed that, in the Alberta Plains, all coal deposits within the top 100 - 200 feet have been glacially disturbed to some extent; some have been extensively deformed.

3. Technology does exist for strip-mining coal under several hundred feet of cover. However, (i) mining costs increase markedly, almost geometrically, with depth; (ii) in the near future, as a result of new ecological awareness, costs of required environmental rehabilitation will reach appreciable proportions; (iii) near-surface coal is usually slightly damaged by weathering and glacial breakage. Furthermore, with relatively flat-lying seams and argillaceous bedrock characteristic of Plains coal deposits, underground mining costs, given large, continuous operations, should not increase appreciably with depth down to 800 or 1000 feet, i.e., down to the point at which economical pillars can no longer support the weight of the roof. Thus, with preemption of the most economic near-surface deposits, the present cost differential between stripping and underground mining can be expected to disappear within a decade. Underground mining should then logically experience a large-scale revival, provided purely fiscal criteria prevail; sociological implications of underground mining could, of course, negate the foregoing argument.

4. Very approximately, it may be assumed that volume-for-volume, the Upper Cretaceous coal-bearing rock units of the Alberta Plains region contain as much coal at depth as in the known occurrences near surface. However, again very approximately, about one half of the volume of the top two hundred feet of the Alberta Plains consists of glacial or postglacial drift. Thus, area-for-area, at depths between 200 and 800 or 1000 feet (the underground mining depths) coal measures probably contain 6 to 8 times as much coal as in the top 200 feet (the strip-mining depth).

5. In the Alberta Plains there is an abundance of geological information on coal occurrences in the top 100 or 200 feet and in the region below the surface casings of oil and gas wells (600 - 1200 foot depths); information is surprisingly scanty, however, between these limits, i.e., almost precisely in the depth range that will become important when underground mining must be considered.

6. Figure 49 shows areas of Alberta where it seems most reasonable to begin exploration for coal deposits suitable for underground mining.

7. A number of surface geophysical techniques are under development as aids in coal exploration. Several, notably "Induced Polarization", have shown some value in distinguishing highly distorted coal bodies in the indurated bedrock of the Rocky Mountains, but at the time of writing none are sufficiently developed to replace, even in part, a conventional drill program in the scarcely disturbed strata and argillaceous sediments of the Plains.

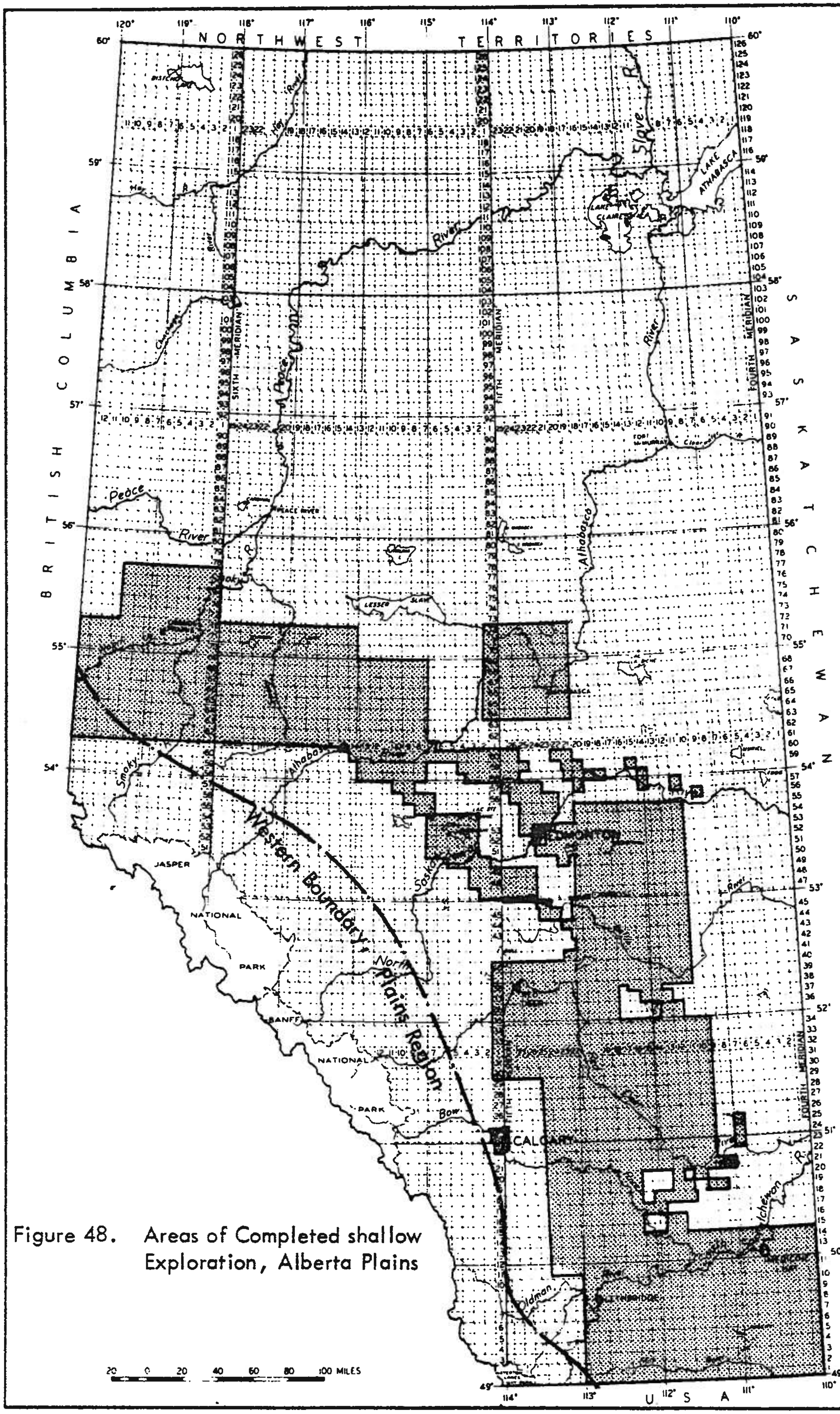


Figure 48. Areas of Completed shallow Exploration, Alberta Plains

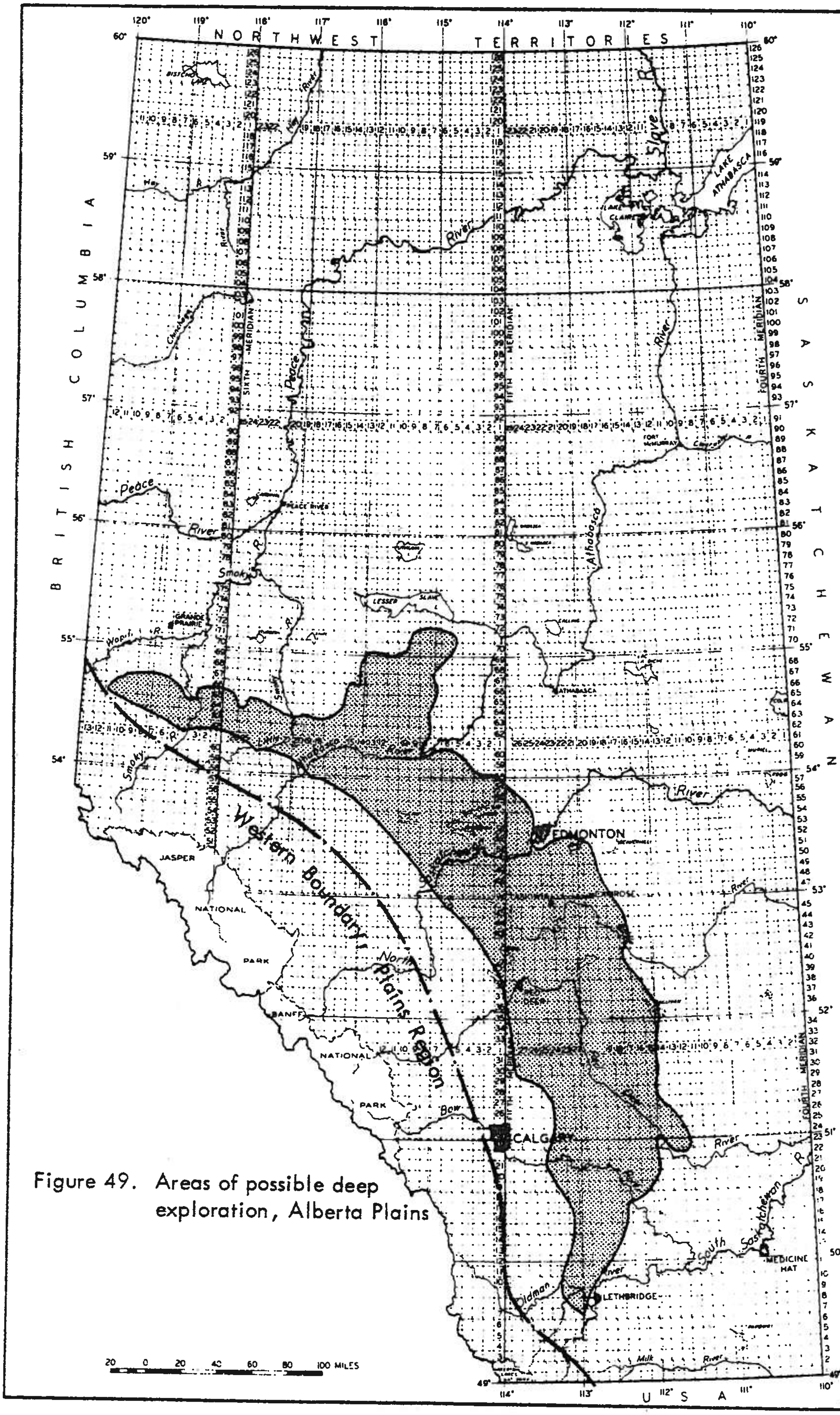


Figure 49. Areas of possible deep exploration, Alberta Plains

8. It is believed that, for exploring to 800 or 1000 feet in the Alberta Plains, the best equipment is a conventional mud-rotary drill rig. For reconnaissance exploration, cutting-samples dipped from the mud-stream and augmented by conventional single-point resistivity log together with spontaneous potential or natural gamma-log, provide adequate information (see Archer and Warrick, 1964). However, for precise surveying, especially preliminary to designing a mine, careful coring of the coal-bearing interval is recommended, and the use of more sophisticated and expensive geophysical logging methods such as density and neutron logs may be desirable (see Reeves, 1971).

9. The term "underground gasification" has, with some justification, fallen into disrepute; consequently, but with much less justification, efforts to extract useful products from coal *in situ* without conventional mining have lapsed. However, there are a number of recent pertinent technical advances in the oil industry in fracturing and underground processing ("secondary recovery", "steam-flood", with and without solvents or reagents etc.; ie. solid-liquid reactions, mostly non-oxidative, in contrast to the old simplistic attempts at solid-gas reactions, all highly oxidative, that characterized "underground gasification" studies). A breakthrough in applying these advances to coal would achieve two major consequences. In the first place, it would dispel the obvious sociological roadblocks to underground coal recovery; in the second place, it would remove the depth limit at which coal can be exploited, thereby increasing the recoverable coal resources of the Alberta Plains, conceivably by 5 or 10 times.

X. ALBERTA LAND SURVEY SYSTEM

(3) Alberta Land Survey system. Townships (Tp.) are six miles square. They are numbered from the International Boundary northward. The 4th, 5th, and 6th Meridians (Mer.) are respectively, 110, 114, and 118 degrees of longitude west of Greenwich. Ranges (R.) are numbered westward from each meridian.

Sections (Sec.) are 1 mile square. Within each township they are numbered as shown:

31	32	33	34	35	36
30	29	28	27	26	25
19	20	21	22	23	24
18	17	16	15	14	13
7	8	9	10	11	12
6	5	4	3	2	1

Sections may be divided into 16 Legal Subdivisions (Lsd.) which are numbered as shown:

13	14	15	16
12	11	10	9
5	6	7	8
4	3	2	1

Figure 50

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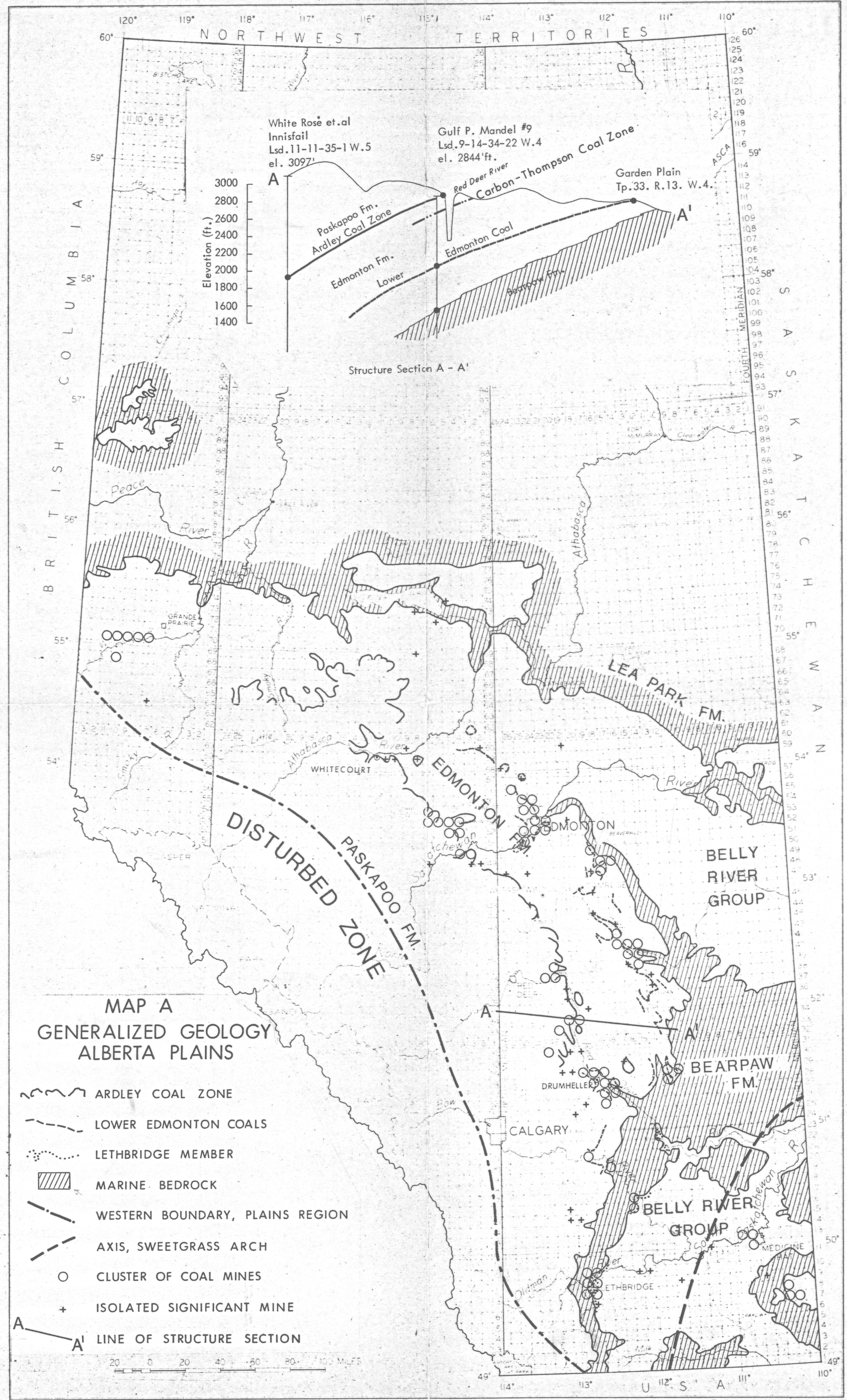
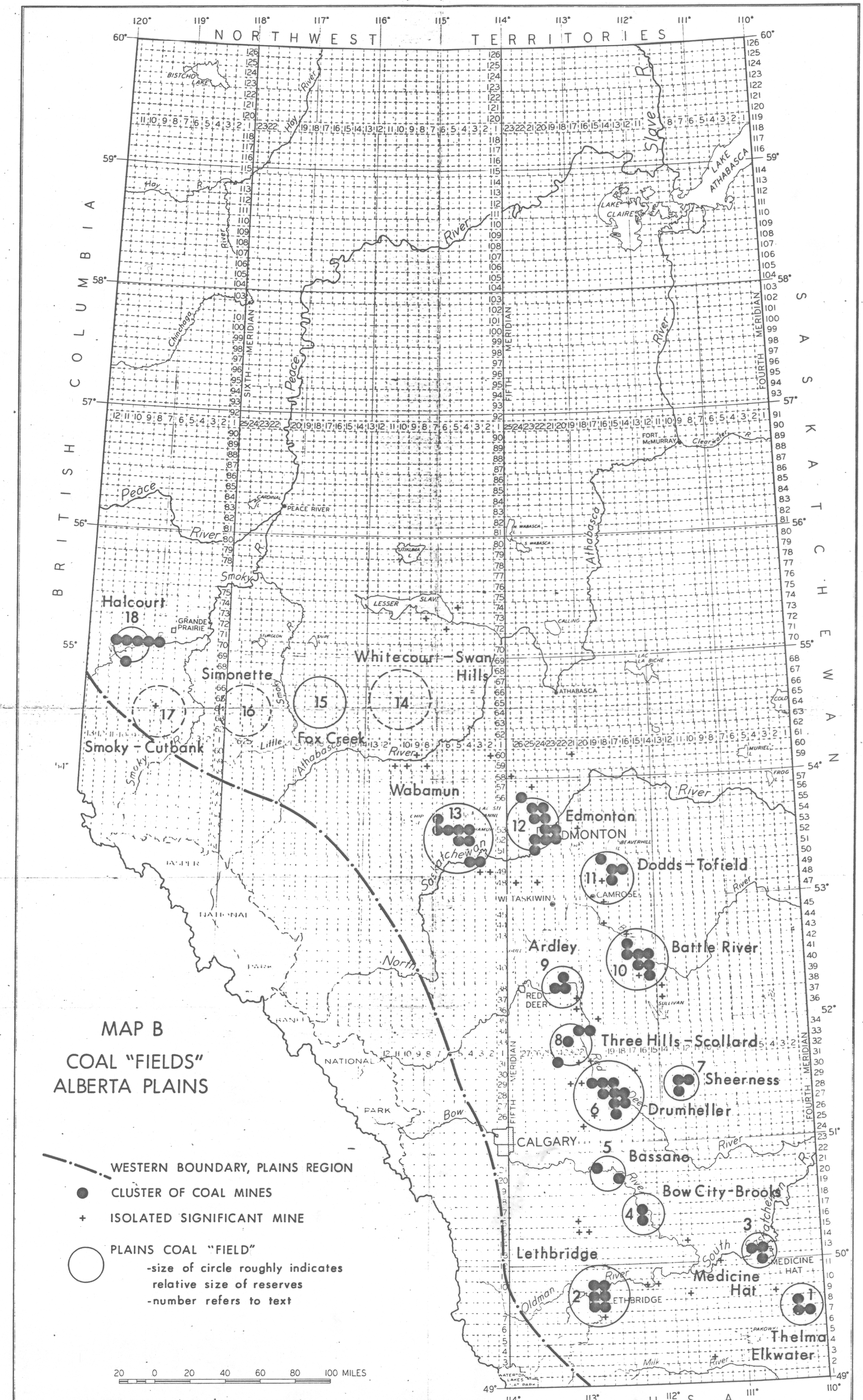

NORTHWEST TERRITORIES
BRITISH COLUMBIA
SASKATCHEWAN
White Rose et.al
Innisfail
Lsd.11-11-35-1 W.5
el. 3097'
Gulf P. Mandel #9
Lsd.9-14-34-22 W.4
el. 2844'ft.
Carbon-Thompson Coal Zone
Garden Plain
Tp.33. R.13. W.4.
Red Deer River
Paskapoo Fm.
Ardley Coal Zone
Edmonton Fm.
Lower
Edmonton Coal
Bearpaw Fm.
Elevation (ft.)
Structure Section A - A'
LEA PARK FM.
EDMONTON FM.
DISTURBED ZONE
PASKAPOO FM.
BELLY RIVER GROUP
BEARPAW FM.
GRANDE PRAIRIE
WHITECOURT
EDMONTON
DRUMHELLER
CALGARY
LETHBRIDGE
MEDICINE HAT
FOURTH MERIDIAN
Peace River
Athabasca
U S A
MAP A
GENERALIZED GEOLOGY
ALBERTA PLAINS
ARDLEY COAL ZONE
LOWER EDMONTON COALS
LETHBRIDGE MEMBER
MARINE BEDROCK
WESTERN BOUNDARY, PLAINS REGION
AXIS, SWEETGRASS ARCH
CLUSTER OF COAL MINES
ISOLATED SIGNIFICANT MINE
LINE OF STRUCTURE SECTION
100 MILES

OFR 1972-3 1/2



MAP B
COAL "FIELDS"
ALBERTA PLAINS
WESTERN BOUNDARY, PLAINS REGION
CLUSTER OF COAL MINES
ISOLATED SIGNIFICANT MINE
PLAINS COAL "FIELD"
-size of circle roughly indicates
relative size of reserves
-number refers to text
20 0 20 40 60 80 100 MILES
NORTHWEST TERRITORIES
BRITISH COLUMBIA
SASKATCHEWAN
U. S. A.
SIXTH MERIDIAN
FIFTH MERIDIAN
FOURTH MERIDIAN
Halcourt 18
GRANDE PRAIRIE
Simonette 16
Smoky - Cutbank 17
Fox Creek 15
Whitecourt - Swan Hills 14
Wabamun 13
Edmonton 12
EDMONTON
Dodds - Tofield 11
CAMROSE
Ardley 9
RED DEER
Battle River 10
Three Hills - Scollard 8
Sheerness 7
Drumheller 6
CALGARY
Bassano 5
Bow City - Brooks 4
3
MEDICINE HAT
Medicine Hat
Lethbridge
LETHBRIDGE
2
Thelma Elkwater 1
PEACE RIVER
FORT McMURRAY
ATHABASCA
LAKE ATHABASCA
LAKE CLAIRE
LESSER SLAVE L.
BISTCHO LAKE
Peace River
Hay River
Slave R.
Athabasca River
Smoky R.
North Saskatchewan
Bow River
Red Deer River
Oldman River
South Saskatchewan
Milk River
Clearwater R.
JASPER NATIONAL PARK
BANFF NATIONAL PARK

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