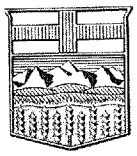
PROVINCE OF ALBERTA
RESEARCH COUNCIL OF ALBERTA REPORT No. 48
University of Alberta, Edmonton, Alberta

Geology and Coal Occurrences of Wapiti-Cutbank Area Alberta

BY
J. A. Allan and *J. L. Carr*



EDMONTON
PRINTED BY A. SHNITKA, KING'S PRINTER
1946

TABLE OF CONTENTS

CHAPTER I.

CHAPTER II.

CHAPTER III.

CHAPTER IV.

ILLUSTRATIONS

LIST OF TABLES

GEOLOGY OF WAPITI-CUTBANK AREA, ALBERTA

CHAPTER I.

INTRODUCTION

General Statement.

Fuel of local origin, except wood, has been scarce in the Peace River and Grande Prairie districts. The fuel requirements in this part of Alberta have been supplied largely with coal transported from other districts in Alberta. The coal production, most of which comes from small mines near the Wapiti river, has been insufficient for the needs of the area. Almost all the coal consumed in this district is shipped in from Edmonton and other points to the south, over the Northern Alberta Railways. The freight charges for this long haul, upwards of three hundred miles, add considerably to the price of coal in the Peace River country.

In an attempt to locate satisfactory coal supplies in this part of Alberta, a geological survey party was sent to the area south of the Wapiti river in the summer of 1944 by the Research Council of Alberta. It was considered that coal deposits of economic value might occur in this area since the area was known to be underlain by non-marine Upper Cretaceous rocks in which coal seams occur in southern Alberta.

Geographical Position and Accessibility

The Wapiti-Cutbank area lies about two hundred and fifty miles northwest of Edmonton and comprises roughly townships 63 to 70, ranges 5 to 11, inclusive, west of the sixth meridian.

The largest nearby town is Grande Prairie. It may be reached from Edmonton by the Northern Alberta Railways, by car or by regular flights of Canadian Pacific Air Lines. The Railway continues west from Grande Prairie and, for the first 24 miles, is situated five to ten miles north of the Wapiti river. A gravelled highway parallels the railway. Secondary dirt roads run south from the highway to the vicinity of the Wapiti river. South of the Wapiti a few dirt roads serve the settlements, which are located south of Grande Prairie and south of Wembley. The Wapiti is crossed by three ferries, two of which are public. One of these lies south of Grande Prairie in section 23, township 70, range 6, west of 6th meridian and the other is south of Wembley in section 11, township 70, range 8. A private ferry is situated in section 14, township 70, range 5, west of 6th meridian. A private bulldozed road extends from the private ferry to the Big Mountain timber berth, near the headwaters of Big Mountain creek. A second bulldozed road runs from township 68, range 8, west of 6th meridian to the Pinto Creek coal mine in section 2, township 68, range 10. The dirt roads are usually good in dry weather, but may become impassable when wet. The bulldozer roads can be used by heavy vehicles, only during seasons when they are perfectly dry or else frozen.

Pack trails lead into the bush from the settled areas. Those travelled by the survey party have been sketched on the accompanying map (Plate I). They are usually passable, but a short portion of the trail below the falls on Cutbank river has been destroyed by slumping. However, most of the trails are overgrown by brush to some extent and are poorly blazed. Consequently, anyone unfamiliar with the trails would have a difficult time to follow them.

The Wapiti river may be travelled by rowboat or canoe. The Smoky river is large enough for small motor launches for some distance above the mouth of Cutbank river. None of the other rivers are large enough for boats.

Field Work, Maps and Reports

The field investigation was carried out by J. L. Carr under the direction of J. A. Allan who spent about two weeks in the field. The report and maps were compiled jointly.

The field work on which this report is based was carried on during the months of June, July and August, and in the latter part of September and the early part of October, 1944. During June, July and August, the party moved with pack horses. A traverse of the Wapiti river by rowboat, from township 68, range 11, west of 6th meridian, to the mouth of Big Mountain creek, was conducted in September and early October. General geological work was done with special emphasis on the coal. All previously reported coal occurrences were visited and a search was made for new ones. Samples of the more important seams were taken and submitted to the laboratories of the Research Council for analyses. Pace and compass surveys were made along parts of Nose and Pinto creeks and Cutbank river.

The base map has been prepared from the following sources: Sectional Sheet 412 (Wapiti), Preliminary Sheets 83 L/12 E½ (Grayling Creek) and 83 L/5 E½ (Hat Mountain), published by the Department of Mines and Resources, Ottawa, and pace and compass traverses by the party. Trails, some roads and some creeks have been sketched. Much of the area is unsurveyed and undoubtedly large geographical inaccuracies exist. For that reason, this map should not be used as a basis for legal claims or precise locations. Names of natural features occurring on the map are those given on previous publications. Where the feature has not been previously named in any publication, the name commonly used by local inhabitants has been retained.

Previous Work.

The earliest geological work done in the area was by G. M. Dawson [1]* who examined the lower part of the Wapiti river and "Mountain creek" (Big Mountain), in 1879. J. F. Caley[4] traversed much of the Wapiti river and the southwest corner of the area. J. A. Allan and R. L. Rutherford have made observations on the northern part of the area. [3,5,6]

*Numbers in brackets refer to the bibliography on page 8.

F. H. McLearn studied the stratigraphy along the Smoky below the mouth of the Wapiti[2]. R. L. Rutherford mapped a large area to the north and east, and recorded certain observations within this map-area, in 1929[5].

Acknowledgments

Thanks are due to many in this district for assistance and courtesies extended to the party. Particular mention should be made of John A. Macdonald, Grande Prairie, who accompanied the party on its first trip to various coal outcrops, of O. Sorley, R. O. Johnston, J. Thompson and R. Cochrane of Grande Prairie, and of W. McAusland and D. Bain of Grovedale.

H. J. MacDonald who served efficiently as assistant, did most of the pace and compass traverses. T. M. Chenoweth, cook, and J. Campbell and P. Campbell, packers, discharged their duties efficiently and cheerfully.

Summary.

The area south of the Wapiti river was examined in the summer of 1944 in an attempt to locate a source of coal for the southern Peace River area of Alberta.

Physiographically, the area lies almost on the border between plains and foothills. Forests and brush cover most of the area. Few roads extend from the settled portions into the undeveloped parts.

Continental beds of Upper Cretaceous age, assigned to the Wapiti formation, underlie the whole region. These beds probably correlate with the upper part of the Belly River and the lower part of the Edmonton formations. Dips are generally low, except in the southwest corner of the area, where dips up to 18 degrees were observed. The region lies along the axis of a large syncline; the dips are westerly in the eastern part of the area and easterly in the western part. Some small folds, with quite gentle dips, are superimposed upon the west limb of the syncline.

Coal has been mined for almost thirty years along and north of the Wapiti river, but the seams are too thin for large production. The field work of 1944 indicated that the largest deposits of coal are to be found south of the Wapiti, in the region of the Wapiti-Cutbank divide. Of the occurrences noted, two are regarded as being of immediate value. Development work has commenced on one of these on Pinto creek, where over five feet of coal are present. The other, on Cutbank river, has not yet been developed. This latter occurrence is of sufficient importance to warrant careful prospecting, and an attempt should be made to find its outcrop on the north side of the Wapiti-Cutbank divide.

While the area would appear to be underlain by possible oil-bearing horizons at depth, there is no structure known which would justify drilling. It is possible that geophysical exploration could locate favorable conditions.

The region has a large reserve of gravel located on a high terrace along the valley of the Wapiti river. Good sand for industrial uses is not known. Clay suitable for bricks exists. A small brick plant south of Grande Prairie is exploiting a deposit of recent age. Other clays are known to underlie some of the muskegs but the physical characteristics of these have not yet been fully investigated.

Bibliography

1. G. M. Dawson, "Report on an exploration from Port Simpson on the Pacific Coast to Edmonton on the Saskatchewan, embracing a portion of the northern part of British Columbia and the Peace River country", G. S. C., Report of Progress, 1879-80, Part B.
2. F. H. McLearn, "Cretaceous, Lower Smoky River, Alberta", G.S.C., Sum. Rept. 1918, Part C, page 1.
3. J. A. Allan, "Grande Prairie District", Research Council of Alberta, Rept. 22, 1928, page 40.
4. C. S. Evans and J. F. Caley, "Reconnaissance Survey of Foothill Area in Wapiti River Basin, Alberta", G.S.C. Sum. Rept. 1929, Part B, pages 36-39.
5. R. L. Rutherford, "Geology and Water Resources in parts of the Peace River and Grande Prairie Districts, Alberta", Research Council of Alberta, Report 21, 1930.
6. J. A. Allan and R. L. Rutherford, "Geology of Central Alberta", Research Council of Alberta, Report 30, 1934, pages 21 and 24.
7. J. A. Allan, "Coal Areas of Alberta", Research Council of Alberta, Report 34, Part V, 1943.
8. E. Stansfield and W. A. Lang, "Coals of Alberta", Research Council of Alberta, Report 35, 1944.

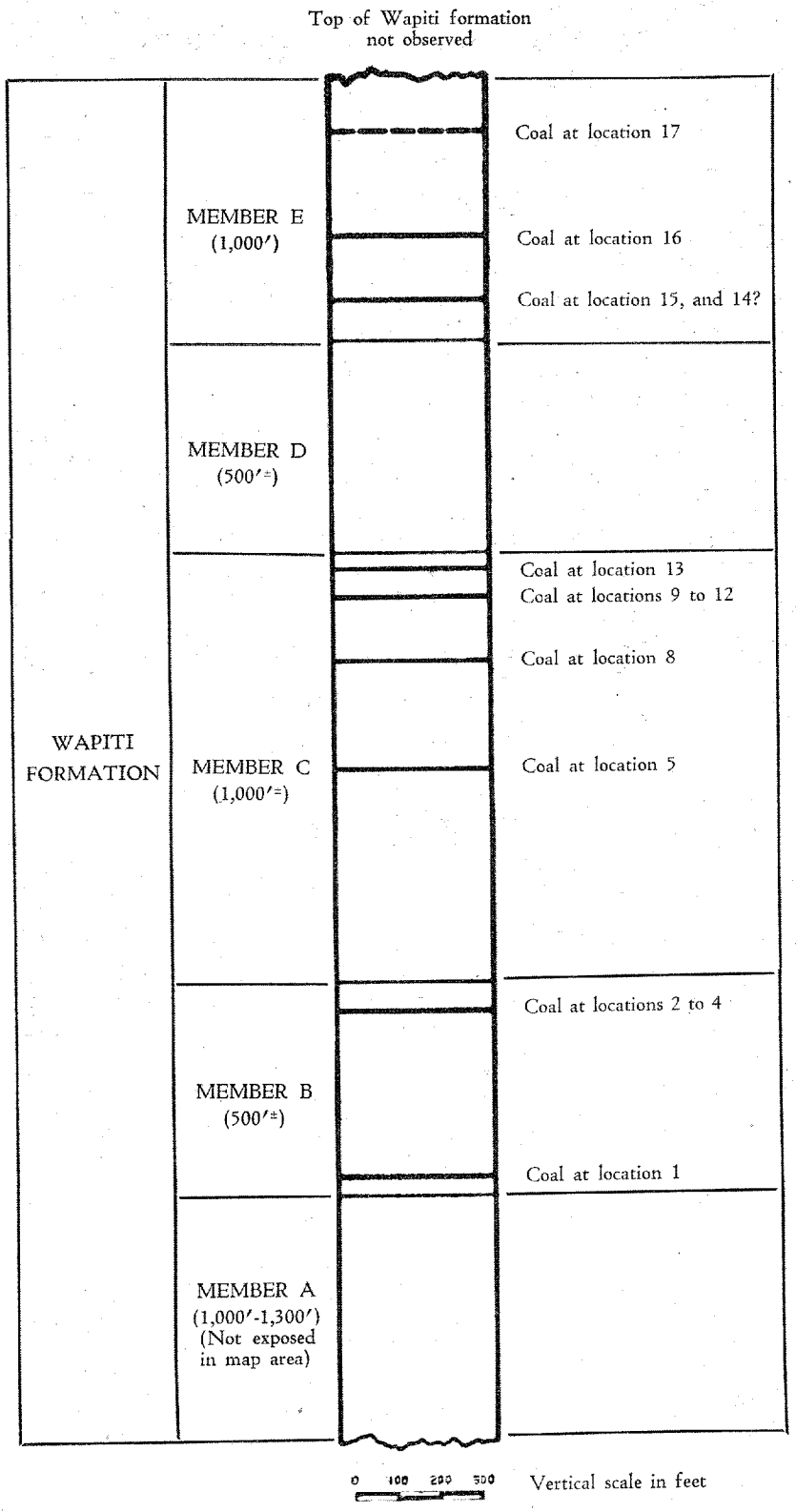


Figure 1.—Generalized columnar section of the Wapiti formation, showing approximate stratigraphical positions of the more important coal occurrences in the Wapiti-Cutbank area. The location numbers correspond to those shown on map (Plate I).

CHAPTER II.

GENERAL CHARACTER OF THE AREA

Physiography

The Wapiti-Cutbank area lies, in the main, within the plains of Alberta, but a small southwest portion of it extends into the foothills. The area is of low to moderate relief, with the greatest relief in the southwest corner. The lowest point in the area is in its northeast corner in the valley of the Wapiti river. Here an elevation of less than 1,700 feet above sea level is reached. The highest point in the area is Nose mountain, which reaches about 4,900 feet above sea level. The total relief is thus almost 3,300 feet. The greatest local relief is a difference of 1,950 feet in three miles, where Nose mountain rises above Nose creek.

The region falls naturally into three physiographic divisions: river valleys, plains and uplands. The river valleys are quite deeply cut, with generally steep sides and fairly narrow bottoms. The valley of the Wapiti is from one-half to one mile wide, and from 200 to 650 feet in depth (Figure 2). The river meanders slightly in its valley, but the curves of the river are generally incised. Traces of a terrace about 150 feet above the bottom of the valley occur from

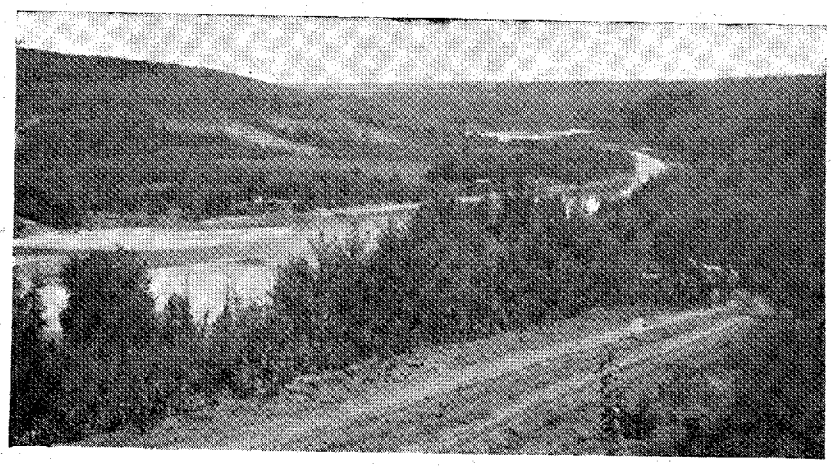


Figure 2.—Looking down Wapiti valley at Pipestone ferry and A. Osborne's ranch.

the mouth of Pipestone creek downstream, and a second terrace, about twenty feet below the first, appears opposite the mouth of Big Mountain creek. A third terrace, about 15 feet above normal water level, is present along the Wapiti. This terrace is covered at stages of very high water.

The valleys of the tributaries usually follow a pattern. The upper reaches of these valleys are quite deep and broad, but the sides are rounded. In the middle parts of the course, the valleys become shallow, gentle and broad. The lower parts of the course are deeply incised, with steep rocky banks. They may become slightly less steep close to the mouth, where most of the valleys

enter the Wapiti valley at grade. Most of the outcrops are to be found in the lower parts of the tributary valleys.

The valley of Cutbank river is generally broad and open, with high, fairly steep banks. The Cutbank meanders within the valley, forming steep cut-banks where it impinges upon the valley walls. In the neighborhood of the forks of the Cutbank in range 10, the valley is gorge-like, with steep banks. In common with the other small streams of the area, the last two miles of its course are through a narrow, steep-sided valley. The tributaries enter at grade in most cases. Their valleys are usually deep, with fairly steep sides, but the larger ones, such as Wolf creek, are sometimes broad with large open meadows.

A gently rolling plain on which most of the settlement of the area has taken place, slopes gradually towards the Wapiti river from the north and from the south. To the north, this plain rises to the Saddle hills, in townships 75 to 77. To the south, it rises to the Wapiti-Cutbank divide. This plain is broken by the valleys of the streams and by small hills which represent the remnants of a former higher plain. Saskatoon mountain, in township 72, range 9, west of 6th meridian, is the largest of these, but smaller ones occur elsewhere.

A zone of low sub-parallel sand ridges occurs within the plains area, extending from east of Iroquois creek southwestwards to at least the west side of Nose creek. The zone lies about three miles south of Wapiti river between Iroquois and Pinto creeks, and extends almost to the river in the vicinity of Nose creek. The most southerly of these ridges lies near the southern boundary of township 68, range 10, west of 6th meridian. The ridges are composed of fine sand, with lenses of coarser sand. Boulders are rare but a few granite or granite gneiss boulders were observed. The ridges vary in length from a hundred feet to about four miles. The long axes of the ridges trend approximately northeast-southwest. Muskeg frequently occupies the surface between ridges. The tops of the ridges are frequently almost bare of vegetation and rarely carry much brush.

The origin of these sand ridges is uncertain. It is probable that the material of which they are composed was deposited by the continental glacier. The sand was possibly derived from Wapiti beds to the northeast. It is not known what agents shaped the ridges to their present form. The northeastwards projection of these sand ridges appear to correspond to the sand hills on the north bank of the Wapiti river south of Grande Prairie. These hills are of quite fine sand and show typical dune shapes.

Large meadows are a common feature along some of the very small creeks on the plain south of the Wapiti. Some of these meadows were formerly occupied by beaver ponds. A few old beaver dams are still to be found as long sinuous ridges up to three feet in height. Another minor but interesting feature consists of large ant hills, which reach two feet in height and up to six feet in diameter. These are sometimes very abundant in some of the meadows. It is probable that over a long period of years, the ants exert a considerable influence on the weathering of the surface materials of the area.

The upland consists of a more or less flat-topped ridge, rising from about elevation 3,000 feet in the east, to almost 5,000 feet in

the west. This upland forms the divide between the Cutbank and Wapiti drainage basins. The western end of this upland drops off abruptly from Nose mountain to Nose creek. Long spurs extend north, between the tributaries of the Wapiti river. Bald mountain in townships 67 and 68, range 6, west of 6th meridian, is the culmination of such a spur. On the north, the slope of the sides of the upland is comparatively gentle, towards the plains. On the south, this upland slopes quite steeply towards the Cutbank. South of the Cutbank, the upland appears to continue to the Porcupine river. Nose mountain, its southern extension especially, forms a well developed westwards-facing cuesta or escarpment due to gently east-dipping beds. The upland probably corresponds physiographically to the Saddle hills, north of the Wapiti-Cutbank area, being an erosional remnant of a former higher plain.

Drainage

The area is quite well drained, with few lakes. Muskeg, however, is extensive on the plains south of the Wapiti and the valleys of some of the streams in places contain muskeg. All the drainage is tributary to the Smoky river and hence forms part of the Mackenzie drainage system.

The largest river of the area is the Wapiti. It rises in the Rocky Mountains in British Columbia and follows a generally northeast course to its junction with the Smoky in township 71, range 2, west of the 6th meridian. Across the map-area, its course is more easterly. The river varies from two hundred to one thousand feet in width, during normal stages of water, but during high water it is much wider. The river meanders very slightly in its steep-sided valley. In late spring and early summer, the river may rise thirty feet above normal and may cover the lowest terrace.

The tributaries of the Wapiti from the south are all small streams. Nose creek is the largest, but it can be waded on foot except during the spring run-off. Pinto and Big Mountain creeks are somewhat smaller, but flow throughout the year. Iroquois creek is intermittent. From the north, several creeks enter the Wapiti. Red Willow river is the largest and it is a little larger than Nose creek. Bear river, which runs through Grande Prairie, is intermittent at present. Pipestone and Spring creeks are small, of about the same order as Iroquois creek.

The Cutbank river rises on the eastern slopes of Nose mountain as two branches, the northern of which flows from a small lake. Cutbank river is scarcely larger than Nose creek and can be readily waded during the summer. In the late spring, however, it is impossible to cross on foot. The Cutbank is rapid on the upper and lower parts of its course. In townships 63 and 64, ranges 8 and 9, west of 6th meridian, the stream widens and flows sluggishly through broad meadows. The tributaries of Cutbank river are all small. The largest is an unnamed creek coming from the north in township 63, range 10, west of 6th meridian.

Culture

The principal industries of the area are agriculture, lumbering and trapping. The area north of the Wapiti river is almost entirely devoted to farming. Wheat and oats are grown extensively. Flax is a minor crop. South of the Wapiti farming is carried on only in a narrow belt immediately south of the river. Here the main crop is

coarse grains along with alfalfa for seed production. A ranch in the Smoky River valley, in about township 67, range 5, west of 6th meridian raises oats for greenfeed. Cattle ranching is important away from the cultivated area. Many cattle are grazed in the valley of Big Mountain creek during the summer.

Lumbering is carried on in the eastern part of the area. Small stands of timber in the vicinity of the mouth of Big Mountain creek, have been cut recently. The largest operations are probably on the "Big Mountain" berth, near the headwaters of the stream of that name. An important stand of timber on the south side of the Wapiti, west of the Grande Prairie ferry, was destroyed by the disastrous fire which occurred in the spring of 1944.

Trapping is carried on in the winter over most of the unsettled area, but it does not give employment to many men. A few men are engaged in coal mining in the area. There is a small brick plant south of Grande Prairie.

The main towns of the area are situated along the Northern Alberta Railways. Away from the railway, small stores and post offices serve the settlements.

Flora

That part of the area which has not been cleared or burned over is covered with a heavy growth of bush, which is broken, usually along the creeks, by open meadows (Figure 3). There are some isolated stands of jackpine and spruce. Tamarack is quite common in the neighborhood of the muskegs. Several species of poplar occur. Willows and alder are abundant, the latter occupying the higher hills which have been denuded of other vegetation by fire.

Except where recent burning has occurred, and along the top of the Wapiti-Cutbank divide, there is a rank undergrowth of grass, pea-vine and other small plants. Numerous beautiful meadows, on the upper part of Big Mountain creek, Pinto creek, Nose creek and occupying much of the Cutbank valley, are rank with green feed. Undoubtedly stock could be grazed quite extensively in the Cutbank valley.

The vegetation on the top of Nose mountain, which is at an elevation of from 4,500 feet to 4,900 feet above sea level, reflects the altitude and exposed position in which it grows. Feed is scarce. Most of the trees are evergreens and these are short and stunted.

There are several important stands of timber which have yet to be exploited. Northeast of Bald mountain is what is known locally as the "Bald Mountain timber", which consists of spruce with some pine. Spruce is abundant in the Cutbank valley.

Fauna

Game is abundant over most of the area. Deer and moose are plentiful. Bears, both black and grizzly, are abundant even in the outlying settlements and have done much damage to cattle on the summer range. Timber wolves are very plentiful and would be a serious threat to any ranching attempted in the Cutbank valley. Coyotes and porcupine are common. Caribou and elk are scarce and mountain goats range as far east as Big Mountain creek. Fur-bearing animals include fox, beaver, muskrat, weasel and squirrel. Fish are present in most of the streams.

CHAPTER III.

DESCRIPTIVE GEOLOGY

INTRODUCTION

The area is underlain by non-marine sedimentary rocks assigned to the Wapiti formation of Upper Cretaceous age, which are lying almost flat or gently dipping. Glacial drift covers a large part of the area. Structurally, the area lies along the axis of a broad gentle syncline which may be the continuation of the Alberta syncline.

TABLE 1.

Table of Formations

Recent			150- feet	Gravel, sand, clay.
Pleistocene				Cordilleran and Keewatin till.
Upper Cretaceous	Wapiti formation	Member E	1000± feet	Massive sandstone, shale, coal, bentonite, minor pebble conglomerate.
		Member D	500± feet	Shale, thin sandstone, minor coal, bentonite.
		Member C	1000± feet	Massive sandstone, shale, coal, bentonite.
		Member B	500± feet	Soft bentonitic light grey sandstone and shale; coal.
		Member A	1100-1300 feet	Not exposed in this area. Probably 1,100 to 1,300 feet to the base of the Wapiti and the top of the Smoky River shales. This contact is exposed on Smoky river at the top of township 73.

STRATIGRAPHY

Wapiti Formation

The first geological work done in the area was by G. M. Dawson in 1879[1]. In his "Subdivisions of the Cretaceous" (page 115), the highest formation of the area is "1. Upper sandstones and shales with lignite coals (Wapiti River Sandstones)", which overlies the "Upper Dark Shales" or "Smoky River Shales". The term "Wapiti River Sandstones" refers to the non-marine beds overlying the Big Mountain creek. Dawson's description of these is as follows (pages 124-125):

> "The *Upper Sandstones and Shales* are well shown at the mouth of Mountain* Creek, which enters the Wapiti or Elk River thirteen miles from its mouth, and on the lower part of the Wapiti River. About the mouth of Mountain Creek are numerous exposures of horizontal beds consisting of sandstones, generally soft and flaggy, shaly sandstones, shales and clays. The sandstones are often nodular and hold bands and sheets of ironstone, together with coaly fragments and obscure fossil plants. They are yellowish, or greyish, or bluish-grey in tint, while the shales and clays have often a brownish earthy appearance. . . . Owing to its horizontal or nearly horizontal attitude, the total thickness of beds exposed, belonging to this subdivision, is not great, probably not more than 200 to 300 feet. . . ."
>
> "The lowest beds of this subdivision occur on Smoky River, at the water level, about ten and a half miles below its junction with the Wapiti, but it is seen in the higher parts of the banks for about eleven and a half miles further down, or to the crossing of the trail from Dunvegan to Sturgeon Lake. . . ."

*Although this creek is called "Big Mountain Creek" on Sheet II of the map accompanying Dawson's report, he refers to it simply as "Mountain Creek". It is known today as "Big Mountain creek".

McLearn[2] in 1919 assigned nine hundred feet of beds on the Smoky river below Bezanson to the Wapiti formation and stated that "its upward extension is not known". Allan[3] suggested the presence of Edmonton beds in the Kleskun hills. Rutherford[5] gave the thickness of the Wapiti as at least 1,100 feet and further stressed the probable presence of beds of Edmonton age in the Kleskun hills. Evans and Caley[4], however, assigned all the beds above the Smoky River shale to the Wapiti, with no attempt at dividing these beds.

Allan and Rutherford state [6] (page 24):

> "The Edmonton is extended west across the Smoky through the Grande Prairie district where the upper part of the Wapiti is correlated with the Edmonton on a lithologic basis. This is a considerable change from that shown on previous maps. In the districts southeast of Edmonton, the upper part of the Belly River (Pale Beds) and the Edmonton formation are almost identical in lithological appearance. The beds in the Grande Prairie district mapped as Edmonton are also of the same type. Exposures showing these lithological characteristics occur along Wapiti and Red Willow rivers, south and west of Grande Prairie and especially in the badland type of erosional forms in the eastern part of the Kleskun hills in township 72, range 4, west of the 6th meridian".

These beds are assigned to the Edmonton rather than to the Belly River, since such highly bentonitic beds are known to extend farther west during Edmonton time than during Belly River time, in the area west and southwest of Edmonton.

These attempts to limit the Wapiti formation to those beds correlated with the Belly River formation of southern Alberta have been based entirely upon lithologic evidence. Until adequate studies of the paleontology of the non-marine Upper Cretaceous of the foothills are made, there can be no sure correlation with the plains of Alberta.

In the Wapiti-Cutbank area, the series may be divided into four members, based upon lithological differences, and designated Members B, C, D, E. The lower part of the Wapiti formation, which is not exposed in the Wapiti-Cutbank area, is here referred to as Member A. However, over most of the area exposures are neither sufficiently large nor sufficiently continuous to permit mapping of each member. In small exposures, it is usually impossible to differentiate the members. Figure 1 shows a generalized columnar section of the Wapiti formation with the approximate positions of the more important coal occurrences in the area.

In this report each of the four members, B, C, D, and E, are described separately, but sufficient data to correlate any of these members with the section on the plains are lacking.

Member A. Between the stratigraphically lowest beds exposed in the Wapiti-Cutbank area and the top of the Smoky River shales, between 1,100 and 1,300 feet of non-marine strata are present. These have been referred to the Wapiti formation by McLearn[2] and Rutherford[5]. These are here referred to as "Member A" of the Wapiti formation.

These beds are described by Rutherford[5] (page 31), as follows:

> "Lithologically the Wapiti formation consists of sandstones and shales of freshwater deposition. The units vary in thickness from a few inches up to as much as 50 feet, the average thickness being more often 10 to 20 feet. All phases of gradation between sandstone and shale are common. The more massive sandstones are frequently crossbedded and concretionary masses are common in eroded faces,

Light grey to buff are the prevailing colors, and on the whole fine grained textures are most common. The shales are poorly stratified, a characteristic common to shales of freshwater deposition.

"It is not possible to divide the Wapiti into definite lithological units from data obtained thus far. The lower 150 to 200 feet are predominantly argillaceous, consisting of compact, poorly stratified clay shales that weather to variegated colors. Thin bands of clay ironstone nodules are common in these, and a thin coal seam ranging from a few inches up to 2 feet in thickness occurs wherever these lower beds are exposed. This seam has been prospected at several places, but has not proven of sufficient thickness to be commercial. McLearn reports another coal seam, 3 to 4 inches thick, occurring 580 feet above the base".

Member B. Approximately 500 feet of strata have been designated as Member B. This is the lowermost lithologic member of the series exposed in the Wapiti-Cutbank area. It outcrops on Wapiti river, below the mouth of Red Willow river, on Spring creek, Big Mountain creek and on Kleskun hills. It was to exposures of these beds on Big Mountain creek that Dawson applied the term "Wapiti", and it is these beds that Allan and Rutherford refer to the Edmonton formation.

This member consists of a series of soft, light colored bentonitic sandstones, and slightly darker shales, with thin coal seams, ironstone nodules and thin beds of bentonite. The shales are poorly bedded, the more carbonaceous shales frequently showing better bedding. The shales are colored various shades of grey, principally olive-grey to greenish-grey. They have a blocky fracture and weather into small angular particles. Carbonized plant fragments are common.

The sandstones are fine-grained, on the whole, fairly soft and light grey in color. Quartz grains form the principal constituent, but chert and white and brown mica were also observed. One bed of somewhat coarser, brown-weathering micaceous sandstone occurs 400 feet below the top of the formation. Certain thin sandstones in this member are very fine, dark brown weathering and tightly cemented with a calcareous cement, but these sandstones represent a very small part of the total thickness.

The outstanding feature of this member is the presence of large quantities of bentonite, occurring as thin beds of bentonitic shale or disseminated through the sandstones. The clay beds are yellowish to greenish white, usually less than 6 inches thick, and are frequently associated with thin coal seams. Exposures of Member B are usually coated with a thin wash of almost white bentonite, sand and minute fragments of ironstone. Fluted weathering on these outcrops is common. Slumping is common, due both to the quantity of bentonite present, and to the soft nature of the beds.

Ironstone is widespread in these beds, usually as small concretions up to 8 inches in diameter. Fragments of carbonaceous matter are often present.

Coal is widely distributed in thin seams less than one foot thick. Dawson[1] (page 124) says:

"In Mountain Creek, large fragments of lignite coal in angular blocks which have evidently not travelled far, strew the bars. Very thin seams of coal were observed in the banks, but the loose pieces must be derived from thicker beds, which may outcrop below the water of the brook or be concealed by slides in the banks. Similar fragments of lignite coal are found along the Wapiti River above the mouth of Mountain Creek, showing that the coal beds must also occur on the upper course of the Wapiti".

There are two main horizons of coal in Member B. The lower horizon outcrops on Big Mountain creek, about one and one-half

miles above its mouth and is probably the same seam that has been mined on the north bank of Wapiti river opposite the mouth of Big Mountain creek. The upper coal horizon outcrops on Big Mountain creek near the south boundary of township 69, range 5, on Wapiti river above Spring creek, and on Spring creek. The lower seam lies about 450 feet below the top of this member and the upper seam about 75 feet below the top of the member.

Member C. Approximately 1,000 feet of strata have been designated as Member C. This member is exposed on Wapiti river above the mouth of Red Willow river, on Iroquois, Pinto and Nose creeks and on Cutbank river east of range 8.

Member C consists of interbedded massive brown-weathering sandstones and freshwater clay shales, with smaller amounts of coal, bentonite, ironstone and freshwater limestone.

The following is a partial section of Member C measured on Pinto creek near its mouth. This partial section illustrates the general character of the beds in Member C.

Feet	*Inches*	
		Top concealed.
11	0	Sandstone, fine grained, grey, buff weathering, in beds from 2 to 6 inches thick.
19	0	Shales, clay to carbonaceous, with ironstone nodules, rusty weathering.
11	0	Concealed in part, largely shales.
1	0	Ironstone, rusty weathering.
4	0	Concealed.
3	0	Sandstone, soft, fine grained, grey.
21	0	Concealed in part, largely shales, with some soft sandstone.
17	0	Sandstone, grey, hard, coarse grained with shale pellets and carbonized stems at base, otherwise fine grained.
0	6	Limestone, freshwater, dark grey, rusty weathering, increasing to 1 foot.
17	0	Concealed in part, largely shales.
20	0	Sandstone, fine grained, soft, grey.
20	0	Concealed in part, shales, carbonaceous shales, thin stringers of coal, much ironstone.
18	0	Sandstone, medium grained, grey, crossbedded, with hard and soft beds alternating, carries much chert.
162	6	Thickness exposed.

The base of this section lies approximately seventy-five feet above the base of Member C.

The sandstones in this member vary from fine to coarse grained, but are usually medium grained. They are usually soft to fairly hard, rarely very hard, grey in color and usually weather to a brownish color, especially the harder phases. All sandstones examined were cemented by calcareous material. These sandstones averaged fifteen to twenty feet in thickness, although one sandstone bed exposed on Pinto creek has a measured thickness of fifty-nine feet. This thick bed, however, lensed out to five feet in less than one-quarter of one mile. Since many of the harder beds, when traced laterally, become soft and, because of the lime content, it is probable that local case-hardening has had an important effect. The softer phases are frequently somewhat bentontic, but to a lesser degree, and are usually darker, than those in Member B. In any of the thick sandstones, the size of grain varies considerably, with the coarser sand being usually in the lower part of the bed. Well-rounded pebbles of chert and quartzite, up to 6 inches in diameter, but usually less than 2 inches, occur sparingly in the lower part of many sandstone beds. These are seldom numerous enough to form a pebble bed. The pebbles are frequently asso-

Figure 3.—Typical upland near Iroquois creek in township 68.

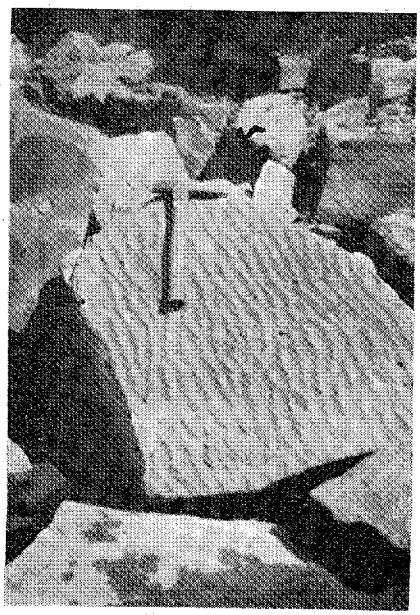


Figure 4.—Ripple-marked sandstone in Wapiti formation, on Cutbank river.

ciated with clay pellets, carbonized plant stems and dinosaur bone fragments. Crossbedding, both coarse and fine, is very common in the sandstones. Ripple marking is fairly common (Figure 4). The sandstones consist of quartz, chert and some mica. Carbonaceous particles are quite abundant.

Interbedded with the sandstones are clay shales and sandy shales, usually with little or no bedding, and showing blocky weathering. These shales are frequently grey, often with an olive cast. Bits of carbonaceous matter are scattered through the beds and leaf imprints are locally abundant. These grade into carbonaceous shales, which usually show better bedding than the clay shales. The shales make up probably about two-thirds of the member, but homogeneous beds are fairly thin. Gradations from a clay-shale to a shaly sandstone exist.

Beds of bentonitic clay shale are common in Member C. They are usually less than one foot in thickness and are greenish grey to almost white in color. There apears to be much less bentonite throughout this member than in Member B.

Ironstone is widely distributed in small amounts. Nodules are more abundant in the shales than in the sandstone. Some lenticular beds of ironstone preserve mud cracks. Lenses of rusty-weathering, dark grey freshwater limestone occur in some places. Thin beds of fairly hard grey siltstone, less than 2 inches in thickness, frequently occur in the shales.

Coal is present in small quantities throughout Member C, with commercial quantities at two horizons. The lower horizon lies about 500 feet above the base of the member. This horizon outcrops on Pinto creek in section 2, township 68, range 10, west of 6th meridian, where 54 to 56 inches of coal occur with four to six inches of clay parting (Plate II, 5). The other principal horizon lies four to five hundred feet above the Pinto Creek coal. This horizon outcrops on Cutbank river in township 64, ranges 6 and 7. The seam pinches and swells considerably, ranging in thickness from 3 feet 7 inches to 8 feet 10 inches of coal. Two other horizons occur on Cutbank river, one about 150 feet below and the other about 75 feet above the principal seam. Neither of these carries commercial quantities of coal. In addition to these, the coal being mined on Red Willow river probably occurs in this member and may correlate with the Pinto Creek horizon.

Member D. Overlying Member C is a series of shales, siltstones and fine, thin sandstones which are referred to Member D. This section is exposed on the west face of Nose mountain. The predominant color is grey. This member is very soft and consequently forms few extensive outcrops. Thin coal seams are present and one bed of coal on Nose mountain reaches almost three feet in thickness but lenses out laterally. Ironstone nodules are present. Clay shales make up by far the greater part of the member. Its thickness is not definitely known, but is estimated at about 500 feet. The lower contact is indefinite and is gradational, due to an increase in the number and thickness of sandstone beds. The upper contact is drawn at the first thick sandstone member.

Following is a section of the upper part of Member D, measured in section 4, township 64, range 11, west of 6th meridian, on the west face of Nose mountain:

Feet	*Inches*	
		Overlying beds, Member E.
1	0	Shale, carbonaceous.
0	3	Clay-shale, buff.
0	3	*Coal.*
0	1	Shale, carbonaceous.
0	3	Clay-shale, buff.
0	6	Shale, olive-grey.
0	6	Shale, buff, sandy.
2	0	Sandstone, soft, light grey, medium to coarse grained.
1	0	Shale, rubbly weathering, grey-green.
1	0	Shale, sandy.
0	6	Shale, rubbly weathering, grey.
2	2	Shale, grey, sandy.
5	0	Shale, rubbly, carbonaceous, with sandstone lenses up to 1 foot thick.
1	6	Shale, sandy.
1	0	Shale, dark grey, sandy.
0	2	Shale, carbonaceous.
1	0	Sandstone, soft, olive grey.
1	6	Sandstone, fine grained, light grey.
2	0	Shale, dark grey, rubbly weathering.
6	0	Shale, rubbly weathering, dark grey, with ironstone nodules.
0	3	*Coal.*
0	6	Shale, carbonaceous.
12	0	Shale, sandy, light grey at top and becoming darker downwards.
0	6	Sandstone, hard, fine grained, poorly preserved *Unios* at base.
10	0	Sandstone, shaly, and shale.
0	8	*Coal.*
1	0	Clay-shale, olive-grey.
0	2	Clay-shale, carbonaceous.
1	8	Shale, hard, carbonaceous.
4	6	Sandstone, very soft, fine grained, grey, grading downwards into sandy shale.
1	0	Siltstone, with plant remains.
5	0	Clay-shale, greenish-white, bentonitic.
4	0	Shale, grey, rubbly weathering.
0	3	*Coal.*
0	5	Clay-shale, light brown.
0	3	*Coal.*
0	6	Shale, brownish grey.
5	0	Shale, sandy, dark grey.
0	8	Shale, carbonaceous, lenses out.
0	3	Clay-shale, olive-yellow.
0	6	*Coal.*
1	0	Shale, sandy, grey, soft.
1	0	Shale, dark grey, rubbly weathering.
3	6	Sandstone, shaly.
0	6	Shale, carbonaceous.
1	0	Shale, purplish grey, rubbly weathering.
1	0	Sandstone, very hard, fine grained, grey; lensing.
2	4	Shale, sandy, dark colored, soft.
4	0	Shale, dark grey.
0	2	*Coal.*
1	4	Shale, carbonaceous.
2	0	Shale, sandy, and sandstone.
3	6	Shale, dark grey, rubbly weathering, with concretions up to 2 feet in diameter, carrying small pelecypods and gastropods.
0	3	*Coal.*
1	0	Shale, sandy, grey.
0	8	Shale, carbonaceous.
0	4	*Coal.*
6	0	Sandstone, shaly, dark grey, lenses of hard sandstone at base with plant remains.
0	6	Shale, well-bedded, grey, with some ironstone, carries plant remains.
106	10	Total thickness exposed.
400	0	Not exposed but estimated, to base of Member D.

A few leaf imprints were collected, as well as a few small poorly preserved molluscs.

Member E. The uppermost member of the Wapiti formation in this area occupies the upper part of Nose mountain and much of the Cutbank valley and Wapiti-Cutbank divide region. It consists of interbedded sandstones and shales, with smaller amounts of coal, bentonitic clay shales, siltstones, ironstone and freshwater limestone.

The sandstones seem to be somewhat coarser in grain than the sandstones in Member C. They are usually grey in color and weather grey, brown and purplish brown. They are usually cemented by lime. A peculiar, soft, fairly coarse phase of a sandstone occurs on Nose mountain. It has weathered to a rusty brown color above, grading into an almost white sandstone below, which appears to be a change of facies, as it is represented elsewhere by normal sandstones. Pebbles may occasionally be found in some of the sandstone beds. Topping the highest points on the western edge of Nose mountain is a brown-weathering pebble conglomerate, with chert pebbles to one-half inch in diameter. This band tends to weather into spheroidal masses.

Local unconformities occur at the base of some of the sandstone members. The base of such a sandstone is apt to carry a considerable number of pebbles (Figure 5). It is probable that such sandstones may represent channel fillings.

The shales are typical clay freshwater shales, with various carbonaceous types which usually show better bedding. Grey is the usual color, with olive to greenish tinges. Plant remains are frequently abundant. Some of the shales are highly bentonitic, weathering to a light colored clay.

It is difficult to distinguish isolated exposures of Members C and E. Member E carries important deposits of coal. Four separate occurrences of coal in Member E, numbered 14, 15, 16 and 17 are shown on the accompanying map (Plate I) and in Figure 1.

Two seams of coal outcrop on the west face of Nose mountain. A third seam occurs on the east bank of the north fork of Cutbank river. On Cutbank river in section 34, township 63, range 10, west of 6th meridian, there is an occurrence which may correlate with the lower seam on the west face of Nose mountain.

Following is a section of the lower part of Member E, measured in section 4, township 64, range 11, west of 6th meridian, on the western slope of Nose mountain (Plate I, Location 16).

Feet	*Inches*	
		Top eroded.
4	0	Sandstone, grey, brown weathering, very coarse grained, with black and white chert pebbles up to ½ inch in diameter abundant.
10	0	Sandstone, shaly, buff weathering.
190	0	Concealed.
0	6	Clay-shale, greenish white, lensing.
1	6	Shale, grey, brown weathering, carrying plant remains.
0	6	Clay-shale, buff, bentonitic.
0	10	Shale, carbonaceous.
0	2	Shale, olive-grey.
0	6	Shale, carbonaceous.
0	8	Clay-shale, buff, with stringers of shaly coal.
1	2	Shale, highly carbonaceous.
0	1	Clay-shale, buff.
0	4	*Coal,* shaly.
0	4	Clay-shale, buff, with stringers of shaly coal.
3	6	*Coal,* shaly, with lenses of bright coal.
1	0	Clay-shale, carbonaceous.

1	0	Shale, highly carbonaceous.
1	4	Shale, grey.
0	5	Siltstone, grey, gradational below into shale.
1	0	Shale, light grey, rusty weathering.
2	0	Shale, carbonaceous, rubbly weathering.
0	3	Shale, carbonaceons, thin-bedded.
2	0	Shale, grey, rubbly weathering.
0	9	*Coal,* soft.
0	6	Shale, carbonaceous.
1	0	*Coal,* soft.
0	8	Shale, brownish grey, rubbly.
0	2	*Coal.*
0	6	Shale, brownish-grey.
0	4	*Coal.*
1	3	Clay-shale, bentonitic, olive grey.
1	6	Clay-shale, bentonitic, grey.
2	0	*Coal,* shaly.
2	0	Clay-shale, brownish grey.
6	0	Shale, grey, rubbly weathering.
10	0	Shale and siltstone, some ironstone nodules; largely concealed.
18	0	Sandstones, shaly at top, becoming sandier and more massive below; chert pebbles to ¼ inch; small ironstone nodules; small shale pellets; surface stained with iron oxides.
10	0	Concealed; at least 1 foot of *coal* in this interval.
6	0	Sandstone, massive, hard, fine grained, pink weathering.
1	4	*Coal,* with a few thin shale partings.
2	6	Shale, dark grey, rubbly weathering.
0	8	Siltstone, with plant remains.
0	4	Shale, grey.
1	6	Shale, sandy, grey.
3	0	Sandstone, hard, fine grained, reddened by burning coal, with a few thin lenses of shale, increasing to 10 feet.
44	0	Concealed, but with much coal corresponding to coal at location 15.
20	0	Sandstone, buff, medium grained, thin bedded at top, more massive below; *Unios* near top; carbonized stems abundant.
2	0	*Coal.*
0	4	Clay-shale, white.
0	6	*Coal.*
1	0	Clay-shale, white.
1	0	*Coal,* with several thin shale partings.
0	2	Clay-shale, white.
1	10	*Coal.*
0	6	Shale, carbonaceous.
1	0	*Coal.*
0	8	Shale, carbonaceous.
1	0	Shale, dark grey, rubbly weathering.
0	1	Clay-shale.
1	0	Shale, dark grey.
0	10	*Coal.*
0	6	Clay-shale, olive yellow.
0	2	Shale, highly carbonaceous.
1	6	Shale, dark grey.
4	0	Siltstone, hard, grey, in six-inch beds.
30	0	Concealed.
25	0	Sandstone, fine grained, grey cross-bedded, in beds 6 inches to 1 foot 6 inches thick.
430	2	Total thickness of section.
		Underlying beds, Member D.

Fossils. Fossils are locally abundant in all parts of the Wapiti formation. Fossilized plants are particularly common, occurring both in the shales and sandstones.

The only fossils found in Member B consisted of fragments of dinosaur bones, which were frequently found in the wash at the base of outcrops. Several well preserved bones were collected by Mr. Robert Cochrane of Grande Prairie, from exposures of this member in the Kleskun hills. These have not been examined by

a vertebrate paleontologist, however, and nothing is known of their taxonomic position.

In Member C, vertebrate and invertebrate fossils, as well as plants, were found. The invertebrate fossils consisted chiefly of *Unios,* with a few small pelecypods and gastropods. These fossils were not sufficiently well preserved for determination. Plant remains, consisting of leaves and stems, occur in both sandstone and shale. Fragments of dinosaur bones were common, usually occurring at the base of the sandstone beds. A toe-bone was collected on Nose creek, in section 27, township 67, range 11, west of 6th meridian, and sketches of this were submitted to C. M. Sternberg who stated*,

> "The sketch appears to represent the ungualar phalanx of the hind foot of a duck-billed dinosaur. There is such a great similarity in most of the unguals of the duck-bills that it is practically impossible to determine to which genus or species it belongs. . . . I fear that in this case I can not say any more than Upper Cretaceous. If the Wapiti formation does not include any marine beds (the equivalent of the Bearpaw), it would mean that specimens found near the middle of the formation might resemble those of the Belly River as much as the Edmonton."

In Members D and E, plants and invertebrates are abundant, but no vertebrate fossils were found. The fossils occur in lenses in otherwise barren rock. *Unios,* small pelecypods and gastropods were collected, as well as plants.

The fossils, especially the pelecypods, were frequently poorly preserved. The number of species appeared to be small, although there was a considerable number of individuals. In addition, the non-marine Upper Cretaceous faunas of the foothills are insufficiently known to permit correlation with the Upper Cretaceous of the plains, hence, these fossils could not be used as a basis for correlating between the Belly River and Edmonton equivalents in this area.

Pleistocene and Recent

Most of the area is covered by a mantle of sands, gravels, clays and tills of Recent and Glacial ages, which reach a maximum of about 150 feet in thickness.

On Pinto creek, in township 68, range 10, west of 6th meridian, typical till overlies fifteen to twenty feet of gravel and sand which may be of pre-glacial age. The gravels consist largely of chert and quartzite. No typical Keewatin pebbles were found in these gravels.

Most of the area is covered by till. Parts of the area were affected by both the Keewatin and the Cordilleran glaciers. The present distribution of boulders of granite, gneiss and schist, typical of the Keewatin tills, shows that the entire region, except for the top of Nose mountain, was covered by the Keewatin ice sheet. The Cordilleran glacier apparently extended over the western part of the area, including Nose mountain. Limestone, quartzite and conglomerate boulders which could only have been derived from the west, are to be found in that part of the area. The relationship of the two separate glaciations was not established.

Boulders of a bluish-green schistose conglomerate are common on the surface in the western part of the area. The easternmost blocks were found on Pinto creek. Northwards, these were observed almost as far as the town of Beaverlodge. Occasionally,

*Written communication.

these boulders reach a large size. One boulder on Muddy creek, at the trail crossing in township 66, range 11, west of 6th meridian, is 20 feet long, 8 feet wide, with only one foot exposed above water level. It is almost certain that these boulders were derived from the west. This is suggested by their present distribution, and because such boulders have not been recognized in the Keewatin till in other parts of Alberta.

The sand ridges previously described probably represent some type of morainal deposit. Most of the material was derived locally, but very rare Keewatin boulders occur upon some of these sand ridges.

Postglacial deposits consist of gravels, sands and clays. In most cases, these form a very thin mantle. Water-laid clays were observed on Bear river, one and one-half miles south of Grande Prairie. Yellow ochre was reported to have been found in a well dug on the margin of a muskeg in section 9, township 70, range 6, west of 6th meridian.

Structure

The area lies along the axis of a broad gentle syncline which may represent the northward continuation of the Alberta syncline. Consequently, the structure is generally in the form of a trough, with minor folds on the west limb. The position of the axis is not exactly known, but in general it may be said to cross the Wapiti river between Pinto and Nose creeks, and the Cutbank river above Wolf creek. The dips on the east flank are low, and are not known to exceed about seventy-five feet per mile. On the west flank, dips rarely exceed fifteen degrees. Small folds occur on the west flank, but no folds were observed east of the axis.

Calculated from the altitude of a coal seam which occurs on Wapiti river and Spring creek in township 70, range 7, west of 6th meridian, and the approximate elevation of the same seam on Big Mountain creek, the strike of the strata in the northeastern part of the area is about north 35 degrees west, and the dip is about seventy feet per mile in a southwesterly direction. Rutherford[5] (page 13) states that the regional strike of the base of the Wapiti formation is north 83 degrees west. The difference between these strikes is probably due to local warping in the Wapiti-Cutbank area. The west limb of this syncline is more strongly marked in this area. Dips on Nose mountain range up to 18 degrees to the east. The strike here varies from north 25 degrees west to north 50 degrees west. The east-dipping sandstones capping Nose mountain have resulted in the formation of a very fine example of a west-facing cuesta or escarpment.

The most easterly folds observed were on Muddy creek, where the beds are gently undulating, forming low anticlines with synclines between. A very small strike fault with a vertical displacement of only about 2 feet, cuts the crest of one of these anticlines at the mouth of Muddy creek.

A gentle anticline crosses Nose creek in township 67, range 11, west of 6th meridian. The southwest limb is well defined, but the northeast limb is obscured by small undulations. Strikes tend to be irregular due to the undulating character of the beds. In section 10, township 67, range 11, west of the 6th meridian, the strike is north 28 degrees west, with a dip of 8 degrees to the southwest. Farther north, the dips decrease and small rolls obscure the prin-

cipal structure. It appears that this anticline is unsymmetrical, with the steeper limb to the southwest.

A small thrust fault, with a vertical displacement of about 10 feet, occurs on Nose creek in section 33, township 67, range 11, west of 6th meridian, on the northeast limb of the anticline. The strike is a little north of west, with a dip of at least 30 degrees to the northeast.

The valley of the North Fork of Cutbank river follows the axis of a narrow syncline which shows dips up to 30 degrees. This syncline may extend south along the South Fork. Immediately to the east of the North Fork the dip reverses, forming a small anticline. For several miles downstream along the Cutbank, east dips predominate. No reliable westerly dips were observed until a short distance above Wolf creek, where the beds show the characteristic very low dips of the eastern limb of the syncline.

CHAPTER IV.

ECONOMIC GEOLOGY

COAL

INTRODUCTION

The principal coal-producing section of the Peace River district is the Halcourt Coal Area, which occupies townships 69-71, ranges 5-13, west of 6th meridian[7]. Production from the rest of the Peace River district has been negligible up to the present, the reported production being usually less than 100 tons per annum.

Production in the Peace River area commenced in 1916, with 390 tons reported. In 1917, 223 tons of coal were produced. No further production was reported until 1923. The annual production of the Halcourt coal area from 1923 to 1945 is shown in Table 2. Data were obtained from the Annual Reports of the Mines Branch of the Alberta Department of Lands and Mines.

TABLE 2.

Coal Production in Halcourt Coal Area.

Year	*Tonnage*	*Year*	*Tonnage*	*Year*	*Tonnage*
1923	193	1931	2,080	1939	3,003
1924	658	1932	2,275	1940	3,163
1925	695	1933	2,873	1941	3,595
1926	494	1934	3,040	1942	2,403
1927	604	1935	3,738	1943	1,873
1928	636	1936	3,479	1944	553
1929	475	1937	4,569	1945	649
1930	436	1938	3,355		

Within the Wapiti-Cutbank area, thirty-six mines have been opened since the first development was undertaken in 1916. In that year, seven mines were opened, but only one of these, Mine No. 651, originally operated by Charles N. Dunlop, and now by the Baldwin Collieries, is still in existence. In 1944 small quantities of coal were produced from six mines; one of these is on Spring creek, one on Pinto creek and four in the neighborhood of Red Willow river.

No figures are available on the annual consumption of coal in the Peace River district. Almost all of the coal consumed is brought into the area by rail. Most of the coal comes from Edmonton, Saunders, Drumheller and Lethbridge areas[7].

The distance from Edmonton to Grande Prairie by rail is close to four hundred miles. The freight rate is sixteen cents per hundred or three dollars and twenty cents per ton for coal in carload lots. Further, there are charges for handling the coal, which add more to the final selling price. The result is that imported coal costs from $9.50 to $12.00 per ton in the Grande Prairie area.

The only available fuel in the area is wood. At one time firewood was more abundant, but with the increase of settlement, wood has become scarcer and has risen in price. The price of stove wood, sawed and delivered, in Beaverlodge during the summer of 1944 was $7.50 per cord.

Consequently, the Peace River area suffers from lack of a local supply of fuel. The geological survey party of the Research Council of Alberta, working in the area south of the Wapiti during the summer of 1944, was primarily concerned with the location of coal deposits which might be economically worked to supply coal to the southern part of the Peace River area.

Coal Occurences in Wapiti Formation

As indicated in Chapter III, the Wapiti formation has been divided into five members designated, in order of age, A, B, C, D and E (Figure 1). Most of the coal seams observed occur in Members B, C and E. The coal occurrences noted in the area are discussed in the section of the report which follows, according to the member in which they occur. The numbers correspond to the localities shown on the accompanying map, (Plate I), and on the sections of the coal seams (Plate II).

Table 3 gives a list of the more important coal occurrences, arranged roughly stratigraphically, and the thickness of the coal at each locality. The number on each occurrence corresponds to the number of the locality shown on the accompanying map (Plate I).

TABLE 3.

Coal Occurrences in Wapiti-Cutbank Area

No.	Location	Thickness of coal	Thickness of section	Distance from Grande Prairie	Remarks
17	36-63-11-W6	3′ 9″	3′ 9″	55 miles	
16	5-64-11-W6	3′ 3″	3′ 3″	55 miles	
15	17-64-11-W6	11′ 2″	15′ 6″	55 miles	
14	34-63-10-W6	12′ 6″	18′ 8″	53 miles	
13	4-64- 7-W6	2′ 7″	2′ 8″	46 miles	
12	3-64- 7-W6	4′ 6″	4′ 9″	45 miles	
11	11-64- 7-W6	9′11″	11′ 3″	45 miles	
10	18-64- 6-W6	5′ 5″	15′11″	43 miles	
9	17-64- 6-W6	7′ 0″	7′ 8″	43 miles	
8	16-65- 5-W6	2′ 7″	4′ 0″	37 miles	
7	65- 9-W6	3′ 0″	3′ 0″	41 miles	
6	2-67-11-W6	4′ 8″	19′ 0″	41 miles	
5	2-68-10-W6	4′ 6″	5′ 0″	32 miles	ABC Development Co., Mine No. 1616 (Pinto Creek Coal Mines Ltd.)
4	69- 5-W6	2′ 1″	2′ 5″	17 miles	R. O. Johnston, Coal Lease No. 5462.
3	35-70- 7-W6	2′10″	3′ 7″	8 miles	Baldwin Collieries, Mine No. 651, LSD 15.
2	21-70- 7-W6	2′ 4″	2′ 8″	11 miles	Wapiti River Mine, LSD 2; Mine No. 1506.
1	69- 5-W6	2′ 4″	3′ 6″	13 miles	

With the exception of 2 and 3, the occurrences are in territory that has not been surveyed. These locations are based largely upon pace and compass surveys and hence are subject to correction. The numbers shown on this table are shown on the accompanying map.

Coal in Member B

Location 1. About three miles above the mouth of Big Mountain creek, in township 69, range 5, west of 6th meridian, is an outcropping of coal which is the lowest seam of any size in the area.

Stratigraphically, it lies about 450 feet below the top of Member B. There are 2 feet 4 inches of coal in 3 feet 6 inches of section (Plate II). The section of this seam is as follows:

0—150′	Cover.
0′ 4″	*Coal*
0′ 6″	Shale
0′ 3″	*Coal*
0′ 8″	Shale
1′ 9″	*Coal*

This occurrence is not of economic importance as it is too thin. Some coal has been dug from the bank of the Wapiti river, opposite the mouth of Big Mountain creek. This probably represents a continuation of the above seam.

Location 2. On Wapiti river in sections 21 and 22, township 70, range 7, west of 6th meridian, a seam outcrops on which some eight mines have been opened. The section in Mine No. 1506 in the northwest quarter of legal subdivision 2, section 21, township 70, range 7, west of 6th meridian, contains 2 feet 4 inches of coal in 2 feet 8 inches of section (Plate II). The details are as follows:

0—200′	Cover
0′ 6″	Bone and coal
0′ 6″	Shale
2′ 0″	*Coal*
0′ 4″	Shale
0′ 4″	*Coal*
75′	Shale and soft bentonitic sandstone

The roof is a soft sandstone. The seam has been on fire at several places. In 1944 no mines were in operation. All entries were blocked.

Location 3. Outcrops of coal occur on Spring creek in sections 25, 35 and 36, township 70, range 7, west of 6th meridian. This seam has been mined intermittantly since 1916. The only operating mine at present is the Baldwin Collieries, Mine No. 651, in legal subdivision 15, section 35, township 70, range 7, west of 6th meridian.

The section in the entry of the Baldwin Mine contains 2 feet 10 inches of coal in 3 feet 7 inches of section (Plate II), as follows:

6′ 0″	Soft light grey sandstone
0′ 3″	Whitish clay (not always present)
0′ 4″	*Coal*
0′ 6″	Bone
2′ 0″	*Coal*
0′ 3″	Bone
0′ 6″	*Coal*
0′ 3″	Clay
	Shales and sandstones in floor

The section in the southwest quarter of section 35 measured in a small entry on the east bank of Spring creek as follows:

	Soft shaly sandstone
0′ 2″	Shale and coal
0′ 2″	Clay
1′11″	*Coal*
0′ 6″	Carbonaceous shale
	Shales and sandstones

The Baldwin Mine is favorably located, being only ten miles by road from Grande Prairie. There is little variation in the thickness of the coal, which is of good quality.

Location 4. This occurrence which lies on Big Mountain creek about three and one-half miles above the mouth of Bridge creek, has

been staked by R. O. Johnston, of Grande Prairie, as coal lease No. 5462. The section contains 2 feet 1 inch of good coal in 2 feet 5 inches of section (Plate II), as follows:

5′—10′	Stream-deposited gravel, sand and clay
1′ 0″	Brown, sandy shale, with lenses of white clay
0′ 7″	Olive-yellow clay
0′ 1″	Black carbonaceous clay
0′ 7″	*Coal*
0′ 4″	Hard black carbonaceous shale
1′ 6″	*Coal*
1′ 7″	Clay, white to carbonaceous
4′ 2″	Shaly coal, carbonaceous shale, clay
2′ 0″	Carbonaceous shale
15′ 0″	Soft sandstone

The coal outcrops about 40 feet above creek level and about 10 feet below a small terrace. There is another terrace about 25 feet above the first. Two hundred and fifty feet downstream, erosion has removed the coal and gravels lie directly on the sandstone below the coal seam. At the outcrop, there are only 20 inches of bedrock above the coal. Consequently, unless the bedrock thickens into the bank, the coal is apt to be badly weathered. Under some parts of the terrace, the coal may have been eroded away. This occurrence of only two feet of good coal, thirty miles by road from Grande Prairie, is not regarded favorably for development.

Correlation. These four coal occurrences lie within Member B (Figure 1). Number 1 lies about 450 feet below the top of this member. Numbers 2, 3 and 4 lie about 75 feet below the top of this member. Numbers 2 and 3 are almost certainly the same seam, because the sections are quite similar and when traced out as far as possible, they appear to coincide. Number 4 is correlated with Numbers 2 and 3 on the basis of its stratigraphic position.

Coal in Member C

The coal seams at localities 5 to 13 inclusive (Plate I) and on Red Willow river are in Member C.

In 1927 Allan[3] examined the coal seam being mined on Red Willow river, south of Halcourt in section 21, township 70, range 10, west of 6th meridian, and reported as follows:

> "The coal seam averages from thirty to thirty-six inches in thickness with a sandstone roof and shale floor. There are several bands of 'bone' in some places which reduce the thickness of the clean coal. In other parts of the seam there are about three feet of clean coal with 'bone' bands at the top and bottom of the seam. Representative samples of the coal seam were taken at two points about one-quarter of a mile apart in adjoining legal subdivisions. The following analyses were made from these samples by the fuels division:
>
> "Lab. Sample No. 71-27.
>
> Red Willow Mine No. 1134 operated by Mr. A. C. Schannell, in legal subdivision 2, section 21, township 70, range 10, west of 6th meridian. This sample was taken from the face which was one month old.

	As Received	Air Dried	Dried
Moisture ..... %	10.1	9.0	.....
Ash ..... %	5.0	5.1	5.6
Volatile Matter ..... %	35.4	35.8	39.4
Fixed Carbon ..... %	49.5	50.1	55.0
Calorific Value, gross B.T.U. per lb.	11,940	12,080	13,280
Fuel Ratio	.....	1.40	.....
Coking Properties		Non-coking	

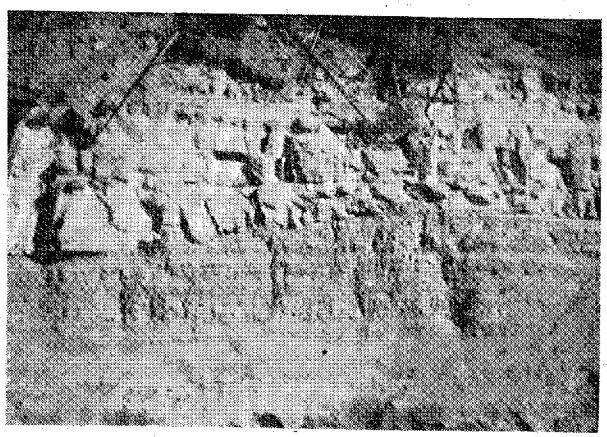


Figure 5.—Unconformable relations with pebble bed at the base of a sandstone, at Cutbank river forks, at west side of township 63, range 10, west of 6th meridian.

Figure 6.—Outcrop of coal seam at location 5, Pinto creek. Two men point to top and bottom of coal seam. Prospect tunnel in centre background.

"Lab. Sample No. 72-27.

From the face of a new entry being opened by Messrs. Dunbar and Beatty in legal subdivision 7, section 21, township 70, range 10, west of the 6th meridian.

	As Received	Air Dried	Dried
Moisture ..... %	9.7	9.0	.....
Ash ..... %	5.1	5.1	5.6
Volatile Matter ..... %	34.6	34.9	38.4
Fixed Carbon ..... %	50.6	51.0	56.0
Calorific Value, gross B.T.U. per lb.	11,900	11,990	13,180
Fuel Ratio	.....	1.45	.....
Coking Properties		Non-coking	

Location 5. This seam outcrops on Pinto creek in section 2, township 68, range 10, west of 6th meridian (Figure 6). The section, measured on an outcrop, contains 4 feet 6 inches of coal in 5 feet of section (Plate II), as follows:

30′	Boulder clay
15′ to 20′	Sands and gravels
0′ to 8′	Soft shaly sandstone and shale
	Two feet above the top of the seam is a 4-inch seam of coal
3′ 1″	*Coal* (2'11" in the tunnel)
4″	Clay
1′ 5″	*Coal*
1′ 2″	Carbonaceous shale

This seam outcrops intermittently for about 1,000 feet along Pinto creek. It is probable that these discontinuous outcrops are the various seams reported by Evans and Caley[4] (page 38). The seam is gently undulating and at one point drops below the level of the stream.

In 1943 operations on this coal commenced, as Mine No. 1616 registered by G. Sparks. In the winter of 1943-44, several buildings were erected, and stripping operations were commenced on a small flat in a meander of Pinto creek. A short tunnel was driven into the outcrop. Stripping to the top of the seam was done over an area of about 3,750 square feet and an equal area was partially stripped within a meander of the creek (Figure 7). However, the cover was not over six feet, the coal was very badly weathered, and stripping operations ceased. During the summer of 1944, the property was acquired by the A.B.C. Development Co., who planned to strip a higher level, with about 15 feet of cover above the coal. This property is now operated by the Pinto Creek Coal Mines Limited.

Transportation to the mine is by truck. From the mine to the graded road at the southwest corner of section 32, township 68, range 8, west of 6th meridian, a distance of about 15 miles, the road is bulldozed and as such, can carry heavy traffic only when frozen or very dry. The mine is about 35 miles from Wembley by road.

Of all the occurrences examined south of the Wapiti, this one is the closest to the railway and most favorable for development. Except for the valley of the Wapiti river, across which any coal mined south of the Wapiti would have to be transported, there are no serious grades with which to contend, but an all-weather road would be essential.

Location 6. This coal outcrops on Nose creek in section 2, township 67, range 11, west of 6th meridian. It was first reported by Evans and Caley[4] (page 38). There are 4 feet 8 inches of coal in 19 feet of section, as follows:

26′	Shale and sandstone
2′ 0″	Black carbonaceous shale
0′ 9″	*Coal,* shaly
0′ 1″	Carbonaceous shale
0′10″	*Coal,* shaly
0′ 2″	Black clay
1′10″	Yellow to greenish white plastic clay
0′ 3″	Black carbonaceous clay
1′ 2″	*Coal*
1′ 6″	Black carbonaceous shale, slickensided
0′ 7″	*Coal*
0′ 3″	Carbonaceous clay
10′ 0″	Soft sandstone and shale
0′ 3″	Soft, yellowish clay
1′ 4″	*Coal*
1′ 0″	Black carbonaceous shale

This occurrence of coal is not of economic value, where exposed. There is a possibility that some of the seams thicken sufficiently to be minable, but exploration would be expensive, with no assurance of ultimate success. The low dipping beds in the Wapiti formation on Nose creek are shown in Figure 8.

Location 7. On the upper part of Muddy creek, below the upper trail crossing, there is a three-foot seam of coal with many thin clay partings, which make up about one-quarter of the seam. The seam is dipping very sharply, probably as a result of slumping. This occurrence had been reported by Indians who stated that the whole bank was coal. It appears that the steep dip, which causes the seam to cut across the bank, was responsible for this statement by the Indians. The coal is of no commercial value.

Location 8. This occurrence is on Cutbank river about three-quarters of a mile below the falls, in section 16, township 65, range 5, west of 6th meridian, and shows 2 feet 7 inches of coal in 4 feet of section (Plate II), as follows:

0′ 3″	Carbonaceous shale
0′ 9″	*Coal*
0′ 5″	Carbonaceous shale
0′ 2″	White clay
0′ 5″	Carbonaceous shale
0′ 4″	Olive-grey clay
0′10″	*Coal*
0′ 1″	Clay
1′ 0″	*Coal*
0′ 6″	Carbonaceous shale

The coal at this occurrence is not of economic value. It indicates an horizon, however, which may carry commercial amounts of coal elsewhere.

Location 9. Coal outcrops at locations nine to twelve inclusive, on Cutbank river, are thought to belong to one horizon. They are described separately.

At location nine, in section 17, township 64, range 6, west of 6th meridian, there are 7 feet of coal in 7 feet 8 inches of section (Plate II), as follows:

25′	Sandstone and shale
0′ 3″	*Coal*
0′ 1″	Clay
1′ 2″	*Coal*
0′ 4″	Clay
1′ 0″	*Coal*
0′ 1″	Clay
1′ 2″	*Coal*
0′ 7″	*Coal* and clay
0′ 6″	*Coal*
0′ 2″	Clay
2′ 4″	*Coal,* lower foot soft, brittle, with a silky lustre.

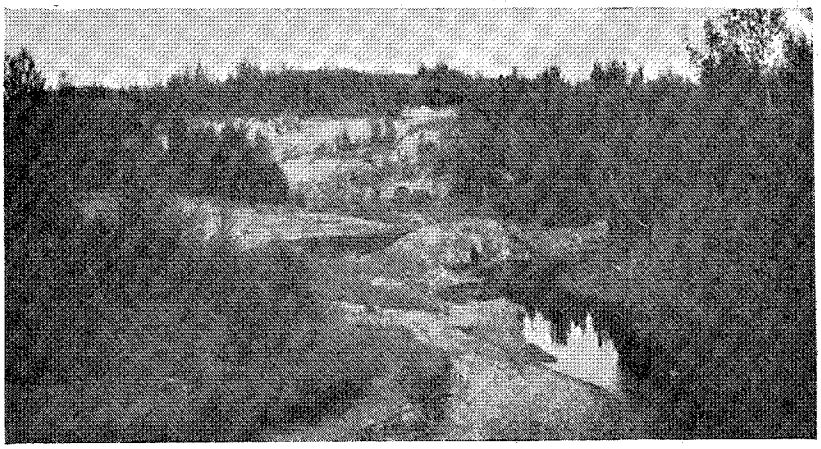


Figure 7.—Coal stripping at location 5, Pinto creek, section 2, township 68, range 10, west of 6th meridian.

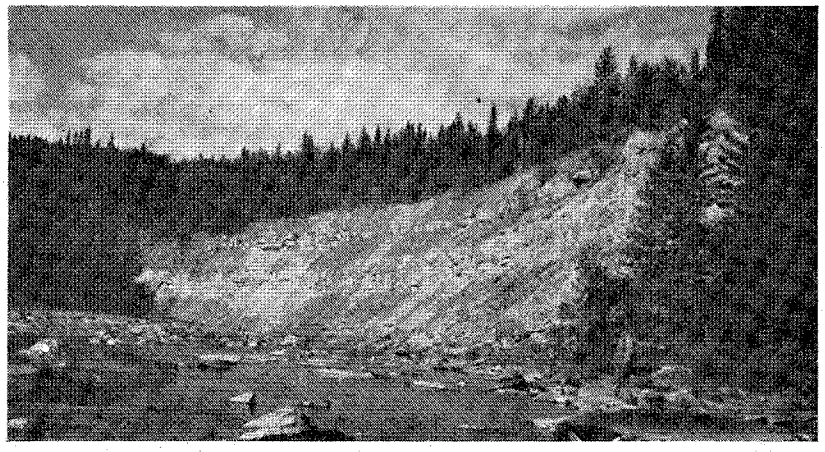


Figure 8.—Low dipping beds in Wapiti formation on Nose creek, near location 6, in township 67, range 11, west of 6th meridian.

Location 10. This occurrence is in section 18, township 64, range 6, west of 6th meridian and shows 5 feet 5 inches of coal in 15 feet 11 inches of section (Plate II), as follows:

15′ 0″	Sandstone and shale
0′10″	*Coal*
1′ 5″	Shale and clay
1′ 1″	*Coal*
0′ 8″	*Coal,* with numerous thin clay partings
0′ 1″	Clay
1′ 0″	*Coal*
9′ 0″	Shale and sandy shale
1′10″	*Coal*

Location 11. This occurrence, in section 11, township 64, range 7, west of the 6th meridian, shows 9 feet 11 inches of coal in 11 feet 3 inches of section (Plate II and Figure 9), as follows:

15′ 0″	Boulder clay
	Traces of yellow clay
2′ 4″	*Hard coal*
0′ 3″	White plastic clay
1′ 9″	*Hard coal*
0′ 2″	Clay
1′ 3″	*Coal*
0′ 4″	Clay
1′ 2″	*Coal,* thin clay partings
0′ 4″	Clay
2′ 4″	*Coal,* lower part soft, brittle, silky lustre
0′ 3″	Carbonaceous shale
1′ 1″	*Coal* and clay, coal very dirty

Location 12. This occurrence in section 3, township 64, range 7, west of 6th meridian, shows 4 feet 6 inches of coal in 4 feet 9 inches of section (Plate II), as follows:

25′ 0″	Rubbly shales, sandstone, etc.
1′ 0″	Lenticular sandy ironstone
0′ 6″	*Coal*
0′ 1″	Clay
1′ 2″	*Coal*
0′ 6″	*Coal* and clay
0′ 4″	*Coal,* dirty, with fossil wood
0′ 1″	Clay
0′ 4″	*Coal*
0′ 1″	Clay
1′ 8″	*Coal*

These four occurrences, locations nine to twelve inclusive, are regarded as representing the same horizon. Although there are almost 100 feet of beds exposed at two of these occurrences, there is no suggestion of any other thick seam being present. The beds are almost flat, with no more than a very gentle westward dip, and the gradient of Cutbank river is slight. The coal occurrences rise above the level of the river downstream. Probably the most significant fact is the presence of a peculiar, brittle, soft, light coal with a silky lustre which tends to break into small blocks; these when broken show a conchoidal fracture. The presence of such coal at locations 9 and 11 at the base of the seam, strengthens the supposition that these occurrences represent a single horizon.

Whether these represent one seam or several seams, however, the occurrences are sufficiently noteworthy that prospecting of the area should be undertaken. It is suggested that trenching be carried out between the outcrops to determine whether the occurrences represent one seam or several seams, and to determine the lateral variation in the coal. It is further suggested that, if indications are promising, an instrument survey should be carried from exposures on Cutbank river to the north side of the Wapiti-Cut-

Figure 9.—Coal seam on Cutbank river, location 11, about section 11, township 64, range 7, west of 6th meridian.

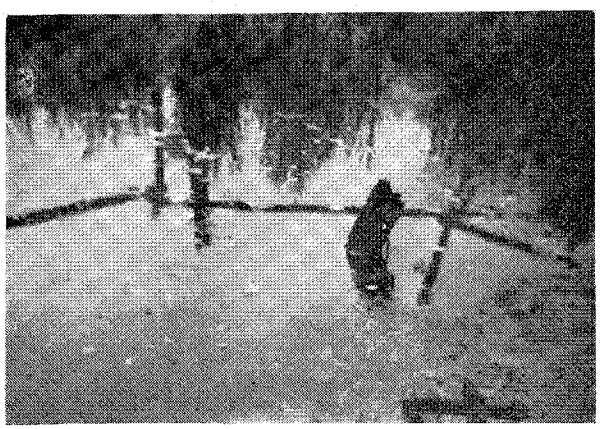


Figure 10.—"Mud volcano" showing gas bubbles on surface of water, at east side of a small lake at head of Bald Mountain creek, in township 68, range 7, west of 6th meridian.

bank divide, to locate the approximate position of the seam. Trenching or shallow bore holes would readily locate any coal seams on the north side of the divide, which could be further investigated with a view to development.

These occurrences lie from 43 to 45 miles from Grande Prairie in a straight line. The distance would probably be closer to sixty miles by any road which might be built to them. It would be necessary to haul the coal out of the Cutbank valley, which is six to eight hundred feet deep. By locating the coal on the north side of the Wapiti-Cutbank divide, the haulage distance would be reduced by several miles. The loaded trucks would have a "downhill" route to the Wapiti river.

To develop this coal, a good all-weather road would have to be built. This would be expensive, and intensive prospecting, either by trenching or bore holes, would be imperative before such construction would be warranted.

Location 13. Coal outcrops along Cutbank river from the mouth of Wolf creek upstream for several miles. This seam is higher in section than the previous occurrences, and is definitely west-dipping, although very slightly. Although of no economic importance at present, it indicates a coal-bearing horizon which may at some place have thickened sufficiently to be of value. An exposure of this coal, half a mile above the mouth of Wolf creek, on Cutbank river, shows 3 feet 3 inches of coal in 3 feet 7 inches of section, as follows:

0′ 2″	Brown clay
0′ 8″	*Coal,* thin clay partings
0′ 1″	White clay
1′11″	Blocky weathering *coal*
0′ 2″	Rubbly weathering grey clay
0′ 2″	*Coal*
0′ 1″	Clay
0′ 6″	Shaly *coal,* grading downwards to carbonaceous shale

Correlation. The correlation of the seams in Member C is difficult due to the distance between exposures and uncertain stratigraphic position of the coal. The Red Willow seam may correlate with the Pinto Creek seam. It is possible that the Red Willow coal occurs stratigraphically somewhat lower than the Pinto Creek coal. The coal on Nose creek appears to be higher in the section than that on Pinto creek. On Cutbank river, the coal at localities nine to twelve is believed to represent a single seam, which is higher stratigraphically than the Pinto Creek coal. The coal at location eight is below this, and that at location thirteen is somewhat higher.

Coal in Member D

No extensive bodies of coal were found in Member D. One seam, about three feet in thickness, was found in this member on the west slope of Nose mountain, but this was observed to lense out very rapidly. A few other thin seams were noted, but these were too thin to be of economic importance.

Coal in Member E

Location 14. This occurrence in section 34, township 63, range 10, west of 6th meridian, was first reported by Adam Kenny, a trapper. The seam has been on fire in places, burning the adjacent rock to a brick red color. The strata dip very slightly towards the northeast. There are 12 feet 6 inches of coal in 18 feet 8 inches of section (Plate II) as follows:

100′	Sandstone and shale
0′ 7″	*Coal* and clay
0′11″	*Coal*
0′ 4″	Clay
1′ 0″	*Coal*
0′ 5″	Clay
2′ 8″	*Coal*
0′ 6″	Clay
0′ 6″	*Coal*
0′ 6″	Clay
0′ 7″	*Coal*
0′ 2″	Clay
0′ 6″	*Coal*
0′ 2″	Clay
1′ 0″	*Coal*
0′ 1″	Clay
2′ 3″	*Coal*, with very thin clay partings
4′ 0″	Greenish shale
2′ 6″	*Coal*
	Shale

This coal occurs in the bottom of the Cutbank valley. The banks are high and steep, and the north side of the Wapiti-Cutbank divide is deeply dissected by tributaries of Nose and Pinto creeks. Grande Prairie lies 53 miles from the occurrence in a direct line. The seam itself carries many thick clay partings, with rather thin beds of coal. For these reasons, this occurrence can not be regarded as a source of coal for the Grande Prairie district in the near future.

Location 15. This occurrence lies on the western slope of Nose mountain in section 17, township 64, range 11, west of 6th meridian. The seam is dipping eastwards at about 7 degrees. A certain amount of burning at the outcrop has occurred. There are 11 feet 2 inches of coal in 15 feet 6 inches of section (Plate II), as follows:

175′	Sandstone and shales
0′ 9″	*Soft coal*
0′ 4″	Brown carbonaceous clay
1′ 2″	*Coal*
0′ 5″	Whitish clay
1′ 0″	*Coal*
0′ 1″	Clay
0′ 2″	*Coal*
0′ 7″	Clay
2′ 0″	*Coal*
0′ 5″	Clay and coal
0′ 9″	*Coal*
0′ 6″	Clay
0′11″	*Coal*
0′ 9″	Clay and shaly coal
1′ 8″	*Coal*
0′ 9″	Carbonaceous shale
1′ 0″	*Coal*
0′ 5″	Shale and clay
0′ 8″	*Coal*
0′ 4″	Clay
1′ 1″	*Coal*
1′ 4″	Carbonaceous shale
	Shale and sandstone

This is not of economic value for the same reasons as stated under location fourteen.

Location 16. This occurrence is on the western slope of Nose mountain and contains three feet three inches of coal in a series of shales and soft sandstones. It has no commercial value at present.

Location 17. This occurrence is on the east bank of the North Fork of Cutbank river and contains three feet nine inches of good-looking coal. About 18 feet above this seam is a six-foot seam,

which is broken by many clay partings. The lower seam was sampled. This occurrence has no commercial value at present.

Correlation. All the exposures of coal examined in Member E probably represent different seams. There is a possibility that the seam at location 14 may correlate with that at location 15, but such a correlation must be regarded as provisional. The coal at location 16 is higher stratigraphically than that at location 15, while that at location 17 is the youngest coal which has yet been found in the area.

Analyses of Coal

Channel samples were collected at the more important outcrops of coal. Trenching was carried across the seam to a depth of from two to four feet. The samples were submitted to the laboratories of the Research Council of Alberta for analysis. The results of these analyses are shown in Table 4. With the exception of samples 429-43 and 424-44, which were collected from the Baldwin and Pinto Creek mines, respectively, all are channel samples from the outcrop.

As most of the samples were taken from the coal in the outcrop, the analyses can not be regarded as wholly representative of the coal. Weathering has undoubtedly affected the coal in most of the samples, causing a decrease in the heat value and an increase in moisture content. These changes result in a lowering of the apparent rank of the coal. Consequently, the ranks indicated for the samples in Table 4 cannot be regarded as necessarily correct, for the unweathered coal.

In the Halcourt Coal Area, two ranks of coal are present, according to Stansfield and Lang[8] (page 128). In township 70, ranges 8, 10 and 11, west of the 6th meridian, High Volatile C Bituminous coal is present. In township 70, range 7, and in township 71, range 9, west of 6th meridian, the coal is Sub-bituminous B. Since the analyses in Table 4 indicate that some of the coals on Nose mountain, the youngest coals in the area, are High Volatile C Bituminous and Subbituminous B in rank, the other coals shown are probably of equal rank, when unweathered.

The classification of the coal by rank is according to the A.S.T.M. classification[8] (Table I, page 8). Those coals which have a heat value, on the moist, mineral-matter free basis, of from 11,000 to 13,000 B.T.U. per pound are classified in the A.S.T.M. classification as either Subbituminous A or High Volatile C Bituminous, depending upon their weathering and agglomerating characteristics. All coals in Table 4 which fall within this range are provisionally classified as High Volatile C Bituminous. Some or all of these may actually be of Subbituminous A rank.

Most of the analyses show a high percentage of ash which reduces the value of the coal. It is doubtful if there is any marked decrease in the ash content away from the outcrop. Where the seam consists of several beds of coal, some of the beds may be lower in ash and these might be mined separately.

Comparisons of analyses of samples 414-44 and 424-44, both taken from location five, show the possibilities for differences between outcrop coal and unweathered coal from the same seam.

The analyses in Table 4 were made in the laboratories of the Research Council of Alberta, unless otherwise stated, and are of coal with moisture in the sample as received.

TABLE 4.

Analyses of Coals from Wapiti-Cutbank Area
(Location numbers shown on map, Plate I)

Location Number	3	4	5	5	9	11	14	15	16	17
Lab. Sample	429-43	429-44	414-44	424-44	423-44	410-44	418-44	421-44	420-44	419-44
Moisture at 99.9% humidity (capacity) ....%	17.0	22.3	27.4	10.3	12.5	13.6	16.3	16.2	22.5	12.6
Moisture at 60.0% humidity (air dried) ....%	12.5	15.7	16.6	8.2	9.9	10.4	11.4	12.1	14.0	9.8
Proximate analysis:										
Moisture ....%	12.3	22.0	29.5	11.8	14.6	13.3	16.7	16.9	22.2	11.9
Ash ....%	5.5	10.2	18.2	18.3	15.9	18.6	22.9	25.1	17.4	11.3
Volatile matter ....%	32.6	27.0	22.7	26.9	28.3	27.4	25.0	25.0	27.6	31.1
Fixed carbon ....%	49.6	40.8	29.6	43.0	41.2	40.7	35.4	33.0	32.8	45.7
Ultimate analysis:										
Carbon ....%		50.10		56.10	54.45					
Hydrogen ....%		5.50		5.10	5.45					
Calorific value, gross B.T.U. per pound	11,340	8,390	6,060	9,750	9,450	8,990	7,720	7,140	6,920	9,900
Fuel ratio (F.C./V.M.)	1.50	1.50	1.30	1.60	1.45	1.50	1.40	1.30	1.20	1.45
Rank*	1	3	4	1	1	1	2	2	3	1

*Rank: 1 = High volatile C Bituminous; 2 = Subbituminous B; 3= Subbituminous C; 4 = Lignite.

Analyses made in the laboratories of the Research Council of Alberta.
All samples collected by J. L. Carr unless otherwise stated.
Location No. 3, LSD. 15, Sec. 35, Tp. 70, R. 7, W. 6th. Lab. Sample 429--43, Sample from Baldwin Collieries, at face, collected by J. A. Allan.
Location No. 4, Tp. 69, R. 5, W. 6th. Lab. Sample 429-44, Sample from outcrop.
Location No. 5, Sec. 2, Tp. 68, R. 10, W. 6th. Lab. Sample 414-44, Sample from outcrop at strip pit.
Location No. 5, Sec. 2, Tp. 68, R. 10, W. 6th. Lab. Sample 424-44, Sample from end of 20-foot tunnel, collected by J. A. Allan.
Location No. 9, Sec. 17, Tp. 64, R. 6, W. 6th. Lab. Sample 423-44, Sample from outcrop.
Location No. 11, Sec. 11, Tp. 64, R. 7, W. 6th. Lab. Sample 410-44, Sample from outcrop.
Location No. 14, Sec. 34, Tp. 63, R. 10, W. 6th. Lab. Sample 418-44, Sample from outcrop.
Location No. 15, Sec. 17, Tp. 64, R. 11, W. 6th. Lab. Sample 421-44, Sample from outcrop.
Location No. 16, Sec. 5, Tp. 64, R. 11, W. 6th. Lab. Sample 420-44, Sample from outcrop.
Location No. 17, Sec. 36, Tp. 63, R. 11, W. 6th. Lab. Sample 419-44, Sample from outcrop.

Conclusions

As a result of the work done in 1944, it appears unlikely that thick coal seams will be discovered north of Wapiti river. While the thin seams that are known north of the Wapiti have been exploited with moderate success, mining operations on a large scale would not be warranted at the present time.

South of the Wapiti, however, several of the occurrences of coal investigated in the field indicate considerable coal reserves. Of these, the occurrence on Pinto creek, on which development has already commenced, is the most favorably located with respect to transportation and market. Other occurrences of importance are on the lower part of Cutbank river. These occurrences are of sufficient importance to warrant systematic prospecting by trenching and possibly by drilling in the vicinity of the outcrops along the Cutbank valley. If such prospecting near the outcrops gave favorable results, then the probable extension of the coal seams on the north side of the Wapiti-Cutbank divide would have to be determined by test drilling.

The analyses show that the coal is of fairly high rank, as High Volatile C Bituminous or Subbituminous A, and Subbituminous B or C. The ash content is high in most of the samples.

OIL AND GAS

No drilling for oil or gas has been undertaken in the area. The nearest drilling has been at Pouce Coupe, about 75 miles northwest of Grande Prairie, where oil "shows" and strong flows of gas have been encountered in beds of Triassic age. To the northeast, near the town of Peace River, about 100 miles northeast of Grande Prairie, gas and small quantities of oil have been encountered in lower Cretaceous beds, assigned to the Loon River formation.

A small mud volcano was observed on the east side of a lake at the head of Bald Mountain creek, in township 68, range 7, west of 6th meridian (Plate I and Figure 10). It gives off considerable quantities of a non-inflammable gas. A spring close by emits small quantities of a gas which burns with a blue flame. It is probable that these gases are produced from decaying vegetation around the lake and not from the bedrock.

No structures were found in the Wapiti-Cutbank area which would warrant drilling. The small anticlinal folds on the west limb of the syncline may be superficial and probably do not extend to depth. Owing to the lack of good horizon markers and the absence of outcrops over most of the area, it is difficult to interpret the structure from surface indications. Possibly the only adequate method for mapping the area structurally, would be geophysical.

Beds of lower Cretaceous age outcrop west of the area and also to the northeast, and almost certainly underlie the area. Triassic beds are reported to outcrop in the foothills west of the area, but are not recognized in the wells at Peace River. The presence of Triassic below the Wapiti-Cutbank area is problematical. The age of the uppermost Paleozoic rocks beneath the area is also unknown, but is probably not earlier than Devonian. However, with the present knowledge of this area, structural conditions favorable for the accumulation of petroleum and natural gas are unknown.

CLAY

Clays of glacial and recent ages are widespread in the Wapiti-Cutbank area. Little attention was given to these during the field season.

One sample of clay was collected from the bottom of a muskeg in the southeast quarter of section 9, township 70, range 6, west of 6th meridian. This clay deposit is of local extent and is four and one-half feet thick where examined. The clay is underlain by boulder clay and overlain by one foot of clayey sand and about five feet of moss and peaty moss. A specimen of this clay was submitted to Professor W. G. Worcester, Department of Ceramic Engineering, University of Saskatchewan, who reported as follows:

> "Sample No. 1 clay from township 70, range 6, west of 6th meridian was of a medium dark shade, was dry and hard, rather granular as to structure, and carried a few small pebbles which would lead one to class this clay as a glacial or more recent flood deposited material. It proved to be free of carbonates. Other than being a little sticky when tempered with water, it has fair plasticity, its drying shrinkage is rather high for full sized ware. It burns to a nice red, but due to an early start of vitrification, plus the presence of gas-forming impurities, possibly sulphates, carbon, etc., severe bloating has taken place as may be seen from the trials (bricklets). This condition would most likely be worse in full-sized ware like brick. This clay is of doubtful value."

A sample received by the Research Council of Alberta from Mrs. J. Perry was reported to have been collected from a dried-up lake bottom near the town of Beaverlodge. Part of this sample was submitted to Professor Worcester, who stated:

> "Sample No. 2 clay . . . as received was dry, granular, greyish in shade and carried some small pebbles, carbonates were present. This sample was less plastic than the previous one, though it had ample for molding purposes. Its drying shrinkage was satisfactory. It burns to a light shade of red at the two lower temperatures (1634° and 1840°F.) and then suddenly overfires at the highest burn (2003°F.). In other words, it has a narrow vitrification. While it burns safely insofar as freedom from bloating is concerned, it carries scum-forming impurities (alkalies and sulphates) as may be seen on the back of each trial (bricklet). This condition can be corrected by chemical treatment during manufacture. Of the samples submitted, this clay offers the most promise for further investigation."

This clay when air dried is quite hard and tough, and does not show shrinkage cracks. The extent and depth of the clay deposit in the vicinity of Beaverlodge from which the sample tested was collected, will be investigated in the field at the earliest possible date.

A small brick plant is operated by K. J. Dalen during part of the summer in the northeast quarter of section 14, township 71, range 6, west of 6th meridian, one-half mile south of Grande Prairie. The clay is a laminated deposit on the east bank of Bear river. Brick is made by the sand-mold process. The product is of a brownish-red color. It is said to be unsuitable for face brick due to a tendency to weather. The bricks are burnt in a non-permanent kiln, using wood for fuel. The sand for the molds is derived from the sand hills between Grande Prairie and the Wapiti river.

A sample of this clay was submitted to Professor Worcester for testing and his report is as follows:

Report on Clay Sample No. 1383

> "This sample, stated to be from near Grande Prairie, Alberta, was submitted by Dr. J. A. Allan on behalf of the Research Council of Alberta, with the request that it be tested and an opinion given regarding improving the quality of the ware now made from it.

"The sample as received consisted of a few pounds of the clay in a dry, lumpy condition. It was yellowish in shade, of an earthy fracture, so silty that it dusted quite easily and when tested with acid, was found to carry carbonates. Examined under the microscope, a fairly large amount of quartz grains of varying sizes was found. These were for the most part clear and quite angular rather than water-worn, an indication that they had not been transported very far.

"The material was easily crushed to pass a sixteen mesh screen, followed by dividing it into two lots; one was tempered for dry pressing, the other for the stiff mud process. In the latter case the range of suitable temper was found to be quite narrow, a condition common to clays of the type, that is, with a small deficiency of tempering water the clay was mealy and lacked plasticity, while with a slight excess of water, the mass became too soft and would not hold its shape when molded.

"When carefully tempered it was possible to mold and repress the trials without any particular trouble, though they would not stand undue handling without losing their shape, a condition largely due to the high quartz (non plastic) content.

"The batch prepared for dry pressing gave little trouble at the press, but the bricks when taken from the mold had to be very carefully handled in order to prevent crumbling off of the edges.

"All trials dried safely and with very low shrinkages, conditions common to most clays carrying carbonates as in the present case. A small amount of scum (white-wash) was noted on the dry trials made by the stiff mud process.

Burning

"Four different temperatures were used in the testing of this clay in that it was necessary to determine the one most suited to the safe burning of this clay.

"In the table below, there are presented the data obtained on the burned trials.

Trials	Fired at cone	% Total Shrinkage	% Absorption	Color
No. 1 Small color trial	*010	6.4	19.10	Light red
No. 2 Small color trial	05	6.4	17.90	Light pink
No. 3. Small color trial	01	16.3	0.60	Yellow-green
Dry press bricks	03	1.13	24.95	Pinkish-buff
Stiff mud 3″x3″x1″	03	6.4	18.25	Pinkish-buff

*010 approximately 1634°F.
05 approximately 1886°F.
03 approximately 1976°F.
01 approximately 2030°F.

"From the above it may be noted by both the shrinkage and absorption that this clay overfires or fails very sharply at cone 01. Hence, in order to be on the safe side a somewhat lower temperature would be best for commercial burning. In the writer's opinion, cone 03 is about the safe upper limit, though at cones 010 and 05 the shrinkage and absorption of the stiff mud trials are practically the same as they are at cone 03. Hence other than far increased strength, nothing would be gained by the higher temperature. In either case, the absorption would be high, a condition which restricts the use of this clay to the manufacture of common bricks.

"Of the two methods employed in this investigation, the stiff mud is the one to be recommended. The strength is lower in the dry press trials and the absorption is much higher, such that they would most likely disintegrate under outside freezing and thawing conditions.

"The soft mud and hand molding methods are both worthy of consideration for this clay but the product would have, in both cases, higher absorption than by the stiff mud process. Even with the latter, there would be some difficulties in the forming of the ware due to the short tempering range.

General Conclusions

"While this clay is not all that could be desired, it can be used for the manufacture of common brick where a high absorption may be permissible. Extreme care must be exercised in the pugging and tempering of this clay for the stiff mud process; a little wider variation is possible in the temper for soft mud or hand molded ware.

"The burning must be carefully controlled as to the maximum temperature. This part of the work should be in the hands of an experienced kiln burner, and if possible, one who has had to deal with short vitrification range clays.

"This clay could no doubt be improved through the addition of a more highly plastic clay, that is, one carrying more clay substance and less quartz (rock dust). This blending would have to be well and uniformly made to avoid other troubles."

The clay deposits in the vicinity of Grande Prairie will have to be investigated in greater detail before it is possible to determine the economic importance of such deposits.

SAND AND GRAVEL

No extensive deposits of coarse sand are known from this area. The sandhills, immediately north of the Wapiti river, are composed on the whole of quite fine sand. Coarser sand occurs in lenses of limited extent.

Gravel occurs in large quantities on a high terrace, of which remnants occur along the Wapiti river from the mouth of Pipestone creek downstream. Gravel pits have been opened on this terrace on either side of the road to the Grande Prairie ferry, to supply gravel for construction in the neighborhood.

WATER SUPPLY

Water for farm use is usually obtainable in wells in this area at depths of less than three hundred feet. Some of the water is obtained from sandstone beds in the Wapiti formation, and the water in other wells is obtained from gravels in the unconsolidated deposits. Difficulty is sometimes experienced in obtaining adequate water supplies close to the edges of the deeper valleys, where the bedrock outcrops. This condition is due to drainage of some of the underground water into the valleys.

INDEX

INDEX

LIST OF PUBLICATIONS
of
RESEARCH COUNCIL OF ALBERTA
EDMONTON, ALBERTA

ANNUAL REPORTS OF COUNCIL

No. 3 (for the calendar year 1920); pp. 36. **(Out of print.)**
No. 5 (for the calendar year 1921); pp. 86. **(Out of print.)**
No. 8 (for the calendar year 1922); pp. 64. **(Out of print.)**
No. 10 (for the calendar year 1923); pp. 76. **(Out of print.)**
No. 12 (for the calendar year 1924); pp. 66. **(Out of print.)**
No. 16 (for the calendar year 1925); pp. 65. **(Out of print.)**
No. 20 (for the calendar year 1926); pp. 53. **(Out of print.)**
No. 22 (for the calendar year 1927); pp. 49. **(Out of print.)**
No. 24 (for the calendar year 1928); pp. 53. **(Out of print.)**
No. 25 (for the calendar year 1929); pp. 65. **(Out of print.)**
No. 26 (for the calendar year 1930); pp. 76. **(Out of print.)**
No. 27 (for the calendar year 1931); pp. 53. **(Out of print.)**
Nos. 28, 29 and 32 (for the calendar years 1932-1934); pp. 90. **Price 35 cents.**
No. 33 (for 1935); pp. 43. **Price 35 cents.**
Nos. 37-43 (for 1936-1942). Not published.
No. 44 (for 1943); pp. 14. **Price 5 cents.**
No. 45 (for 1944); pp. 18. **Price 5 cents.**
No. 47 (for 1945); pp. 21. **Price 5 cents.**

REPORTS—FUELS

No. 10A (1923); COMBUSTION OF COAL FOR THE GENERATION OF POWER, by C. A. Robb. **(Out of print.)**

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

No. 35 (1944); pp. 174. COALS OF ALBERTA—THEIR OCCURRENCE ANALYSIS AND UTILIZATION, by Edgar Stansfield and W. Albert Lang. In six parts. **Price $1.00.**

Parts I-V—Occurrence, classification, production, special tests, general properties, preparation, utilization and combustion. **Price 50 cents.**

Part VI—Analytical and technical data by coal areas. **Price 50 cents.**

No. 46. ALBERTA COALS AND AUTOMATIC DOMESTIC STOKERS. Edgar Stansfield and Colin A. Genge. **Price 20 cents.**

REPORTS—ROAD MATERIALS

No. 18. THE BITUMINOUS SANDS OF ALBERTA, by K. A. Clark and S. M. Blair.
Part I (1927)—Occurrence, pp. 74. **Price 25 cents.**
Part II (1927)—Separation, pp. 36. **Price 25 cents.**
Part III (1929)—Utilization, pp. 33. **Price 25 cents.**

REPORTS—SOIL SURVEY DIVISION

No. 23 (1930); PRELIMINARY SOIL SURVEY ADJACENT TO THE PEACE RIVER, ALBERTA, WEST OF DUNVEGAN, by F. A. Wyatt and O. R. Younge; pp. 33 and colored map. Scale 1 inch to 4 miles. **(Out of print.)**

No. 31 (1935); PRELIMINARY SOIL SURVEY OF THE PEACE RIVER-HIGH PRAIRIE-STURGEON LAKE AREA, by F. A. Wyatt; with colored map. Scale 1 inch to 4 miles. **(Out of print.)**

REPORTS—GEOLOGICAL SURVEY

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

No. 1 (1919); pp. 104—A summary of information with regard to the mineral resources of Alberta. **Price 25 cents.**

No. 2 (1920); pp. 138+14. Supplements the information contained in Report No. 1. **(Out of print.)**

No. 4 (1921); GEOLOGY OF THE DRUMHELLER COAL FIELD, ALBERTA; pp. 72, and 6-color map (Serial No. 1). **(Out of print.)**

No. 6 (1922, Part I); GEOLOGY OF THE SAUNDERS CREEK AND NORDEGG COAL BASINS, ALBERTA, by J. A. Allan and R. L. Rutherford; pp. 76 and 2-color map (Serial No. 2). **(Out of print.)**

No. 7 (1922, Part II); AN OCCURRENCE OF IRON ON THE NORTH SHORE OF LAKE ATHABASKA, by J. A. Allan and A. E. Cameron; pp. 40; two maps (Serials Nos. 3 and 4). **(Out of print).**

No. 9 (1923); GEOLOGY ALONG BLACKSTONE, BRAZEAU AND PEMBINA RIVERS IN THE FOOTHILLS BELT, ALBERTA, by J. A. Allan and R. L. Rutherford; pp. 48, and 6-color map (Serial No. 5). **(Out of print.)**

No. 11 (1924); GEOLOGY OF THE FOOTHILLS BELT BETWEEN McLEOD AND ATHABASKA RIVERS, ALBERTA, by R. L. Rutherford; pp. 61 and 8-color map (Serial No. 7). One inch to two miles. **(Out of print.)**

No. 13 (1945): GEOLOGY OF RED DEER AND ROSEBUD SHEETS, by J. A. Allan and J. O. G. Sanderson; pp. 125. Two geological maps in 8 colors. Scale one inch to three miles. Serial No. 8 Red Deer Sheet and No. 9 Rosebud Sheet. Five structure sections. **Price 75 cents.**

Map No. 10 (1925); GEOLOGICAL MAP OF ALBERTA, by J. A. Allan. In 14 colors. Scale one inch to 25 miles. **(Out of print.)**

No. 15 (1926); GEOLOGY OF THE AREA BETWEEN ATHABASKA AND EMBARRAS RIVERS, ALBERTA, by R. L. Rutherford; pp. 29 and 3-color map (Serial No. 11). One inch to two miles. **(Out of print.)**

No. 17 (1927); GEOLOGY ALONG BOW RIVER BETWEEN COCHRANE AND KANANASKIS, ALBERTA, by R. L. Rutherford; pp. 46 and 9-color map (Serial No. 12). Scale 1 inch to 1 mile. **Price 50 cents, or map alone 25 cents.**

No. 19 (1928); GEOLOGY OF THE AREA BETWEEN NORTH SASKATCHEWAN AND McLEOD RIVERS, ALBERTA, by R. L. Rutherford; pp. 37 and 3-color map (Serial No. 13). Scale 1 inch to 3 miles. **Price 10 cents.**

No. 21 (1930); GEOLOGY AND WATER RESOURCES IN PARTS OF PEACE RIVER AND GRANDE PRAIRIE DISTRICTS, ALBERTA, by R. L. Rutherford; pp. 80 and 6-color map (Serial No. 14). Scale 1 inch to 4 miles. **Price 50 cents.**

No. 30 (1934); GEOLOGY OF CENTRAL ALBERTA, by J. A. Allan and R. L. Rutherford; pp. 41 and 10-color map (Serial No. 15). Scale 1 inch to 10 miles. **(Out of print.)**

Map No. 16 (1937); GEOLOGICAL MAP OF ALBERTA (Coloured), by J. A. Allan. Scale 1 inch to 16 miles. **Price 75 cents.** Obtainable from the Dept. of Lands and Mines, Administration Building, Edmonton.

Map. No. 17 (1939); GEOLOGICAL MAP OF ALBERTA (Black and white), by J. A. Allan. Scale 1 inch to 32 miles. **Price 5 cents.**

Map No. 18 (1940); COAL AREAS OF ALBERTA, by J. A. Allan. Scale 1 inch to 32 miles. **Price 25 cents.**

No. 34 (1943), in five parts by J. A. Allan; pp. 202. **Price $1.50.**

Part I—General Geology of Alberta, pp. 37, and geological map No. 17, scale 1 inch to 32 miles. **Price 50 cents.**

Part II—Rock Salt Deposit at Waterways, pp. 19.

Part III—Geology of Alberta Soils, pp. 87. **Price 25 cents.**

Part IV—Relief Model of Alberta and its Geological Application, pp. 9.

Part V—Coal Areas of Alberta, pp. 36, and Map No. 18, scale 1 inch to 32 miles. **Price 75 cents.**

REPORTS—RURAL ELECTRIFICATION

No. 36 (1944); pp. 107. RURAL ELECTRIFICATION IN ALBERTA, by Andrew Stewart. (Not available for distribution.)

Appendix I (1944); pp. 77. (Not available for distribution.)

Appendix II (1944); pp. 115 with maps. (Not available for distribution.)

CONTRIBUTION SERIES

This series comprises papers submitted to technical societies or journals by members of the technical staff. They are not available for general distribution; but can be consulted in the original publication cited.

No. 1—Fuel Investigations of the Research Council of Alberta (1919-1940), by W. A. Lang. Trans. Canadian Institute of Mining and Metallurgy, Vol. XLV, 1942, pp. 27-44.

No. 2—Humidity Data Expressed in Grains Water Vapour per Pound of Dry Air, by Edgar Stansfield. Canadian Journal of Research, A 21, 1943, pp. 51-55.

No. 3—Alternative Fuels for Motor Vehicles, by W. A. Lang, The Engineering Journal, August 1943, pp. 449-454.

No. 4—Hot-Water Separation of Alberta Bituminous Sand, by K. A. Clark, Trans. Canadian Institute of Mining and Metallurgy, Vol. XLVII, 1944, pp. 257-274.

No. 5—Some Physical Properties of a Sample of Alberta Bituminous Sand, by K. A. Clark, Canadian Journal of Research, F 22, 1944, pp. 174-180.

No. 6—Purification of Silica Sand—Alberta Tar Sands Suitable for Glass Manufacturing, by E. O. Lilge, Canadian Chemistry and Process Industries, Vol. XXIX, July, 1945, pp. 480-482.

No. 7—Bituminous Sands of Alberta, by K. A. Clark, The Oil Weekly, August 13, 1945, pp. 46-51.

No. 8—Asphaltic Road Oils from Alberta Bituminous Sand, by K. A. Clark, Canadian Chemistry and Process Industries, Vol. XXIX, September, 1945, pp. 616-618.

No. 9—Research and the Coal Industry in Canada, by W. A. Lang, Trans. Canadian Institute of Mining and Metallurgy, Vol. XLIX, 1946, pp. 51-62.

No. 10—Recent Work of the Research Council of Alberta, by E. Stansfield, Bulletin Canadian Institute of Mining and Metallurgy, No. 406, February, 1946, pp. 121-128.

Research Council of Alberta, 1946 Report 48, Plate I

MAP No. 19

WAPITI-CUTBANK AREA, ALBERTA

COAL OCCURRENCES

Base map compiled from published maps and from pace-and-compass traverses.

LEGEND:

Wapiti formation (Upper Cretaceous) underlies the whole area.

- Coal Mine
- 5 Coal Occurrences (Described)
- 2 Coal Outcrops (Undeveloped)
- Outcrops
- 10 Strike and Dip
- Fault
- Axis of Anticline
- Axis of Syncline
- Pack Trail (Sketched)
- Road (Sketched)
- 2154 Bench Mark, with Elevation
- 2612 Triangulation Station with Elevation

Scale of Miles. 1 ½ 0 1 2 3 4 5

119°30' 119°15' 119°00' 118°45' 118°30'

55°00' 54°45' 54°30'

Hualien Northern Wembley Alberta Railway Dimsdale Spring Flying Shot Lake Settlement Grande Prairie 2151' Brick Plant Hermit L. 2180' Hughes L. 2193' L. Saskatoon 2331' Beaverlodge River Leighmore Halcourt Pipestone Creek Red Willow River Elmworth Hinton Trail Pipestone Creek Pipestone Ferry WAPITI RIVER Grande Prairie Ferry Gravel Pit Private Ferry Grovedale Sylvester Wapiti Beaverdam Creek Bear River Bridge Creek Mud Volcano Smoky River Mountain Creek Big Bald Mountain Cr. Bald Mountain BALD MTN Nose Creek East Fork Pinto Creek West Fork Pinto Creek Muddy Creek Sporadic outcrops, float to gently dipping Grayling Cr. Wolf Creek Horse Creek Rat Creek Coyote Cr. Falls Cutbank Lake North Fork Nose Creek Mountain South Fork Cutbank River

71 70 69 68 67 66 65 64 63

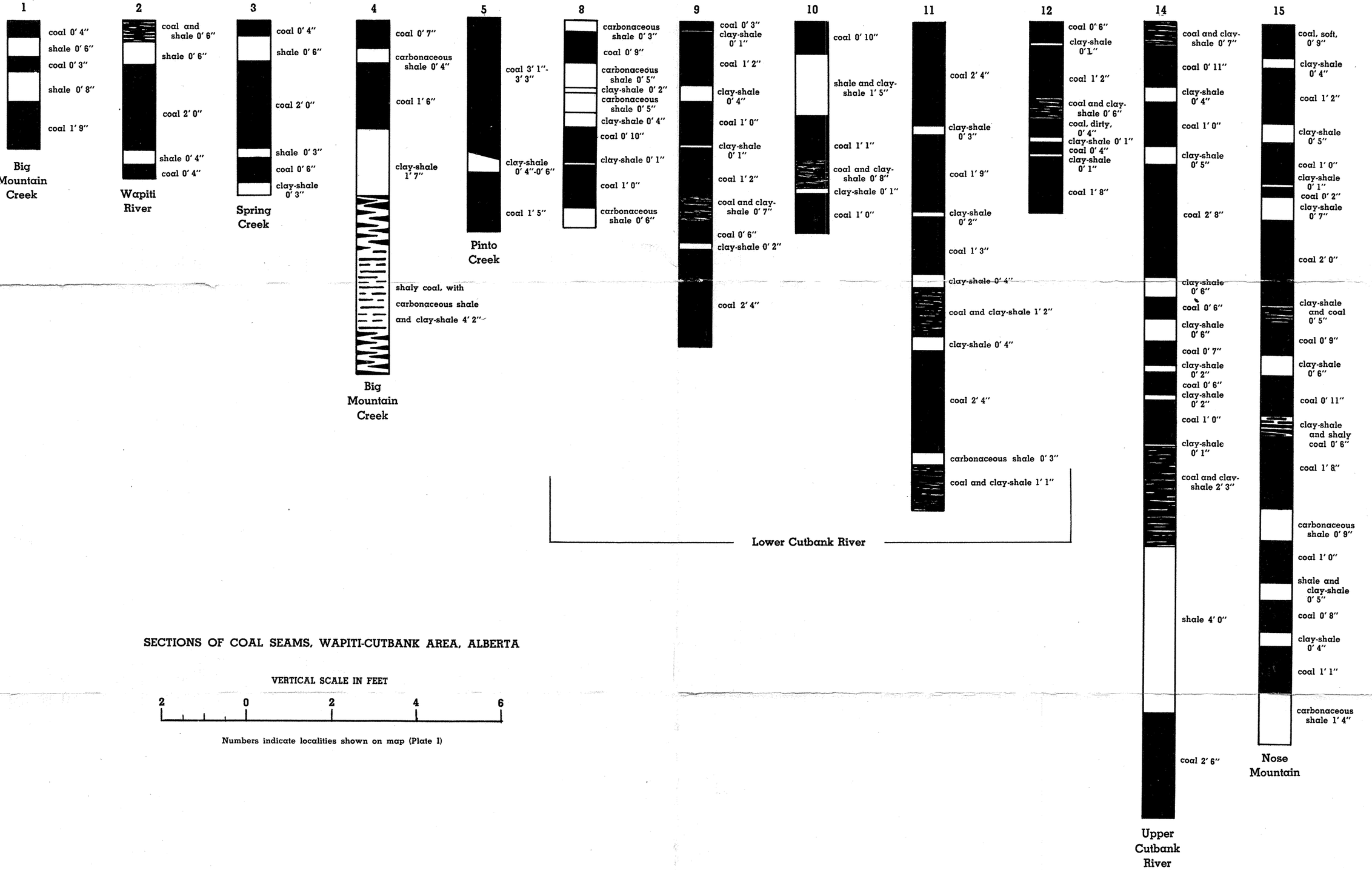
10TH BASE LINE 17TH BASE LINE

XI X IX VIII VII VI V IV

West of the 6th Meridian.

SKETCH MAP SHOWING LOCATION OF THE WAPITI-CUTBANK AREA.

Scale of Miles:- 30 0 30 60 90



SECTIONS OF COAL SEAMS, WAPITI-CUTBANK AREA, ALBERTA

VERTICAL SCALE IN FEET

2 0 2 4 6

Numbers indicate localities shown on map (Plate I)