Eug. Poitevin

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DANIELS FLATS MAP-AREA, ALBERTA

(REPORT AND MAP)

By

E. J. W. Irish

OTTAWA

1950

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(Summary Account)

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Illustration

Preliminary map - Daniels Flats, Alberta ..... In envelope

DANIELS FLATS MAP-AREA, ALBERTA

INTRODUCTION

Location

Daniels Flats map-area, comprising 170 square miles, is situated in the eastern part of the Foothills belt of west-central Alberta, between latitudes 54°00' and 54°15' and longitudes 119°00' and 119°15'. The area is about midway between the transcontinental line of Canadian National Railways, which follows the valley of Athabasca River about 80 miles to the southeast, and the Northern Alberta railway, which passes through the towns of Grande Prairie and Beaverlodge about 80 miles to the north.

Accessibility

The village of Entrance, on the main line of the Canadian National railway, 190 miles west of Edmonton, has been for many years the outfitting point for the large region extending north and northwest and including the Smoky River territory. Coal prospectors, hunting parties, and, more recently, exploratory geological parties representing oil companies, have made Entrance their base.

The map-area may also be reached from the towns of Grande Prairie and Beaverlodge, situated just north of Wapiti River on the Northern Alberta railway, but the trail to the north is in poor condition compared with those farther south.

Entrance provides a good store, post office, and telegraph service, and may be reached either by railway or by a branch road that connects with the Edmonton-Jasper highway 2 miles to the south. For many years travel in the extensive territory north of Athabasca River has been facilitated by pack-trails maintained by rangers of the Alberta Forest Service. At one time these trails were kept in excellent repair, but for some years past no trail crews have been available to replace

bridges and corduroy, with the result that most of the trails are in poor condition, and in places almost impassable for horses.

Prior to the summer of 1946, the only means of access to the map-area was by pack-trail. The Lower trail, the most direct route from Entrance, followed the eastern edge of the Foothills northwesterly to the Muskeg ranger cabin and then extended westerly to the Indian village of Grande Cache. Twelve miles west of the Muskeg ranger cabin, the Grande Prairie trail branches from the Lower trail and follows down Muskeg River to the northwest. In 1946 and 1947, under the Northern Foothills Agreement, a road, following more or less the route of the Lower trail, was constructed from Entrance to the site of Muskeg No. 1 well. This road was suitable for trucks during 1947, 1948, and 1949, but now that the well has been abandoned may soon become impassable for trucks. Westward from the well site, the Lower trail is followed for about 6 miles to its junction with the Grande Prairie trail, and from there the latter route is followed down the northeast side of Muskeg River to its confluence with Smoky River just inside the south-east corner of Daniels Flats map-area. Smoky River must be forded here, and from the north side of the ford the Grande Prairie trail follows down Smoky River, crosses Sheep Creek near its mouth, and from there extends northwestward across the map-area.

An alternative, though less direct, route is by the Mountain trail, a more westerly route that branches from the Lower trail (now the Muskeg road) about a mile north of Wildhay River and about 20 miles northwest of Entrance. This trail follows Wildhay River westward and northwestward almost to its source, then west through Eagle's Nest pass and northwest up Rock Creek to its source. Leaving Rock Creek, the trail crosses the divide and follows down Sulphur River to Smoky River just west of the village of Grande Cache. From there an Indian trail extends down the east side of Smoky River to a ford opposite Gustavs Flats, and thence follows down the river on the northwest side to Daniels Flats map-area.

Few trails exist within the map-area itself. An Indian trail enters the area in the southwest corner, follows down the north side of Sheep Creek for 3½ miles, and then extends northwestward over steep-sided, high ridges to the western boundary of the area. This trail and several other trap-line trails were widened and used to facilitate travel throughout the area, but they are difficult, and in places dangerous, for loaded pack-horses.

The only ford across Smoky River that was used during the summer of 1949 was that at Daniels Flats just downstream from the mouth of Muskeg River. Like all fords on this river it cannot be used at times of high water, but at other times this crossing is satisfactory. The position of the gravel bars changes each year, and inexperienced travellers wishing to cross the river would be advised to obtain help from the Indians of the district.

Sheep Creek has two fords near its mouth: one at the mouth and one upstream about 300 yards. The upper crossing was found to be the better. Sheep Creek, like Smoky River, is too deep and swift to be crossed when in flood.

Horses are the only means of transportation of both men and supplies to and within the map-area.

Previous Work

The only published geological information on the map-area is contained in reports by J. MacVicar (1917, 1920, 1924), who made a reconnaissance survey of the region north of the Grand Trunk Pacific (now Canadian National) railway, and by James McEvoy (1924), who examined the Smoky River coalfields, Alberta, for the Dominion Fuel Board. More recently, the Foothills region north of Athabasca River has been actively prospected for petroleum by various oil companies.

Acknowledgments

The present report is based on field work begun and completed during the summer of 1949. The writer was assisted in the field by G.H. MacDonald, C.J.H. Pedrick, and H.S.M. Cook. He is indebted for many courtesies to members of the Alberta Forest Branch, to Messrs. R. Neighbor and S.H. Clark of Entrance, and to Daniel Wanyandie at Smoky River.

Fossils collected from the area were identified by F.H. McLearn of the Geological Survey of Canada.

Physical Features

Daniels Flats map-area lies within the eastern part of the Foothills belt of west-central Alberta, and the southwestern third of it is characterized by northwesterly trending ridges and valleys. In the northeastern two-thirds of the area, however, this alinement of elongated ridges gives way to broad, irregularly shaped, gently rounded or flat-topped ridges separated by wide, flat-bottomed, swampy valleys. Elevations and regularity of the ridges both increase toward the southwest.

The highest summit is about 5,500 feet above sea-level and the lowest point about 2,900 feet, giving a maximum relief of some 2,600 feet. The highest hills are in the southwestern part of the area, but none projects above timber-line.

Forest fires have burned over most of the map-area at various times in the past, so that the country is now either covered with a tangled mass of logs and brush or with second-growth jack pine. Very little virgin forest remains except for small patches of spruce in the creek valleys in the extreme northeast corner of the area. Along Smoky River and, to some extent, along Sheep Creek the south slopes of the bordering hills are bare of trees and are covered to the summits with a luxuriant growth of grass.

The principal streams draining Daniels Flats map-area are Smoky River, Sheep Creek, and Prairie Creek. Smoky River and Sheep Creek drain the southwest part of the area. The former occupies a broad, U-shaped valley fringed with gravel terraces. It is a stream about 300 feet wide, has a very swift current, and can be forded only during very low water at a few places. The floor of the valley is uneven, as a result of the alluvial fans each tributary has built into the valley.

The main tributary of Smoky River in the map-area is Sheep Creek, a stream about 100 feet wide and about 3 feet deep, which roughly parallels the valley of Smoky River. Its lower part, to near its junction with the Smoky, occupies a narrow canyon about 10 miles long, in which the walls range from 100 to 300 feet high. Above the canyon, Sheep Creek flows in a steep-walled, V-shaped valley.

Most of the northeastern two-thirds of Daniels Flats map-area is drained by Prairie Creek, a stream about 10 to 15 feet wide, which flows northeast and empties into Kakwa River beyond the map-area. This stream and most of its tributaries flow through wide, flat areas of open muskeg and bog, which are separated by low ridges covered with jack pine.

In the northern part of the area are several large creeks that flow northeastward and empty into Kakwa River.

The map-area contains no lakes, but a large part of the northern two-thirds of it consists of swamp and muskeg.

GENERAL GEOLOGY

General Statement

Daniels Flats map-area is underlain by a succession of marine and non-marine sedimentary strata ranging in age from Lower Cretaceous to, probably, Paleocene. The strata have been folded along northwesterly trending axes and displaced by strike thrust faults that parallel the

axes of the folds. As a result, the formations are, in general, exposed as long, relatively narrow, northwesterly trending bands.

The older formations are exposed in the southwestern third of the area, and are faulted and complexly folded. The northeastern two-thirds of the area is underlain by late Upper Cretaceous and, probably, Paleocene strata.

Bedrock is best exposed in the stream valleys, especially where canyons have developed, but good rock exposures are also found on some of the higher ridges. Outcrops are scarce in the large area underlain by the later Upper Cretaceous strata, owing to the low inclination of the beds and the resulting low, rounded hills and extensive muskegs. The best exposures occur along Sheep Creek from the point where the stream enters the map-area to its confluence with Smoky River.

Outcrops are sufficient in most places to permit reasonably accurate location of geological boundaries, but in parts of the area these positions have been inferred from relatively little outcrop data.

The formations have been traced from other map-areas to the southeast, and most of them are the approximate counterparts of formations that were first studied and named in southwestern Alberta, 200 to 300 miles away. However, the stratigraphic succession in the map-area shows analogies to that of the Peace River district, where the sequence is somewhat different and where a different formational nomenclature has been adopted. For this reason explanations regarding the terminology used in this report accompany the description of certain formations.

Table of Formations

Period or epoch	Formation or group, and approximate thickness in feet	Subdivision and approximate thickness in feet	Lithology
Paleocene ?			Sandstone, shale, conglomerate (non-marine)
Upper Cretaceous	Brazeau 6,000 ±		Sandstone, shale conglomerate (non-marine)
		Solomon member 80-100	Sandstone (marine)
	Wapiabi 1,000	Baculites ovatus zone Scaphites ventricosus zone	Shale, shaly sandstone (marine)
	Bighorn 600		Quartzitic sandstone, shale, sandy shale (marine and non-marine)
	Blackstone 1,800 ±	Prionotropus zone	Shale and minor siltstone (marine)
	Dunvegan 400		Sandstone, shale, sandy shale (marine and non-marine)
Lower Cretaceous	'Fort St. John' 400 +		Shale and sandy shale (marine)
	Blairmore group: Luscar and ? Mountain Park 2,000		Sandstone, shale, conglomerate, coal (non-marine)
	Blairmore group: Cadomin 30-100		Conglomerate
	Disconformity		
	Nikanassin 500 +		Quartzitic sandstone and shale (marine and non-marine)

Lower Cretaceous

Nikanassin Formation

Nikanassin strata are the oldest exposed in the map-area. The largest area underlain by these rocks is in the extreme southwest corner where they outcrop on both sides of Sheep Creek. Farther down this creek are three small ovate areas where erosion of the valley has exposed the Nikanassin formation in the cores of anticlinal structures. The only exposure on Smoky River, near the south boundary of the map-area, is also due to erosion of an anticline.

The upper 500 feet only of these strata are exposed in Daniels Flats area. Here they consist of very hard, grey, dark grey, and brown, grey and buff weathering, fine- to medium-grained, quartzitic sandstone, with some interbedded grey shale. The sandstone beds range in thickness from about 6 inches to 3 feet. Ripple-marks are common in these beds, and carbonized plant remains occur in some.

Cadomin Formation

The Cadomin formation lies stratigraphically above the Nikanassin. It is well exposed in the valley of Sheep Creek, where it encloses the small areas underlain by Nikanassin beds. In the southwest corner of the map-area, the Cadomin outcrops intermittently as a long, northwest-trending band. The formation is distinctive, and usually forms conspicuous outcrops, and for this reason is an excellent horizon marker.

In Daniels Flats, as in the adjoining Pierre Greys Lakes map-area to the southeast, the Cadomin formation can be divided roughly into three parts. The upper part consists of about 30 feet of conglomerate with intercalated sandstone lenses and beds. Below this are from 50 to 60 feet of grey sandstone and siltstone in beds from 6 inches to 2 feet thick, and, at the bottom, 30 to 50 feet of massive conglomerate, with a few grey sandstone lenses.

The conglomerate consists of closely packed pebbles of black, grey, green, brown, and reddish chert, and pink and white quartzite, which range from ¼ inch to 4 inches in diameter. The matrix is siliceous, and the rock fractures across the pebbles rather than around them.

Luscar and(?) Mountain Park Formations[1]

The Luscar formation overlies the Cadomin conformably. It underlies a wide, closely folded, northwest-trending band that occupies most of the southwestern third of the map-area. Outcrops are abundant along Sheep Creek, but in general the formation is poorly exposed.

The Luscar consists of non-marine and brackish-water, fine- to medium-grained, grey, greyish green, and brownish sandstone; grey and black shale; coal seams from 6 inches to 20 feet thick; and thin, yellow weathering ironstone bands, which are usually associated with shale. These strata show lateral variations in lithology within relatively short distances, but all sections are composed of similar types of rocks.

The upper part of the map-unit, which may represent the Mountain Park formation, consists of about 300 to 350 feet of fine-, medium-, and coarse-grained, grey and greenish grey, buff weathering, thick-bedded sandstone.

The following partial section was measured in the large gulch on the north side of Smoky River about 2 miles above the mouth of Muskeg River:

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[1] A query is used in this heading because of the uncertainty of the continuation of the Mountain Park formation or its equivalents into the Daniels Flats map-area. In the following account the term 'Luscar formation' will, unless otherwise noted, be used to include any possible overlying Mountain Park strata or their equivalents.

	Thickness Feet
Overlying beds: 'Fort St. John' group	
Grit and fine conglomerate; composed of dark-coloured chert; rusty weathering	2
Covered	180
Sandstone, hard, grey, fine-grained	8
Covered	90
Sandstone, hard, grey, fine-grained; some thin, grey, shale partings	200
Sandstone, hard, greenish grey, medium-grained, platy	82
Siltstone, dark grey	6
Sandstone, grey, medium-grained, crossbedded; contains carbonized wood remains	28
Shale, black, carbonaceous; coaly streaks	10
Sandstone, grey, medium-grained	40
Shale, grey, silty; some carbonaceous shale	8
Sandstone, soft, light grey, medium-grained; contains carbonaceous fragments	74
Shale, grey, silty; some carbonaceous and coaly material	34
Sandstone, grey, medium-grained	52
Sandstone, grey; some silty sandstone	5
Sandstone, grey; some interbedded silty sandstone	5
Shale, grey	4
Shale, black, carbonaceous	1
Coal	3
Shale, grey, somewhat silty	25
Sandstone, grey, fine-grained, thin-bedded	6
Sandstone, hard, light grey, fine-grained	50
Shale, grey; some carbonaceous shale; numerous ironstone concretionary bands up to 2 feet thick; a few thin sandstone bands; 3 feet of coal near the top	100
Sandstone, grey, fine- to medium-grained, massive, crossbedded	19

	Thickness Feet
Sandstone, grey, medium-grained; interbedded siltstone; beds up to 3 feet thick	8
Shale, black, carbonaceous	4
Sandstone, brownish grey, fine-grained, thin-bedded	3
Shale, black, carbonaceous; some yellow weathering, concretionary, ironstone bands; some silty shale	32
Shale, grey, silty; some interbedded, black, carbonaceous shale; a few yellow weathering ironstone bands	20
Sandstone, grey, hard, fine-grained, platy	6
Shale, grey; some carbonaceous shale	8
Sandstone and siltstone, interbedded, brownish grey, fine-grained, thin-bedded	40
Sandstone, grey, fine- to medium-grained; some carbonized wood remains; a few ironstone concretions	52
Shale, grey; some interbedded, grey, fine-grained sandstone	20
Shale, black, carbonaceous	2
Coal	18.5
Shale, black, carbonaceous; somewhat silty	10
Sandstone, hard, brown-grey, fine-grained; poorly preserved pelecypods at upper contact with shale	14
Shale, dark grey to black; one regular ironstone band 4 inches thick	13
Sandstone, grey, fine-grained, platy; some poorly preserved plant remains and pelecypods	10
Shale, grey; interbedded with dark grey, shaly sandstone; thin partings of carbonaceous shale	50
Sandstone, grey, hard, fine-grained	8
Shale, silty, dark grey	10
Total thickness exposed	1,360.5

Underlying beds: covered

No complete section of the formation is exposed within the map-area. The total thickness was estimated graphically on structure-sections to be about 2,000 feet, but this apparent thickness may be exaggerated by minor folds and faults.

'Fort St. John' Group

Lying conformably above the Luscar formation is about 400 feet, or more, of dark grey to black shale, much of which is silty. The shales are confined to the southwest part of the map-area and underlie narrow bands due to the erosion of numerous small anticlines and synclines within the wide belt underlain by the Luscar formation. Probably the largest area underlain by the 'Fort St. John' beds is that south of Smoky River and in the southeast corner of the map-area. Exposures of the shale are few and poor.

The section consists mainly of more than 400 feet of dark grey to black, silty shale, but sandstone beds up to 4 feet thick were noted in a zone about 40 feet above the top of the Luscar formation.

No fossils except fish scales were found in this shale, but its stratigraphic position below the Dunvegan suggests that it is equivalent in age to a part of the Fort St. John group of the Peace River district.

Upper Cretaceous

General Statement

In southwestern Alberta the formations of the Blairmore group are overlain by a thick succession of marine shales, with some intercalated sandstone. This succession has been referred to as the 'Benton' or Alberta shale (3), and was divided into Upper and Lower Alberta formations separated by the relatively thin 'Cardium sandstone'. Mallock (10), when mapping the Bighorn coal basin, gave the name 'Bighorn' to a sandstone unit that is of the same age, although thicker, than the typical 'Cardium' beds. He named the shales below the Bighorn the 'Blackstone' and those above it the 'Wapiabi'. These formational names are now in general use throughout the Foothills belt of Alberta, and have, from the beginning, been regarded as representing

strata of Upper Cretaceous age. The upper part of the Blackstone is of Colorado age, according to American nomenclature, and contains abundant Inoceramus labiatus as well as other fossils of the 'Inoceramus labiatus zone'. The lower part of the formation contains few fossils; it has generally been considered to be of early Upper Cretaceous (Colorado) age, though this consideration has been based rather on lithological continuity with the upper part than on its sparse fossil content. Above the Blackstone, the relatively sandy Bighorn formation contains, in its upper part, the diagnostic fossil Cardium pauperculum, also indicative of Colorado time. The succeeding Wapiabi formation is divisible into a lower, Scaphites ventricosus zone and an upper, Baculites ovatus zone, the former of Colorado age, the latter indicating a transition from Colorado to Montana time (15).

The Upper Cretaceous succession in the Peace River district of British Columbia, on the northwesterly continuation of the Foothills belt, varies considerably from that outlined above. There, the lowest strata comprise the Dunvegan formation, which attains a thickness of 1,100 feet and overlies the Lower Cretaceous Fort St. John group. It is overlain, in turn, by the Smoky group, which is thought to have roughly the same stratigraphic range as the Alberta group of the southern Foothills and to correspond with the Blackstone, Bighorn, and Wapiabi formations of Athabasca Valley. At its base a series of dark marine shales forms the Kaskapau formation. This is overlain by the relatively thin Bad Heart sandstone formation, which is succeeded in turn by an unnamed series of marine shales.

The present map-area lies in the southern part of a region in which the geological succession is transitional between the more southerly and more northerly districts. In this report the writer has continued to use the southern nomenclature as far as possible rather than that of Peace River district, until further stratigraphic and palaeontological evidence is obtained and definite correlations can be established.

In the Foothills region south of Athabasca Valley, the stratigraphic interval above the Blairmore group and below the Bighorn formation is occupied by a succession of mainly dark marine shales to which the name Blackstone formation has been applied, and which has been thought to represent the basal formation of the Upper Cretaceous series in this region. North of the Athabasca, however, the same stratigraphic interval has been found to be occupied by a somewhat different assemblage. There, a basal section, about 400 feet thick, overlying the Luscar beds of the Blairmore group, is composed of black, marine shales from which fossils recently collected by R. Thorsteinsen for the Geological Survey appear to indicate a Lower Cretaceous age, equivalent to that of some part of the Fort St. John group of the Peace River district. Northwest from Brûlé map-area (6), this marine shale is overlain by a gradually thickening wedge of sandstone, partly at least of marine origin, and at least 300 feet thick where it reaches Daniels Flats map-area. From this sandstone, fossils characteristic of the basal Upper Cretaceous Dunvegan formation have been collected, and the similarity in lithology to that formation, which is widespread in the Peace River country, leaves no alternative but to identify the sandstone of the Brûlé-Daniels Flats region as Dunvegan. This sandstone is overlain, in turn, by 1,800 to 2,000 feet of mainly black, marine shales such as comprise at least most of the Blackstone of more southerly areas. The shales are succeeded by the Bighorn formation, which carries specimens of the diagnostic fossil species Cardium pauperculum.

The 'Fort St. John' shales of Daniels Flats map-area appear to maintain a generally uniform thickness southeast to Athabasca Valley, and on the assumption that they persist for at least some distance south of the valley, beyond any recognizable extension of the Dunvegan sandstone, their lithological separation from the overlying Blackstone shales would be difficult or impossible. For this reason, therefore,

it seems probable that for some unknown distance south of the Athabasca, including, perhaps, the original type area of the Blackstone formation of the Bighorn coal basin (10), this formation, as mapped, includes some undifferentiated Lower Cretaceous marine shales of the Fort St. John group, shales that can only be separated from the overlying, dominant Upper Cretaceous beds of the Blackstone formation on fossil evidence. No information is yet available as to how far south of Athabasca Valley the northern marine seas of Fort St. John time may have extended, nor, for that matter, that they did reach any appreciable distance south of that valley, for the present, therefore, and except where fossil evidence indicates otherwise, it seems best to regard the Blackstone as an Upper Cretaceous marine formation, which in the Daniels Flats-Brûlé region overlies the Dunvegan and underlies the Bighorn formation, and in areas beyond the southeasterly extension of the Dunvegan overlies the Blairmore group but may include some undifferentiated, Lower Cretaceous, Fort St. John shales.

In the Peace River district, the stratigraphic position of the Bad Heart formation relative to the Bighorn formation of Athabasca Valley is uncertain, and until further investigations are made and more diagnostic fossils collected it appears unsafe to identify either this sandstone or the underlying Kaskapau shale with the Athabasca succession.

Dunvegan Formation

The Dunvegan formation overlies, and has a similar distribution to, the 'Fort St. John' shales. Like the 'Fort St. John', it is confined to the southwest third of the map-area, where it forms long, narrow belts exposed by erosion of numerous small folds.

The formation consists of hard, fine- to medium-grained, grey sandstone, and dark grey to black, silty shale. Thirty feet of hard, grey, quartzitic sandstone were observed at the base of the formation

wherever the lower contact is exposed. Crossbedding and carbonized wood fragments are common in some sandstone beds.

The Dunvegan is poorly exposed in the map-area, and no section could be measured. Its thickness is assumed to be about the same as that in the nearby À La Pêche map-area, where the formation measured about 400 feet.

Specimens of Inoceramus dunveganensis var. and of a species of Unio were collected from the formation near the western border of the map-area, the former at 10 feet above the base of the formation.

Blackstone Formation

The Blackstone formation overlies the Dunvegan conformably. It forms a wide, northwest-trending band and several smaller patches in the southwestern part of the map-area.

The formation consists almost entirely of black, fissile to thin-bedded, somewhat silty, marine shale, with numerous, interbedded, hard, grey, yellow weathering, concretionary ironstone beds. A few intercalated, thin sandstone beds occur throughout the formation and at the top is a sandy transition zone.

Blackstone strata, being soft, are generally poorly exposed in the map-area. The best exposure is where Sheep Creek has cut through the formation, but no section could be measured and no fossils were collected.

Bighorn Formation

The Bighorn formation overlies the Blackstone conformably. In Daniels Flats map-area these strata occupy a narrow, northwesterly trending strip extending from a point close to the southeast corner to a point just below the middle of the western border of the map-area. The Bighorn beds occur mainly on the northeast limb of an anticline, but near the western border they occur on both limbs of this structure.

Bighorn strata consist of hard, slabby, quartzitic sandstone and silty shale; dark grey to black, marine shale; and minor amounts of chert-pebble conglomerate. The conglomerate is composed of grey and black chert pebbles generally about the size of peas, but in some places is fine enough to be called a grit.

In this map-area the formation consists of three distinct lithologic units, an upper and lower sandstone band separated by about 300 feet of marine shale. Exposures are poor southeast of Sheep Creek, but to the northwest the sandstone parts of the formation outcrop well. A complete section is exposed where Sheep Creek has cut through the formation. Other good exposures occur on the ridge about 3 miles north of Sheep Creek.

The following section was measured on Sheep Creek:

	Thickness Feet
Overlying beds: Wapiabi formation	
Sandstone, hard, grey, quartzitic; beds up to 1 foot thick	21
Conglomerate; composed mainly of chert pebbles up to ½ inch in diameter	2
Sandstone, hard, grey, quartzitic; almost massive	12
Sandstone, grey, hard; interbedded with grey siltstone and shaly sandstone	150
Shale, grey to black, partly fissile and partly silty; very fossiliferous	285
Conglomerate; pebbles up to 3 inches in diameter	1
Sandstone, hard, grey, quartzitic, slabby	2
Shale, grey, silty	2
Sandstone, hard, grey, quartzitic; interbedded with grey, silty shale	22
Shale, light grey, clayey, soft; some weathers yellowish	44
Sandstone, hard, grey; minor amounts of grey shale as thin partings	36

	Thickness Feet
Shale, dark grey, silty; some carbonaceous	21
Sandstone, light grey, very fine-grained; contains carbonized wood	28
Sandstone, hard, grey, quartzitic; in beds up to 2 feet thick	44
Total Thickness of formation ..	670

Underlying beds: Blackstone formation

The thickness of the formation as measured on Sheep Creek is 670 feet.

Fossils were collected from the Bighorn formation and were identified by F.H. McLearn of the Geological Survey.

Group 1. Collected from a zone between 220 and 530 feet below the top of the formation on Sheep Creek.

Inoceramus umbonatus Meek and Hayden
Scaphites ventricosus Meek and Hayden

Group 2. Collected from a zone about 180 feet below the top of the formation on Sheep Creek.

Cardium pauperculum
Scaphites ventricosus Meek and Hayden

Group 3. Collected on ridge between Smoky River and Sheep Creek

Anomia subquadrata Stanton
Cardium cf. *pauperculum* Meek

Group 4. Collected from the upper part of the formation near the west border of the map-area.

Inoceramus sp. (*lamarcki* group)

Wapiabi Formation

Conformably above the Bighorn are about 1,000 feet of marine shales constituting the Wapiabi formation. These strata underlie a long, relatively narrow, northwesterly trending band on the northeast side of that underlain by the Bighorn formation.

The Wapiabi consists chiefly of fissile, grey to black shale and silty shale, with some interbedded, thin, concretionary, calcareous, buff weathering bands. The upper 200 to 250 feet is very sandy, forming a transition to the overlying formation.

Good exposures of these shales are found on two or three small creeks flowing into Smoky River on the east side of Muskeg River. The best sections of the Wapiabi formation occur on two small creeks that cut across the formation between 1 mile and 2 miles north of Sheep Creek and on the high ridge about 3 miles north of this creek. At these localities the Wapiabi formation has a measured thickness of between 975 and 1,000 feet. This is considerably less than the thickness obtained for the Wapiabi in areas to the southeast, and may indicate a gradual thinning of the formation to the northwest.

Fossils collected from the Wapiabi formation in Daniels Flats area were identified by F.H. McLearn, and include the following:

Oxytoma
Inoceramus sp. (lobatus group)
Scaphites ventricosus Meek and Hayden
Anomia subquadrata Stanton
Baculites sp.
Oxytoma cf. nebrascensis
Cardium cf. pauperculum Meek

These forms, with the exception of Inoceramus sp. (lobatus group), are from the ventricosus zone. The Inoceramus of the lobatus group is considered to represent either the top of the ventricosus zone or beds higher in the Wapiabi.

Brazeau Formation

The Brazeau formation, of late Upper Cretaceous age, overlies the Wapiabi shales, and underlies the northeastern two-thirds of Daniels Flats map-area.

Solomon Member. The Solomon sandstone, forming the lower 80 to 100 feet of the Brazeau formation, is a useful horizon marker,

and has been mapped separately. It forms a thin, northwesterly trending band roughly separating the highly disturbed strata of the southwestern third of the map-area from the gently dipping beds to the northeast.

The Solomon sandstone is best exposed on the high ridge about 3 miles north of Sheep Creek. It consists of a distinctive, hard, grey to greenish grey, buff weathering, slabby sandstone.

Marine fossils have been found in the Solomon member in nearby areas, but not in Daniels Flats area; there is no reason to doubt, however, that it is marine here as elsewhere.

Main Part of the Brazeau Formation. Strata lying immediately above the Solomon member consist of dark greenish grey, medium-grained, soft sandstone, with interbedded grey shales and silty shale, and resemble beds occupying a similar position in other areas. These strata are generally softer and more shaly than overlying beds of the lower main part of the Brazeau formation.

The remainder of the formation consists of roughly 6,000 feet of thick-bedded sandstone, conglomerate, and shale. The sandstone is generally medium to coarse grained, grey and greenish grey, green and brown weathering, commonly crossbedded, and fairly soft. The conglomerate consists mainly of pebbles from ½ to 1 inch in diameter composed of white quartzite and grey and black chert. In places the pebbles are closely packed, but elsewhere the rocks show gradations from conglomerate to sandstone containing scattered pebbles. The conglomerate and pebble beds are more abundant in the lower part of the formation, and are commonly crossbedded like the sandstone. The shales are dark grey and greenish grey, and are commonly silty. The formation contains some beds that appear to be water-lain ash.

Only the lower beds of the Brazeau formation are well exposed in Daniels Flats map-area. The best exposures occur on two small creeks

about 2 miles northwest of the point where the Solomon member crosses Sheep Creek. Good exposures are also found in the lower part of the Sheep Creek canyon and on the high ridges on both sides of Smoky River near the east border of the map-area.

No fossils were collected from the Brazeau strata in the map-area.

Paleocene (?)

Strata in the northeast corner of the map-area may be of Paleocene age. The beds are similar to, and conformable with, strata that are known to be part of the Brazeau formation, but it is probable that some are younger than Upper Cretaceous. They consist of sandstone, shale, and conglomerate resembling those of the Brazeau formation but are, on the whole, more thickly bedded, softer, and fresher in appearance. The lithological difference between these strata and those of the Brazeau formation is not sufficient to permit the drawing of a geological boundary. The strata outcrop poorly, and because no identifiable fossils were found in them they have not been mapped separately on the map accompanying this report.

Pleistocene and Recent

Till and fluvioglacial gravel mantle large areas of the northeastern part of the map-area, but in the southwest part of the area these deposits are confined more to the larger stream valleys. The terraces that flank Smoky River are composed mainly of reworked glacial debris that was probably transported and deposited by the stream since the disappearance of the ice that formerly filled the valley. Most of this material is coarse gravel, but there are also deposits of finer gravel and sand. Near its mouth, Sheep Creek has cut through unsorted gravel to a depth of 100 feet, and just east of

the mouth of this stream are two kettle-holes about 200 yards in diameter and 100 feet deep. Recent gravel, sand, and silt form flood-plain deposits in the valleys of Smoky River and Sheep Creek.

STRUCTURAL GEOLOGY

General

Northwesterly trending complex folds and strike thrust faults are the dominant structural features of the southwestern third of the map-area. With few exceptions anticlines form the ridges and synclines the valleys, and the anticlines are generally more narrow and compressed than the synclines. The folds are irregular, and form a somewhat en échelon pattern.

In the northeastern two-thirds of the area the underlying Brazeau and, probably, Paleocene strata have very gentle dips, mainly to the northeast, but there appear to be no major folds or faults.

Faults

Three faults, probably strike thrust faults, were recognized and mapped in Daniels Flats map-area. The most northeasterly lies mainly within the Wapiabi formation between Smoky River and Sheep Creek. On the ridge between these two streams a repetition of strata involves the uppermost part of the Wapiabi formation and lowermost Brazeau beds, indicating a thrust from the northeast with a small displacement. The fault passes downward into Wapiabi strata in the valleys northwest and southeast of the ridge, and there is no evidence to suggest that it continues far in either of these directions.

A second fault enters the map-area from a point near the south-east corner, crosses Smoky River about ½ mile east of the mouth of Muskeg River, and extends across the area to the northwest. Along it a wide belt of the Lower Cretaceous Luscar formation has been thrust to

the northeast over the Upper Cretaceous Blackstone, Bighorn, and Wapiabi formations. The fault continues to the southeast across Pierre Greys Lakes map-area.

The third fault, southwest of that just described, is assumed to lie within the Luscar strata. Its presence is indicated at a few places, but sufficient evidence was not obtained to be certain of its location or even of its occurrence at all points across the map-area. The fault is believed to represent a thrust from the southwest and, from the information obtained, appears to have displaced only Luscar strata.

It is probable that the map-area includes many small faults that have not been recognized because of lack of exposures.

Folds

No folds were recognized in the northeastern two-thirds of Daniels Flats map-area, where the strata are flat lying or dip gently to the northeast. The formations in the southwestern third, however, are intensely crumpled.

The Nikanassin strata that underlie the extreme southwest corner of the area form part of the northeast limb of a major anticlinal structure, the axis of which lies beyond the map-area. The two anticlines and one syncline within the Daniels Flats map-area are, therefore, subsidiary folds on the larger structure. Both anticlines are slightly asymmetrical, with their steeper limbs toward the northeast.

Immediately northeast of this anticlinal area is a syncline involving Luscar, 'Fort St. John', Dunvegan, and Blackstone formations. Within the area of this syncline outcrops are few, but those observed indicate considerable deformation of the beds, and it is probable that the structure is much more complicated than indicated on the accompanying map.

Northeast of this synclinal area is a wide, northwesterly trending belt underlain by Lower Cretaceous strata and bounded on the northeast by a fault contact with Upper Cretaceous formations (See accompanying map and Structure-sections A-B and C-D). This belt has been elevated and crumpled into numerous, closely spaced folds, and may be regarded as an anticlinal area modified by much minor folding. It is underlain predominantly by rocks of the Luscar formation, but, due to differential elevation and erosion of the many folds, other formations are exposed in small patches and long tongues.

Sheep Creek cuts through most of the folded strata, and has exposed the Nikanassin and Cadomin formations in three of the larger anticlines. The same two formations are exposed again where Smoky River crosses the most southwesterly of these three folds.

On some of the higher ridges within the band of Luscar strata are remnants of the overlying 'Fort St. John', Dunvegan, and Blackstone formations. These occur as long tongues or irregular patches due to erosion of the crumpled strata, and the length of the tongues depends mainly on the plunge of the structures.

The complex anticlinal belt of Luscar strata is thrust to the northeast onto an anticline that exposes Blackstone, Bighorn, and Wapiabi formations. This anticline is relatively open, and appears to plunge both to the northwest and to the southeast from near the centre of the map-area. Northeast of this anticline, the strata dip gently to the northeast. In the disturbed areas, numerous minor folds are too small to map.

ECONOMIC GEOLOGY

Coal

No coal seams more than 2 inches thick were observed in any formation except the Luscar, which in Daniels Flats map-area contains several good seams of bituminous coal.

Coal seams outcrop in the east bank of Muskeg River about half a mile above its mouth. The following section was measured:

	Thickness Feet
Overlying beds: covered	
Sandstone, grey, sheared	10.0+
Shale, and shaly sandstone	4.3
Coal, sheared, friable	1.5
Shale, dark grey to black	2.0
Shale and silty shale, grey	12.1
Sandstone, hard, grey, medium-grained, massive; contains wood fragments	16.0
Shale, grey and dark grey; contains two 6-inch coal seams near the middle	70.0
Shale, black; with coaly stringers	6.0
Coal	13.5
Sandstone, silty, grey, soft	1.0
Sandstone, grey, medium-grained, massive	9.0
Sandstone, fine-grained, grey, silty	45.0
Shale, grey	2.4
Sandstone, hard, grey, medium-grained	1.5
Siltstone, grey	2.0
Shale and silty shale, grey	12.0
Coal	0.3
Shale, grey	0.4
Coal	0.5
Shale, grey	0.5
Coal	1.0
Shale, grey and black; some thin, concretionary bands	7.0
Sandstone, fine-grained, grey, concretionary	1.5
Shale, carbonaceous, black; some thin sandstone bands	6.5

	Thickness Feet
Coal, sheared	4.0
Siltstone, grey; with some black shale partings	15.0
Total thickness of section measured	246.0

Underlying beds: covered.

In the above section are three main seams, the thicknesses of which are: 1.5, 13.5, and 4 feet.

An exposure of the Luscar formation in a gulch on the northwest side of Smoky River about 1½ miles above Muskeg River revealed three coal seams. The largest of these, about 1,243 feet below the top of the formation, is 18.5 feet thick, and is both underlain and overlain by black, carbonaceous shale. The second seam, about 1,000 feet below the top of the formation, consists of 7.5 feet of coal with a 2-inch clay parting near the top. The uppermost of the three seams is about 879 feet below the top of the formation, and measured 8 feet in thickness, but only the upper 5 feet was considered to be clean coal.

On Sheep Creek, coal is exposed in both banks just southwest of the Luscar-Blackstone fault contact. The coal there is so crushed and broken that no measurements were obtained, but the seam appears to be about 6 feet thick.

About ½ mile up Sheep Creek from the fault contact, coal outcrops in the south bank at the mouth of a small stream. The strata there strike at north 60 degrees west and dip 25 degrees southwest. The section from top to bottom is as follows:

	Thickness Feet
Shale, black, carbonaceous	5.0
Siltstone, grey	3.0
Coal, hard, banded	0.7
Shale, black	4.5

	Thickness Feet
Coal, dirty	0.3
Shale, grey, silty	3.0
Shale, grey; with 4-inch coal stringers	3.0
Coal, bright, sheared	4.5
Coal, dirty	0.1
Coal, sheared, bright	2.0

Still farther upstream, about $\frac{3}{4}$ mile above the fault contact, another seam is exposed near water level in the south bank. This seam contains 22.5 feet of coal, with a 3-inch shale parting near the middle. It is underlain by 2.5 feet of grey and black shale and overlain by 3 feet of carbonaceous shale succeeded by 5 feet of grey shale. The strata strike north 60 degrees west and dip 65 degrees northeast.

About 200 feet stratigraphically above the last seam, another is well exposed in the northwest bank. The following section was measured in the southeast bank: -

	Thickness Feet
Overlying beds: sandstone	
Coal, shaly	0.9
Shale, black, carbonaceous	2.0
Coal	3.0
Shale, grey	1.0
Coal	2.9
Shale	1.0
Underlying beds: sandstone	

Time did not permit any attempt to trace or correlate the coal outcrops. The area is relatively inaccessible at present, and no mining has been done, but it is probable that the southwestern part of Daniels Flats map-area contains large reserves of bituminous coal that can be made available when required.

Oil and Gas

No wells have been drilled for oil or gas within the map-area. Surface structures do not appear to be very promising, especially in the highly folded and faulted southwestern part. The Muskeg anticline, on which a well was drilled in Pierre Greys Lakes map-area, apparently does not extend as far northwest as Smoky River, and no evidence of it could be found in Daniels Flats map-area.

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