these exposures is apt to suggest the existence of an extended coal deposit, whereas investigations have later shown that this coal had been removed by adjacent pre-glacial channels the existence of which was not suspected due to the blanket of glacial drift.

This blanket, which conceals the bedrock over much of the area, consists mainly of unconsolidated ground-up rock and clay largely impervious to water. Where it directly overlies the seam it has protected the coal from weathering. It seldom exceeds 30 feet in thickness and again where it immediately covers the coal it provides from the point of view of depth of cover and ease of its removal favourable conditions for open-cut mining. However the nature of the glacial drift also raises problems in respect to these operations. Unlike the bedrock, due to its unconsolidated character it readily slumps into the open-cuts, especially where the drift exceeds 25 feet in thickness. Again the impervious nature of the boulder clay tends to retain surface water in the excavations and to restrict the seepage of this water to the bedding plane of the coal seam, with the result that it not only retards operations on the site, but interferes with operations down the dip of the seam.

The last three geological factors listed above are of special significance in respect to drainage problems generally. The nature of the coal measures and the basin-like structure of the deposit permit the surface water which enters at the outcrop, or seeps down the joint planes of the overlying sediments, to percolate down the bedding planes of the coal seam. The entry of water at the outcrop is particularly important in areas where the coal deposit has been cut by water courses and extends beneath the level of Grand Lake.

The concentration of water becomes of increasing importance in regard to the development of the deposit down the dip of the seam and reaches serious proportion in the centre of the basin where the intake is from all directions. Disposal of water throughout most of the Minto coal basin is difficult owing to the low relief of the area generally. In respect to the centre of the basin where the accumulation is greatest, the problem is accentuated by the fact that the coal seam lies well below the level of Grand Lake and its several inlets.

According to the provincial Department of Mines, the Minto coal field in 1943 had reserves amounting to 69,474,900 tons of recoverable coal with a further possible reserve of 8,809,400 tons.

The estimate prepared for the Commission, details of which appear in Table 8, Appendix A, places the reserves of recoverable coal at 45,000,000 short tons with a possible additional 6,000,000 tons. The coal operators in the Minto field consider the reserves should be placed between 18 and 25 million tons of recoverable coal as extraction of the coal in some areas is problematical.

The Commission is advised that about one-third of the above reserves, or about 15 million tons, are available for recovery by stripping operations, but that underground operations will continue to be of primary importance in the field. The figures suggest that the reserves are sufficient to last for at least 75 years on the basis of maximum annual production to date.

PROVINCE OF ONTARIO

There are no deposits of coal of any immediate commercial significance in the Province of Ontario. The presence of a poor quality lignite in northern Ontario in the region south of James Bay has been known to Indians and Traders for a long time and these deposits have been examined periodically by the Geological Survey since 1871.

The most important of these deposits outcrops at Blacksmith Rapids on Abitibi River, 70 miles up-stream from James Bay. This deposit has its maximum development some 2 miles west of the outcrop near Onakawana River and for this reason has been called the Onakawana field.

Since 1929 intensive investigations have been made, principally by the Ontario provincial authorities, to determine the extent of this deposit, its mineability and possible beneficiation of the coal for commercial use. These investigations have shown that the deposit covers an area of about 6 square miles, the coal occurring as an open-basin deposit and lying beneath a cover of glacial drift ranging to 150 feet in depth and capped by swampland, bush and muskeg. The coal seam in this area ranges in thickness from 10 to 40 feet, averaging about 20 feet, and in the central part of the area, covering less than a half square mile, is overlain by an upper seam ranging up to 30 feet in thickness, separated from the lower deposit by a clay bed from 5 to 20 feet in thickness. The deposit is irregular due to intensive erosion. According to the Ontario Department of Mines the deposit contains about 100,000 000 tons.

Although classified under the A.S.T.M. classification as lignite, the very inferior quality of the coal is evidenced in the following typical analysis provided by the Federal Department of Mines.

	(As received basis)	
Moisture	Per cent	50.0
Ash	Per cent	6.3
Volatile Matter	Per cent	21.3
Fixed Carbon	Per cent	22.4
Sulphur	Per cent	0.7
Calorific Value	B.t.u./lb.	5,090

Recent investigations have included the erection of a small plant designed to convert this inferior lignite into a marketable product for domestic, railway and industrial use. The results have been unsatisfactory, and in 1944 a Select Committee of the Ontario Legislature reported the development of the deposit at Onakawana to be commercially unsound. The Committee further advised that in view of the investment already made, certain experimental work should be continued, and it is noted that the Ontario Government is currently producing about 30,000 tons for local use in order to meet the anticipated fuel shortage in parts of Canada this winter.

PROVINCE OF MANITOBA

Very limited deposits of lignite of Tertiary age occur in southwestern Manitoba, about 150 miles southwest of Winnipeg. These deposits are believed to be an eastern extension of the lignite deposits of southern Saskatchewan, apparently having been isolated by erosion from the main deposit.

The deposits occur along the northern and western slopes of Turtle Mountain, but their full extent is not known. Determination of the boundaries of the coal measures and the continuity of the seams is difficult due to the thick blanket of glacial drift which mantles the area, and there has been little incentive to initiate the necessary exploration and development to reveal these factors. Small mines operate on the hill slopes near Goodlands, the surrounding countryside offering a small domestic market, as it is relatively devoid of trees. Competition however is keen from the large scale mines of southern Saskatchewan, and their hold on the larger potential market of Brandon and Winnipeg, has discouraged exploration and development of the Manitoba deposits.

Present knowledge of the deposit is largely confined to coal seams which outcrop in gullies, or have been penetrated by water wells. These occurrences lie in a line from the International Boundary for a distance of about 9 miles to the north, and from thence for some 27 miles along the northern slopes of the mountain, to its eastern bend. The seams are of the same horizon, but no correlation has been made to show that the occurrence consists of a single seam. The seams are probably of the same horizon as the lowest seams in the main Saskatchewan deposit. Evidence is not available to show that the seams are continuous over a large area, and it is possible that they occur as lense-like isolated deposits comparable to those of the Wood Mountain-Willowbunch district in Saskatchewan. The quality of the coal is comparable to the Saskatchewan lignite coals, a typical analysis giving the following result:

		(As received basis)
Moisture	Per cent	35.0
Ash	Per cent	7.1
Volatile Matter	Per cent	25.6
Fixed Carbon	Per cent	32.3
Sulphur	Per cent	0.5
Calorific Value	B.t.u./lb.	6,660

The seams are of commercial thickness in a few localities only, generally occurring less than 3 feet in thickness. In these few localities the deposit offers possibilities of underground and stripping operations, but any major development is conditioned by the more favourable conditions in the Saskatchewan coalfields where thicker seams lie under less depth of cover.

The Commission is advised that it is reasonable to assume an area of about 20 square miles to be underlain by coal of commercial thickness, and Dr. MacKay for estimate purposes has so assumed. The figures included in the estimate (see Table 1, Appendix A) are no more than an indication of the relative value of the deposit. They show that it is of purely local significance.

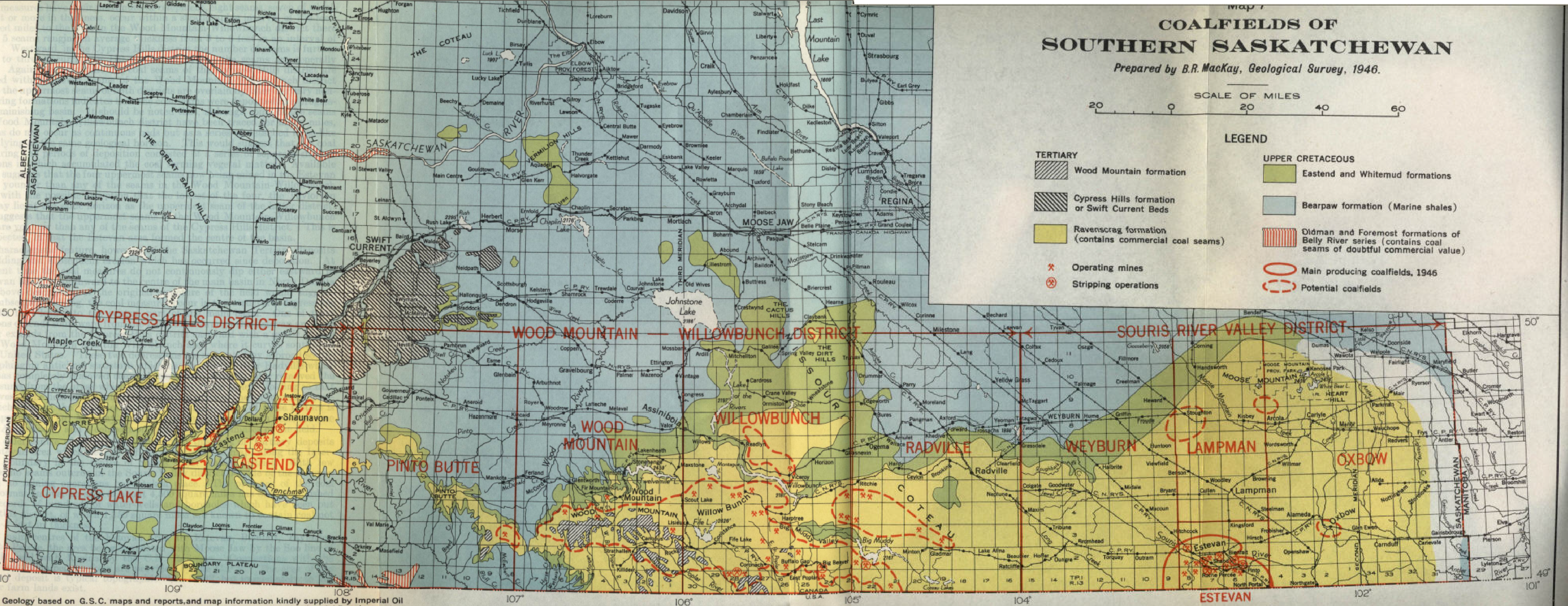
PROVINCE OF SASKATCHEWAN

Large areas in Southern and Western Saskatchewan are underlain by coal-bearing formations. The productive coal measures in Southern Saskatchewan all occur in the Ravenscrag formation which is of early Tertiary (Paleocene) age and represent the northern fringe of a large coal basin covering approximately 60,000 square miles which has its centre in North Dakota in the United States of America. The productive measures of Western Saskatchewan are of Upper Cretaceous age. They constitute the Oldman formation which lies about 1,200 feet below the Ravenscrag formation. These productive measures form an eastward extension of sediments of the same geological age that underlie large areas of Eastern Alberta. They differ, however, from the Alberta measures in that, in Alberta, these measures are all of fresh water origin and normally carry well developed coal seams whereas, in Saskatchewan, they are generally brackish or of marine origin and the seams are thinner and of inferior quality. All the Tertiary coal deposits of Saskatchewan are of lignitic rank whereas the Upper Cretaceous deposits vary from sub-bituminous "C" to lignite. In comparison with the Cretaceous, however, the Tertiary deposits are of much greater significance in respect to both present and future mining operations in Saskatchewan.

Southern Saskatchewan

As will be seen from Map 7, the Tertiary productive coal measures all occur south of latitude 50° and underlie a total area of about 10,000 square miles in an irregular belt extending from near the Manitoba boundary to Alberta. Over most of this area a mantle of glacial drift, ranging from a thin veneer to a thickness of more than 300 feet, conceals the coal measures, a feature which has hindered the acquisition of intimate knowledge of the extent and nature of the belt and the development of mining operations. The belt is continuous from the Manitoba border to beyond Wood Mountain with the exception of a relatively small enclosed area in the central section near Radville, where pre-glacial erosion has removed the coal measures and exposed older barren rocks. In the western section of the belt the measures have been severely dissected by erosion and occur as a series of isolated deposits.

Available evidence suggests that the Estevan area was the centre of deposition of the Saskatchewan Tertiary deposits, the basin originally extending westward to include the Cypress Hills district and eastward into Manitoba but



Geology based on G.S.C. maps and reports, and map information kindly supplied by Imperial Oil Limited, and the Saskatchewan Department of Natural Resources and Industrial Development.

To accompany Report by the Royal Commission on Coal, 1946.

gradually narrowing to the Estevan area. Thus in the Estevan area, where the coal measures have their maximum development, eight seams, seven of which are 4 feet or more in thickness, occur within a stratigraphic interval of 750 feet. A hundred miles to the west in the Wood Mountain-Willowbunch district there are only 5 seams ranging in average thickness from 3 to 6 feet in an interval of 410 feet. Westward, in the Cypress Hills district the number of seams is further reduced to three occurring in 110 feet of strata and the seams are generally thinner. Again, the fact that the coal seams of the Cypress Hills district are correlated with the lower seams of the Wood Mountain-Willowbunch district and that the uppermost seams of both districts are overlain by later Tertiary non-coal bearing formations indicates that the coal seams were deposited in a progressively diminishing basin. It should be noted that, although some of the seams in the Wood Mountain-Willowbunch district have been traced for many miles, the seams do not occur as continuous beds but as a series of detached lense-like deposits lying at the same geological horizon. This would suggest that the coal basin during the periods of deposition consisted of a series of separate shallow depressions in which accumulated the coal forming vegetal matter. Available evidence suggests that the four uppermost seams now being mined in the Estevan area are younger than any of the seams in the Wood Mountain-Willowbunch district, with the possible exception that the lowest of the four, the Taylorton seam, may lie at the same horizon as the uppermost seam of the latter district. It also suggests that the uppermost seams of the Wood Mountain-Willowbunch district are younger than any of the seams of the Cypress Hills district. This is to be expected, in that the Estevan area formed the centre of the basin.

A characteristic feature, however, of the Saskatchewan Tertiary deposits is the folding and subsequent erosion which has occurred since deposition. At the present time the coal measures do not continuously dip either eastward to the Estevan basin or southward to the centre of the main basin in North Dakota as the above description of the original structure of the field would suggest. Due to subsequent folding, the coal measures occur in two structural depressions or troughs that lead into the central part of the main basin. One of these depressions extends southward from the Lampman through the Estevan area and the other extends from the Cypress Hills district eastward with a gentle plunge through Wood Mountain into the Willowbunch area where it curves southward into the United States. These two depressions are separated by a broad south-easterly plunging anticlinal structure which has its summit near Radville where erosion has completely removed the coal measures. Erosion later removed the coal measures from the areas which were elevated at the time of folding so that the reserves of the field are largely confined to the areas of the structural depressions which escaped the effects of erosion. The importance of these factors is readily apparent in Dr. MacKay's estimate of the Saskatchewan reserves (see Table 9, Appendix A) and a comparison with previous estimates of the field.

The chief centre of mining development in this belt of Tertiary deposits is the Estevan area which lies, as will be seen from the map, along the International Boundary in the centre of Souris River Valley district. With few exceptions no seams outcrop in the Souris Valley district outside of the Estevan area and no mining operations have taken place. The presence of the coal bearing formation over an area of about 4,500 square miles has been established by the records of hundreds of water-wells and boreholes which have been put down in this district, of which 1,350 square miles are known to contain coal not less than 3 feet in thickness.

The main centres of the Estevan area are Estevan, Bienfait, Taylorton and Roche Percée, the area being connected with Moose Jaw by the Soo line of the C.P.R. and with Regina by the C.N. Railways. Connections with the Brandon and Winnipeg markets are provided by the C.P.R. The area of the actual coal deposit is typical topographic "bad land", but immediately to the north fair farm lands exist.

The four seams being worked in the area in descending order have average thicknesses of 5, 5, 7 and 10 feet and are separated by strata averaging 52, 20 and 25 feet. The uppermost seam is found only in the highest ground south of Souris River and covers a maximum area of about 20 square miles. No. 2 Seam is best developed at Roche Percée south of Souris River and underlies an area of about 30 square miles. No. 3 Seam, the Estevan Seam, has a relatively shallow overburden north of the Souris Valley and has been extensively mined by large stripping operations. The seam underlies about 95 square miles. Seam No. 4, the Taylorton Seam, is the lowest seam being mined and is probably the most continuous and extensive of the seams. It is thought to underlie about 150 square miles. A deep borehole at Taylorton penetrated four seams having thicknesses of 2, 4, 4 and 4 feet and depths of 130, 337, 546 and 573 feet, and evidence from the records of numerous water-wells shows that these seams underlie an extensive area. No anxiety as to reserves was expressed by the operators and the evidence suggests that there is sufficient coal in the area to maintain production at the current level for many years. Large scale stripping operations will eventually deplete the reserve of shallow-lying coal, which is largely confined to No. 3 Seam, and the long-term life of the field is undoubtedly related to underground development of Seams Nos. 1, 3 and 4.

The next most important reserves of the Tertiary belt occur in the Wood Mountain-Willowbunch district further to the West. Of this district, 4,200 square miles are underlain by Ravenscrag coal-bearing formation. Evidence is insufficient to establish that all this area is underlain by coal of commercial thickness but the records available show that at least 1,000 square miles contain one or more seams over three feet in thickness. Whereas it is not known whether the seams continue in full thickness in every section of this 1,000 square miles, over much of the area at least five seams occur, ranging in thickness from 5 to 15 feet. They have been traced in some instances for a distance of over 50 miles.

This 1,000 square mile area, as will be seen from the map, is an elliptical-shaped area occurring in roughly the centre of the Wood Mountain-Willowbunch district. It extends from the western end of Wood Mountain eastward for some 550 miles beyond Big Muddy Lake and from near the International Boundary to the north side of Willowbunch lake near Viceroy. The centre of the main reserves lies to the north of Big Muddy lake. Small scale mining has been carried out in the area, notably at Coronach, Buffalo Gap, Harptree and Willowbunch, communication with the main transcontinental Railway lines for these centres being provided by the C.N.R. and C.P.R. branch lines from Moose Jaw. The Commission is advised that the reserves in the area are substantial and that in a number of localities may be suitable for large scale stripping operations similar to those presently being conducted in the Estevan field.

As will be seen from the map and Dr. MacKay's estimate, the reserves of the Cypress Hills district, further to the southwest, are much less than those of the previously mentioned district. About 900 square miles of the Cypress Hills district is underlain by coal-bearing formation. The formation contains two seams of mineable thickness, but there is insufficient evidence to show that these are continuous at mineable thickness over much of the district. The main reserves are believed to occur in the Shaunavon and Eastend areas, those at Shaunavon occurring to the north and southwest of the town of Shaunavon and those of the Eastend area occurring to the north and south of Swift Current Valley near Eastend. The reserves of these areas are being developed on a small scale for local domestic purposes.

As previously mentioned, all the coals of the Tertiary belt in Saskatchewan classify as lignite. The following table indicates analyses of the coals mined in the various districts:

District or Area	Proximate Analysis (As received basis)				Sulphur	Calorific Value	Softening Temp. of Ash
	Moisture	Ash	Volatile Matter	Fixed Carbon			
	Per cent	Per cent	Per cent	Per cent	Per cent	B.t.u./lb.	°F.
Souris Valley District—							
Bienfait	35	6.1	26.1	32.8	0.4	7,345	2185
Roche Percée	35	6.5	26.4	32.1	0.5	7,420	
Estevan	35	9.3	25.1	30.6	0.3	6,905	2120
Wood Mountain— Willowbunch District	40	8.2	24.6	27.2	1.0	6,175	2275
Cypress Hills District	40	8.2	25.7	26.1	1.0	5,880	

Western Saskatchewan

Geological mapping has shown that about 30,000 square miles in western Saskatchewan are underlain by the Oldman Formation, which is of Upper Cretaceous age and which in Alberta is the uppermost coal-bearing formation of the Belly River Series. This area is triangular-shaped with its base along the Alberta border and its eastern boundary extending roughly from Maple Creek on the south to Saskatoon and thence northwestward to Lloydminster. Coal seams ranging up to 13 feet in thickness have been reported as occurring at numerous widely separated localities. These seams occur in natural exposures or have been penetrated by water-wells and deep borings. A deep borehole at Maple Creek, for example, penetrated a 4-foot seam at 192 feet and a 7-foot seam at 235 feet.

The great majority of these occurrences lie within 11,000 square miles in which the Oldman Formation immediately underlies the glacial drift. This area is largely confined to a belt 30 to 80 miles wide that extends from the Alberta border eastward, narrowing to an apex some 75 miles east of Saskatoon. The glacial drift is comparatively shallow, seldom exceeding 50 feet, whereas in the remaining area the coal lies under an additional bedrock cover ranging to a maximum thickness of over 1,000 feet. The most attractive possibilities of this area lie within a 2,500 square mile block centring in the vicinity of Kelfield, Unity, Salvador and Brock, where seams 3 feet, 4 feet, 8 feet and 8 feet have been prospected.

Mining and prospecting have been carried on spasmodically in a number of these localities. These have shown that the deposits were not continuous but were either isolated lens-like deposits, or terminated by faults or removed by pre-glacial erosion. The Commission is advised that data on which to estimate the reserves are very meagre as the behaviour of the seams can only be determined by systematic drilling or by the sinking of shafts due to the concealment of the coal measures by glacial drift. Any estimates therefore must be very approximate and Dr. MacKay's are no more than an attempt to indicate the relative value of these deposits as compared with the Tertiary deposits of southern Saskatchewan and those of the same Upper Cretaceous formation in the related coal areas of Alberta.

PROVINCE OF ALBERTA

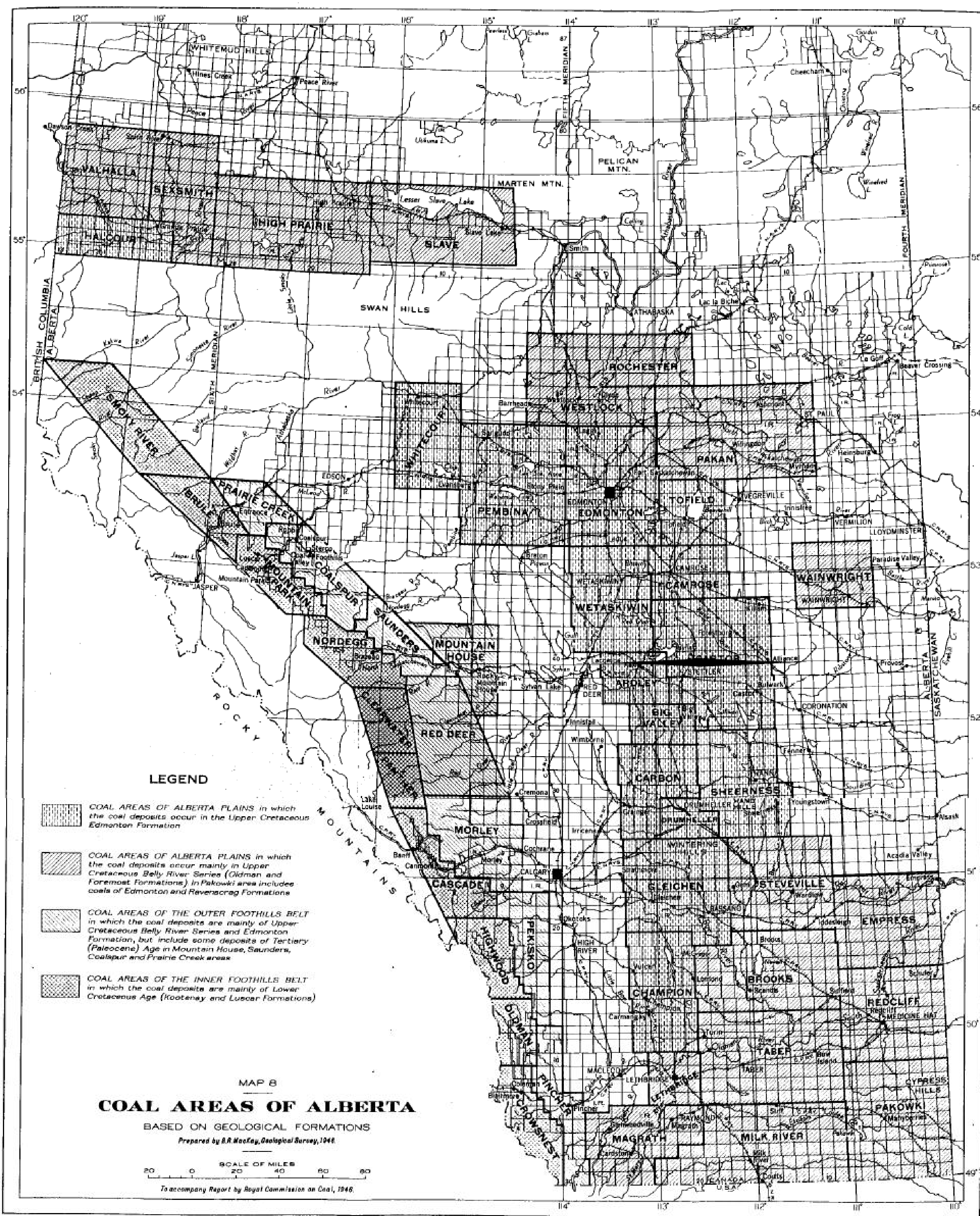
As will be seen from Map 8, coal-bearing formations underlie most of the southern half of the Province, and occur both in the Plains and the Rocky Mountain Foothills. These formations contain extensive coal deposits of commercial value. In addition to being the leading coal producing province in Canada, Alberta possesses the major proportion of Canadian coal reserves. These reserves consist largely of bituminous and sub-bituminous coals, but coals of all ranks from lignite to anthracite are represented. The largest reserves in the Province occur in the Foothills immediately adjacent to the mountains and consist mainly of medium and low volatile bituminous coals. The next largest reserves are the high volatile bituminous coals which occur mainly in the outer Foothills nearest the Plains. Extensive deposits of sub-bituminous coals occur in the central Plains area. Small deposits of lignite are found in the southeast and northeast of the Province on the outer rims of the Alberta coal basin, and small areas of anthracite occur at a few localities in front of the Rocky Mountains in the vicinity of Banff.

Alberta coals are all geologically much younger than those of the Maritime Provinces. Although Carboniferous sediments of the same Pennsylvanian age as the coal-bearing formations of the Maritimes occur in the Rocky Mountain Foothills, these are of marine origin and do not contain coal. The oldest coal-bearing rocks occurring in Alberta are of Lower Cretaceous age. These occur in the western or inner belt of the Rocky Mountain Foothills and contain the most important deposits of bituminous coal in the Province. Next in age are the coal deposits of Upper Cretaceous age which underlie a large portion of the southern part of the Province and outcrop along the outer Foothills belt of the mountains and over much of the central Plains. The youngest coal deposits are of Tertiary age. They underlie a small area in the Cypress Hills in the southeastern part of the Province and are believed to form the coal-bearing measures of the important coal deposits which occur in the outer Foothills of central Alberta, in the Prairie Creek, Coalspur, Saunders and Mountain House coal areas.

The coal deposits within these three geological groups differ further in age which is apparent from the six geological formations in which they occur. The coals of Lower Cretaceous age occur in two formations, the Kootenay and Luscar formations. Those of Upper Cretaceous age occur in three formations which, in ascending order, are the Foremost, Oldman and Edmonton formations, the first two of which belong to the Belly River series. Fossil plant evidence indicates that the Tertiary deposits of the two widely separated areas previously noted are both of Paleocene age and are equivalent in age to the lignite deposits of Saskatchewan.

The distribution of the six coal-bearing formations and the characteristics of the coal seams are closely related to the general geological history of this part of Canada. The coal deposits represent vegetation which either grew or accumulated in swamps which successively existed along ancient shorelines bordering rising land areas. All the areas of coal formations during this period were confined to a broad shallow basin trending in a northwesterly direction and lying between the rising land areas of the East and West. In the earliest period of coal formation, this basin extended from northeast British Columbia southeast into the United States. Its eastern limit conformed closely with a line drawn from near Winnipeg, Manitoba northwesterly to Peace River, the western boundary lying a little to the west of the present Rocky Mountain Range. By Tertiary times, the basin was very much more confined in respect to both length and breadth.

Conditions favourable to coal formation were intermittent and these intervals were relatively brief in comparison with periods in which no coal was formed. The areas in which conditions were favourable to coal formation were



MAP 8

COAL AREAS OF ALBERTA

BASED ON GEOLOGICAL FORMATIONS

Prepared by B.R. MacKay, Geological Survey, 1946.

To accompany Report by Royal Commission on Coal, 1946.

also limited and their location differed in the various periods. During the periods in which conditions were favourable to the growth or accumulation of vegetation in one area, fresh water sediments and marine shales were being deposited in other areas. These changing conditions arose from an intricate series of earth movements over a long interval of the geological history of the rise of this part of the North American Continent. The general rise of this land area was periodically interrupted by periods of quiescence and recession and even submergence. During periods of emergence, the coal deposits were subjected either to erosion or were covered by coarse sands and gravels from the mountains; whereas during periods of submergence, the deposits were covered by fine clays deposited in embayments of the sea. During some of the periods of the coal formation, volcanic activity resulted in beds of fine volcanic ash and dust being deposited along with the coal-forming vegetation.

The coal deposits of Lower Cretaceous age are not all of the same geological age but are limited to two periods of coal formation. Those of the southern Foothills, extending from the Crowsnest area northwards into the Panther area, belong to the Kootenay formation which had its centre of development in the Crowsnest region of southeastern British Columbia. The sediments and coal seams of this formation decrease in thickness and number to the north and eastward through southern Alberta. Those of the northern area occur in the Luscar formation which extends from the Clearwater to beyond the Smoky River area and has its main centre of deposition in the Mountain Park area. These two formations are separated by a considerable time interval as indicated by the existence of a thick series of coarse sands and a conspicuous thick bed of conglomerate which lies between the two formations. The coal deposits of both of these formations have their greatest development at the mountains and thin rapidly to the east into the Plains area where they are deeply buried beneath younger sediments. For example, in the Fernie area of southeastern British Columbia there are in places 22 seams having an aggregate thickness of 150 feet of coal in a stratigraphic interval of 3,500 feet; whereas at Coleman in the Alberta Crowsnest area, the measures are only 800 feet in thickness and contain a maximum of five seams aggregating about 47 feet of coal. At Bellevue ten miles further east, the measures are reduced to 430 feet with only three seams aggregating about 37 feet of coal. So also in the Luscar formation to the north in the Mountain Park basin there are eight seams of commercial thickness aggregating about 77 feet of coal contained in about 1,200 feet of measures; whereas in the Cadomin-Luscar basin 7 miles to the north there are only three seams aggregating 35 feet of coal in a stratigraphic interval of less than 1,000 feet. Further east in the Plains region coal seams in both of these formations have been penetrated by deep borings but they are thin and the coal is of inferior quality.

The upper Cretaceous coal deposits are separated from the Lower Cretaceous coals by a great thickness of marine shales interspersed by thin non-coal-bearing sandstones which would indicate a long period of submergence in which much of northeastern British Columbia, Alberta and Saskatchewan were covered by the sea.

Following this there was a general emergence of the continent which resulted in the sea being largely expelled from central Alberta to be followed by further periods favourable to the formation of coal in central Alberta and western Saskatchewan. During these periods there were deposited the Foremost, Oldman and Edmonton coal-bearing formations.

These three Upper Cretaceous coal-bearing formations are separated by time intervals which, in the eastern Plains region, are represented by marine sediments indicating further invasions of an arm of the sea from the south and southeast. The sediments separating the Edmonton from the Oldman formation are much more extensive than those separating the Foremost and Oldman formations. The marine beds separating the Foremost and Oldman formations in the Plains have their greatest development in Saskatchewan and peter out in the central Plains of Alberta. The marine beds separating the Oldman and Edmonton formations cover southern Saskatchewan and continue westward into the Foothills having been traced northward to the Red Deer area. In the Foothills and western Plains beyond the extension of these marine beds, the deposits of Upper Cretaceous age cannot be divided into individual formations but in some areas age relationships have been established on the basis of fossil evidence.

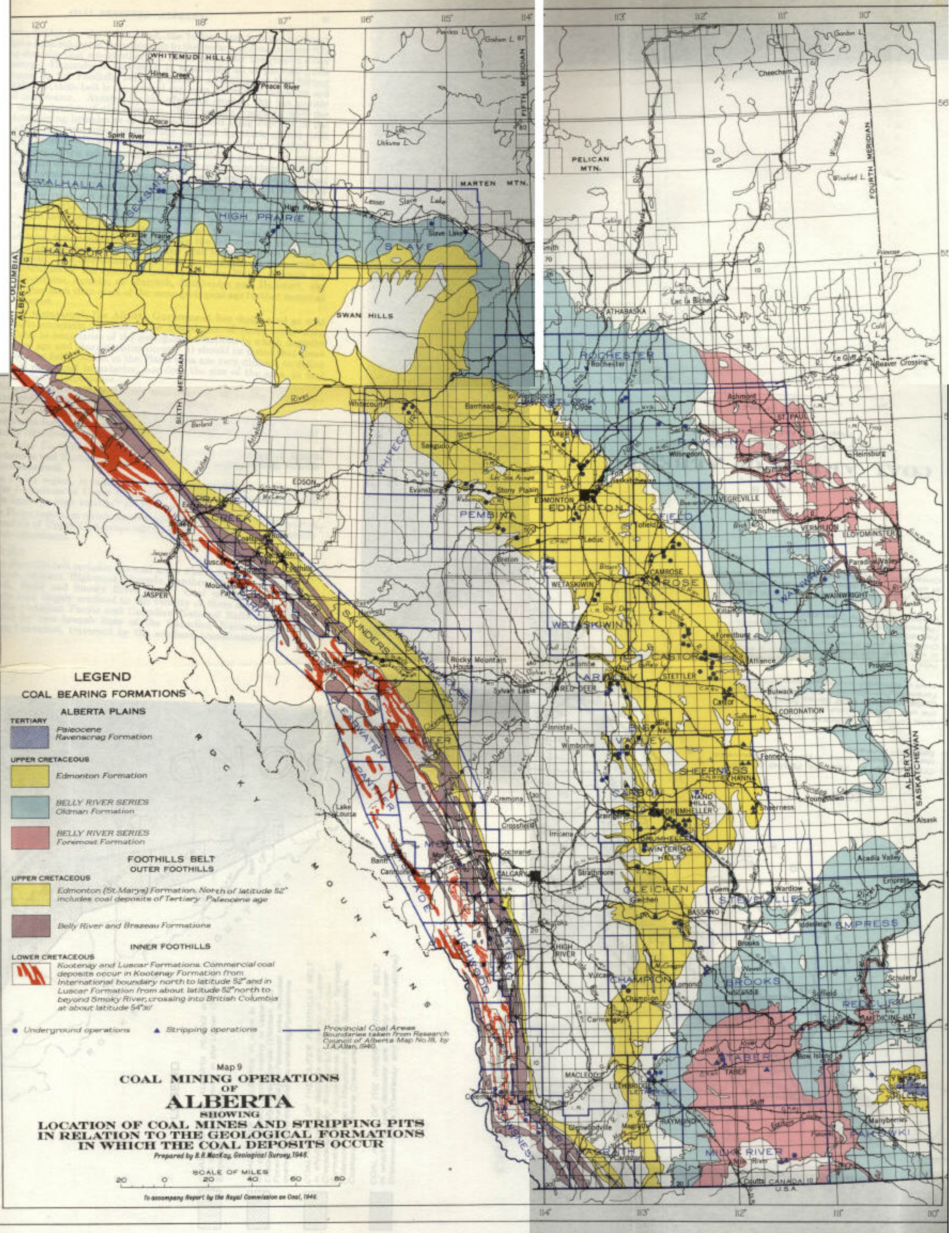
As a result of these fluctuating conditions, the Upper Cretaceous coal deposits are not nearly as well developed or as continuous as those of Lower Cretaceous age and in the eastern areas are known to form thin isolated deposits of inferior quality.

The early Tertiary period was characterized by a further elevation of the Continent with the result that the area of formation of coal was much more confined than in Upper Cretaceous times. The main centre of coal formation in Alberta became the Foothills belt in the central Foothills where occur the important deposits of the Prairie Creek, Coalspur and Saunders areas. The deposits of these areas are of the same age as the deposits of southeastern Alberta which form the western extension of the important Tertiary coal deposits of southern Saskatchewan. These coal forming conditions were succeeded by continued land elevation to the East and the West which resulted in the removal of the coal seams of the upper part of the Edmonton formation in certain areas of the central Plains and thick accumulation of sediments derived from the rising mountains to the West.

The elevation of the rising land area to the West finally culminated in late Tertiary times in the formation of the Rocky Mountains which are characterized by numerous major folds and faults.

As a result of the combination of the foregoing events, embracing the rising Continent in the East and mountain building in the West, there now exists a large structural basin known as the Alberta Syncline. This basin has its centre near Mountain House, its axis extending from the International Boundary south of McLeod, northwesterly closely paralleling the trend of the Foothills. The youngest formations occur in the centre of the basin and progressively older formations occur in the outer rims of the basin. This is apparent from the geological map of Alberta (Map 9) and the arrangement of the fifty coal areas delineated by the Provincial Government which appears on Map 8.

The effects of mountain-building forces on the coal deposits of this section of Canada are outstanding and are particularly evident along the Rocky Mountain Foothills belt which forms the western limb of the Alberta Syncline. In this area the coal measures were subjected to intensive dynamic pressure accompanying the formation of the mountains and as a result, are highly folded and faulted. The seams in the belt are, as a rule, steeply inclined with a general northwesterly trend parallel to the mountain front. Local irregularities exist in respect to trend and dip due to the presence of numerous plunging folds. In other places, the seams are either cut off by faults or are so thinned by pinching as to be unworkable. In a number of cases, folding and thrust faulting has resulted in a large concentration of coal near the surface giving rise to valuable deposits which would otherwise not exist. Examples of this are the coal deposits in the Cadomin-Luscar basin in the mountain area and the even more extensive concentration of coal along the fault of the Sterco—Coal Valley deposit in the Coalspur area. In the latter instance, coal 50 to 120 feet in thickness is being recovered by open-cut operations, the pits in places being about 600 feet wide and having a depth of over 250 feet. For the same reasons the coal in many areas in the Foothills belt is severely crushed which has, in many cases, seriously affected mining operations and generally has the effect of reducing the percentage of recovery to a very low figure owing to the difficulty of marketing fine coals



LEGEND
COAL BEARING FORMATIONS
ALBERTA PLAINS
TERTIARY
Paleocene Ravenscrag Formation
UPPER CRETACEOUS
Edmonton Formation
BELLY RIVER SERIES Oldman Formation
BELLY RIVER SERIES Foremost Formation
FOOTHILLS BELT
OUTER FOOTHILLS
UPPER CRETACEOUS
Edmonton (St. Marys) Formation. North of latitude 52° includes coal deposits of Tertiary Paleocene age
Belly River and Brazeau Formations
INNER FOOTHILLS
LOWER CRETACEOUS
Kootenay and Luscar Formations. Commercial coal deposits occur in Kootenay Formation from International boundary north to latitude 52° and in Luscar Formation from about latitude 52° north to beyond Smoky River, crossing into British Columbia at about latitude 54°30'
Underground operations
Stripping operations
Provincial Coal Areas Boundaries taken from Research Council of Alberta Map No.18, by J.A.Allan, 1940.
Map 9
COAL MINING OPERATIONS
OF
ALBERTA
SHOWING
LOCATION OF COAL MINES AND STRIPPING PITS
IN RELATION TO THE GEOLOGICAL FORMATIONS
IN WHICH THE COAL DEPOSITS OCCUR
Prepared by B.R. MacKay, Geological Survey, 1946.
SCALE OF MILES
20 0 20 40 60 80
To accompany Report by the Royal Commission on Coal, 1946.
ROCKY MOUNTAINS
EDMONTON
CALGARY
SWAN HILLS
WHITEMUD HILLS
PELICAN MTN.
MARTEN MTN.
FIFTH MERIDIAN
FOURTH MERIDIAN
SIXTH MERIDIAN
ALBERTA
SASKATCHEWAN
BRITISH COLUMBIA
CANADA
U.S.A.

from the Alberta field. On the other hand, the folding and faulting to which the measures have been subjected have brought to the surface and made accessible for easy mining deposits that would otherwise have been under too great a cover to permit recovery. Examples of this occur in practically all of the coal fields under development in the Foothills belt. A further advantage of this folding and faulting in the Foothills belt is the general exposure of the coal measures and their contained coal seams. Assisted by the effects of erosion, this has greatly facilitated the determination of the reserves. This feature contrasts with the difficulties of determining boundaries of the relatively flat lying deposits of the Plains region where the measures are generally covered by thick glacial drift and are generally exposed only where major streams have cut deep channels.

A further feature of the influence of mountain-building pressure in respect to Alberta coals is that the rank of these coals does not conform to their geological age. Two factors normally determine the rank of a coal, namely, its geological age and the pressure to which it has been subjected, and in general it holds that the geologically older coals are more mature and of higher rank than are the younger coals. In Alberta there is a general progression in rank across the Plains westward into the Foothills and coals geologically younger in the regions of the Foothills have reached greater maturity than geologically older coals further removed from the mountains. Essentially the influence of mountain-building pressures on the metamorphism of the coal beds has been of overwhelming importance. It is interesting to note that the coal areas at the northern and southern extremities of the synclinal basin where the Plains deposits are closest to the Mountains, namely, at Magrath, Lethbridge and Halcourt, the coals are also of higher rank than coals of the same geological age further removed from mountain stresses.

As previously maintained, the Alberta Government has designated as coal areas fifty districts underlain by coal. The boundaries of these areas were designed to conform to boundaries of the geological formations in which deposits of similar geological age and characteristics occur. It should be noted that these coal areas are not coal fields, which in the Plains area are very difficult to define due to the lack of structural boundaries; nor does the size of the area, in any way, indicate its relative importance.

In the following discussion of Alberta coal reserves, these fifty coal areas have been arranged for convenience under four groupings:

1. The Inner Foothills belt, in which the deposits occur mainly in Lower Cretaceous formations, and the coals are largely of medium and low volatile bituminous rank.
2. The Outer Foothills belt, in which the deposits are mainly of Upper Cretaceous and Tertiary ages, and the coals are largely of high volatile bituminous rank.
3. The Plains region, in which the deposits occur mainly in the Belly River formations of Upper Cretaceous age, the coals ranging in rank from lignite to high volatile "B" bituminous.
4. The Plains region, in which the deposits occur largely in the Edmonton formation of Upper Cretaceous age in which the coals classify mainly as sub-bituminous.

Inner Foothills Belt

The Inner Foothills belt includes ten coal areas which, from south to north, are the Crowsnest, Oldman, Highwood, Cascade, Panther, Clearwater, Nordegg, Mountain Park, Brulé and Smoky River areas. Coal mining operations in these areas have been largely confined to the vicinity of three mountain passes traversed by the Canadian Pacific and Canadian National Railways and two areas penetrated by two branch lines of the Canadian National Railways. These areas are Crowsnest, traversed by the southern transcontinental line of the Canadian Pacific Railways; the Cascade coal area, crossed by the main transcontinental line of the Canadian Pacific Railways; the Brulé area, traversed by the main line of the Canadian National Railways; the Mountain Park area, reached by the Canadian National Railways Coal Branch line from Edson; and the Nordegg area, reached by a further Canadian National Railways branch line from Red Deer. At present no mining development is taking place in the Brule area, mining operations having been terminated due to the badly crushed nature of the coal, faulting and difficulties in marketing the low volatile product. As might be expected, the coals of this area form the main source of railway coal supply in Western Canada.

As previously noted, this coal-bearing belt contains the most important coal reserves of Alberta. The Lower Cretaceous coals of this belt are mainly of medium and low volatile bituminous rank. The ash content of the coals is considerably higher than most of the Maritime coals, whereas in contrast their sulphur content is negligible, this low sulphur content being a feature of all Alberta coals. The calorific values of the coals range from 12,490 to 13,930 B.t.u./lb. and is comparable with the coals of the Sydney coal field. Their fusion point of ash, however, is much higher ranging from 2,400 to 2,900 degrees Fahrenheit. The coals of this belt are generally friable, notably in regard to developed areas, in the Cascade, Nordegg, and Brulé areas. The friable nature and non-coking qualities of the low volatile coals have impaired their use for railway-locomotive purposes but the medium and high volatile coals are good coking coals and have proved suitable for all phases of industrial use. Detailed analyses of the coals in the various areas of this and other belts are given in a report on the Coals of Alberta by Edgar Stansfield and W. Albert Lang (Report Number 35, Research Council of Alberta, 1944).

All the areas in this belt have been mapped by the Geological Survey and much more is known of the deposits in this region than any of the other coal-bearing areas of Alberta. Somewhat less is known about the deposits in areas in this belt where development has not taken place, particularly in the Panther area in the southern portion of the Clearwater area. However, it is known that the most extensive reserves along this belt occur in the areas where the Kootenay and Luscar formations have their greatest development. The main reserves of the Kootenay formation are in the Highwood area with lesser concentrations occurring in the Cascade, Oldman and Crowsnest areas. The main reserves of the Luscar formation lie in the Mountain Park area, with lesser deposits occurring in the adjoining Brulé and Nordegg areas. The coal areas having the least reserves are the intermediate Panther and Clearwater areas, in which occur the limits of coal formation of the Kootenay formation in the south and the Luscar formation in the north. These observations are borne out in the evidence on coal reserves submitted by the Alberta Government and by the following figures from the Commission estimate, details of which appear in Table 11, Appendix 00.

Area	Mineable Coal		Recoverable Coal	
	Probable	Possible (Additional)	Probable	Possible (Additional)
	(Thousands of net tons)			
Crowsnest	3,157,280	872,480	1,578,640	436,240
Oldman	2,811,200	397,600	1,405,600	198,800
Highwood	3,762,080	1,684,480	1,881,040	842,240
Cascade	2,228,800	660,800	1,114,400	330,400
Panther	431,200	128,800	215,600	64,400
Clearwater	224,000	124,320	112,000	62,160
Nordegg	1,892,800	868,000	946,400	434,000
Mountain Park	2,816,800	554,400	1,408,400	277,200
Brulé	761,600	683,200	380,800	341,600
Smoky River	2,250,000	1,349,600	1,120,000	674,800
Total—Inner Foothills Belt	20,325,760	7,323,680	10,162,880	3,661,840

It is readily apparent that the reserves of the various areas in this belt are very substantial. The companies operating in this belt informed the Commission they are satisfied that their reserves are sufficient to allow operations at the current maximum level of production and at present sites for over 100 years. This estimate does not include further reserves which would be available by starting operations at new sites contiguous to present operations or those which would be available with additional railway construction. These operators, through their organization, The Western Canada Bituminous Coal Operators' Association, presented the following statement:

> With respect to development and reserves at the present operating sites and to depths of cover generally not exceeding two thousand feet, the consolidated returns show:
>
> 1. Known reserves in tons in present working areas and development*
>
> | Reserves | Estimated percentage of Recovery | Recoverable |
> |---|---|---|
> | 78,108,000 | 74 | 54,449,550 |
>
> On the basis of the maximum actual annual production (year 1942) this represents eleven years' operations.
>
> 2. Additional reserves as in No. 1 but based on some knowledge of continuity of seams provided by drilling or prospecting
>
> | Reserves | Estimated percentage of Recovery | Recoverable |
> |---|---|---|
> | 339,473,860 | 70 | 233,682,400 |
>
> On the same basis as No. 1, this would provide for an additional fifty years' operations.
>
> 3. Estimated additional reserves, assuming continuity of seams on structural evidence only
>
> | Reserves | Estimated percentage of Recovery | Recoverable |
> |---|---|---|
> | 418,826,000 | 74 | 311,414,600 |
>
> This would provide for a further sixty-five years of operations at present operating sites.

*This estimate includes the reserves of the Crow's Nest Pass Coal Company, Fernie, B.C.

It is abundantly clear from the foregoing that the coal deposits of the Inner Foothills belt represent most extensive reserves of low and medium volatile bituminous coal. Only a limited portion of these reserves is under mining development and we feel it is impossible to dismiss further consideration of this area without reference to the possibility of new developments.

During the past two years public attention has been drawn to the Highwood area which lies about 60 miles southwest of Calgary. Two companies have been sponsoring prospective mining operations in this area, Ford Highwood Collieries Limited on land known as the Ford property and Allied Industrials Limited on land known as the Burns' property. In connection with the venture of Ford Highwood Collieries Limited a railway charter was secured from the Province of Alberta and it was proposed to finance both railway construction and the development of a mine by capital subscribed by the public. Allied Industrials Limited, on the other hand, sought extensive assistance from the Dominion Government for the development of its holdings both in respect to the construction of a railway and the raising of capital.

Both of these ventures contemplated in a very large measure a domestic market for the coal they would produce. The limited market for Alberta coals in the Prairie Provinces and the northwestern sections of the United States and the difficulties inherent in moving these coals to the densely populated portion of central Canada are discussed in later chapters on Markets and Transportation. In brief, the bituminous operations in Alberta are dependent upon the railways for a market of roughly 70 per cent of their production and the existing mines are more than capable of meeting the requirements of the normal market. Transportation assistance in the form of subventions has been provided to absorb their surplus production in Ontario markets to which normally they would not have access. Similar assistance has been given to the Alberta sub-bituminous mines which are almost solely dependent on a domestic market.

Presumably the proposed new mines in the Highwood area would operate in competition with established mines in Alberta and transportation assistance would be required to provide access to the Ontario market. Apart from a relaxation during recent war years, the benefits of transportation subvention were limited to the mines operating prior to December 31, 1930.

Both Ford Highwood Collieries Limited and Allied Industrials Limited have emphasized the quality of the Highwood coals claiming that they are fully comparable if not superior to Pennsylvanian anthracite and Pocahontas low volatile coals imported from the United States. Particular emphasis has been placed on the physical structure of the coal. It has been referred to as "hard" coal suggesting in this way that the coal is comparable to imported anthracite. After full investigation the Commission is satisfied that the Highwood area constitutes a very valuable deposit of low volatile bituminous coal. We are equally convinced that there is no evidence to suggest that the coals of this area when mined will fulfill the claims of the promoting companies. These coals are of the same geological horizon as those of the Cascade area now being mined at Canmore and there is some evidence to show that the Highwood coals are somewhat inferior in grade to the Cascade coals, principally in respect to ash content. It is particularly important to note that the operator at Canmore is obliged to briquette one-third of the mine output owing to the extreme friability of the coal. Again, friability in large part has limited the Ontario market for Cascade coals to briquettes owing to the large percentage of degradation accruing from transhipment. The Commission is convinced that if these ventures result in the opening of new mines, the coals produced will exhibit marked friability thus presenting serious marketing problems.

The Commission does not suggest that a project such as Ford Highwood Collieries Limited should be prevented by Governmental action from risking its capital on the development of this area but in the circumstances there is no valid reason for extending Government assistance other than the transportation subventions available to existing operators.

Outer Foothills Belt

The Outer Foothills belt includes eight coal areas which, from south to north, are the Pincher, Pekisko, Morley, Red Deer, Mountain House, Saunders, Coalspur and Prairie Creek areas. As in the instance of the Inner Foothills belt, mining operations are largely confined to the areas traversed by the main line of the Canadian Pacific and Canadian National Railways and the two branch lines of the Canadian National Railways from Edson and Red Deer; although small mines have operated intermittently in the other coal areas to supply local requirements for coal.

The coal areas of this belt include deposits of the Belly River, Brazeau and Edmonton formations of Upper Cretaceous age and the Coalspur deposits of Tertiary age. The Belly River and Edmonton formations outcrop intermittently in narrow bands in the Pincher Creek, Pekisko and Morley areas, being separated in this area by the Bearpaw shale formation. In the Red Deer area, these coal formations cannot be separated, and in the Saunders, Coalspur and Prairie Creek areas they are grouped in the Brazeau formation. The important coal deposits in the Saunders, Coalspur and Prairie Creek areas occur in younger beds which, on the basis of plant fossils, are considered to be of Tertiary age. These Tertiary coal-bearing beds are believed also to occur in the Mountain House area.

It will be noted that this belt of coal areas does not extend as far northward as the Inner Foothills belt. The reason for this is apparent from previous discussion, namely, that conditions favourable to coal formation in Upper Cretaceous and Tertiary times were more restricted than those in the Lower Cretaceous age.

The deposits of this belt comprise high volatile "B" bituminous and high volatile "C" bituminous coals, the Upper Cretaceous coals being largely of high volatile "B" bituminous and the younger Tertiary coals being largely high volatile "C" bituminous. There is a wide range in the quality and physical characteristics of the coals in this belt. Most of them are of hard structure and will withstand handling and exposure to weather, whereas other coal seams in the same area, where they have been subjected to faulting, are very friable. As a rule, these coals have a lower ash content than the majority of the coals of the Inner Foothills belt and a somewhat higher ash content than that of the coals of the central Plains. These Outer Foothills belt coals are not good coking coals and find their most ready market as a domestic fuel. For railway-locomotive use they are blended with the coals of the Inner Foothills belt.

With the exception of the Mountain House area and part of the Red Deer area, all the areas in this part have been mapped by the Geological Survey and portions of it have been mapped by the Provincial Government. However, due to the heavy blanket of glacial drift that conceals the bedrock over much of this region, it is more difficult to trace the coal seams and to determine their variations in thickness and attitude than in the areas of the Inner Foothills belt. Sufficient, however, is known of the coal deposits of each of these areas of the Outer Foothills belt to establish beyond doubt that the reserves are very substantial. This was the submission of the Provincial Government and is apparent from the estimate prepared for the Commission (Table 12, Appendix A) which gives the following figures:

Area	Mineable Coal		Recoverable Coal	
	Probable	Possible (Additional)	Probable	Possible (Additional)
	(Thousands of net tons)			
Pincher	156,800	201,600	78,400	100,800
Pekisko	728,000	593,600	364,000	296,800
Morley	375,200	554,400	187,600	277,200
Red Deer	420,000	520,800	210,000	260,400
Mountain House	8,960	35,840	4,480	17,920
Saunders	1,275,680	874,720	637,840	437,360
Coalspur	3,376,800	576,800	1,688,400	288,400
Prairie Creek	240,800	173,600	120,400	86,800
Total—Outer Foothills Belt	6,582,240	3,531,360	3,291,120	1,765,680

The Coalspur area, which, as will be seen from the foregoing estimate, possesses by far the largest reserves, is the largest producing area in this belt. This production is derived from both underground mining and stripping or open-cut operations. Only very limited reserves are available for recovery by stripping operations and recovery of reserves generally in this belt will be by underground operations.

Plains Region (Belly River)

As may be seen from Map 8, the Plains region, in which the coal deposits occur mainly in the formations of the Belly River series, includes seventeen coal areas. From south to north, these are Magrath, Lethbridge, Milk River, Pakowki, Taber, Redcliff, Brooks, Empress, Steveville, Wainwright, Pakan, Westlock, Rochester, Slave, High Prairie, Sexsmith and Valhalla. The Lethbridge area, the smallest of these, is the most important both in respect to present development and reserves for future operations.

With the exception of the Taber area, very limited development of the reserves has taken place elsewhere in this Plains region. In many areas no mining has taken place.

The coals in this region present a wide range in rank from lignite at the Saskatchewan border in the Pakowki area to high volatile "B" bituminous in the Magrath area. In most of the areas, the coals are of sub-bituminous rank but the coals of the Lethbridge area are high volatile "C" bituminous. The coals of the region also show wide range in physical characteristics. The majority of them do not withstand exposure to weather but the coals of the Lethbridge and Magrath areas are more compact and withstand exposure. The coals of these two areas closely resemble those of the Outer Foothills belt, the improvement in the quality of the coal being due to proximity to the mountains.

Relatively little is known as to the coal reserves of this region, as the bedrock is largely concealed by a blanket of alluvium and glacial drift. The region has been extensively mapped by the Geological Survey or by the Province but such investigations have yielded very little data respecting the number, thickness and continuity of the coal seams in these areas due to the flat-lying nature of the coal measures, and the fact that very few of the streams have cut deep enough channels through the glacial drift to expose the underlying coal-bearing rocks. Existing mines and prospects and records of water wells and deep borings for oil and gas have formed the main source of information on which to base estimates of coal occurring in these areas. It is apparent that estimates in such instances are only approximations. The Province indicates that the reserves in all of the areas in the region are substantial and this is confirmed in the estimate prepared for the Commission (See Table 13, Appendix A).

Area	Mineable Coal		Recoverable Coal	
	Probable	Possible (Additional)	Probable	Possible (Additional)
	(Thousands of net tons)			
Magrath	437,900	39,200	218,950	19,600
Lethbridge	678,720	144,480	339,360	72,240
Milk River	428,960	282,240	214,480	141,120
Pakowki	254,240	57,120	127,120	28,560
Taber	408,800	229,600	204,400	114,800
Redcliff	51,520	78,400	25,760	39,200
Brooks	182,560	425,600	91,280	212,800
Steveville	16,800	33,600	8,400	16,800
Empress	20,160	30,240	10,080	15,120
Wainwright	6,720	20,160	3,360	10,080
Pakan	13,440	20,160	6,720	10,080
Westlock	26,880	47,040	13,440	23,520
Rochester	13,440	20,160	6,720	1,080
Slave	10,080	16,800	5,040	8,400
High Prairie	15,680	23,520	7,840	11,760
Sexsmith	16,800	13,440	8,400	6,720
Valhalla	30,240	20,160	15,120	10,080
Total—Alberta Plains (Belly River Series.)	2,612,940	1,501,920	1,306,470	750,960

There are doubtless many local occurrences in the region suitable for stripping operations, but the principal recovery will be derived from the coal seams occurring in the Oldman formation and by underground operations. The reserves in each of the operating localities are sufficient to allow many years of operation.

Plains Region (Edmonton)

The Plains region underlain by the Edmonton formation includes 15 areas, which from south to north are the Champion, Gleichen, Drumheller, Sheerness, Carbon, Big Valley, Castor, Ardley, Wetaskiwin, Camrose, Tofield, Edmonton, Pembina, Whitecourt and Halcourt areas. Large areas are underlain by this formation between the areas indicated and the Foothills belt, but in the central part of the Alberta Syncline the coal deposits lie at too great a depth to be of commercial importance.

Mining operations in the Plains region have been largely concentrated in the Drumheller and Edmonton areas, the annual production from Drumheller representing about two-thirds of the total production from this Plains region. Production from these fields is largely for domestic consumption, and in most of the areas outside of the Edmonton and Drumheller areas, only limited or intermittent mining has been carried on.

With the exception of the Halcourt area, all the coals in these areas are of sub-bituminous rank. In the Halcourt area, the coal ranks as high volatile "C" bituminous. The coals of this region have a relatively low ash content and exhibit a wide range in respect to moisture content, the percentage of moisture being directly related to the distance of the various areas from the mountains. Thus the coals of the Edmonton area have a moisture content of about 25 per cent, whereas that of the Drumheller coals is less than 19 per cent. In contrast to the coals of the Inner Foothills belt, the fusion point of ash of these Edmonton formation coals is low. None of these coals are coking coals. They are very friable and slack on exposure to weather.

The Geological Survey has mapped a considerable part of this Plains region, but the most intensive studies of these coals have been carried out by the Province. These investigations have shown that the Edmonton formation in the central part of this belt has a thickness of 1,224 feet, and contains 14 coal seams having an aggregate thickness of 62 feet. They have also shown that over much of the area the upper portion of the Edmonton formation and its contained seams have been removed by erosion.

More is known of these deposits than those of the Plains region underlain by the formations of the Belly River series. However, glacial drift again offers a serious handicap in securing essential data on which to base estimates. Evidence submitted by the Province, however, shows that the coal reserves in each of these areas are large. The estimate prepared for the Commission (Table 14, Appendix A) gives the following tonnages:

Area	Mineable Coal		Recoverable Coal	
	Probable	Possible (Additional)	Probable	Possible (Additional)
	(Thousands of net tons)			
Champion	67,200	16,800	33,600	8,400
Gleichen	58,800	16,800	29,400	8,400
Drumheller	994,000	324,800	497,000	162,400
Sheerness	235,200	26,880	117,600	13,440
Carbon	302,400	50,400	151,200	25,200
Big Valley	89,600	44,800	44,800	22,400
Castor	336,000	26,800	168,000	13,400
Ardley	280,000	20,160	140,000	10,080
Wetaskiwin	56,000	28,000	28,000	14,000
Camrose	112,000	16,800	56,000	8,400
Tofield	246,400	33,600	123,200	16,800
Edmonton	627,200	120,960	313,600	60,480
Pembina	1,260,000	252,000	630,000	126,000
Whitecourt	84,000	16,800	42,000	8,400
Halcourt	168,000	84,000	84,000	42,000
Total—Alberta Plains (Edmonton Formation)	4,916,800	1,079,600	2,458,400	539,800

No estimate of the future of any operations within these areas, however, can be deduced from the above figures as these relate to the area as a whole rather than to any particular properties or section of the area.

This observation has particular relevance to the operations presently being conducted in the Red Deer Valley of the Drumheller area, commonly referred to as the Drumheller coal field. The estimate figures for this area, which are based on seams having a minimum thickness of 3 feet lying beneath a maximum depth of cover of 1,000 feet, indicate a substantial tonnage of probable mineable coal. On the other hand, the Commission has received engineering advice to the effect that the Drumheller coal field has now reached its maximum capacity and that, with few exceptions, the life of the mines at the present level of annual production is limited to twenty to thirty years. The essential feature of this local situation is the "bad land" topography of this section of the Red Deer Valley. The Edmonton formation in this area has a thickness of 1,050 feet and contains five workable seams which, in ascending order, are Nos. 1, 2, 5, 7 and 11. Most of the operations in the area are confined to seams Nos. 1 and 2. Seam No. 1 ranges in thickness from 3.3 feet to 7 feet and averages 5 feet. The seam lies about 130 feet above the base of the formation. Seam No. 2 ranges in thickness from 3 feet to 6.5 feet and averages 4.5 feet. It lies 30 feet above No. 1 seam. Red Deer Valley has a depth ranging from 300 to 500 feet in a width of 3 miles, beyond which limits the topography rises to considerably higher elevations. It is evident, therefore, that where No. 1 seam outcrops at valley level, the maximum depth of mining, which engineering advice has set at about 600 feet, will be reached when mining operations have proceeded about 1.5 miles from the point of entry. Where the Red Deer has cut its channel below the seam outcrop, the cover is generally correspondingly less, thus permitting more extended workings. On the assumption that 600 feet constitutes a maximum cover and that seams Nos. 5, 7 and 11 are not commercial in the Red Deer Valley, it would seem that the reserve situation in respect to many of the mines is assuming primary importance. It is possible that the operators in this area will find it feasible to continue operations beyond the point at which 600 feet of cover is reached. Failing that, the alternative will be for them to open up new operations in the adjacent uplands or in other areas. This may involve higher operational costs and the loss of convenient railway facilities.

SUMMARY

It is clear from the foregoing that Alberta has very extensive reserves of bituminous and sub-bituminous coals. The most valuable reserves from the point of view of both quality and quantity are concentrated in the Foothills belts, notably in the Inner Foothills belt. Of the Plains regions, the Edmonton formation is the more important and represents an extensive reserve of sub-bituminous coal. Markets, rather than reserves, are the fundamental problem of the Alberta coal mining industry.

PROVINCE OF BRITISH COLUMBIA

Coal deposits occur in widely distributed areas throughout the Province of British Columbia. Reference to Map 10 also shows that the deposits are generally confined to small areas. The majority of them, it will be noted, occur at great distances from the main population and industrial centres, important deposits in the northern part of the Province being without railway facilities.