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PEDLEY MAP-AREA,
ALBERTA
(Report and Map)

BY

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PEDLEY MAP-AREA, ALBERTA

(Summary Account)

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Illustration

Preliminary Map -- Pedley, Alberta.

PEDLEY MAP-AREA, ALBERTA

INTRODUCTION

Pedley map-area lies in the Foothills belt of west-central Alberta between latitudes $53^{\circ}15'$ and $53^{\circ}30'$ and longitudes $117^{\circ}15'$ and $117^{\circ}30'$. Parts of the Athabaska and Brazeau forest reserves are included in this area.

Both the Canadian National Railway and the Edmonton-Jasper highway cross the northwest corner of the map-area. The village of Hinton, situated on the highway 4 miles to the west of the western boundary, provides the nearest post-office, and the nearest telegraph and express office is located at Entrance, on the railway, 12 miles by road west of Hinton.

A number of winter logging roads branch off from the highway and penetrate the forest for a few miles. It is, however, impossible to drive a car over them for any great distance during the summer because of muskeg and swamp.

Travel in the district is facilitated by three good pack trails which are maintained by the Forestry Branch. The Cache Percotte trail, starting at Hinton, crosses the northern part of Pedley map-area in an easterly direction and joins the McLeod trail on the west side of McLeod River. The Bighorn trail starts at Hinton, crosses the southwest corner along the crest of High Divide ridge, and joins the McLeod trail at Gregg River just south of the map-area. The McLeod trail follows up McLeod River to its confluence with Gregg River and from there extends up the west side of Gregg River to a point beyond the southern edge of the area.

Field work was undertaken by the writer during the summer of 1944. Capable assistance was rendered in the field by Messrs. R.L. McIntosh, J.S. Barnby and C. Leonoff. Dr. W.A. Bell of the Geological Survey reported on the fossil collections, and the coal analysis was made by the Bureau of Mines, Department of Mines and Resources, Ottawa.

PHYSICAL FEATURES

Pedley map-area comprises a part of the Foothills belt. High, timbered ridges and uplands, separated by broad, swampy valleys, strike approximately north 60 degrees west. In general, the average elevation increases toward the southwest across the area to where the High Divide ridge attains a height of 5,600 feet.

All ridges, with the exception of the High Divide, have relatively gentle slopes that descend gradually to the valleys. The steep slopes of High Divide ridge are due to its capping of conglomerate. Both the Cache Percotte and High Divide, the two main ridges, become less pronounced toward the valley of McLeod River, and are represented on the southeast side of the river by low hills surrounded by areas of muskeg.

Topographical features acquire some of their expression from the character of the bedrock, which consists mainly of Upper Cretaceous and Paleocene conglomerates, sandstones, and shales, of various degrees of hardness. The relative resistance to weathering of these rocks is reflected in step-like, parallel ridges over parts of the area. Where they occur, these ridges emphasize the rock structures.

The unconsolidated rocks consist of glacial and fluvial deposits of gravel, sand, and clay. Most of the area is covered either with glacial drift or with a mantle of soil that has been derived from the erosion of the underlying formations. Gravel and silt deposits of Recent age form flood-plain deposits in the valleys of the larger creeks and along McLeod River. Thick deposits of fluvio-glacial sand and gravel occur as terraces on

both sides of Athabaska River at least as far east as Pedley station. Some of the terraces consist of both sand and gravel, but most of them are composed almost entirely of one or the other of these sediments. Glacial erratics of limestone and conglomerate up to 4 feet in diameter are present on many of the ridges.

Few areas of virgin forest remain. Most of the country has been burned over and is now covered with second-growth jack pine, spruce, and poplar. Travel is commonly impeded by windfall, small second-growth trees, and muskeg.

STRATIGRAPHY

Table of Formations

Period or Epoch	Formation	Approximate thickness (Feet)	Lithology
Paleocene	Paskapoo	?	Sandstone, shale and conglomerate (non-marine)
Upper Cretaceous	Edmonton	3,500 ±	Chiefly sandstone and shale (non-marine)
	Brazeau	?	Chiefly sandstone, shale, and pebble-beds (non-marine)

General Statement

The map-area is underlain by a thick succession of non-marine, sedimentary strata of Upper Cretaceous and Paleocene age. Because of extensive deposits of overburden and the softness of the rocks, outcrops are few, and those that do occur are extremely weathered. Although some occur near the tops of the ridges, the better exposures are confined to stream canyons. This great thickness of beds lying stratigraphically above the Upper Cretaceous marine shales of the Wapiabi formation was mapped by Allan and Rutherford (1922)¹ as the Saunders formation, and a division into Upper and Lower Saunders was based on the position of commercial coal seams. Later, this division was abandoned when it was found that it could not be applied regionally.

More recently, these beds have been separated into the Brazeau and Edmonton formations, and the boundary between the two placed at the base of a prominent bed of pebble-conglomerate. The name "Entrance conglomerate" was given to this horizon marker by Lang (1944) in the Entrance area where it is about 20 feet thick. In that area the conglomerate outlines a major anticline and syncline, and outcrops as three bands to the west of the western boundary of Pedley map-area.

¹

A list of references is given at the end of this report.

In Pedley area only two exposures of the Entrance conglomerate were found, namely near the middle of sec. 32, tp. 49, rge. 24, on the southwest limb of the synclinal structure. But, as this conglomerate is conspicuous in the Entrance area to the west, and also in the vicinity of Coalspur to the southeast, it is probably more or less continuous, although not exposed, across the intervening Pedley area. For this reason an assumed contact has been drawn between the Brazeau and Edmonton formations. The approximate position of this contact on both the northeast and southwest limbs of the anticlinal structure (See map) has been inferred from the limited information obtained in Pedley map-area, assisted by information available in the adjoining areas.

The uppermost beds exposed in the map-area contain fossil plants of probable Paleocene age, and no means of separating them from the underlying Edmonton beds has been found. The strata overlying the Brazeau formation are, therefore, mapped together as "Edmonton and Paskapoo formations".

Lithologically the entire sequence of rocks is similar, and apparently of fresh or brackish water deposition. The Entrance conglomerate separates the Brazeau and Edmonton-Paskapoo formations, and where it is obscured a division is very difficult. There appears, further, to be no possible lithological division between the rocks of Upper Cretaceous age and those of Paleocene age.

The strata of both the Brazeau and Edmonton-Paskapoo formations consist chiefly of conglomerate, sandstone, and shale, with all gradations between the three types of sediments. Sandstone is most common. Lithological units are more or less lenticular and show rapid variations in texture both vertically and laterally. The rocks, with some exceptions, are moderately hard, and those of the Edmonton formation are relatively more poorly consolidated than those of the Brazeau formation. Since there appears to be little difference in the kinds of detrital minerals composing the rocks, this difference in hardness is probably in part due to the greater weight of cover that, in the past, has overlain the older beds. Buff- and brown-weathering rocks are more numerous in the younger formations than in the Brazeau.

It was impossible to obtain complete sections of either the Brazeau or Edmonton-Paskapoo formations in order to ascertain their thicknesses. The reasons for this are paucity of exposures, and lack of persistent horizon markers. Moreover, the top of the Paskapoo formation has been eroded and the base of the Brazeau is not exposed. The structure section along line A-B (See map) indicates that the thickness of strata between the Entrance conglomerate and the thick conglomerate beds assigned to the Paleocene is approximately 3,500 feet. However, there are as yet no criteria for establishing the base of the Paskapoo in this area, and, consequently, 3,500 feet is probably a maximum thickness for the Edmonton formation.

MacKay (1943) gives a thickness of 6,000 feet to the Brazeau formation in the Coalspur district of the Cadomin map-area. In the Entrance map-area, Lang obtained a graphical estimate of 6,000 feet for the Brazeau formation, but considers that the true thickness is probably less than this.

In Pedley map-area, the Brazeau strata, as indicated on the structure-section along line A-B, would have a thickness of about 8,000 feet. However, abrupt changes of dip in these rocks indicate some faulting, and probably these faults are much more numerous than can be determined from surface work. The structure, therefore, is considered to be more highly complicated than shown, and any such complications would tend to reduce the graphical estimate of the thickness of the Brazeau formation. Similar reasoning would apply as well to the Edmonton formation.

Brazeau Formation

The Brazeau formation, consisting of conglomerate, sandstone, and shale, with thin coal seams and several beds of volcanic ash, is exposed in a belt about 3 miles wide, trending northwesterly across the southern half of the map-area.

The base of the formation, represented in other areas by a bed of hard, fine-grained, brown-weathering sandstone overlying Wapiabi shale, is not exposed. The lowest strata observed are predominantly conglomeratic sandstones and pebble beds, and although this zone can be recognized in different exposures throughout the area, individual beds and lenses within it have no great lateral extent. Pebble beds range from a few inches up to 6 feet in thickness, and consist of quartzite and chert pebbles averaging half an inch in diameter. The sandstones are moderately well cemented in the lower part of the formation, but less so in the upper part. The rocks are commonly buff and grey on weathered surfaces, but fresh surfaces range in colour from light to dark grey. There is considerable lateral variation in grain size.

Massive, crossbedded sandstone is the most common rock type, although platy and concretionary beds are present. Much of the coarser sandstone and grit contains pellets and small nodules of clay. Carbonized wood fragments are common, and the inclusion of considerable minute fragmentary carbonaceous material gives to some beds a "pepper and salt" appearance.

The shales of the Brazeau formation are grey and greenish grey and break with an irregular 'shaly' fracture. The extremely fine-grained sandstones or siltstones are a little harder and coarser than the shales. Both shale and siltstone commonly contain fragmentary plant remains. Thin, rusty layers of ironstone, much of which is concretionary, occur near carbonaceous shale or coal seams.

Numerous coal seams up to $1\frac{1}{2}$ feet thick are exposed along McLeod River for a distance of about 4 miles upstream from the mouth of Anderson Creek, but elsewhere outcrops of coal are rare. Considerable carbonaceous shale usually accompanies the coal seams, and yellowish-grey, clay partings in the coal are common.

Volcanic ash beds, such as have been reported to occur in adjacent areas, are present in Pedley map-area. These are, in all instances, hard, light greenish grey rocks that are more resistant to erosion than the associated sediments. Fine banding is quite noticeable in all outcrops.

The upper contact of the Brazeau formation has been placed at the top of a massive sandstone that underlies the Entrance conglomerate.

Edmonton and Paskapoo Formations

Strata of these formations underlie all of the northern two-thirds of the map-area, and also occupy a synclinal structure about $3\frac{1}{2}$ miles wide that strikes north 60 degrees west across the southern third of the area.

The Entrance conglomerate at the base of the Edmonton formation is not exposed in the Pedley area, except for the two outcrops previously mentioned. The conglomerate consists of closely-packed, well-rounded pebbles of quartzite and chert in a sandy matrix. Some of the pebbles have diameters up to 5 inches, but most of them average $1\frac{1}{2}$ inches across.

The Entrance conglomerate is overlain by a thick succession of interbedded sandstone and shale with minor pebble beds and occasional beds of volcanic ash. Coal seams of commercial thickness were observed in Edmonton strata at one place in Pedley area.

Fossil plants were collected from two localities. They were reported on by W.A. Bell of the Geological Survey as indicative of Paleocene time, in which case the upper part of this series of strata belongs with the Paskapoo formation. However, since there is no change in lithology, and as a structural break was not observed, no attempt has been made to map the Paskapoo separately from the underlying Edmonton formation.

Sandstone is the main constituent of the Edmonton-Paskapoo strata. The sandstone beds, with some exceptions, are not as thick as are those of the Brazeau. Both massive and platy types occur, the massive ones generally showing conspicuous cross-bedding. Carbonate, as a cementing material, appears to be more abundant in these sandstones than in those of the underlying formation. All gradations in grain size were observed, from very fine silt to coarse grit, and the change from one to another may be quite sharp or may be very gradual. Conglomerate lenses and beds become more numerous in the upper part of the Edmonton-Paskapoo group, and thin pebble or cobble beds are very common throughout the section thought to be of Paleocene age. Many of these beds appear, in section, as a single row of cobbles averaging 4 to 5 inches in diameter between sandstone beds. Scattered pebbles ranging in diameter from $\frac{1}{2}$ to 4 inches are common in nearly all of the sandstone. Carbonized remains of wood fragments and plant material are also present, but clay inclusions are not as common as in the sandstones of the Brazeau formation.

Most of High Divide ridge in tps. 49 and 50, rge. 24, is capped by coarse, closely-packed, cobble conglomerate at least 500 feet thick. The cobbles range from 2 to 6 inches in diameter and are poorly cemented by fine sand. Although this rock gives very steep slopes to the ridge, exposures are rare, as the small amount of loosely compacted sandy matrix permits ready disintegration of the exposed rock. Consequently, much coarse gravel covers the top of the ridge and occurs as talus deposits at the foot of steep slopes and in creek bottoms.

Lack of outcrops makes it difficult to determine the nature of the conglomeratic deposit, but it is quite probable that some sandstone is interbedded with it. The deposit probably represents a thick, local concentration of gravel high in the Edmonton-Paskapoo section, and of approximately the same age as the numerous pebble beds that occur in the upper part of the same group to the northeast, in tp. 52, rges. 24 and 23.

The area occupied by this conglomerate has been outlined. However, the approximate boundary shown on the map is meant only to define an area underlain predominantly by conglomerate, and does not represent a formational boundary. The conglomerate does not persist to the east as far as Gregg River, but since Paleocene fossils were collected on McLeod River, and as the syncline appears to plunge to the southeast, beds of approximately the same age as the conglomerate should occur on both Gregg and McLeod Rivers, and the fact that the strata there are mainly of sandstone indicates a lithologic change in that direction from the conglomerate of the High Divide ridge.

The shales of the Edmonton-Paskapoo formations are soft, and range from yellowish grey to greenish and dark grey. Exposures are not as numerous as those of sandstone, and where observed, are considerably weathered. Most of them contain poorly-preserved plant remains, but some are completely barren.

Good fossil plants were found at only two localities, and at both places in grey silty-shale. One locality is in sec. 3, tp. 52, rge. 24, on Pedley Creek, 900 feet upstream from the highway. The other locality is in tp. 49, rge. 23, where the 3,900-foot contour first meets the east side of McLeod River (See map). This is about 2,500 feet south of the large fault.

Two beds of hard, light greenish-grey ash rock were noted, and probably many others are present although not exposed. These rocks are quite similar in colour, texture, and hardness, and are more resistant to erosion than the other sediments. Similar rocks described from adjacent areas are associated with a bentonitic material, but this is not present with the tuffs observed in Pedley area. The tops of both of these beds were obscured by drift, but thicknesses are estimated to be between 5 and 10 feet. One sample showed extremely fine, intricate cross-bedding.

Many thin lenses of coaly material were noted, but coal seams more than 2 feet thick are exposed at only one locality, a small south-flowing tributary of McPherson Creek. This coal is described in detail on a subsequent page.

The flora collected from the Edmonton-Paskapoo formations includes the following:

Ferns

Onoclea sensibilis fossilis Newberry

Conifers

Sequoia nordenskioldii Heer

Glyptostrobus europaeus (Brongniart) Heer

Angiosperms

Trochodendroides richardsoni (Heer)

Trapa? microphylla Lesquereux

Aralia taurenensis (Ward) Sanborn

STRUCTURAL GEOLOGY

The strata of Pedley map-area occupy the eastern edge of the disturbed belt immediately east of the Rocky Mountain front, and have not suffered as much deformation as have strata farther to the west. The intensity of deformation decreases across the area from southwest to northeast. Rock exposures are sufficient to permit interpretation of the major structures, but probably many minor faults and folds are obscured by drift.

Two major structures, the Prairie Creek-Coalspur anticline and the Entrance-Mercoal syncline cross the southern half of the area, axes of both structures striking north 60 degrees west. Northeast of these folds the beds, except for minor, local warping, have low dips to the northeast.

The Entrance-Mercoal syncline, where it crosses Pedley area, is a broad, open fold with a moderate plunge to the southeast. Neither the amount of plunge of the structure nor the angle of dip of the axial plane could be determined on the evidence available. Steep-dipping to vertical strata in the valley of Wigwam Creek suggest an asymmetrical fold.

The Prairie Creek-Coalspur anticline parallels the syncline to the northeast. It is faulted near the crest, and the position of the anticlinal axis is difficult to determine. The strata on both limbs maintain gentle dips up to quite close to the fault, and then suddenly become very steep. Where the break is exposed on Gregg River, in tp. 49, rge. 23, strata in the fault zone are intensely sheared. Similar evidence was obtained from outcrops on McLeod River, although the rocks are not as well exposed. Fossil plants, reported to be of Paleocene age, were collected by the writer from a locality about half a

mile up McLeod River on the south side of the fault. They suggest that the strata on this side are of Paskapoo or, perhaps, of upper Edmonton age. On the other hand, beds exposed on the north side of the fault are low in the Brazeau formation. This evidence indicates an underthrust from the southwest having considerable displacement.

Several faults of small displacement were noted along McLeod River; elsewhere in the area abrupt changes in the dip of the beds suggest that there are probably many such faults, and they may account for the great apparent thickness of Brazeau strata as shown in the structure-sections (See map). It is to be noted, moreover, that in the part of the area lying north of the main fault, no reverse dips (to the southwest) were observed. Scarcity of outcrops may account for this in part, but it is thought that the small angle of dip of the strata over most of the area, as well as the crossbedding, make it difficult to observe any minor warping that may occur.

ECONOMIC GEOLOGY

Coal

Coal was observed at few localities in Pedley map-area. Seams occur in both the Brazeau and Edmonton-Paskapoo formations, but none over 3 feet thick was seen in Brazeau strata.

Numerous thin coal seams of Brazeau age outcrop along McLeod River between the mouth of Anderson Creek and the junction of Gregg and McLeod Rivers. Several of these are about 3 feet thick, but most of them have thicknesses of 2 feet or less. Outcrops are not continuous along this part of the river; thus it is probable that other seams are present but are not exposed. Some of the exposed seams contain small rounded or elongated blebs of resin up to half an inch long. Considerable coaly shale is associated with each seam.

Coal float occurs on Quigley Creek about half a mile upstream from the point where the creek turns to flow northeast, and on the main branch of Anderson Creek about three-quarters of a mile above the point where the 4,300-foot contour crosses the creek (See map). This location on Anderson Creek is just east of the uncut line between secs. 14 and 15, tp. 50, rge. 24. Fragments of coal were noted at other places on these creeks but these had probably been transported considerable distances. No outcrop of coal was seen.

For some years coal has been known to outcrop on Coal Creek, a small, south-flowing stream that enters McPherson Creek about three-quarters of a mile west of the eastern edge of Pedley map-area. Prospecting was carried on in the vicinity of McPherson Creek during the spring of 1925, and several pits were sunk.

During the field season of 1944 a telemeter survey was made from the mouth of Coal Creek upstream to the last rock exposure. Unfortunately the old prospect pits were filled with water and debris, so that only approximate measurements of the seams could be obtained. At least two seams more than 4 feet thick are exposed. Prospect No. 1, 1,000 feet upstream from the mouth, shows 4 feet of coal in the creek bank. No lower contact is visible and the upper contact is eroded and overlain with drift. The seam has been reported by prospectors to be 14 feet thick.

Another large seam occurs between 260 and 300 feet stratigraphically above No. 1 seam. It is partly exposed in the creek bed and in the banks 2,800 feet above the mouth of the creek. At this point, prospect No. 2, two pits had been dug. Both are now caved. No. 2 seam measures 7 feet in

thickness where exposed, but the top has been eroded. Fifty feet downstream from No. 2 prospect a seam that measures 11 feet in thickness is exposed in the creek bed. Overlying it is a 10-foot zone composed of thin beds of sandstone and clay-shale with thin coal seams. At a point 30 feet downstream from No. 2 prospect, the strata, including coal seams, are considerably warped and slickensided. Possibly a fault with a 20-foot vertical displacement occurs here, and the 11-foot seam may be a downfaulted part of No. 2 seam. If not, two thick seams, separated by 10 feet of alternating sandstone, shale, and coal, are present. Below the 11-foot seam is 12 feet of sandstone with minor coal stringers and below this again, is a coal seam $2\frac{1}{2}$ feet thick. Downstream between the $2\frac{1}{2}$ -foot seam and the No. 1 seam, are occasional outcrops of sandstone and shale. No other exposures of coal were observed, but about 240 feet of strata, much of which is obscured, is represented in this distance, and other seams may exist.

The coal-bearing zone on Coal Creek is in the Edmonton formation, and contains the only commercial seams so far discovered in the map-area. An attempt was made to trace the coal eastward to McLeod River, but, although some rock outcrops near the mouth of McPherson Creek, much of the bank is drift covered. Future prospecting on these seams should be done east of the present exposures, toward McLeod River, before an attempt is made to trace them toward Athabaska Valley. Much drilling and trenching would be required to obtain information to the northwest.

The stratigraphic position of these seams with reference to the base of the Edmonton formation could be determined only approximately, as the scarcity of outcrops and lack of distinctive horizon markers make it impossible to build up a columnar section from disconnected exposures that, in places, are separated by faults. No. 1 seam is estimated graphically to be approximately 3,000 feet above the Entrance conglomerate.

Analysis of Coal Sample from No. 2 Seam, Coal Creek, Alberta

Moisture condition		As received	Dry
Proximate analysis			
Moisture	%	8.0	
Ash	%	12.3	13.3
Volatile matter	%	34.5	37.5
Fixed carbon (by difference)	%	45.2	49.2
Ultimate analysis			
Sulphur	%	0.2	0.3
Calorific value			
B.T.U. per lb. gross		10,500	11,420
Caking properties		Non-agglomerating	

The coal, as exposed, is much weathered, and the above analysis cannot be regarded as representative of its quality. The rank, indicated by the analysis is sub-bituminous.

Oil and Gas

No wells have yet been drilled in Pedley map-area, the nearest being those of the Imperial Oil Company, near Coalspur which is about 11 miles southeast of the area.

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Coal mined at Coalspur to the southeast and at Drinnan to the northwest occurs at a much lower horizon than that estimated for the McPherson seams.

The first well was located in 1921 by the Northwest Company Limited, about a mile east of Coalspur station, on the northeast side of a broken anticline. Later this hole was abandoned. A new one was located in 1924 in the NW $\frac{1}{4}$ sec. 34, tp. 48, rge. 21, on the southwest side of the same structure. A considerable flow of gas was encountered in Cretaceous strata. This hole also was abandoned.

The present well, Imperial Coalspur No. 1, is located in ls. 10, sec. 3, tp. 49, rge. 21, W. 5th Mer., and is on the northeast side of the faulted anticline. Gas has also been obtained from this well, which, by January, 1945, had been drilled to a depth of 10,430 feet, and was still in Upper Cretaceous strata.

Field work in 1944 indicated that the structure on which these wells are located, continues to the northeast across Pedley area. The anticline was found to be faulted, and the limited amount of available information indicates an underthrust from the southwest. However, neither the depth to which the fault persists nor its inclination at depth are known. The fault may not reach the underlying Palaeozoic strata. Also, minor folds and faults in the Upper Cretaceous may not affect the more competent underlying limestones, and a simpler anticline possibly exists at depth.

The Prairie Creek-Coalspur anticline is the only known structure with oil possibilities in Pedley map-area, and future interest in this anticline will depend to a large extent on the results obtained by the Imperial Oil Company at Coalspur.

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