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THE COAL DEPOSITS OF THE HAY RIVER DISTRICT

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THE COAL DEPOSITS OF THE HAY RIVER DISTRICT

INTRODUCTION

For a number of years it has been known that coal of good quality and in beds of workable thickness, existed in the neighbourhood of Brule Lake, in the Jasper Park area, but up until 1916 little was known of them. In the summer of that year John McVicar of the Geological Survey of Canada investigated the coal deposits on Smoky, Hay and Berland rivers, Alberta. The object at this time was to determine what coals of Kootenay age occurred in this part of Alberta and the practicability of a railroad to them by way of the foothills. The results of his work are published in the Summary Report, 1923, Part B.

No further work was done in the Hay River area until the summer of 1928, when the Dominion Government had two parties in this district. Mr. W. H. Miller was engaged to map the district, 7 square miles of which was mapped in detail. Under the direction of Dr. B. R. MacKay of the Canadian Geological Survey, the geology of the detailed, mapped area was ascertained and mapped. It was the writer's privilege to be employed on both these parties.

The contents of this paper are based upon data derived from field work, and upon Mr. McVicar's report.

Location

The Hay River Area is located on the north branch of Hay river some 20 miles east of the British Columbia - Alberta boundary line, and 30 miles northwest of Bedson, a station on the main line of the Canadian National Railroad. Lying between the northwest extension of the first mountain range, known as Roche Boule, and the second range of the Rocky mountains, this area corresponds in position to the Pocahontas area, 30 miles east of Jasper. The claims actually staked

cover a rectangular area 18 miles in length and 4 miles in width, the long axis of which trends northwest and the south eastern end of which lies 30 miles northwest of Bedson on the Canadian National Railroad.

Accessibility

The area is easily accessible. At present there are two good pack trails, one from Entrance and one from Brule, which join at mile 25 from Entrance. These trails which extend as far as Smoky and Sulphur rivers are in excellent condition being used constantly by outfitters, hunting parties and by the forest rangers. In 1915 a survey was made for a proposed railroad route into the Smoky and Peace river areas from Solomon, a station some 7 miles west of Entrance on the Canadian National Railway. This route has been blazed, but up to the present time no road work has been done.

In 1928 a wagon road was cut by the Canadian Coal Fields, Ltd., in order to take into the area, a diamond drill outfit.

GENERAL CHARACTER OF THE AREA

Topography

The area from Brule Lake to Hay river, which lies along the foot of the eastern slope of the front range of the Rockies, is characterized by a series of rugged ridges, which parallel the axis of the front range, and in which the upturned Devono-Carboniferous limestones are exposed. North from Brule Lake the region extends in a broad valley made by the erosion of the relatively non-resistant Cretaceous shales, in which the valley was developed. From an elevation of 2500 feet at Brule Lake, this valley rises gradually for a distance of 15 miles to an elevation of 4500 feet from which point it slopes downward to Hay river, a distance of 8 miles.

Along the west side of the valley the upturned coal bearing Cretaceous rocks give rise to a ridge-like hogback which at intervals

is dissected transversely by a number of small streams that drain into the valley.

The area between Hay river and Muskeg river constitutes an elongated basin-like depression, bounded on the northeast by the first range of the Rocky mountains and on the southwest by the second range. The bottom of this basin is about 3000 feet above Brule Lake and about 1000 feet below the crests of the bordering ranges.

Climate

The climate of this area is continental in character resembling to some extent that of the coast, in that the temperatures are moderate and rainfall plentiful. The winter months are characterized by sunshine and abundant snowfall. West of the Hay river, the chinook winds prevail, preventing to some degree the heavy accumulation of snow.

Flora and Fauna

Wild flowers are very plentiful, and are those characteristic of high altitudes. Abundant rainfall assures an ample growth of grass and peavine thus providing grazing for stock. As a rule the hills are covered with a thick stand of spruce and jackpine, but large areas have been destroyed by fire and on these a second growth of evergreen has started.

This area has long been a famous hunting ground of the Indians and big game hunters and game such as moose, deer, cariboo, sheep, goat and bears are numerous. Fur bearing animals such as lynx, martin, fishers, fox, otter and weasel abound. The lakes and streams are well stocked with trout and other fish.

GENERAL GEOLOGY

Lower Cretaceous Series

The series in the Hay River district are divisible into the same mapable units as in the Mountain Park area some 100 miles to the south east, the geology of which was determined by B. R. MacKay in 1925, and hence the same nomenclature may be used. The individual formations vary slightly in thickness and minor character, but in no case was this such as to interfere with the recognition of the structure, which in some instances was almost identical with that of the Mountain Park area. In the Hay river area the Cadomin conglomerate maintained its usual thickness of about 30 feet and its unique lithological character, and due to its resistance to weathering stood out as a ridge or buttress 50 feet high, thus being the most conspicuous topographic feature in the lower Cretaceous Series.

Nikanassin Formation

The oldest formation in the Lower Cretaceous Series is the Nikanassin. The lowermost beds outcropping consist of a series of fine grained, thin and massive bedded, brown, buff and green weathering, finely cross-bedded sandstones, with some shale and several small coal seams of no commercial value. At the mouth of Carson creek, the formation is observed to overlie conformably, beds believed to be of Jurassic age. Here the Nikanassin formation is made up of thin and massive bedded sandstones containing a few chert pebbles, but the middle section of the formation has been removed by the erosion of the Hay river. At the mouth of Redmond creek emptying into the Hay from the south, and opposite Carson creek, 250 feet of sandstone and shale, with a 3 foot seam of dirty coal underlie the Cadomin conglomerate. On the west side of Thoreau creek, the Nikanassin formation forms the crest of an easterly plunging anticline which is broken here and there by a series of thrust faults. The total

thickness of the Nikanassin formation is believed to be around 1900 feet.

The following is a section of the Nikanassin formation taken where Carson and Redmond creeks empty into the Hay.

Cadomin Conglomerate.

Feet	Inches	
200	0	White weathering sandstone and Carbonaceous shale.
3	0	Coal.
1203	0	Concealed by Hay River.
324	0	Olive green, fine grained sandstone.
0	5	Shaly conglomerate.
25	0	Olive green sandstone.
10	0	Shaly sandstone.
10	0	Olive green sandstone.
15	0	Shaly sandstone.
70	0	Olive green to gray, coarse grained sandstone.
50	0	Coarse gray sandstone, somewhat rusted, and containing chert pebbles.
1912'	5"	Total Thickness.

Cadomin Conglomerate

This formation is the most unique in the Lower Cretaceous sediments from the point of view of retaining its lithological and physical characteristics over an extensive area. Taking its name from the district of Cadomin, Alberta, where it was first studied by B. R. MacKay in 1925, this conglomerate is massive bedded, varying from 20 to 35 feet in thickness and is composed of quartz, chert and quartzite pebbles of various hues and ranging in size from small pellets up to boulders 6 inches in diameter, most of which are well rounded. The matrix is of some sandy material, forming less than 30 percent of the rock

and of such great binding qualities, that the pebbles when struck with a hammer often break rather than be dislodged from their matrix. Two systems of joints are present one of which parallels the strike of the beds and the other related almost at right angles to it. The former running parallel to the strike of the strata gives the appearance of bedding.

The pebbles show no evidence of glaciation, thus making the question of its origin a puzzling one. The conglomerate occurs between shale beds showing evidences of abundant vegetable matter, and has been traced from the Saskatchewan river, northward to Hay river, and doubtless it will continue for some few miles further. The following explanation as to its origin is advanced by B. R. MacKay and appears to be quite reasonable. "Apparently the conglomerate was laid down after a period of marked organic activity, causing the area to the west to be elevated, thus permitting rapid erosion. The pebbles may have been deposited along the front of a newly elevated land area, by streams issuing into the sea, and resorted along the coast by shore current action."

On the north side of the Hay the conglomerate outcrops in a narrow ridge on the south slope of the major anticline, which has been traced a distance of 6 miles. 4000 feet to the north of this locality it reappears in the north limb of the major syncline. Folding and strike faulting have resulted in the duplication of the conglomerate in some places and in its elimination in others.

Luscar Formation

This formation overlies the Cadomin conglomerate in the Lower Cretaceous series, and takes its name from Luscar, Alberta, in which locality it was first studied in 1925 by Dr. B. R. MacKay. It is of extreme importance since it is the coal bearing formation, and consists

f alternating beds of sandstone and shale, plus the intermediate phases, nd contains at least six seams of coal, three of which are of such uality and thickness as to be of commercial value. In the vicinity of he coal seams the sandstone contains fragments of carbonized and silified wood, but shows much less cross-bedding than the other formations lthough in many localities ripple marks and moulds are common. This ormation has been determined by drilling and measurement and is uniform n character and thickness, averaging about 750 feet.

In the vicinity of Redmond creek, south of Carson creek, the ormation covers most of the area to the south of the Hay, forming flanks of an easterly plunging syncline. West of Thorean creek it outcrops as a ong narrow belt forming the steeply dipping south flank of a syncline.

Locally in this formation plant remains in abundance were found. he species present were similar to those found by the writer in 1927, in he Brule area to the south east, and will be important in determining the ge of this formation.

The following is a section of the Luscar formation:

Feet	Inches	
270	0	Alternating beds of brown and buff sandstone and gray shale.
30	0	Thin bedded sandstones with carbonaceous layers.
3	0	Coal.
20	0	Thin bedded sandstone and shale.
6	0	Coal.
194	0	Shales and soft sandstone.
25	0	Coal.
548'	0"	Total thickness. Some of the formation is missing.

Mountain Park Formation

The Mountain Park formation consists of a series of brown eathering sandstones, olive-green shales and a lense of fine pebbled onglomerate, overlying the coal bearing Luscar formation. This formation s the same as that designated by McVicar as the Dakota sandstone and ater as the sunset sandstone./ The sandstones, which form about 70 per- ent of the formation, are massive, soft, coarse grained and heavily cross- edded, thus indicating a rapid deposition. The conglomerate is composed of fine sandy particles and small black chert pebbles, and in thickness aries from 4 to 15 feet.

In the Hay river area this formation caps the hills to the east ind west of Redmond creek, forming the trough of a south-easterly plunging syncline, while west of Thoreau creek it occurs on the limits of a long narrow syncline.

This formation appears to be about 600 feet in thickness. The following section was measured on the divide between Thoreau creek and Berland river.

Feet	Inches	
20	0	Soft gray sandstone.
10	0	Soft brown, fine grained sandstone.
5	0	Hard quartzitic sandstone.
10	0	Soft, thin bedded, gray sandstone.
10	0	Olive-green shales.
15	0	Soft gray sandstone.
40	0	Hard gray sandstone.
25	0	Fine quartzitic sandstone.
30	0	Fine gray sandstone.
10	0	Coarse, gray green sandstone.

/ Summary Report, 1923, Part B.

Feet	Inches	
10	0	Shales and sandstone.
15	0	Brown weathering gray sandstone.
80	0	Soft sandstones and gray shales.
40	0	Coarse gray sandstone.
20	0	Green shale and sandstone.
125	0	Coarse sandstone, heavily cross bedded, containing some black chert pebbles.
3	0	Coarse, brown weathering, chert and quartzitic pebbled conglomerate.
5	0	Coarse grained, olive-green sandstone.
45	0	Green shales.
40	0	Quartzitic sandstone and shales.
20	0	Soft, green-gray shales.
25	0	Coarse pepper and salt sandstone.
25	0	Thin, brick-red and buff weathering sandstone.
628'		Total Thickness.

UPPER CRETACEOUS SERIES

Berland River Shales.

The Berland river shales, a local nomenclature, overlie the Mountain Park formation of the Lower Cretaceous series and are composed of black, gray and green shales containing a few lenses of fine gray sandstone and many ironstone nodules. Being quite soft they weather very rapidly giving rise to prominent shale banks. They correspond in lithological character and in stratagraphic position with the Blackstone shales, the lowermost Colorado formation of the Saskatchewan - Athabaska area. These shales occupy the center of the principle synclines in the Hay river area. On the north they are bounded by sandstones and shales of the Mountain Park formation and on the south by a southward dipping fault plane along which the Lower Cretaceous beds have been overthrust upon them.

Where observed the Berland River shales appeared to be badly olded and faulted, so that a complete section of their thickness was mpossible to determine. The following is an incomplete section of the hales taken on the north side of Watsons ridge, one mile west of Thoreau amp.

Feet	
74	Olive green shale.
82	Black shale.
5	Rib of grey sandstone.
85	Black shale.
7	Hard gray sandstone.
10	Shaly, sandstone.
7	Black shale.
3	Rib of fine gray sandstone.
3	Black shale.
2	Shaly sandstone.
72	Black shale and gray sandstone.
406	Black shale, sandy shale and gray sandstone.
775	Total Thickness.

PLEISTOCENE

During the glacial period an ice sheet covered the whole of the ay river district as evidenced by numerous small limestone boulders ound on hill tops having an elevation of 7400 feet. These boulders appear o have been transported by ice moving from the south and west rather than rom the limestone range to the north. Cirques are common on the range o the south and many small glacial lakes are in evidence. One mile west rom Thoreau creek on Hay river a lateral moraine projects from north to

outh.

The vallies of the Hay river and its larger tributaries are eavily floored with glacial drift, and three distinct terraces are isible along the Hay at an elevation of 30 feet above the river channel.

RECENT

The recent deposits consist mainly of alluvial fans and deltas uilt up at the bases of tributary vallies. The streams excavate channels n the glacial gravels and boulder clays and deposit their load as bars arther down stream. A rich black soil from 4 to 6 inches deep covers a onsiderable part of the area where the surface is smooth.

STRUCTURAL GEOLOGY

General Structure

The Hay river coal basin is a belt of Cretaceous rocks five miles in width, lying between two Palaeozoic mountain fault blocks which attain an average elevation of 8800 feet. The southwest border is determined by the westward dipping fault plane of the front range of the Rockies, while the northeast border of the basin is characterized by the limit of the Cretaceous rocks on the southwestern dipping fault block.

The coal measures are folded into a series of anticlines and synclines which generally have the south dipping beds more gently inclined than those on the northeast, and as a rule parallel the sides of the basin. Strike faulting is very common in which the south limb of the anticlines is thrust to the north over the younger measures.

At least one prominent fault occurs cutting across the measures at an angle of 45 degrees to the strike and displacing the beds on both sides of the fault a considerable distance.

Detail Structure.

The major fault which crosses the Hay a short distance below Thoreau creek divides the valley into two different areas. The area to the east is characterized by a broad south easterly plunging syncline the north flank of which included formations from the Mountain Park to the Jurassic without a break. The south flank of this syncline is characterized by anticlinal folds and southward dipping thrust faults. West of the fault the structure is much more complicated. Here the measures are folded into a major anticline and syncline, complicated by minor folding and strike thrust faulting. The anticline crosses Thoreau creek 2000 feet from its junction with the Hay and trends in a western direction. There is little evidence of faulting here but a southward dipping thrust fault parallel to the ridge crosses Thoreau creek some 4000 feet from its junction with the Hay. Here the older beds are thrust upon the younger, the Mountain Park sandstone being only partly present and is overthrust upon the Berland shales. West of Thoreau creek the Mountain Park beds are entirely lost and the Luscar formation is overthrust upon the Berland river shales. Further west the Cadomin conglomerate is overthrust upon the shales, while still further west the lower Nikanassin beds overlie the shales. At the west edge of the mapped area the Mountain Park formation re-emerges from beneath the overthrust Nikanassin beds.

Along most of the basin the south limb of the syncline has been overturned by a thrust from the north, with a vertical displacement estimated at 4000 feet. This syncline crosses Thoreau creek 5800 feet up stream from its junction with Hay river. The shales in this basin are crushed and broken, and are flanked on the north by a 600 foot bed of Mountain Park sandstone. The Luscar formation outcrops to the north of the Mountain Park, while the region between it and the Cadomin conglomerate is characterized by a minor anticline and syncline, the axes of

which are respectively 600 and 1400 feet north of the Mountain Park exposures.

The north limb of the major syncline is flanked by a ridge of Cadomin conglomerate, which underlies the Luscar formation. In places overlapping or concealment is caused by thrust faulting.

ECONOMIC GEOLOGY

Coal is the only mineral of economic importance found in the mapped area, this fact being proven by extensive prospecting and drilling. Below the Cadomin conglomerate a few small, worthless, seam-like pockets of coal occur, while at least six seams are known above, one of which, a 30 foot seam, No. 1, 750 feet above the conglomerate, warrants development. A 6 foot seam of good coal, is known to lie 150 to 195 feet above the No. 1 seam and of the same areal extent as it, while an 8 foot seam of impure coal, is found 285 feet below the No. 1 seam, but at the present time would not be profitable if developed. Each of the remaining three seams are less than three feet in thickness and are found in the Luscar formation.

The No. 1 seam has been traced throughout the area mapped and where exposed was from 16 to 45 feet. The two smaller seams have less variation having from 6 to 8 feet of coal, but as the large seam, they are characterized by shale and clay partings, while the 6 foot seam is separated into two benches by a sandstone rib.

On Redmond creek 1300 feet south of Hay river the No. 1 seam outcrops having a total width of 36 feet, 3 inches of coal, dipping 65 degrees south, with a soft shale roof and soft carbonaceous shale floor. In this locality the seam was traced by prospect pits, east a distance of 4000 feet and also 4000 feet west, where it is found in the base of an easterly plunging syncline. It is thought to fold over as a sharp anti-cline and continue westward beyond the area mapped. A drill hole sunk by

Bushes Diamond Drill outfit at the outcrop on Redmond creek shows the coal as lying 895 feet above the conglomerate and 368 feet above the 8 foot seam.

On Thoreau creek 3100 feet up stream from its junction with Hay river, the big seam No. 1 outcrops again, having a total thickness of 32 feet 5 inches of coal, dipping 75 degrees north, with a shale roof and a floor of hard gray sandstone. 3800 feet west of this outcropping, the seam was exposed on the hillslope and was found to lie as the crest of a tightly compressed and slightly faulted anticline, with the south limb dipping 60 degrees to the south and the north 70 degrees to the north. The seam was found to terminate abruptly 1500 feet west of this point and a probable explanation is that it was cut off by a strike fault, in which case the coal bearing beds have been thrust over the Berland river shales and removed by erosion.

On the Berland-Thoreau divide, some 3 miles west of Thoreau camp, at an elevation of 6700 feet a big showing of coal 100 feet in thickness was uncovered, but this seam was proven to lie on the crest of an anticline. The normal seam is at least 30 feet thick, and the south limb of the fold has been traced by prospect pits east across Thoreau valley to the crest of the ridge east of Thoreau camp. Throughout the length of the south limb of this canoe-like formation of coal, the small 6 to 8 foot seam was found to lie 185 feet to the south of the No. 1 seam.

The coal seam forming the north limb of the fold is of limited extent as here it again forms a synclinal basin. This seam was traced by prospect pits around the border of the basin and was found to terminate 3400 feet east of the divide and also at about the same distance west. Throughout the whole area mentioned here the seams are inclined at such a high angle that if developed they would have to be worked by the vertical method of mining.

The coal found in the Hay river district is of bituminous rank

and of a good coking variety. It burns readily with a yellow flame giving an intense heat and emits very little smoke. Upon exposure most of the coal breaks down into fine particles but blocks and slabs weighing as high as 150 pounds have been found.

Some sampling was done during the season but as yet the results have not been published. A sample of the lower outcrop on Thoreau creek was taken by R. H. Watson and the tests from the Fuel Testing Branch, Ottawa, showed an average percentage of 8.22% moisture and 12.39% ash.

In the 30 foot seam outcropping below Thoreau camp on Thoreau creek, small pockets of peacock coal were found. These specimens were highly colored ranging from a brass purple, through bright and dull blue, to a rose purple.

The total tonnage of coal in the area investigated is put at a conservative estimate of 47,321,753 tons.

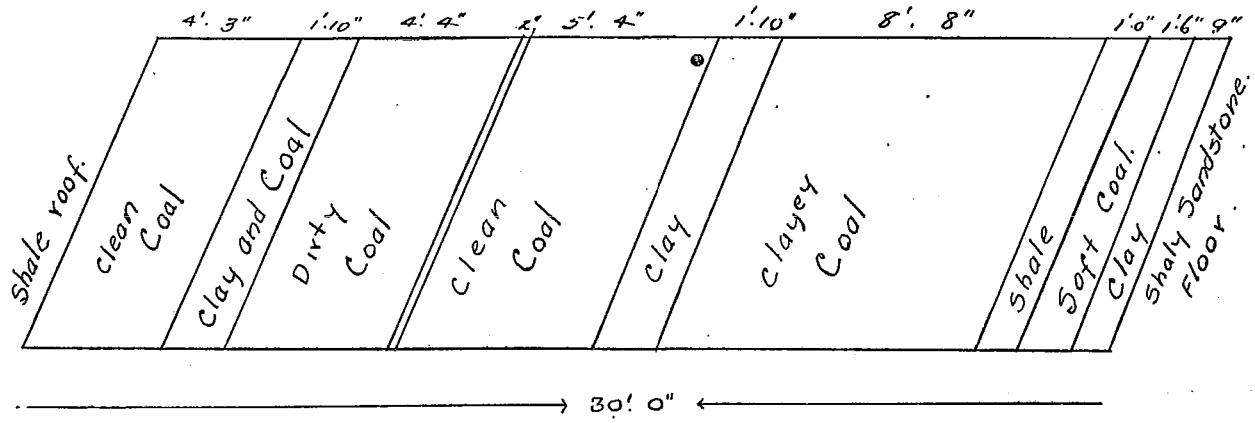
MINING CONDITIONS

At present lack of transportation facilities is the main drawback to this area. The nearest railway is the Canadian National at the extreme southern boundary of the area. The construction of the proposed branch line from Solomon would involve only moderate engineering difficulties.

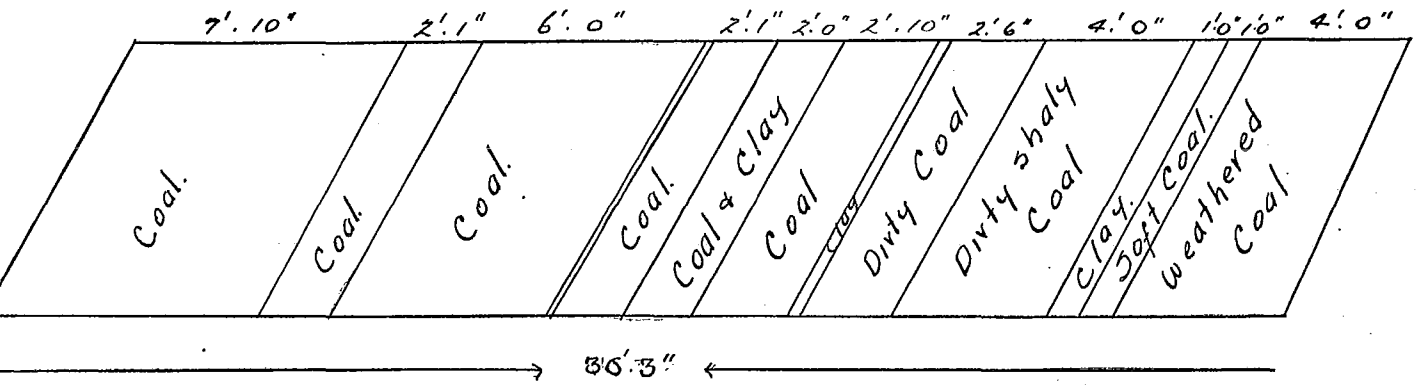
The streams which head in the hills give an abundant supply of water to all parts of the field. Ample opportunity for the development of water and electrical power is afforded on the larger streams about 50 miles to the west and north, if mining operations warrant the undertaking. The coal field is entirely within the forest reserve of which large areas are heavily timbered, and the available timber is capable of supplying the needs of extensive mining operation.

MARKETS

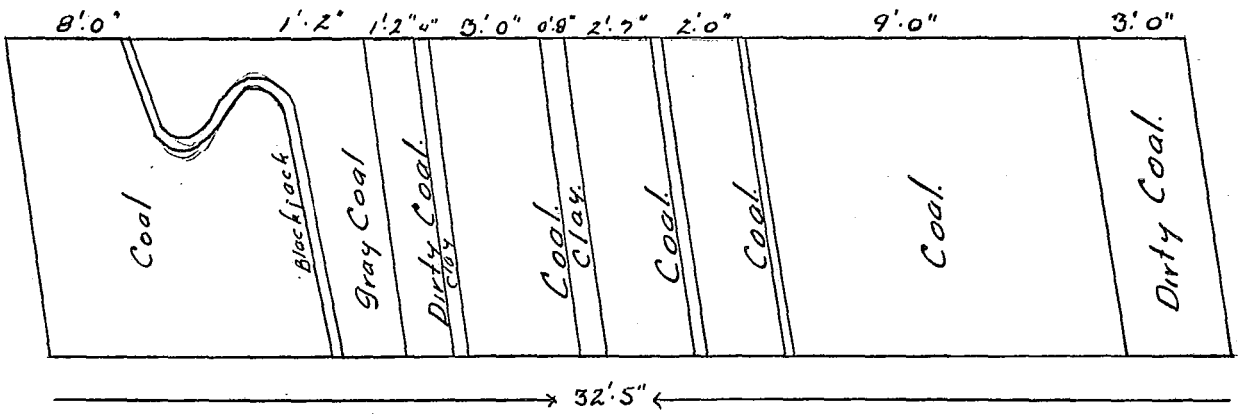
The railroads will be the principle markets for this coal, as it is a good quality of steam coal. Doubtless part of it will find a market in the metallurgical industries of British Columbia.



Section Of Seam NO I On Berland Divide.



Section Of Big Seam On Redmond Creek.



Section Of Big Seam On Thobeau Creek.

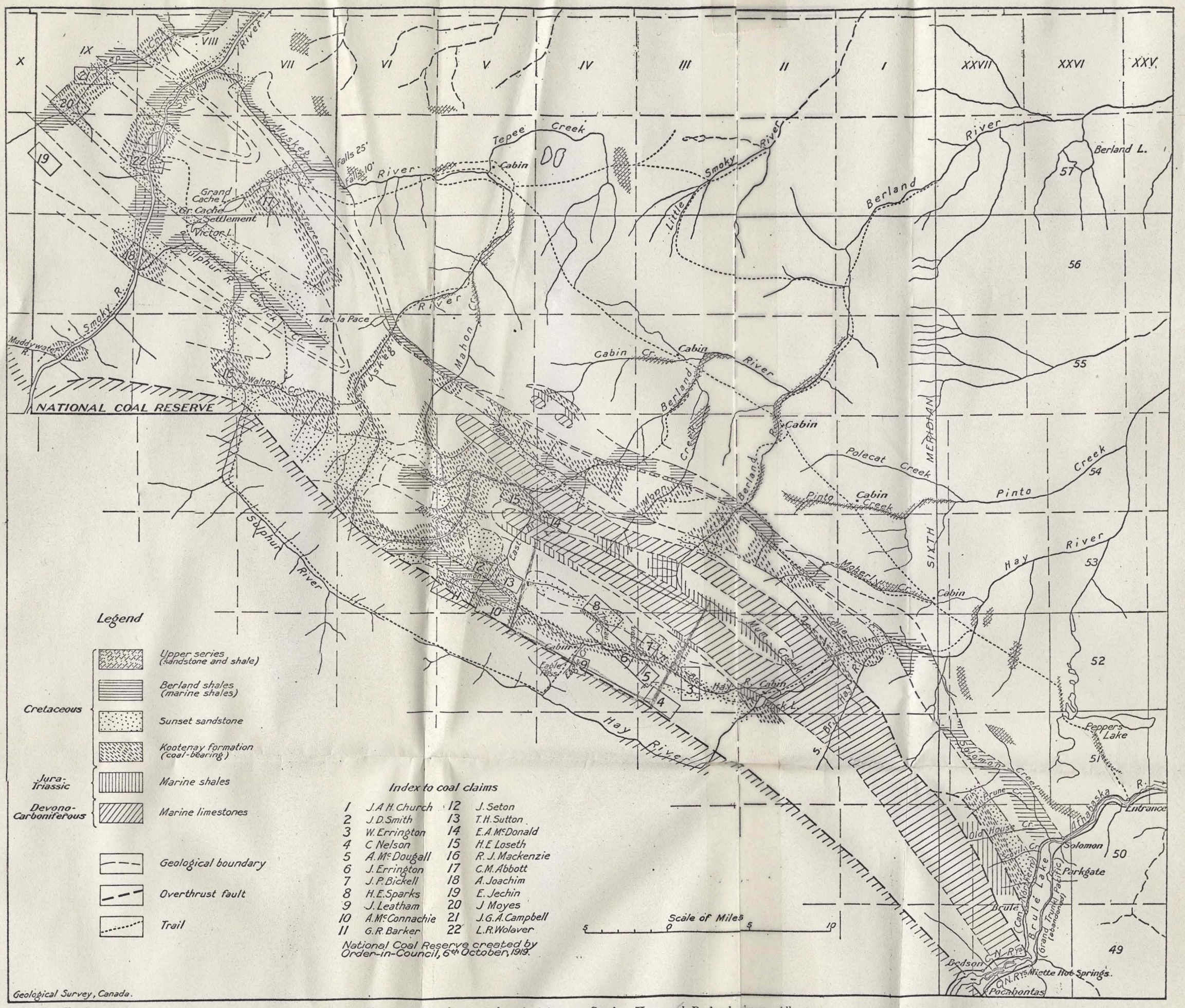


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FIGURE 2. Sketch map of coal claims on Smoky, Hay, and Berland rivers, Alberta.