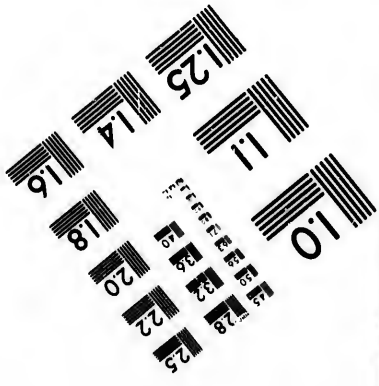
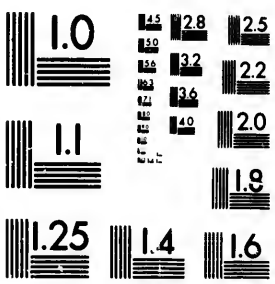


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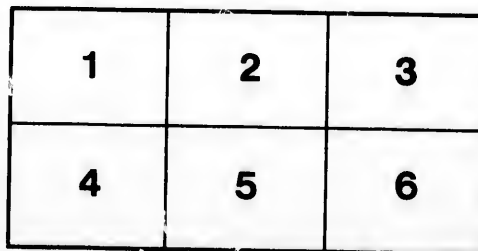
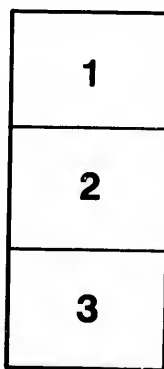
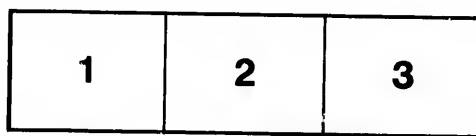
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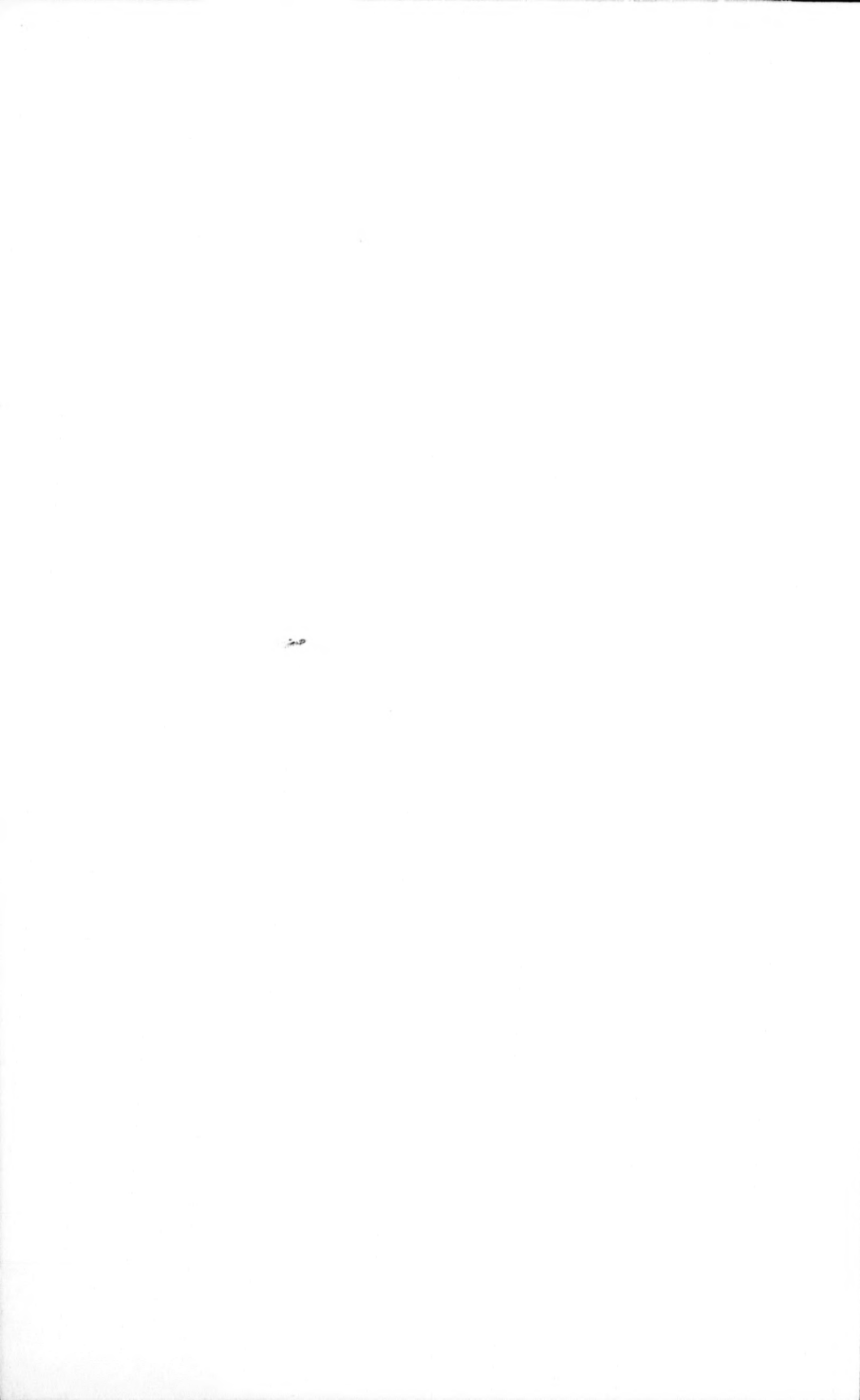
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NOTES

ON THE

COALS AND LIGNITES

OF THE

CANADIAN NORTH-WEST,

CHIEFLY DERIVED FROM THE REPORTS OF THE GEOLOGICAL SURVEY OF CANADA,

BY

GEORGE M. DAWSON, D.S., F.G.S., Assoc. R.S.M.

Assistant Director Geological Survey.



MONTREAL:

PRINTED BY THE HERALD PRINTING AND PUBLISHING CO.

1884.

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NOTES
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ASST. DIRECTOR GEOL. SURVEY.

The coals and lignites of the North-west Territory and British Columbia are entirely of Cretaceous and Tertiary age, and differ, in this respect, from the fuels of the Eastern Provinces and States, and of Great Britain, which are included in the Carboniferous system.

The district of the North-west Territory which, so far as yet known, affords the most abundant and valuable deposits of mineral fuel, is that in proximity to the Bow and Belly Rivers and their tributaries, extending eastward from the base of the mountains to about the 111th meridian. This district is, however, the only one which has, up to the present time, been made the subject of careful and approximately complete observation by the Geological Survey, and it is thus quite possible that the country holding the same relation to the base of the Rocky Mountains further north, may yet prove throughout equally valuable as a source of fuel. Some of the more important coal discoveries already made in the northern region are mentioned on a succeeding page.

In my preliminary report on the Bow and Belly River coal region, the principal points in connection with its workable coal seams are summarized. A detailed map and complete report on

the district are at present in course of preparation. From the preliminary report above referred to the following particulars for this region are extracted:—

NOTES ON THE MORE IMPORTANT COAL SEAMS OF THE BOW AND
BELLY RIVER DISTRICT.

The fuels embraced in this district vary from lignites, but slightly superior in quality to those of the Souris region, to coals containing a very small percentage of water, forming a strong coke on heating, yielding abundance of highly luminous hydrocarbons, and precisely resembling ordinary bituminous coals, though of Cretaceous or Laramie age. In describing them the general term *coal* will be used, as it is impossible to draw a definite line between the two classes among the numerous intermediate varieties.

A coal seam, which occurs on the lower Bow and Belly Rivers, is seen in the banks for many miles at a varying height above the water, due to the light undulating dips by which it is affected. It is generally not more than a foot or eighteen inches in thickness though persistent in extent, but at one point on the Belly River it thickens to three feet, forming a workable seam, which appears to be of good quality throughout. This locality is thirty-two miles in a direct line from "Coal Banks." (Range XVI, Township 10.) No analysis has yet been made of this fuel.

The locality just referred to as "Coal Banks" is at the crossing of the Belly River by the trail to Benton. The coal occurring at this place is in shale of the Cretaceous formation at the base of the Pierre. It is one of the best in the district, and has been worked to a small extent for some years at this point by Mr. N. Sheran. A second mine has lately been opened on the opposite side of the river, and a considerable quantity of coal is being extracted. The outcrop of this seam is now known to extend, in workable thickness, from a point about six miles up the St. Mary River to that part of the Belly near and below Coal Banks, and thence northward to the Bow River, a distance of seventy miles.

Notes on the Coals And Lignites of the Canadian North-West, chiefly derived from the reports of the Geological Survey of Canada,
 By George M. Dawson, D.S., F.G.S., Assoc. R.S.M. Assistant Director Geological Survey.

Montreal: Printed by the Herald Printing and Publishing Co.
 1884. 8 vo., 21 pp.

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	ft	in
.....	1	0
al.....	0	6
.....	1	3
.....	0	2
.....	0	9
ale.....	4	0
.....	1	4
ale (to water).	4	0

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the district are at present in course of preliminary report above referred to the this region are extracted:—

NOTES ON THE MORE IMPORTANT COALS
BELLY RIVER DISTRICT

The fuels embraced in this district are slightly superior in quality to those coals containing a very small percentage of a strong coke on heating, yielding abundant hydrocarbons, and precisely resembling those of Cretaceous or Laramie age. The general term *coal* will be used, as there is no definite line between the two classes of intermediate varieties.

A coal seam, which occurs on the banks of the Belly River, is seen in the banks for many feet above the water, due to the light color of the coal it is affected. It is generally not more than a few inches in thickness though persistent on the Belly River it thickens to thirty-two inches in the seam, which appears to be of good quality. The locality is thirty-two miles in a direct line from the mouth of the river (Range XVI, Township 10.) No analyses of this fuel.

The locality just referred to is at the crossing of the Belly River by the Pierre. The coal occurring at this place is in shale at the base of the Pierre. It is on the west side of the river and has been worked to a small extent by Mr. N. Sheran. A second mine has been opened on the opposite side of the river, and a considerable quantity of coal is being extracted. The outcrop of coal extends, in workable thickness, from the St. Mary River to that part of the Pierre on the west side of the Banks, and thence northward to the mouth of the river, a distance of seventy miles.

The drift deposits average about one hundred feet in thickness over the plains near the Belly River, and it is consequently, in general, only in the river valleys, or in the larger coulées which flow into them, that the Cretaceous rocks can be seen. The Belly Valley in this part of its course is about 300 feet deep, and averages nearly a mile in width. It therefore cuts about 200 feet into the Cretaceous rocks, and displays fine sections of these. There are in this vicinity several associated coal seams; one of these, that which has been opened by Mr. Sheran, I may, for the sake of clearness, refer to as the "main seam." It is more or less perfectly exposed at intervals along this part of the Belly for a distance of about twelve miles, or from the workings at Coal Banks to Big Island of the map. Above Coal Banks the measures are affected by a light anticlinal swell which brings up older rocks, and the outcrop runs round to the west, appearing on the river again at the mouth of the St. Mary. At the furthest point up the St. Mary, at which the coal appears (about seven miles from the mouth of the river), it shows the following section, the second column being a continuation of the first at a spot about 100 yards further down stream:—

	ft. in.			ft in	
Rusty ironstone layer.....	0	8			
Blackish and rusty shale.....	5	0			
Coal.....	0	3			
Blackish shale.....	6	0			
Coal.....	0	6			
Soft carbonaceous shale.....	0	4			
Coal.....	0	8			
Soft, thin shale, highly carbonaceous in upper part....	0	6			
Ironstone shale.....	0	6			
Blackish shale.....	3	0			
Coal.....	0	8	Coal.....	1	0
Carbonaceous shale (some coal)	1	6	Shaly coal.....	0	6
Coal (partly below water).....	1	6	Coal.....	1	3
			Shale.....	0	2
			Coal.....	0	9
			Grey shale.....	4	0
			Coal.....	1	4
			Grey shale (to water).	4	0

About two miles further down the St. Mary the coals are again seen, with the following development:—

	ft.	in.
<i>Coal</i> (rather shaly).....	1	0
<i>Coal</i>	1	4
<i>Shale</i>	0	3
<i>Coal</i>	0	9
<i>Shale</i>	10	1
<i>Coal</i>	3	8
<i>Shale</i> (with obscure plant impressions).....	6	0

At the mouth of the St. Mary the main seam has a thickness of 3 feet 6 inches, but about 18 inches at the top is rather shaly.

On comparing these sections on the St. Mary with those at Coal Banks and on the Belly River to the north, it will be found that the coal at the first-mentioned locality is more divided by shales and less favourably situated for working.

On the part of the Belly River near Coal Banks the measures have, as a whole, a light westerly dip, while that part of the outcrop between Coal Banks and Big Island forms a minor synclinal hollow in its edge, across which the river cuts in a direction nearly coinciding with the main strike of the measures, and gives rise to a great display of coal on this part of the valley. The coal-bearing horizon, as above mentioned, lies at the base of the Pierre, and its position between the dark shales of this formation and the pale sandy beds of that underlying it, renders it easy to define the situation of the coals, even where their actual outcrop is concealed. For a distance of five miles north of the Coal Banks exposures, the dark shales just referred to occupy the river valley, while the outcrop of the coal is carried eastward to an uncertain distance by the light synclinal undulation above referred to. The gentle inclination of the measures shows that the coal might be reached at a moderate depth by shafts sunk through the dark shales in this part of the valley, from which it might, with facility, be worked up its slope to the eastward. The undulating character of the dips renders it impossible to estimate the exact depth at which the seam would be found, but it is probably not over 500 feet below the river, midway between its southern and northern outcrops in the valley. It may also be worked on a smaller scale, but with great facility, by levels driven into the actual outcrops in the river banks.

Having thus briefly described the general mode of occurrence of the coal on this part of the Belly River, the following more detailed notes on the outcrops which occur will serve to show the actual character of the seam.

At Coal Banks, the coal was at first extracted chiefly by quarrying along the natural outcrop. During the summer of 1881 the first level was opened. The outcrop is situated in the front of a steep scarped bank facing the river, and the seam, which at the southern end of the bank is about 30 feet above the water, dips away below the water at the northern. The following section shows the mode of occurrence and association of the coal in the bank, but does not extend upward to the base of the drift deposits.

		ft. in.	
	Finely laminated grey shale.....	8 0	
	Coal (shaly below).....	1 6	
	Grey, thin-bedded shale.....	12 0	
	Ironstone.....	0 3	
	Grey shale.....	1 9	
	Coal.....	0 8	
	Grey shale and nodular sandstone, carbonaceous below.....	7 0	
Main seam. {	Coal.....	1 4	} Coal, 5' 4"
	Shaly parting (often almost absent).....	0 4	
	Coal.....	4 0	
	Carbonaceous shale.....	2 0	
	Grey shale.....	2 0	
	Ironstone.....	0 4	
	Greyish and brownish shale.....	3 0	
	Carbonaceous shale.....	3 0	
	Coaly shale.....	0 8	
	Grey shale.....	2 0	
	Coal.....	0 4	
	Carbonaceous shale (to water).....	1 4	

The dip at this place is about N. 83° W. (mag.) at an angle of 5 to 8 degrees.

On the opposite side of the river, at its next bend, the coal seam is again well shown. It is here that the second mine above referred to has been opened. The seam is slightly undulating, and dips gradually away below the water level at the

northern end of the bank. The part of the section designated above as the main seam is here as follows:—

	ft. in.
<i>Coal</i>	1 6
Shaly parting (1 to 3 inches).....	0 2
<i>Coal</i>	3 3
	<hr/>
Total coal.....	4 9
	<hr/> <hr/>

About four inches in thickness at the base of the seam is here laminated in texture, but appears, nevertheless, to be of good quality. The general dip is about N. 50° W. (mag.), at an angle of less than 5 degrees.

From this point for a distance of five miles down the valley, the dark shales overlying the coal are alone seen. When it again appears, on the west bank of the river, the main seam shows the following section:—

	ft. in.
<i>Coal</i>	1 6
Shale.....	0 3
<i>Coal</i>	4 6
Shale.....	1 6
<i>Coal</i>	2 9
	<hr/>
Total coal.....	8 9
	<hr/> <hr/>

The lowest division of the seam at this place is apparently not represented in the sections previously described. The coal in it is somewhat laminated, but seems to be of good quality. The dip is here about S. 70° W. (mag.), at an angle of 5 degrees.

About three miles further north, extensive exposures of the coal are again found in the scarped bank or cliff facing the river, at a height of about 100 feet above the water level. The dip is light and undulating, but, on the whole, westward, or away from the river. The main seam is here composed as follows:—

	ft. in.
<i>Coal</i>	2 6
Carbonaceous shale	0 7
<i>Coal</i>	2 2
Carbonaceous shale	1 0
<i>Coal</i>	1 3
	<hr/>
Total coal.....	5 11
	<hr/> <hr/>

The coal here appears to be of good quality throughout. North of this point on the river the main seam is not again found well exposed, though in several places the associated rocks are shown in such a way as to indicate that it outcrops below the drift a short distance east of the river valley.

At the point at which the base of the Pierre should cross the Little Bow River, a seam of coal a few inches thick was observed by Mr. McConnell, but the exposures did not bring the Main Seam into view.

This coal-bearing horizon appears again on the Bow River at Grassy Island, about thirty-three miles in a direct line below the Blackfoot Crossing, in lat. $50^{\circ} 25' 15''$ (Range XVII, Township 17.) In their general appearance, arrangement and thickness, the seams here exposed closely correspond with those on the Belly River. The subjoined section exhibits the relations of the coal at this place:—

	ft.	in.
Lead grey shale	25	0
<i>Coal</i>	1	6
Soft grey and yellowish-grey shaly sandstone ...	13	0
Carbonaceous shale, coaly streaks	2	3
<i>Coal</i> (good and sound throughout).....	4	6
Dark grey shale and shaly clay.....	7	0
<i>Coal</i>	1	0
Carbonaceous shale	1	9
<i>Coal</i>	0	8
Soft shale and clay.....	8	0
<i>Coal</i> and carbonaceous shale (to water).....	1	6

The seams dip westward at a very light and constant angle. The seam, 4 feet 6 inches in thickness, probably represents the main seam of the Belly River.

It is probably this seam which has been passed through at a depth of 262 feet in the boring, at No. 8 siding on the railway.

Some general facts regarding the composition of the coal of this horizon in the Cretaceous may be given. The analysis by Prof. Haanel, quoted in my report on the Geology and Resources of the 49th Parallel (p. 179, No. III., in table), is of coal from this seam, but probably from that part of the outcrop near the mouth of the St. Mary River. The same remark applies to a specimen which was analyzed by Dr. Harrington. (Report of Progress,

1877-78, p. 49 C.) Prof. Haanel's analysis shows 6.69 per cent. of moisture and 6.36 per cent. ash. Dr. Harrington's specimen contained 5.79 per cent. water and 2.05 ash. A specimen from Mr. Sheran's mine, collected and examined by myself, yielded the following result:—

Water	6.52
Volatile combustible matter.....	31.03
Fixed carbon.....	56.54
Ash	5.91
	100.00

The coal is compact, does not easily break up by handling or exposure, and is in every respect a very excellent fuel, but does not yield a coherent coke.

In correspondence with the increased distance from the mountains of the outcrop of the same seam on the Bow River, and probable inferior degree of alteration to which it has been subjected, the coal is there found to contain more water, approximating in this respect to some of the Souris River lignites. From these, however, it still differs in its more compact texture and resistance to weathering and the regular vertical cleat or jointage planes by which it is traversed, which cause it to assume cuboidal instead of conchoidal forms on fracture. A preliminary examination of an outcrop specimen from this locality gave the following result:—

Water	12.37
Volatile combustible matter....	32.33
Fixed carbon.....	46.39
Ash	8.91
	100.00

A seam occurring at the summit of the dark Pierre shales on the Bow River, at the point which I have designated as Horse-shoe Bend, (Range XIX, Township 20) has a very light westerly or north westerly dip, and is not certainly known to be represented elsewhere. The outcrop at Horse-shoe Bend is situated about fifteen miles east-north-east of the Blackfoot Crossing. The seam appears at a height of 135 feet above the water in a steep scarped bank on the south-east side of the river, and is exposed for nearly half a mile. It is 4 feet 4 inches in thickness, compact and hard where not long weathered and in physical

character resembles that last described. A preliminary examination of an outcrop specimen showed the following composition:

Water	13·67
Volatile combustible matter.....	37·16
Fixed carbon.....	40·50
Ash (reddish)	8·67
	<hr/>
	100·00

Still following an ascending order in the series, the seam which has been known for some years at Blackfoot Crossing next claims attention. This is several hundred feet higher in the section than the last, and is distinctly included in the Laramie.

Coal occurs in several places on the Bow River a few miles above the Blackfoot Crossing. The seams are too thin to work, but are probably on the same horizon with that described below. Throughout this region the beds are affected by gentle undulating dips, and though they have besides a very light general inclination westward, they may be considered as practically horizontal.

The outcrop from which a small quantity of coal has been extracted, and which has been referred to by several travellers, is situated six and a half miles eastward from the Blackfoot Agency buildings, on a coulée which runs northward to the Bow. The deposit here consists of two seams, the upper averaging 1 foot 8 inches in thickness, the lower 3 feet. They are separated by about a foot of carbonaceous shale. At this spot the bed may be traced about 500 feet in natural exposures, and is affected by variable dips, which do not exceed 5° in amount. The thickness of the seams continues nearly uniform, and they would afford, say, 4 feet 6 inches of clean coal, the whole of which could be worked at once. The immediate banks of the coulée are about 80 feet high at this place, the upper two-thirds being composed of drift deposits, which rest on a worn undulating surface of the rocks below. The general level of the surrounding prairie is about 110 feet above the horizon of the coal, and no exposures of the coal or associated rocks are found except in the river banks or coulées, which cut deeply into the surface of the plain.

In following the coulée northward from the spot just described, the coal is frequently seen on the right or east bank for about a mile, after which the coulée opens into a wider valley with

sloping grassy sides, and exposures cease. Owing to the slope of the bottom of the coulée toward the river, the beds are cut into more deeply near its mouth, and at the last exposure the seam is about thirty feet up in the bank. The upper seam is here not well shown, but the lower exhibits a few inches over 4 feet of good coal. In an exposure intermediate between this and the first, the upper seam is 8 inches thick, the shales 1 foot, and the lower seam 4 feet 4 inches. The seams are underlaid by at least twenty feet of soft whitish sandstone.

Between the Blackfoot Cross...g and the coulée above described, the same coal-bearing horizon appears in several places in the banks of Bow River. The seams are here more favourably situated for working, and of greater thickness than in the coulée. The subjoined section shows their mode of occurrence at one point:—

	ft. in.
<i>Coal</i>	1 8
Black carbonaceous shale	1 4
<i>Coal</i>	1 8
Shale	0 3
<i>Coal</i>	0 9
Shale	0 3
<i>Coal</i>	3 0
Shale	1 0
<i>Coal</i>	1 10
Total	<hr/> 11 9
Total coal	<hr/> 8 11 <hr/>

The coal is here again underlaid by whitish sandstone for about 30 feet, or to the water's edge. Nearly opposite this exposure, on the south side of the river, the seam appears at intervals in the bank, at a height of about 40 feet above the water, for at least a quarter of a mile. It is affected by a series of light undulations.

On Crowfoot Creek, about four miles from the Bow, the same coal-bearing horizon occurs, but the exposure of the seams is not sufficient to enable their thickness to be determined. Exploration by boring is now in progress.

The natural exposures serve to prove the continuity in good workable thickness of this coal deposit over a tract of country

several miles in extent, and its nearly horizontal attitude and moderate depth below the surface of the plains, would enable it to be proved by boring, at a small expense, over any desired area.

In texture this coal is not so firm or well adapted for transport as those of the localities previously described, but in composition appears closely to resemble that of Horse-shoe Bend.

The following are analyses of the fuel from this place; the first, from a specimen obtained by Prof. Macoun; the second, from one collected by myself, and probably not subjected to such prolonged desiccation:—

	I.	II.
Water	10·72	13·20
Volatile combustible matter	29·26	33·80
Fixed carbon	46·09	48·10
Ash	13·93	4·90
	<hr/>	<hr/>
	100·00	100·00

Four coal-bearing localities on the head waters of the Old-Man River appear to be of sufficient importance to obtain notice at the present time, but as the country toward the base of the mountains becomes more fully known, it is probable that numerous additional outcrops will be discovered.

At the Government Indian Farm, south of Pincher Creek, a seam of coal occurs about one mile from the farm buildings, up the valley of the small stream on which they are situated. The rocks in the lower part of the valley belong to the St. Mary River subdivision of the Laramie, and dip north-north-east (mag.) Their angle gradually increases from about 20° till the beds become nearly vertical where the coal occurs. Beyond this point the rocks are concealed, but the coal probably occupies a position very near the base of the Laramie.

Near the coal seam the beds have been much disturbed, and the coal itself is slickensided and broken throughout in such a way as to cause it to crumble easily by handling. The seam is two feet in thickness where exposed, but is said to have been considerably thicker where followed into the bank. The opening made on the coal has, however, since been filled in. This seam should re-appear on Pincher Creek above the crossing place of the road, but the horizon at which it should occur appears to be covered.

An analysis of the coal from this seam by Mr. Hoffmann is given in the Report of Progress for 1878-79, p. 12 n. It may be quoted here for comparison with those of the other seams, and illustrates the improvement in quality of the coals on their approach to the base of the mountains:—

Water	6·26
Volatile combustible matter.....	29·31
Fixed carbon.....	55·70
Ash	8·73
	<hr/>
	100·00
	<hr/> <hr/>

On the middle fork of the Old Man River, a few miles below the Falls, and nearly north of the mill on Mill Creek, two seams of good coal occur in a scarped bank on the north side of the stream. The beds are each about three feet in thickness, and are folded in a very remarkable manner, illustrating the intensity of the force which has acted in crumpling the rocks near the base of the mountains. It is probable that these beds occupy a horizon near the base of the Laramie. They approximate in character to true bituminous coals, and would yield coherent cokes, but no analysis has yet been made of them.

The section in which these coal seams occur is as follows. The order appears to be descending, but the whole may not improbably be overturned:—

	ft.	in.
Grey to black, very fine shale, with occasional small fish scales and bones, becoming sandy and yellowish at base	6	0
Ferruginous sandstone	0	6
Greyish soft sandstone or arenaceous clay, with some thin ironstone layers	10	0
Harder greyish and ferruginous sandstone, with some obscure plant fragments	6	0
Hard, flaggy, yellowish sandstone	2	0
Grey sandy shale and shaly sandstone.....	3	0
Coal	3	0
Soft black carbonaceous shale.....	0	9
Grey sandy shale	3	6
Grey sandy shale and sandstone	4	6
Grey flaggy sandstone, weathering rusty	2	6
Grey sandy shale and shaly sandstone.....	5	0
Coal. Imperfectly seen, but at least 3 feet of good quality	3	6

Carbonaceous shale	1	0
Grey sandy shale	4	0
Ferruginous sandstone	0	6
Greenish-grey sandstone.....	10	0
Grey and blackish carbonaceous shale.....	4	0
Greenish-grey soft sandstone	6	0
Sandstone and arenaceous and carbonaceous shale, with general greenish-grey tints, (about).....	80	0
	<u>155</u>	<u>9</u>

On Mill Creek, about four miles above the mill, a seam of coal outcrops. The measures are somewhat broken, and the seam appears to be rather inconstant in thickness. The coal is of excellent quality, and yields a firm coke. It has been used to a small extent in blacksmith work at the mill. The following are sections of the seam on opposite sides of a break or fault which traverses the measures at the outcrop:—

	ft.	in.
Coal (rather shaly)	3	1
Coal	2	0
Shale.....	1	4
Coal	2	0
Shale.....	1	4
Coal	2	0
Total coal.....	<u>9</u>	<u>1</u>

	ft.	in.
Coal (rather shaly).....	2	0
Shale.....	1	0
Coal (apparently good throughout with the exception a few shaly partings not equalling 4 inches in all.)	6	0
Total coal.....	<u>8</u>	<u>0</u>

About a mile and a half from the first limestone range on the north fork of the Old Man is a seam of excellent coal about five feet thick, dipping westward at an angle of thirty-five degrees.

The occurrence of workable coal seams at several different horizons, and the proved continuity of some of them over great areas, guarantees an abundant supply of fuel in this district, a matter of great importance in a country which, over wide tracts, is almost entirely destitute of wood. The quality of some of the fuels is such as to render them suitable for transport to a distance,

and it is doubtless on this belt of coal-bearing rocks in the vicinity of the mountains that the railways of the North-west will depend chiefly for their supply.

The quantity of coal already proved to exist is very great. The distances for which the outcrops of certain seams have been traced have been mentioned. Approximate estimates of the quantity of coal underlying a square mile of country in several localities have been made, with the following results:—

Main Seam, in vicinity of Coal Banks, Belly River. Coal underlying one square mile, 5,500,000 tons.

Grassy Island, Bow River. (Continuation of Belly River Main Seam.) Coal underlying one square mile, over 5,000,000 tons.

Horse-shoe Bend, Bow River. Coal underlying one square mile, 4,900,000 tons.

Blackfoot Crossing. Workable coal seam as exposed on Bow River. Underlying one square mile, 9,000,000 tons.

COAL IN THE ROCKY MOUNTAINS.

During the summer of 1883, anthracite coal has been discovered on Cascade River, near its confluence with the Bow, in immediate proximity to the line of the Canadian Pacific Railway. The Cretaceous coal-bearing rocks, with a width of about two miles and undetermined length here occupy a valley. They are much disturbed and folded together, and it is doubtless owing to the metamorphism occasioned by this disturbance that the coal contained in the rocks has passed into the state of anthracite. It is not yet known whether the various outcrops of coal in this district indicate several seams, or merely represent the same seam folded upon itself. The high angles at which the coal lies will render it more difficult to work than that of the plains, but its more valuable character will probably compensate for this. The only point at which the seam had been properly uncovered last autumn, showed it to be about three feet in thickness and of very promising appearance. A preliminary analysis of this fuel (fast coking), yielded the following result:—

Water	1 34
Volatile combustible Matter	8 57
Fixed carbon	86 27
Ash (light grey)	3 82
	<hr/>
	100 00

The anthracite-producing area of Cascade River, is, however, merely a special case of the inclusion of Cretaceous coal-bearing rocks in the mountains. My exploration south of the Bow Pass during the past summer has proved the existence of large areas of these rocks in that part of the mountains:—on the head waters of the North Fork of the Old Man, on the Crow Nest and North Kootanie Passes and on Elk River. These rocks contain in some places excellent seams of coal. In the event of the discovery of metalliferous deposits in this part of the range, these coals would be of great immediate utility for smelting purposes.

EXTENSION OF COAL-BEARING REGION TO THE NORTH AND WEST.

As above stated, the coal-bearing rocks developed so extensively on the Bow and Belly Rivers and their tributaries, are known to extend far to the north and west, though up to the present time it has been impossible to examine them at more than a few points.

On the North Saskatchewan several seams of lignite-coal, resembling those of the Souris River region, outcrop at Edmonton. The most important is about six feet in thickness, and has been worked to some extent for local purposes. Thirty miles above Edmonton a much more important coal seam occurs. This, as described by Dr. Selwyn (Report of Progress 1873-74), has a thickness of eighteen to twenty feet. It is of excellent quality, and much resembles the "Coal Banks" coal from the Bow River. It has the following composition:—

Water	7·82
Volatile combustible matter	31·35
Fixed carbon	54·97
Ash	5·86
	<hr/>
	100·00
	<hr/> <hr/>

Large seams are exposed at many other places in this part of the country. Several are reported of considerable thickness on

the Bruzeau, a tributary of the Saskatchewan. On the North Pembina River, a tributary of the Athabasca, about fifty-six miles west of Edmonton, a seam eight feet thick is said to outcrop. From specimens received, the composition of this coal has been determined as follows:—

Water	11·88
Volatile combustible matter.....	28·66
Fixed carbon.....	57·25
Ash	2·21
	100·00

Still further north, on the Athabasca River, several seams of lignite-coal are found, and may be traced for many miles in the scarped banks of the vallèy. The most important observed seam is ten feet in thickness, and is underlaid in the same section, by a second seam of three feet thick.

Of these the following are analyses, No. I. being the upper, and No. II. the lower seam:—

	I.	II.
Water	11·47	10·58
Volatile combustible matter.....	28·96	29·29
Fixed carbon.....	50·92	53·69
Ash	8·65	6·44
	100·00	100·00

That portion of the Athabasca River and its tributaries, which lies nearer the mountains than the district examined, may be expected to yield yet better fuels.

The Peace River and some of its tributaries have been examined geologically, but in a manner necessarily more or less cursory. Coal has been observed in a number of localities, but in most of those so far discovered it is too thin to be considered as of economic value. There can, however, in my opinion, be very little doubt that this district also will eventually be found to be well supplied with mineral fuels. Just as is the case further south, the coals nearest the base of the Rocky Mountains are superior to those lying further out from them. A specimen from a seam two feet in thickness, in the canon of the Mountain of Rocks, on Peace River, yielded the following result on analysis:—

Water	2.10
Volatile combustible matter.....	21.54
Fixed carbon.....	71.63
Ash	4.73
	<hr/>
	100.00
	<hr/> <hr/>

REGION EAST OF BOW AND BELLY RIVER DISTRICT. SOURIS DISTRICT.

The interior continental trough or basin of coal-bearing Cretaceous and Tertiary rocks is widest in the vicinity of the 49th parallel, in which region therefore, we find the coals and lignites extending much further east than they do on the North Saskatchewan, Athabasca and Peace Rivers. Eastward from the Bow and Belly district, the first known important locality is in the vicinity of Medicine Hat, on the South Saskatchewan.

Exposures of the Medicine Hat seam are found to occur on nearly every bend of the river from a point about thirty miles below the junction of the Bow and Belly to Medicine Hat. The seam is, however, more variable in thickness and character than many in this part of the North-west, and at two places on the river, scarcely a mile apart, changed from two feet in thickness of shaly, impure lignite, to six feet of very good lignite-coal. An exposure about ten miles above Medicine Hat showed two seams 4 feet 6 inches and 4 feet respectively in thickness. Three miles above Medicine Hat the coal is again well shown in the side of the river valley at a height of about eighty feet above the water level, with a thickness of 4 feet.

Since the above paragraph was written, the advance of the railway has lead to the opening of a mine at a point about six miles above Medicine Hat, on the north bank of the river, the seam worked here being from 4 feet 6 inches to 5 feet 4 inches in thickness. The mine has been connected by a branch line of about a mile in length with the railway, and the daily output has already surpassed a hundred tons. Other preliminary openings have been made in this vicinity, and the quantity of fuel which can be obtained is practically unlimited. In quality it is distinctly lignitic, resembling in composition, though not in texture, the better class of Souris Lignites. Actual

practical tests have, however, proved its value as a fuel for all ordinary purposes, and it is already largely in use in Winnipeg.

Mr. Hoffmann's analysis of the fuel from this seam, is as follows:—

	Slow Coking.	Fast Coking.
Water.....	17 70	17 70
Volatile combustible matter.....	28 63	29 96
Fixed carbon.....	49 83	48 56
Ash.....	3 84	3 84
	<hr/> 100 00	<hr/> 100 00

In the Cypress Hills several outcrops of lignite-coal have been known for some years. It was found by Mr. McConnell during the past summer that one of these is continuous over almost the entire area of the hills, and shows in places about five feet of fair lignite. In quality, however, this fuel is inferior to that of Medicine Hat.

East of this point, and south of the line of the Canadian Pacific Railway, beds of lignite of varying thickness and quality, but likely, in several instances, to become important as sources of supply of fuel for local purposes, occur. Most of these are described in my report on the Geology and Resources of the 49th Parallel (1875), and the Report of Progress of the Geological Survey, 1879-80. Of this district the portion situated nearest to Manitoba, and therefore likely to be of the greatest immediate importance, is that on the Souris River. The measures are here almost perfectly horizontal, and the valley having been cut out to a great depth, the lignite seams are exposed very favourably for working. The thickest bed here found is a little over seven feet. In 1880 Dr. Selwyn effected a series of borings in this region for the purpose of more fully defining the extent of the seams. In his report the following general statement is made:—

“It may be assumed that there are in this region, above the level of the Souris River, at least eight feet of available lignite-coal for an area of not less than 128 square miles. This would give 7,136,864 tons to the square mile, calculating the cubic foot at only 64 lbs.”

On the southern escarpment of Turtle Mountain, in Dakota, in the valleys of small streams flowing to the Souris, seams of

lignite-coal have been found. One of these five feet in thickness has been examined by Dr. Selwyn. The northern slopes of Turtle Mountain are thickly covered with drift deposits, but lignite-coal has been reported from wells in one or two places between Ranges XVIII and XXIV, in Townships 1 and 2 and elsewhere. Dr. Selwyn considers it probable that the whole of the higher country about Turtle Mountain constitutes an outlyer of the Souris lignite-bearing rocks. Workable seams resembling those of the Souris (useful at least for local purposes), may thus not improbably be discovered in this district.

A large number of analyses of the Souris lignite-coals have been made; they show a remarkable general constancy, and it may be sufficient to quote the following average statement by Dr. B. J. Harrington, arrived at from the examination of twenty-one analyses of lignites from the region east of the 108th Meridian:—

Water	15·46
Volatile combustible matter	37·97
Fixed carbon	41·21
Ash	5·36
	100·00

While, therefore, these fuels of the Souris hold a distinctly inferior place to those which have been previously described as occurring nearer to the Rocky Mountains, they closely resemble those of the Saatz-Teplitz basin of Bohemia, and other places in Europe, where similar fuels have given rise to considerable industrial centres; and they must have at least a great local value as fuels for those settlements which are growing up in their immediate vicinity.

