FINAL

GEOLOGICAL REPORT

on

"CARCAJOU RIVER - LITTLE BEAR RIVER DIVIDE AREA"
N.W.T. (Canada)

IMPERIAL OIL LTD - CANOL PROJECT.

Assignment No. 28

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Date submitted: February 24, 1944.

Read and accepted by: Sherrit Gordon

Date: 3/29/44

CONFIDENTIAL

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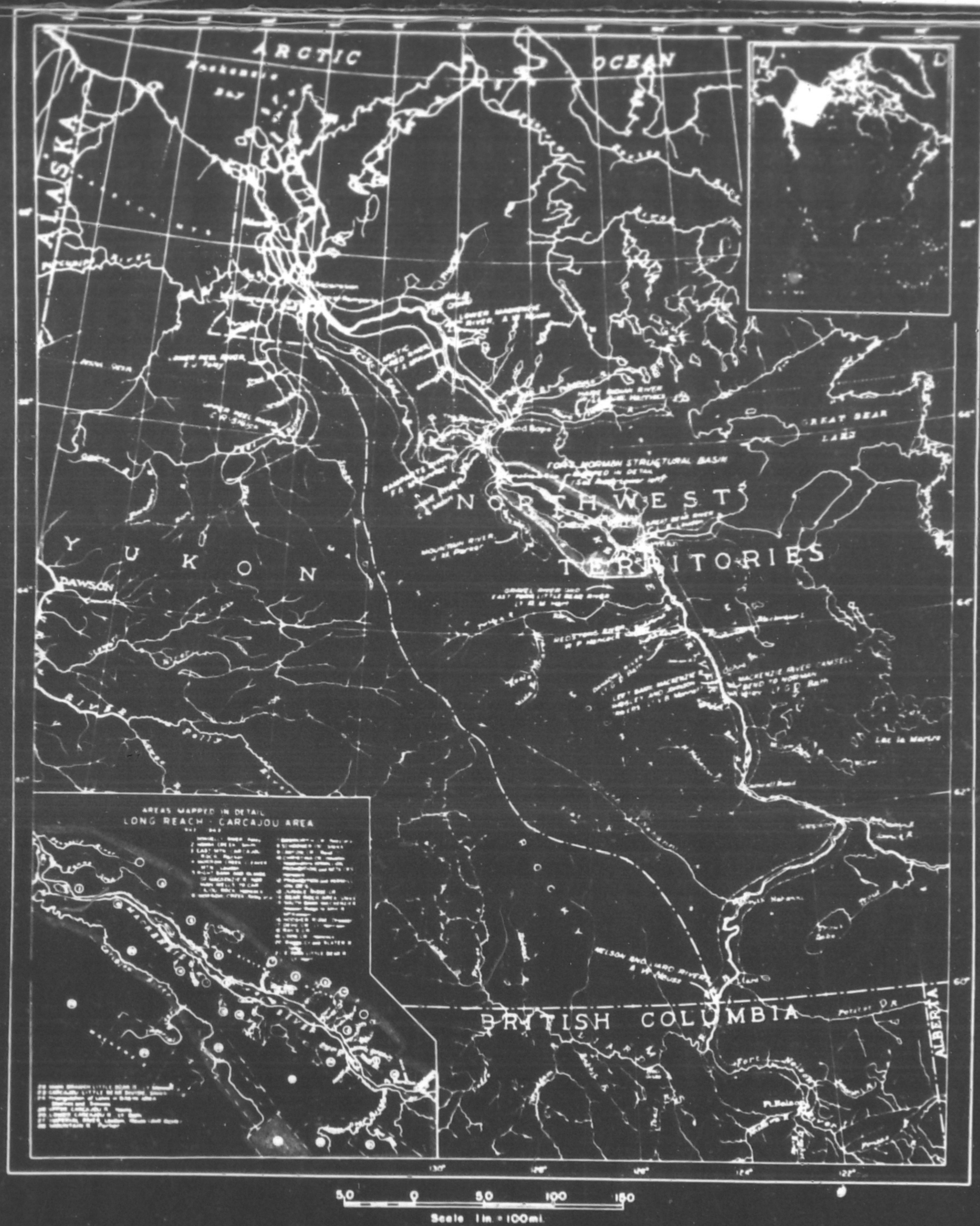
A B S T R A C T

The Carcajou River-Little Bear River Divide area is a dissected upland with rejuvenated canyon drainage.

A considerable stratigraphic interval from Cambrian to Lower Cretaceous is exposed. Cambrian quartzites are succeeded by red-beds. Silurian and Middle Devonian limestones are succeeded by Upper Devonian shales and sandstones. Carboniferous, Permian, Triassic and Jurassic beds are not represented. An erosional remnant of Lower Cretaceous shales completes the section.

Complete detailed sections of the Middle Devonian and Middle Silurian were measured. The main structural feature is a large north-plunging anticline known as the "Rouge Mountain Anticline". The entire map sheet is on the crest and northeast flank of this structure. Incorporated into the east limb is a triple set of minor anticlines that form the southern expression of the MacDougal River Anticline. Bituminous shales are present in the area but no oil structures were found to warrant testing.



INDEX MAP OF
NORTH WESTERN CANADA SHOWING
LOCATION OF CARCAJOU-LITTLE BEAR DIVIDE AREA

Chapter I.

INTRODUCTION

The Carcajou River - Little Bear River Divide Area, as comprehended in this report, includes an area of around 300 square miles lying immediately south of the big bend of the Upper Carcajou River to the south of the MacDougal Range. The area is continuous south with the map sheet of the Upper Carcajou River report of Dr. Nauss (Ref.7). This is the first time the area has been reported on geologically.

Field Work

On July 8, 1943, Party 'B' consisting of C. R. Stelck, geologist, and J. L. Carr, assistant geologist, were flown in from Norman Wells to Lake "Pluvius" by a small float plane piloted by R. Blackwood. R. Blackwood picked up the party on July 29, taking two trips to remove the party as Lake Pluvius is not long enough for a full load take off.

A base camp was set up on the east side of Lake Pluvius and all field work was done out from this centre as the continuous daylight made possible long walking trips. For working in the southeast corner of the map sheet, a large cave on the west side of "Grotto" Lake provided welcome shelter for several nights.

It rained every day that the party was in the area, but except that fog conditions slowed down plane-tabling no time was lost.

Mr. A. Frame's map, Little Bear River sheet, No. 2 (one inch to one mile) was used as a mapping base. Lake Pluvius was not shown on any map or flight strip so a line was run from Lake Pluvius to the edge of the flight strip, C.P.A. Job 199, #54 to #72 which was already plotted on Mr. Frame's map (supra). All latitudes used in constructing

the map were taken from this tie in. The remainder of the map was constructed from plane table sheets, 6, 7, 8 and 9 ('L.Carr instrument) and from compass and alidade triangulation. Stations within the flight strip were recorded on the aerial photographs involved.

Fossil suites 3661 to 3694 were collected during this trip.

Geographical Position and Accessibility

The Carcajou River - Little Bear River Divide Area is in the District of Mackenzie, Northwest Territories of Canada and lies between latitudes 64° 28' N and 64° 43' N, and between longitudes 126° 36' W and 127° 10' W. The area is 40 miles south of Norman Wells and 35 miles southwest of Fort Norman. It lies south of the MacDougal Range on the eastern edge of the Mackenzie Mountains and extends from the Carcajou River to the Little Bear River. Any development of the area is of necessity linked with the Mackenzie River basin as there is no communication through the mountains on the west.

The area is 25 miles south of the Canol pipeline road. In the original search for the pipeline route bull-dozer caterpillars knocked down several trails to the area to the east of Grotto Lake and east to lower "Rouge Mountain River". These trails, which follow up lower Grotto Creek and wander over the upland east of lower Rouge Mountain River, never ascended the upland west of Grotto Lake or around Lake Pluvius.

Roads could be brought into the area by coming south from the Canol road to lower Grotto Creek, crossing by an old abandoned valley to the valley of the lower Rouge Mountain River, and ascending to the Lake Pluvius area by the badlands area on the west side of the valley which is about seven miles above the mouth of Rouge Mountain River. From this main road "cat" roads could be run to any part of the area. Small float planes can land on Lake Pluvius and ski planes could land

in winter on Grotto Lake.

Culture and Vegetation

Nobody lives in the entire area. A few old but no recent Indian hunting camp locations were all that were noted.

The uplands are tundra growth with scrub alder in the marshy areas. The stunted occasional clumps of spruce are thin and the trees are not over fifteen feet in height. The valleys carry larger spruce to fifty feet in height and the valley sides are covered with willow and alder. Birch and occasional poplars are river course trees. The only true muskegs noted were on lower Grotto Creek where sphagnum growth has extended out into the water filling depressions of abandoned meanders.

Previous and Pertinent Reports

A preliminary report "Carcajou River - Little Bear River Divide Area" Assignment No. 28, Report No. 34, G.C. 43-35, August 1943, by the writer, is the only previous report on the area (Ref. 9). Dr. Nauss' Preliminary and Final Reports on the "Upper Carcajou River area" assignment #10, are the only reports that touch the area, and no difficulty was found in integrating with these reports (Ref. 7 and 8). Lt. V. B. Monnett worked to the east of the "Divide" area on the Upper Little Bear River (Ref. 5 and 6), but unfortunately a hiatus of 8 to 10 miles of unmapped country was left between the map sheets as the two parties did not know the location of each other.

Acknowledgments

J. L. Carr is responsible for any special merit this report contains, for he operates as an efficient and cheerful collector and surveyor no matter the conditions. He also compiled the base maps and the columnar section for the preliminary report. S. S. Cosburn, A. Hemstock, and H. A. Gibson did the drafting of the various plates.

Chapter II.

T O P O G R A P H Y

The map sheet of the Carcajou River - Little Bear River Divide Area covers a portion of the gently dipping post-Middle Devonian basin and a portion of the gentle structural front of the Mackenzie mountains carved out of earlier Paleozoic limestones and quartzites. The country is plateau type with deep canyons incising the uplands.

Drainage

This is part of the Mackenzie River drainage and more particularly of the Carcajou River. The Little Bear River appears on the southeast corner of the map sheet but the watershed divide is very close to it. The Carcajou River makes a big bend around the south end of the MacDougal Range and flows through the north edge of the map sheet. It is a swift river with a braided channel and flows in a canyon about 1000 feet deep. It is about 500 feet across and canoes would require lining most of the time. The Little Bear River runs in a braided channel in a canyon 800 feet deep.

Grotto Creek heads in Grotto Lake, picking up much of its water from underground drainage along the Beavertail terraces. It flows in a southeasterly direction along the Fort Creek-Beavertail contact and then swings east and north in a big bend to enter a broad flat valley that trends north. Here Grotto Creek gathers waters from the dip slope of the interstream area to the west with little water from the east. The lower fifteen miles of Grotto Creek is a system of complex meanders, oxbow lakes and beaver dammed lakes. The Creek is without braiding. The wide valley in which the creek flows presumably carried a much larger river (upper Little Bear ?) at an earlier date. The lower twenty miles

of Grotto Creek could be used for canoeing.

"Rouge Mountain" River drains the central portion of the map sheet. It is a typical mountain stream with a boulder-choked channel, braided and subject to sudden floods. The upper branches of Rouge Mountain River traverse V-shaped valleys in the uplands with an integrated dendritic pattern. The central portion of the river has carved a deep narrow gorge in Devonian limestones and spreads a fan-delta where it spills out into its lower valley. This delta has blocked the valley sufficiently to cause aggrading and meandering in the tributary from the south. For the lower ten miles of its course Rouge Mountain River follows the Beavertail - Fort Creek contact, then it cuts across to join the Carcajou River. Rouge Mountain River is no good for canoeing.

"Jacoe Creek", which drains the northwest portion of the map area is entrenched in deep gorges that are 1000 feet deep near the Carcajou River. The canyons are cut entirely from Silurian and Bear Rock limestones and are unfit even for foot traverse.

Occasional small lakes are found in rock basins throughout the area with many of them in limestone areas possessing underground drainage (Pluvius, Grotto Lakes). Lake Pluvius has been used for small planes on floats but is actually too small. Grotto Lake is unsafe for float work as limestone reefs extend into the lake.

Land Forms

The Carcajou River - Little Bear River Divide area covers part of the foothill front of the Mackenzie Mountains. The drainage pattern is dendritic juvenile with waterfalls common and canyons predominating. The valley pattern gives evidence of previous subsequent drainage pattern and later rejuvenation. Canyons and the plateau-like interstream areas

are carved in most part in bed rock, although some of the earlier valley system is etched in unconsolidated material.

The valleys of the Carcajou River, lower Rouge Mountain River and Grotto Creek are about 500 to 1000 feet above sea level. The interstream areas east of "Rouge Mountain" run from 1000-2000 feet elevation. The mountains range f om 3000 to 4500 feet elevation. Interstream areas tend to be large and are dip slopes in most part.

In the southwest corner of the map sheet a large rounded plateau, with steep cliffs on the north side, is set out in front of a range of triangular peaks that lie west, just off the map sheet. This plateau is flanked on the east and north by a set of dip-slope cuesta-like hills carved from red Cambrian strata. These red mountains are in turn flanked by a range of hills carved from the erosional escarpment of later limestones that rises to considerable relief in "Pyramid"Mountain.

Terraces and benches of unconsolidated material have been left on the upland west of the Grotto Lake - lower Rouge Mountain River valley indicating old shore lines in glacial time. The drainage of this hypothetical glacial lake probably took place through an abandoned valley system on the uplands that run down past Lake Pluvius and eastward toward the Little Bear River.

Except for some rounding of features glacial forms are almost entirely absent. Badlands are developed to the west of Bacee Creek south of the Carcajou River along the west side of Grotto Lake, and west of the lower part of lower Rouge Mountain River.

Physiography

The entire area is carved from the northwest flank and crest of the Rouge Mountain Anticline. The earlier Paleozoic quartzites and limestones build the uplands and mountains west of Grotto Lake while the

plains to the east and north of Grotto Lake are underlain by the gently dipping Upper Devonian and Cretaceous shales and sandstones.

The Cambrian quartzite in the axial region is stripped of overlying shales to form a massive rounded plateau. The axis of the anticline plunges north and the hills range in concentric northwest arcuate pattern to conform to the outcrop edge of the more competent limestone members. Scarp faces are south and west with gentle dip-slopes east. Vertical walled canyons are cut where the streams break through the harder members.

Prominent cliffs are maintained where Cambrian limestones overlie red shales, where Silurian limestone overlies gypsiferous shales, and where upper Middle Devonian limestones overlie shaley limestones of early Middle Devonian. The Bosworth sandstone maintains a ledge over the Fort Creek shales. The dip slopes are crested by Bosworth sandstone, uppermost Silurian limestones and Cambrian limestones and quartzites. Vertical cliffs are maintained by jointing in the Cambrian quartzites, in the uppermost Silurian limestones, and in the Beavertail limestone. Hoodoo shapes and badland weathering are common to areas of Bear Rock and Beavertail formations. Natural bridges and caves are common to the Beavertail formation in the terrace region near Grotto Lake. Slumping is common in the uppermost Fort Creek shales where a certain percentage of bentonitic (?) material seems to be present.

The dual sets of drainage patterns find their origin in the drainage of an old glacial-front lake, on withdrawal of the Keewatin ice, followed by simple isostatic readjustment uplift of the mountain front, after withdrawal of the ice, causing rejuvenation. The valleys of lower Rouge Mountain River and lower Grotto Creek follow the soft shales of the Middle-Upper Devonian contact and the Devonian-Cretaceous

contact respectively.

Geography

This area is little known and some of the major features were given names in this report, as indicated by quotation marks where first referred to.

"Grotto Creek"- A meandering creek flowing into the Carcajou River from the east side at approximately Latitude 64° 44' N and heading in Grotto Lake. It flows out of the south end of Grotto Lake and, after a big bend to the south, flows in a generally N.N.W. direction to the Carcajou.

"Rouge Mountain River"- A gravel-braided mountain stream that flows into the upper Carcajou, at the big bend, at approximately Latitude 64° 42' N, Longitude 126° 52' W. on Mr. Frame's map sheet. (Little Bear River Sheet No. 2, 1" - 1 mile, 1943). Two streams enter near here and Rouge Mountain River is the downstream one and its valley comes in from the east. Rouge Mountain River rises in the mountains to the southwest of Rouge Mountain, cuts into the south side of Rouge Mountain and then enters a canyon for the next six miles, thence into a fairly wide steepwalled valley that trends north until opposite the Carcajou River where the river cuts west for two miles to join the Carcajou River.

"Jacee Creek"- A small braided creek entering the Carcajou from the south, just above the mouth of Rouge Mountain River. This creek heads in the country northwest of Rouge Mountain and appears crossing the center of photograph 70, C. P. A. 199.

"Grotto Lake" - A small lake about one and one half miles long, one quarter to one half mile wide at approximately Latitude 64° 32' N, Longitude 126° 42' W, Mr. Frame's map (op.cit). It appears on photographs 58 and 59, C.P.A. No. 199. The west side of the lake is made of limestone carved into natural bridges, caves and badland shapes.

Much of the drainage and source of waters of Grotto Lake is underground.

"Lake Pluvius" - A small lake about one mile long on the uplands at Latitude 64° 35' N., Longitude 126° 54' W on Mr. Frame's map. (ibid). Small float planes used this lake in 1943. It may have been termed "Duck Lake" in some early notes by pilots. Plane table stations 1, 2 and 3 are on the shores of this lake.

"Meeny Lake" - "Miney Lake" - Two small ponds lying north of plane table stations 10 and 11 respectively.

"Rouge Lake" - A small lake in the cirque-like basin to the east of Rouge Mountain Peak.

"Rouge Mountain"- An orange, reddish, triangular peaked mountain about 4000' elevation, located about Latitude 64° 33' N, Longitude 127° 02' W on Mr. Frame's map (ibid). Plane table station 21 is on the top of the mountain. It is five miles W.S.W. of Lake Pluvius.

"Red Mountain"- A small brick-red cuesta-shaped mountain three miles southeast of Rouge Mountain.

"Pyramid Mountain" - A flat topped mountain around 4500 feet elevation, carved from light buff limestone about six miles northwest of Rouge Mountain. This is the peak farthest south on the range of hills formed by the west facing scarp of Silurian limestones.

Chapter III

STRATIGRAPHY

General

The Carcajou River - Little Bear River Divide Area provides a good comprehensive section of the strata of the region from Cambrian time to Cretaceous. A thickness of Cambrian clastics consisting of quartzites, sandstones, and shales is overlain by red beds and precipitates. Silurian and Middle Devonian provided limestones several thousand feet in thickness and Upper Devonian provided clastics progressively coarser upward in section. Cretaceous shales lie unconformably on Upper Devonian. Several major disconformities are recorded, viz. post Middle Cambrian - pre Lower Silurian, post Middle Silurian - pre Middle Devonian, post Upper Devonian - pre Cretaceous. Other minor disconformities are indicated.

The section revealed in the area correlates very closely with that of Dr. Nauss on the Upper Carcajou (Ref. 8) and with that of Dr. Williams in the Franklin Mountains (Ref. 2).

The stratigraphy of the area is best summarized in the following table, and the detailed stratigraphy is best illustrated by Plate IV accompanying this report.

(Table on following page)

Summary of Geological Formations

QUATERNARY	Recent	Talus gravels peat. Post-Glacial lake and terrace sands.	------ 0 - 200'
	Pleistocene	Keewatin glacial drift	------
CRETACEOUS		Shales and sandstones. Basal conglomerate	500' + 3'
UPPER DEVONIAN	Bosworth	Calcareous sandstones and shales.	700' +
	Ft.Creek	Shale, calcareous shale sandy and bituminous shale.	1345'
MIDDLE DEVONIAN	Beavertail	Brown limestones	97'
	Ramparts ls.	Brown limestone	42'
	Ramparts sh.	Coquinas and dark shaley ls.	255'
DEVONIAN OR SILURIAN	Bear Rock	Dolomites and breccia	315'-400'
MIDDLE SILURIAN	S_4	Massive dolomites	450'
LOWER SILURIAN	S_3	Thin bedded limestones with chert bands at top	965'
SILURIAN OR ORDOVICIAN	S_2	Gypsiferous shales.	500' +
CAMBRIAN	C_5	Red-weathering limestone maroon shales, green shales.	445'
	C_4	Oolitic limestone, quartzites, conglomerate red shales.	220'
	C_3	Reddish limestones shales and sandstones.	150'
	C_2	White quartzites.	800'

CAMBRIAN

Cambrian strata are exposed in the center of the anticline which lies west of Rouge Mountain. The strata were divided into four units for field mapping C_2, C_3, C_4, C_5 and these units are used in the discussion following. The total Cambrian exposed, measured around 1600 feet, with the base concealed or unrecognized.

Cambrian ? C2.

The base of the Cambrian is unknown, but is represented here by eight hundred feet of thick-bedded, medium grained, white quartzite that weathers grey to pink and is in appearance similar to the Lower Cambrian quartzites of Alberta and the Mount Selwyn quartzites of North-eastern British Columbia. This section lies entirely below anything recorded by Dr. Nauss to the north (Ref. 7). However, Dr. Laudon's section (Ref. 4) in the Imperial River canyon would indicate that shaley beds occur again below this thick section of quartzites if there is no duplication involved in his section. Dr. Laudon reports these postulated correlative beds as quartz sandstones. If these beds become less indurated under the basin to the east they could provide a reservoir horizon as the overlying beds are shaley and impervious.

The writer would see no objection to any correlation of the lower part of Dr. Laudon's section with the former's C3 and C4 groups allowing for a considerable thickening in these groups to the north. In this case a tentative correlation of the C2 group of lower quartzites would be made with the thick Precambrian ? quartzites found by M. Y. Williams on the east slope of Mount Clark. (Ref. 2).

Cambrian C3

Overlying the thick series of white quartzites C2 is a series (150 feet in thickness) of reddish weathering beds, mainly grey shales

carrying black limestones near the base and thin grey sandstones at the top. These latter sandstones are not excessively indurated. The thickness of this series is entirely an estimate and it may be much thicker as dips were increasing back from the scarp face where the series was observed. The base of Dr. Nauss' section of Cambrian is in this series and it is included by him in his Katherine Group. This C3 group is included by Dr. Laudon in his MacDougal group and if the correlation with Williams is followed out as mentioned under C2 it would be placed correlative with Williams' Precambrian (?) shales on Mt. Cap with a possible overlying disconformity.

Cambrian C4

This C4 series of Cambrian is a catch-all for several hard beds of various origins. Totalling 220 feet in thickness it carries at the base about 100 feet of quartzites similar to those found in C2, with a very coarse conglomerate phase appearing at the top. Overlying the conglomerate are 18 feet of red shales grading into 30 feet of dark shales capped by argillites and oolitic limestones.

A section exposed in a canyon just south of Rouge Mountain about one quarter mile south of Rouge Mountain River is given here:-

~~	overlying greenish shales and argillites of C5.
- -	Contact apparently conformable.
30'	Argillites, black, limey bands, veined with calcite. Some beds with shaley habit.
6'	Limestone, hard black oolitic.
6'	Shales and limestones, black, hard.
3'	Shales carrying large argillite nodules to 3'.
20'	Limestones oolitic. Oolite beds to 2' in thickness divided by argillite bands 6" thick.
7'	Oolitic limestone, black, hard, one bed.
30'	Shales, argillites, sandy limestones and silicious shales.
18'	Red shales and greenish shales with a thin sandstone band at top. This sandstone band becomes conglomeratic and carries malachite green colored chert grains to ¼" in size.
100'	Quartzitic sandstone, coarse pink weathering with band of conglomerate at the top carrying boulders to 8" in diameter.
~~	Contact not observed.
~~	underlying sandy shales of C3.

The top of this division is chosen by Dr. Nauss as the top of the Katherine Group. It is included by Dr. Laudon in the MacDougal Group. The writer has little hesitation in correlating these beds (C4) with the Mount Clark formation as defined by M. Y. Williams on Mount Clark and Mount Cap. Williams has assigned the Mount Clark formation to the Lower Cambrian on fossil evidence (Ref. 2, p.76).

The presence of conglomerates and oolitic limestones suggests shallow water conditions during deposition and possibly an early Cambrian disconformity or several disconformities are represented in this series. This would also provide for the lateral variations that occur locally and the difficulty of correlating individual members with other areas.

Cambrian C5.

This division of the Cambrian makes up Rouge Mountain and is well exposed along the canyon of Rouge Mountain River just east of the mountain where the dip slope brings it down.

Overlying the colitic limestones of C5 are 275 feet of maroon nodular shales that grade transitionally upward into 170 feet of orange weathering limestone. The competent nature of the upper beds, and the brilliant colors of the whole formation provide a set of reddish-hued dip-slope triangular peaked mountains.

A section on Rouge Mountain River just below Rouge Mountain shows the following:

---	concealed beds of S2 series.
---	contact not seen, believed disconformable.
100'	Limestones, dark, argillitic, orange-weathering, carrying large quartz crystals and barite nodules on Rouge Mountain. Upper part concealed.
70'	Limestone, black, argillitic, blocky. Beds about 2 feet thick.
40'	Maroon beds about four feet thick, interrupted by argillitic limestone beds and bands of green shale carrying maroon nodules to 3" in diameter.

30' Shales, greenish slatey with some thin red-beds and thin limestones.
75' Maroon beds. Nodular shales reddish and green with 50% of maroon limey nodules to 2" in diameter.
40' Maroon beds. Nodules are much smaller and make up only 5% of the shales.
60' Maroon beds. As above only increasing in greenish beds toward the bottom.
30' Shales, greenish with black limey argillites.
--- contact apparently conformable.
--- Argillites and limestones of C4 series.

Cambrian C5 includes the Dead End shale and the Echo Canyon limestone of Dr. Nauss, (Ref. 6) with apparently much thickening of the limestone member at the top. This is not unreasonable as the Echo Canyon limestone varies in thickness within the Upper Carcajou Area. The presence of barite and rock crystal at the top of the limestone suggests an unconformity. The red color of the limestone indicates shoaling conditions at time of deposition. It is not unreasonable to assume that the change in thickness of the upper limestone is the result of erosion progressively greater to the north as Dr. Laudon reports little of this limestone observed in the Imperial River section.

The age of this group is dated Middle Cambrian on the evidence of fossils collected by Link (Ref. 3) and Hume (Ref. 1, p.53) in the Upper Carcajou River Area. This makes correlation with the Mount Cap formation and possibly part of the Saline River formation of Williams in the Franklin Mountains. As Williams does not define the top of the Mount Cap formation the writer suggests that the top be defined as immediately below the introduction of gypsum precipitates in which case C5 is equivalent to the Mount Cap only.

SILURIAN

Above known Middle Cambrian strata and below known Middle Silurian strata are approximately 1400 feet of strata that have to be dated on lithological correlative data and by pure hypothesis. The writer has broken the section by including all gypsum bearing strata in the post-Cambrian as the gypsum bearing shales run up gradationally into the overlying Silurian beds. By placing the break at the top of the C5 group simpler correlations seem possible with the Franklin Mountains. The writer would not necessarily exclude the basal portion of these strata from Cambrian age, but rather exclude them from the conditions of the early seas.

The three divisions used in this report under S2, S3, and S4 correspond to Williams' three formations, Saline River formation, Franklin Mountain formation, and Mount Kindle formation respectively.

Ordovician or Silurian -S2

Above the orange-weathering limestones that form the dip slope of Rouge Mountain is a badly concealed interval of around 500 feet that contains red beds, dark jetty-like shales and some sandstones. Poor exposures made correlation with nearby areas difficult and the reader is referred to Dr. Nauss' section of Alder Sandstone, Clemis and Sanguine shales and Dodo formation for a description of this interval (Ref. 8). The writer correlates this with the Saline River formation of Williams and with the basal red beds of the Bear Mountain section.

Silurian S3

Below the beds of Middle Silurian age are 965 feet of thin bedded light weathering limestones carrying occasional green shales and replaced in large part near the top by light colored banded cherts.

These beds form the light buff face of Pyramid Mountain and are well exposed in the Canyon of Rouge Mountain River near the upper end, southwest of Lake Pluvius.

A section, partially detailed, at the latter locality shows the following lithology:

--- overlying dark brown ls. with angular chert. Middle Silurian S4.
--- Contact apparently conformable.
1' Limestone, dark brown crystalline with Crinoid fragments.
8' Chert, white banded replacing limestone by 95%.
1' Limestone, crystalline.
2' Chert light banded, 70% replacing limestone.
1' Limestone, coarse light brown.
6' Chert, white to light grey brown chert, 90% replacing limestone.
1' Limestone, coarse grey.
7' Chert, pearl grey, banded, 80% replacing limestone.
4' Limestone, 50% replaced by banded chert.
2' Limestone, light, buff, fine grained, blocky weathering.
7' Chert, banded, white and pearly grey, 90% replacing limestone.
6½' Limestone, thick bedded grey coarsely crystalline, with three 2" chert bands.
6' Limestone, grey coarsely crystalline porous.
1½' Chert and silicified limestone.
9' Limestone, coarse crystalline porous grey buff.
2' Dolomite, very fine grained grey, 3 thin chert bands.
5' Dolomite, medium grained porous - brown sugar.
1' Chert zone, lensing, sometimes absent.
11' Limestone, fine grained, crystalline light buff blocky, angular, jointed.
1' Chert, banded white and pearl grey.
9' Limestone, fine grained pink crystalline beds 8".
8' Limestone, fine grained pink, beds 1'.
1' Limestone, shaley bedded with chert bands.
1' Chert, grey to pearl grey banded.
1' Limestone, thin shaley bedded, pearl grey.
4' Limestone, white fine grained, blocky 6" beds.
9' Limestone, light grey with small calcite geodes.
2' Limestone, light grey, blocky beds to 4".
13' Limestone, fine grained brown crystalline massive.
2' Chert, white to grey.
15' Limestone, massive fine grained yellow weathering light buff.
2' Limestone with greenish silicification.
2' Limestone, coarsely crystalline, geodal, grey.
½' Limestone, lithographic, blocky grey.

2'	Limestone, shaley white weathering, fine greenish.
7'	Limestone, coarse grained crystalline jointed.
1'	Chert, greenish and white and limestone.
10'	Limestone, fine grey with zones and sporadic centers of chert.
1½'	Chert, white and grey.
19½'	Limestone, grey and grey brown fine grained.
2'	Chert, orange and greenish white weathering.
1'	Limestone.
½'	Chert, greenish and orange.
66'	Limestones thin bedded with gastropod zone in quartzite at base. Suite 3694.
700'±	Limestones thin bedded with interbedded shales and probably gypsiferous shales toward the base. Section not detailed.
---	Contact not defined.
---.	Underlying formation S2 badly concealed.

The above section is presented to illustrate the mode of occurrence of this cherty horizon that has been recognized by Laudon and Foley, and others. On the strength of the occurrence of this chert banding, Dr. Laudon proposed a disconformity at the top of this division and restricted the term Mount Ronning to beds above this horizon.

The base of the formation was not defined in this area as exposures of the base and underlying formation are obscured. Dr. Laudon drew the base at the occurrence of an Algal horizon that was not recognized in this area.

This formation is correlated with the Franklin Mountain formation of Williams that is dated Lower Silurian on fossil evidence (Ref. 2, p.78). It is correlated with the complete section of Silurian on Bear Mountain and with beds forming the scarp face of the Discovery Range. This formation has the widest recognized distribution for the earlier Paleozoics in this area.

This formation is too tight to be of any real value as a reservoir rock. Gypsiferous shales near the base and silicification of the top destroy the little original porosity.

The only fossils collected were some poor gastropods of doubtful

diagnostic value as Suite 3694.

Silurian S4 - Mount Kindle Formation

The upper part of the Silurian in the Carcajou River - Little Bear River Divide Area consists of 450 feet of massive, thick-bedded, porous and cavernous limestones and dolomites that carry a prolific Middle Silurian fauna. A section taken directly south of Lake Pluvius on the Canyon of Rouge Mountain River reveals the following strata:

---	typical Bear Rock.
6'	Dolomite, thin bedded uneven silty with paper thin black shale.
4'	Dolomite, granular silty brown showing mud cracks.
1'	Limestone, gypsiferous marly rubbly light colored.
½'	Dolomite, shaley.
2'	Dolomite, banded silty.
---	contact of Bear Rock and S4, unconformable.
9'	Limestone, grey beds 4" to 1', chert bearing.
8'	Limestone, mottled grey and light grey thin bedded.
6½'	Limestone, brown, medium grained, jointed.
1½'	Limestone, dolomitic, dark brown, rubbly thin bedded.
2½'	Limestone, dolomitic, dark brown fine grained, rubbly.
2'	Dolomite, blocky weathering (looks like the boulders in Bear Rock formation).
6'	Limestone, dolomitic, fine crystalline, porous.
3'	Limestone, porous.
1'	Limestone, dolomitic, brown, fine crystalline, one bed.
3'	Limestone, dolomitic, brown, fine crystalline, one bed.
4'	Limestone, dolomitic, fine, developing banded chert.
12'	Limestone, dolomitic, brown, medium fine grained, porous.
16'	Limestone, dolomitic, mottled medium fine grained, massive cavernous at top. Fossil suite 3671.
6'	Limestone, mottled, massive carrying Favosites.
5'	Limestone, grey buff and brown buff mottled.
6'	Limestone, thin rubbly-bedded, grey, fine.
2'	Limestone, dolomitic fine grained, dark.
18'	Limestone, dolomitic brown cavernous at top with Dawsonoceras and Conchidium at base - shows slight bedding.
33'	Limestone, dolomitic, massive, brown, porous and cavernous with Favosites and Cyathophyllum. Fossil Suite 3667.
3'	Limestone, grey with prolific Conchidium. Fossil Suite 3670.
2'	Limestone, buff, four beds.
2½'	Limestone, buff with white chert in layers and sporadic lenses, Suite 3669 collected from the beds for 58 feet below the top of this bed.

5' Limestone, bedded grey and grey buff mottled.
6" Limestone, shaley with cup coral. Suite 3668.
2' Limestone, brown dolomitic with Conchidium and Favosites.
48' Limestone, bedded, rubbly to blocky with some porosity and geodal cavities. Carries Conchidium.
10' Limestone, light grey and light buff, mottled. (Section from this bed down measured at later date than above).
16' Limestone, poor, platey to blocky, some mud cracks.
6' Limestone, grey massive compact.
13' Limestone, thick bedded, grey and grey buff mottled.
13' Limestone, thin bedded brown with cleavage developed.
11' Limestone, grey, blocky rubbly, beds sutured 3".
8' Limestone, buff grey, yellow weathering with small Halysites. Suite 3692 collected from beds for 42 feet below top of this horizon.
8' Limestone, brown and grey buff mottled, massive.
26' Limestone, massive jointed blocky brown (looks like Beavertail) with Zaphrentis, Diphyphyllum, Halysites, Stromatoporoid.
2' Limestone, brown, thin poorly bedded.
23½' Limestone, rubbly bedded to cavernous, brown mottled, carries Cladopora type colonies.
7' Limestone, thick bed, dark brown carrying cup corals, Halysites.
7' Limestone, brown, thick bed, with cup corals.
1' Limestone, buff, mottled, brecciated at base.
20½' Limestone, grey brown, crystalline, 3" to 1' rubbly beds.
9½' Limestone, dark brown, thick bedded.
13' Limestone, bedded, thin, blocky brown with angular grey gypsum centers with some grey chert.
--- Possible disconformity, here or within beds immediately above.
6' Limestone, brown crinoidal, crystalline, geodal with chert development. Large coral colonies. Suite 3693 from here to contact.
30'+ 4' Limestone, dark brown with sporadic angular white chert.
--- contact of S4 and S3, possible disconformity.
1' Limestone, dark brown crystalline with crinoid fragments.
--- Typical banded white cherts of S3.

The above section is complete with no covered intervals. It reveals a definite contact at the top and, compared with other localities, shows the contact to be disconformable. The superjacent Bear Rock formation weathers back quite readily, leaving long dip slopes of Silurian to the west of Lake Pluvius and west of Jacee Creek.

The gorges of the rivers are cut in Bear Rock and floored by the top of the Silurian. The upper part of the Silurian "looks" older in the field than any of the later formations suggesting that the major

disconformity comes between Bear Rock and Silurian beds. Looking to other areas, such as Bear Mountain, where the Bear Rock lies directly on the Franklin Mountain formation, with the Mount Kindle formation missing, the major unconformity is placed at the top of S4.

Whether an erosional unconformity exists at the base of the S4, Mount Kindle formation, is open to question, but the presence of cherts and some gypsum near the base of the formation would suggest either a radical change in the conditions of deposition or a possible stratigraphic hiatus involving a period of non-deposition. There is no evidence of any angular disconformity at this time.

The writer has no hesitation in correlating this formation with Williams' Mount Kindle formation on lithological, stratigraphical and paleontological grounds, and assigning to it a Middle Silurian age. This is also correlated with Laudon's restricted Mount Ronning in the Imperial River area.

It is interesting to note that Mr. Burwash brought in Middle Silurian fossils from along the Canol road route as far west as Carcajou Lake.

The formation would make an ideal reservoir rock as it is porous and cavernous, and lies under an efficient capping of Bear Rock gypsiferous beds. Although no bitumen was found in the formation the outcrops examined were all low on the flanks of the main structure and would not be expected to be petroliferous. The formation is not present at Bear Rock to the east, hence a stratigraphic pinch out against the erosional unconformity should be encountered somewhere between the two localities.

Fossils collected from the Mount Kindle formation in the "Divide" area include the following suites:

Between plane table Stations 8 and 9 - over 60' of upper S4.

Suite 3661 - upper 10 feet.

Conchidium
Halysites catenulatus
Syringopora
Stromatoporoid
Halysites microporous
Zaphrentis
Favosites
Cladopora?

Suite 3665 - under 3661, 10 feet.

Favosites
Syringopora

Suite 3664 - under 3665, 10 feet.

Favosites.

Suite 3663 - under 3664, 10 feet.

Syringopora
Conchidium

Suite 3662 - bottom 20 feet.

Favosites
Algae
Cup corals
Zaphrentis
Halysites
Syringopora.

From section given on Rouge Mountain River arranged in order, see detailed section for position.

Suite 3671

Halysites

Suite 3667

Syringopora
Prismatophyllum

Suite 3670 A (3670 B is a Ramparts suite)

Conchidium

Suite 3668

Conchidium
Dawsonoceras
Diphyphyllum

Suite 3692

Zaphrentis
Syringopora
Halysites
Stromatoporoid

From north of Lake Pluvius to Sta. 201 (picture)

Suite 3681

Orthis	Stromatoporoid
Favosites	Streptelasma
Halysites microporous	

DEVONIAN

The Devonian of the Carcajou River - Little Bear River Divide Area includes known Upper Devonian and Middle Devonian strata. Below the known Middle Devonian and above the known Middle Silurian strata lie a series of beds of undetermined age that seem to be more closely related to the Devonian sequence and may possibly be of Lower Devonian age.

This lower formation, a dolomite and limestone breccia, is termed Bear Rock formation and is over 315 feet in thickness. The Middle Devonian includes the Ramparts formation and the "Beavertail" formation totalling 394 feet of limestones. The Upper Devonian introduces clastics of the Fort Creek shales and the overlying Bosworth sandstones. The total thickness of Upper Devonian is something over 2000 feet. An erosional unconformity and a long time break from Upper Devonian to Lower Cretaceous time marks the upper limit of the Devonian.

The section corresponds with the section of Devonian as found in the remainder of the Mackenzie River lowlands and correlates simply with it.

Devonian or Silurian - Bear Rock Formation

The Bear Rock formation is 315 feet thick in the canyon of Rouge Mountain River and thickens to over 400 feet to the north near Carcajou River. It is well exposed in the tributaries coming into the lower Rouge Mountain River from the west as the rivers cut gorges through the formation with waterfalls common over the upper members. Badlands, rounded hillocks, and hoodoo shapes carved from the formation are common on both sides of Lower Jacee Creek, and run in a band south toward little Bear River at the foot of the Silurian dip slope.

The Bear Rock formation of this area is very similar to the Bear Rock in the Schooner Creek Area with a basal bedded portion similar to the underlying Silurian, a center part of a coarse dolomite breccia, and an upper bedded part transitional with the overlying Ramparts.

A section in the Canyon of Rouge Mountain River reveals the following lithology:

---	Shales carrying basal Ramparts fossils.
2'	Shales, blocky, argillitic, black, limey.
1'	Shale, thin black.
---	contact Ramparts - Bear Rock.
8½'	Dolomite, coarse, brown, one bed, sometimes thinner.
12'	Limestone, dark, blocky, bedded thick to thin, sometimes merges laterally into below type.
18'	Limestone, gypsiferous (?) light crossbedded to massive.
10'	Dolomite, granular, blocky, poorly bedded.
8'	Dolomite, brown one bed.
30'	Limestone, dolomitic, brecciated, poorly bedded.
195' ±	Breccia, coarse, dolomitic, massive, hoodoo weathering, with only occasionally poorly bedded zones, carries blocks of limestone up to two feet in diameter, matrix is limestone to dolomite.
10'	Limestone, white, gypsiferous ? weathers rounded, sometimes absent.
6'	Dolomite, uneven bedded, thin, silty with paper thin black shales.
4'	Dolomite, granular, silty looking, brown showing mud cracks.
1'	Limestone, rubbly, marly, gypsiferous, light colored.
½'	Dolomite shaley.
2'	Dolomite, banded, silty.
---	Contact Silurian and Bear Rock, assumed erosional.
---	Limestones, bedded of S4 Silurian.

The Bear Rock is seen resting unconformably on the Silurian in the canyon of Lower Jacee Creek where a relief of over 100 feet is noted on the contact of the bedded Silurian and the Bear Rock breccia. Thicknesses of Bear Rock formation far exceeding the section measured on Rouge Mountain River, were noted on lower Jacee Creek and immediately east but the lack of bedding in the Bear Rock, and the entire absence of fossils as well as its heterogenous nature, made it impossible to measure definite sections that are not bounded by the overlying Ramparts and underlying Silurian. Except for occasional thin, gypsiferous limestones at the base of the section in the "Divide" area, the Bear Rock formation seems to lack the basal gypsiferous phase found elsewhere.

The discussion of the origin of the central "breccia" zone of the Bear Rock has brought forth varied opinions. This area has revealed high Silurian beds of composition similar to boulders found in the Bear Rock, has revealed considerable relief on the pre-Bear Rock surface, has revealed rapid variation in thickness of the Bear Rock, therefore the writer is of the opinion that the Bear Rock "breccia" is primary and not secondary.

The upper part of the Bear Rock is bedded, and with the basal Ramparts, forms a definite unit. No disconformity has been observed in the field between the two formations, and for this reason the writer prefers to assign a Devonian age to the Bear Rock. The formation is correlated with the Bear Rock formation of Bear Mountain, and with the Lone Mountain formation as redefined by Williams for the Franklin Mountains. No fossils were found in the formation.

This formation should make a good reservoir rock as in the area there is little contained gypsum and the overlying Ramparts are shaley.

Middle Devonian - Ramparts and Beavertail

The Middle Devonian of the Carcajou River - Little Bear River Divide Area is similar to the Middle Devonian of the Discovery Range. There are three divisions; the lower Ramparts shale, the Ramparts limestone and the Beavertail limestone. These three divisions are recognizable faunally, but lithologically, and for mapping purposes, the division is two-fold into Ramparts shale and Ramparts - Beavertail limestone.

The Ramparts shale is a shaley limestone formation carrying a large number of thin coquina horizons and occasional Stromatoporoid bioherms. It is 255' thick.

The Ramparts - Beavertail limestone forms a massive cliff forming member totalling 139 feet of dark brown fine-grained limestone.

A section on a small canyon south of Rouge Mountain River, toward Grotto Lake, shows the following detail:

---	Broded off, approximately the base of the Fort Creek.
97'	Limestone, thick bedded and massive, brown.
---	Shale, thin black, Beavertail - Ramparts contact.
7'	Limestone, brown, blocky weathering with black shale partings, Syringopora.
13'	Limestone, massive dark grey, jointed, blocky at top.
11'	Limestone, massive dark grey.
11½'	Limestone, dark brown 10" beds with thin brown shale partings.
---	Base of Beavertail - Ramparts limestone.
4'	Limestone, beds blocky 4", with shale partings.
4'	Limestone, black, jointed.
10'	Limestone, rubbly to blocky with thin shale partings.
3'	Limestone, black, rubbly weathering.
3'	Limestone and brown shale rubbly weathering with Martinia. Fossil suite 3690.
1½'	Limestone, dark, chippy weathering.
4'	Shale and limestone rubbly weathering with corals.
1'	Limestone, black.
6'	Shale, limestone and coquinas, rubbly weathering.
6'	Limestone and shale rubbly weathering, brown.
1½'	Limestone dark.
4'	Limestone dark, one bed.

13' Shales and limestones slaty bedded with thin coquina layers, Atrypa spinosa.
6' Limestone, argillaceous shaley to slaty with Actinopteria and Productella. Suite 3689 from here and 21 feet below.
21' Shale and limestone, rubbly brown, thin coquinas.
3' Limestone and shale with coquina at top.
3' Limestone and shale with coquinas carrying Streptelasma, Martinia, Euomphalus, Tentaculites, Atrypa devoniana, etc.
4½' Limestone and shale, rubbly weathering, with coquinas and Cladopora.
2' Limestone, blocky weathering, argillaceous slaty.
15' Shale and limestone, rubbly weathering with coquinas. Suite 3680 from this horizon.

Section below continues from 3680 horizon on Rouge Mountain River in the lower part of the canyon.

9' Limestone dolomitic and black shales, rubbly. Suite 3679 from this bed and underlying 4½ feet.
1½' Limestone, blocky and shale. Orthoceras
3' Limestone and shale rubbly weathering.
2' Stromatoporoid bioherm, Suite 3678 from here and underlying 21½ feet.
2' Limestone and brown shale, rubbly weathering.
2½' Limestone, grey brown crystalline, Acervularia
6' Stromatoporoid bioherm.
11' Limestone rubbly with thin brown shale partings. Favosites
1' Shale brown and thin rubbly limestone. Suite 3677 collected from here and underlying 32' of beds.
½' Limestone, slaty.
½' Shale limey soft.
9½' Shale, thin limey wavy bedded.
1' Limestone, dark brown dolomitic.
21' Shales and thin shaley limestone.
2' Coquinas, wavy bedded limey, Schuchertella. Suite 3676 collected from here and underlying 3 feet of beds.
1' Shale, fissile grey brown.
1' Limestone, brown dolomitic with Pelecypod coquina at top.
½' Limestone and brown shale rubbly. Suite 3675.
11' Shale grey with thin pearl grey limestone. Actinopteria
3' Limestone brown crystalline, dolomitic.
1½' Limestone and shale, thin bedded, rubbly.
1' Limestone, brown crystalline, dolomitic.
1' Limestone, with brown sh. Actinopteria Suite 3674.
1½' Shale, soft brown.
½' Shale, hard.
1½' Shale, limey.
1' Shale, limey. Suite 3673.
2' Shale, dark brown.
1½' Limestone, medium grained dolomitic, thinly bedded.
3' Limestone, pearl grey with thin shale breaks.
½' Shale, pearl grey limey.

1½'	Limestone, black.
1'	Shale, dark brown
2½'	Limestone, black, blocky weathering.
2'	Limestone, buff unevenly bedded
1'	Limestone, black thinly bedded.
2½'	Limestone, dark grey thinly bedded.
2'	Limestone, pearl grey, shaley.
1'	Shale, pearl grey limey.
3½'	Shale, brown fissile.
2½'	Limestone, pearl grey, shaley, thin bedded
3'	Limestone, black, platey.
3'	Limestone, pearl grey, slatey.
½'	Shale, limey, light grey.
1½'	Limestone, pearl grey, slatey.
3'	Limestone, pearl grey, shaley.
3'	Marl, light colored with crineid fragments
2'	Limestone, black, argillaceous, blocky-weathering.
1½'	Limestone, grey shaley habit, ledge forming.
3½'	Limestone, black argillitic with shaley partings.
	Suite 3672.
2'	Shale, blocky argillitic, limey, black.
1'	Shale, thin black.
---	Contact conformable. Ramparts - Bear Rock.
---	Coarse dolomites of Bear Rock formation.

The above sections, except for the contact with the Fort Creek itself, contains no covered intervals. However, the contact with the Fort Creek is abrupt and readily defined as the black shales of the basal Fort Creek stand out in marked contrast to the heavy cliffs of Beavertail. This contact is well exposed opposite the mouth of the canyon of Rouge Mountain River and appears conformable at least locally.

The contact of the Ramparts and the underlying Bear Rock appears conformable and the writer suggests that the basal Ramparts was continuous deposition with the Bear Rock, with a return to normally saline seas and open seaway connections in Remparts time.

The contacts of Beavertail - Ramparts - Ramparts shale were drawn to conform faunally and stratigraphically to the arbitrarily set-up divisions that were used on Schoomer and Bosworth Creek by the Canol geologists. These divisions do not attempt to correlate with the type sections of these formations.

The Beavertail - Ramparts section is Middle Devonian and correlates directly with Nauss' section to the north, and with the Discovery Range sections to Bear Rock. It correlates with the unnamed Middle Devonian of Williams from the Franklin Mountains and with the Pine Point limestones on Great Slave Lake.

The horizon is not considered to be favorable as an oil reservoir, as the upper beds are too tight and the lower beds are shaley. Although caves, natural bridges and porosity is developed in the Beavertail-Ramparts west of Grotto Lake, this is considered entirely a local phenomenon due to the action of surface water and that these properties do not extend to the buried portions of the strata. In any case the Beavertail - Ramparts in the area is not involved in any known structure under cover. The terraces and small anticlines along the west side of Grotto Lake and Lower Rouge Mountain River have their surface expression in these strata giving the Beavertail - Ramparts an abnormal outcrop width for its total thickness.

Fossils collected from the Beavertail - Ramparts and Ramparts shale include the following suites.

Suites collected along Rouge Mountain River canyon, stratigraphic position indicated by section given from Ramparts shales.

Suite 3680

Pelecypods	Cladopora
Cystiphyllum	Cup Coral
Orthoceras	Acervularia.
Favosites	

Suite 3679

Orthoceras

Suite 3678

Atrypa
Acervularia
Cystiphyllum
Alveolites
Stromatoporoid
Schuchertella
Martinia

Suite 3677

Actinopteria
Odontocephalus
Schuchertella
Bryozoan
Martinia
Tentaculites

Suite 3676

Pelecypods

Suite 3675

Pelecypods
Productella
Gastropods

Suite 3674

Cystiphyllum
Pterinea
Gastropod

Suite 3673

Modiola

Suite 3672

Modiola
Ostracods
Martinia

From opposite canyon mouth Rouge Mountain River Sta.232 picture Beavertail - Ramparts.

Suite 3683

Cladopora
Alveolites
Prismatophyllum

From small canyon south of Rouge Mountain River, near canyon mouth for stratigraphic position see section.

Suite 3690

Martinia	Cladopora
Gastropod	Odontocephalus
Alveolites	Favosites

Suite 3689

Spirifer	Paleocyclus
Proetus	Productella
Actinopteria	Fenestella
Crinoids	Gastropod
Atrypa reticularis	

Upper Devonian - Fort Creek and Bosworth

The Upper Devonian of the Carcajou River - Little Bear River Divide area consists of the Fort Creek shale (thickness 1345' ±) and the overlying Bosworth (thickness 750' ±). The mapped boundary has been drawn arbitrarily about 150 feet above the base of the Bosworth as defined in the Norman Wells area by O. D. Boggs and placed at the base of the first heavy sandstone member that is persistent throughout the area. Only the lower five hundred feet of the Fort Creek shales is well exposed, and except for the thick sandstone member at the base of the Bosworth, the remainder of the section is mostly concealed.

The valley of lower Rouge Mountain River and Grotto Lake, runs along the Middle Devonian - Upper Devonian contact, and the upland east of this valley is carved from Upper Devonian strata. The section just above the contact on the east side of the Rouge Mountain River valley shows many petroliferous bands that have been burned to a bright pink, and these bands of color characterize the valley sides for several miles. The section following, taken in a small canyon (Sta. 233 picture) on the east side of lower Rouge Mountain River, shows the petroliferous nature of these lower beds.

--- Shales covered, Fort Creek.
100' Shales dark grey with thin ferruginous bands.
20' Shales, thin bedded blocky limey, intercalated fissile shales.
10' Shale, black fissile.
1' Sandstone, black argillaceous, limey, weathers buff.
41' Shale, limey blocky bedded, intercalated fissile shales.
3' Limestone, thin shaley dark grey.
1' Limestone, nodular weathering silty.
4' Shale, dark grey.
25' Shale, dark grey black, blocky, 2" bedding.
15' Shales, dark grey, thin bedded.
12' Shales, dark grey slatey, slightly limey.
3' Argillite, dark brownish, silty, blocky, nodular.
15' Shales, dark grey sulphurous.
1' Shales, dark grey with petroliferous black nodules.
8' Shales, dark grey.
1' Shale, blocky, black, sulphurous.
16' Shales, thin, dark grey with rusty sulphurous limey nodules.
1' Shale, petroliferous, thin, silty.
13' Shales, dark grey slightly sandy with rusty bands and yellow sulphur bands. Pink zone.
2½' Shale, limey petroliferous.
4' Shale, fissile to slatey with sulphur and rust.
1' Shale, soft rusty, sulphurous.
15' Shales, fissile brittle with sulphur.
6' Shales, thin, slatey, rusty and sulphurous.
1' Shale, rusty.
56' Shale, slatey, blue-black some brownish zones.
10' Shale, bedded, carries sulphur.
8' Shales, thin bedded slatey with sulphates.
1' Shale, sandy lenticular, petroliferous.
8' Shale, sandy, thin with sulphur and sulphites.
9 Shales, thin fissile sandy petroliferous with Tentaculites. Suite 3684.
1' Shale, sandy, dolomitic, petroliferous.
3' Shales thin fissile with sulphur and sulphates.
30' Shale thin slatey with marcasite nodules.
12' Shale, thin bedded black slatey.
½' Argillite limey black sandy pencil jointed.
45' Shales and argillite bands, (covered here).
--- contact Beavertail - Fort Creek - conformable.
--- Limestones, Beavertail.
503' Total section measured - Lower Fort Creek.

The above section was the only detailed one made and represents the horizon of the Lower Fort Creek shales. No reef horizon is present in the area and no equivalent limestone group was noted. However, if there is faulting in the covered zone immediately east of the above

measured section, these lime horizons may be present, faulted down, and the shales of the covered zone above this section would belong to the Upper Fort Creek. This is not probable. The only fossils collected from this zone were small Pteropods. Suite 3684. The measured section is correlated with the Lower Fort Creek, as defined in the Norman Wells Area and with the Simpson shale of the Upper Mackenzie River area.

Above the bituminous shales of the Lower Fort Creek formation are sandy and limey shales of the Upper Fort Creek. Poorly exposed and badly slumped, little new information on them was obtained from this area. The discovery of Cyrtospirifers in the upper part of the Upper Fort Creek shales has given a definite correlation with the Hay River shales of the Great Slave Lake area.

The Cyrtospirifers occur in a coquina in greenish grey sandy clay shales about 400' below the Bosworth sandstone. A small exposure at Sta. 236 picture, shows the following section.

---	Covered and slumped - Upper Fort Creek
2'	Coquina beds carrying Cyrtospirifer, Leptaena, Lingula. Suite 3685.
30'	Shale, greenish grey, clay weathering.
3'	Shale, purple.
25'	Shale, greenish grey clay weathering.
1'	Shale, purple.
20'	Shale, green, sandy.
60'	Sandstone, shaley calcareous micaceous purple and green. Suite 3686.
---	Unknown.

Fossils collected here,

Suite 3685

Cyrtospirifer
Martinia ?
Lingula
Productella

Suite 3686

Pelecypod

The occurrence of Cyrtospirifer in the Upper part of the Fort Creek, and the presence of micaceous sandstones, and the transitional boundary with the overlying Bosworth sandstone, leads the writer to the conclusion that the Lower Fort Creek is one formation and the next natural division includes both the Upper Fort Creek and the Bosworth sandstone. The name Carcajou series has been proposed for this conjunction and seems apropos. The writer is unable to define the limits of this series within this area.

The mapping contact, Bosworth - Fort Creek, was drawn at the base of a massive sandstone that carries Bosworth sandstone fauna. This sandstone is well exposed on the east side of the lower part of lower Rouge Mountain River where it forms a long cliff about 80 feet high at the top of the valley walls. The sandstone is transitional into the underlying shales and should be considered a coarse phase of the sandy shale series. The beds above the sandstone return to the shaley type that is found below. Only 700 feet of beds were estimated to occur between the base of the heavy sandstone and the basal Cretaceous. This shows considerable erosional thinning from the areas to the north where the sequence goes much higher stratigraphically. The actual amount of bevelling within the area is unknown, but the outcrop width of Bosworth increases northward.

Fossil suite 3682, from the heavy sandstone, shows correlation with the Bosworth sandstone horizon of the Bosworth Creek delta.

Suite 3682

Plants	Camarotoechia
Pteria	Streptelasma
Acervularia	Ostracods
Atrypa	Cladopora
Productella	Cyrtospirifer
Stropheodonta	Brachiopods (small)

Suites from horizons above this show Hay River affinities

Suite 3687	Suite 3688
Coquina Pecten	Camarotoechia

The Upper Devonian sandstones all show considerable calcification on outcrop and are not considered very favorable as reservoirs. However, this may be a surface induration phenomenon and if it does not extend to the buried portions of the sands, conditions are ideal for source beds and cap rocks. The Lower Fort Creek is very petroliferous and the shales of the Upper Fort Creek and the shales above the Bosworth, ie. Devonian and Cretaceous are impervious cap rocks. However, at no place in the area are the Upper Devonian porous beds involved in a known structure and stray lense possibilities are the only type of traps present. No reef conditions are known to be present in the Fort Creek and no clean sand lense is known below the Bosworth sandstone itself.

CRETACEOUS

Beds overlying the Bosworth sandstone are exposed on the valley sides of lower Grotto Creek. The age of these beds is unknown, but they were assigned to the Cretaceous on lithological and stratigraphical grounds. There are at least 900 feet of Cretaceous beds on lower Grotto Creek and undoubtedly higher beds come in east, down dip.

Except for isolated outcrops the formation was not examined closely. There is a basal conglomerate two to three feet in thickness carrying quartzite and chert pebbles up to two inches in diameter in a quartz sand matrix. Several hundred feet higher in section an isolated outcrop showed about 100 feet of marine shales carrying ironstone

nodules. These beds are assigned to the Lower Cretaceous.

QUATERNARY

The Pleistocene glacial drift is of Keewatin origin, and carries boulders of Tertiary, Cretaceous and Upper Devonian possibly picked up from the basin area. The glacial and post-glacial (?) lake terraces are composed of sand and little clay is included in them.

The recent deposits range from silts deposited along lower Grotto Creek to the coarse boulder bars of the Cercajou and lower Rouge Mountain River.

Chapter IV

STRUCTURAL GEOLOGY

General

The main structure of the Carcajou River - Little Bear River Divide area is a large anticline plunging north, the axis of which runs to the west of Rouge Mountain. This anticline will be referred to as the Rouge Mountain Anticline. The east limb of this anticline is very broad and, incorporated into the northwestern flank, is the expression of the southern extension of the south plunging MacDougal River anticline that is set en-echelon to the north. No structures favorable for oil exploration were located. The structures are best understood by reference to Plate III.

Rouge Mountain Anticline

In the southwestern corner of the map sheet there is a large exposure of early Cambrian quartzites that forms the areal expression of the crest of the Rouge Mountain Anticline. The axis of the anticline strikes N 65° W and plunges northwardly at 200 feet to the mile. The anticline in cross-section is nearly symmetrical, with dips near the crest rarely over ten degrees.

The west limb of the structure forms a range of mountains carved from west dipping Silurian beds. Whether there is any faulting on this mountain front is unknown, but if present, it is of no great magnitude.

The north plunge of the anticline also brings in Silurian beds to form a flat-topped set of hills carved from the beds near the axis (cf. Pyramid Mountain). The east limb of the anticline is very broad, and except for three minor wrinkles, very gentle, and brings down Cretaceous beds on the eastern edge of the map sheet.

The western limits of this anticline are unknown. The southern

extension south of the Little Bear River is unknown. Northward it probably dies out and becomes incorporated into the west limb of the Macdougal River Anticline. Eastward it is limited by the syncline that is located between Monnett's map sheet and the eastern edge of the "Divide" map sheet.

The symmetry of this anticline is probably due to the involving of the thick Cambrian quartzites in the folding without rupturing.

Macdougal River Anticline.

This anticline is the main structural feature of Dr. Nauss' Upper Carcajou River Area. A steep plunge to the south, in the neighborhood of the big bend of the Carcajou, brings down Bear Rock formation that masks immediate relations just south of the Carcajou.

A few miles south of the Carcajou the axial expression of this anticline is found in a triple set of minor structures that have very short west limbs (i.e. less than 500' of west dipping reversal) and which die out as terraces in the region of Grotto Lake.

Only one major fault is involved in this anticlinal wrinkling and it shows an overthrust from the west of a few hundred feet, and strikes nearly north and south, cutting obliquely the axis of the Macdougal River Anticline east of Jacee Creek.

These three anticlines are not pronounced enough to carry to any great depth effectively, and their shale cover is stripped off at the crest making them useless for shallow oil prospecting.

The easternmost of these three small anticlines has oil seepages from the Fort Creek shales near the crest, as if the wrinkling had been sufficient in the past to stop up-dip migration from the syncline. However, no really effective reservoir rocks are involved before the structure dies out.

Chapter V.

HISTORICAL GEOLOGY

The Carcajou River - Little Bear River Divide Area reveals a pattern of history of Paleozoic time similar to that of the Rocky Mountain geosyncline to the south.

Cambrian

The earliest rocks exposed are thick Cambrian white quartzites that are common from the 49th parallel north. This indicates that the area was included in the geosynclinal basin at this time and was receiving coarse detrital quartz from the same upland source of Cascadia (?). Partial drainage and fluctuating conditions in the trough toward the end of the Middle Cambrian left a pattern of red-bed conglomerates, coarse and fine clastics, also iron-bearing and oolitic limestones. These conditions carried on into Ordovician (?) time, but basins of excess salinity developed and gypsum was deposited. A possible erosional period at the end of Ordovician time deposited black shales above the red-beds although the basins continued precipitating gypsum. There was probably a period of uplift and erosion in this locality in early Silurian time, as none of the thick sections of Ordovician shales found to the west are preserved.

Silurian

In Lower Silurian time the area was reflooded and thin bedded dolomites and shales were laid down. The shales are limey, so the source area (Cascadia ?) must have been base levelled by this time. Chert replacement of beds at the top of the Lower Silurian seems to indicate a possible disconformity within Silurian time, not of any great severity, but rather a condition of non-deposition and silicification

of the ocean floor.

Middle Silurian saw the advent of quiet limestone seas with prolific fauna that probably carried on into Upper Silurian.

Uplift in late Silurian caused extensive erosion of Silurian beds and possibly structural deformation during later Silurian or early Devonian. It is assumed that considerable relief was attained by this uplift period as the succeeding formation carries large blocks of dolomites in breccia form, and varies considerably in thickness from place to place.

Devonian

Before known Middle Devonian time the preceding formations were levelled and normal deposition was taking place so the transition to Middle Devonian is conformable. Early Middle Devonian time was a period of shallow seas with still a large percentage of clastic deposition. Life was prolific and remains are excellently preserved. The seas deepened, and toward the close of Middle Devonian time the limestones seas were very clean with no argillaceous material of account.

At the beginning of Upper Devonian time a new source of clastics was introduced (from uplift in the north ?) and the seas laid down several hundred feet of bituminous shales. Uplift of the source continued and coarser clastics appear with a suggestion of bentonitic material (there was vulcanism in Alaska about this time) and plant remains appear in the detritus.

The remainder of Devonian time has no record as subsequent erosion has removed the evidence. No strata record is present for Carboniferous, Permian, Triassic or Jurassic.

Cretaceous

Chert and quartzite pebbles in the basal Cretaceous suggest that a period of uplift and erosion in pre-Cretaceous time was sufficient to expose early Paleozoics.

During late Aptian time the area was reflooded and thick shales were laid down. This is as far as the record is preserved in lithology.

During the Laramide revolution the region was uplifted and folded into broad Appalachian type folds. Erosion of these mountains undoubtedly provided much of the debris for the Tertiary deposits to the east.

Quaternary

In glacial time the Keewatin Ice front deposited morainal material over much of the area, and in its retreat dammed the drainage waters of the region in large lakes between ice and the mountains. Terraces and beaches were built at various levels as drainage was re-established. Various high-level valley systems were established and abandoned.

Final post-glacial uplift of the area and stream piracy, has stamped the area with a juvenile drainage of canyons, waterfalls and braided streams.

Bituminous shales occur at the base of the Fort Creek on a small anticlinal wrinkle just east of the canyon mouth of Rouge Mountain River. These shales are burned red, and color the east valley wall of lower Rouge Mountain River for several miles. These shales are too tight to provide reservoir beds and no suitable structure for drilling involves these horizons at depth. No bitumen was found associated with the limestones of the region.

The only minerals of economic interest were found on Rouge Mountain where large nodules of pure bluish-white barite occur in sporadic centers, on the dip slope at the top of the Cambrian C5 member. There is not sufficient concentration to warrant exploitation. Exploration of this horizon would be justified with a view to finding larger bodies of the ore.

Chapter VII

CONCLUSIONS AND RECOMMENDATIONS

No suitable oil structure was found within the area. The rocks exposed at the crest of the main structure are too low stratigraphically and too highly indurated. The minor structures of the area have no closure to the north, are very narrow, and are stripped of shale covering.

The Middle Silurian strata are porous and would provide an excellent reservoir.

No drilling test is recommended for this map area.

Further field reconnaissance should be carried out between Monnett's area and this area to outline the features of the Cretaceous syncline there.

In view of the excellent reservoir possibilities of the Middle Silurian, all deep tests in the Mackenzie River lowlands basin should explore to this horizon.

B I B L I O G R A P H Y

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3. Link, T.A. "Geological Report on Port Norman Area" Imperial Oil Report, 1921.

4. Laudon, L.R. "The Imperial River Area" - Imperial Oil Ltd., Canol Project Report No.22. Final Report, 1943.

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9. Stelck, C.R. "Carcajou River - Little Bear River Divide Area". Imperial Oil Ltd., Canol Project, Preliminary Report No. 34, 1943.

APPENDIX

Edmonton, Alberta,
February 17, 1944.

TO: Dr. T. A. Link
RE: Fossil Identification

Attached is a tentative identification of fossils collected by Mr. C. R. Stelck on Assignment No. 28 - Carcajou - Little Bear Divide Area.

C. R. Stelck

KH/tm

Fossil Identification

Suite No.	Date (1943)	Location	Fossil	Accession No.	Age
3679	Jul. 14	Sta. 34, Rouge Mtn. Area	Orthoceras	42693	Ramparts
3636	----	---------Rouge Mtn. Area	Algae	42694	Ramparts
3694	Jul. 25	-------- Rouge Mtn. Area	Gastropod	42695	Silurian
3686	Jul. 18	Sta. 236, Rouge Mtn. Area	Pelecypod	42696	Ramparts
3688	Jul. 19	-------- Rouge Mtn. Area	Camarotoechia	42697	Ramparts
3680	Jul. 14	Sta. 34, Rouge Mtn. Area	Favosites	42698	Ramparts
			Cladopora	42699	"
			Cup coral	42700	"
			Acervularia	42701	"
----	----	Lake north of Grotto Lake, Rouge Mtn. Area	Pelecypods & Gastropods	42702	Recent
3670	Jul. 13	Sta. 31, Rouge Mtn. Area	Conchidium	42703	Silurian
3681	Jul. 16	Sta. 201, Rouge Mtn. Area	Orthis	42704	Silurian
			Favosites	42705	"
			Halysites microporous	42706	"
			Stromatoporoid	42707	"
			Streptelasma	42708	"
3690	Jul. 21	-------- Rouge Mtn. Area	Martinia	42709	Ramparts
			Gastropod	42710	"
			Alveolites	42711	"
			Cladopora	42712	"
			Odontocephalus	42713	"
			Favosites	42714	"
3674	Jul. 14	Sta. 34, Rouge Mtn. Area	Cystiphyllum	42715	Ramparts
			Pterinidae	42716	"
			Gastropod	42717	"
3682	Jul. 16	Sta. 217 - 218, Rouge Mtn. Area	Plants	42718	Bosworth
			Pteria	42719	"
			Acervularia	42720	"
			Atrypa	42721	"
			Camarotoechia	42722	"
			Streptelasma	42723	"
			Ostracods	42724	"
			Cladopora	42725	"
			Productella	42726	"
			Strophecdonta	42727	"
			Cyrtospirifer	42728	"
			Brachiopods	42729	"

Fossil Identification

Suite No.	Date 1943	Location	Fossil	Accession No.	Age
3689	Jul. 21	-------- Rouge Mtn. Area	Spirifer	42730	Ramparts
	----		Proetus	42731	"
			Actinopteria	42732	"
3664	Jul. 9	Sta. 8, Rouge Mtn. Area	Favosites	42733	Silurian
3661	Jul. 9	Sta. 8, Rouge Mtn. Area	Conchidium	42734	Silurian
			Halysites catenularia	42735	"
			Halysites microporous	42736	"
			Springopora	42737	"
			Stromatoporoid	42738	"
			Zaphrentis	42739	"
			Favosites	42740	"
3683	Jul. 18	Sta. 232, Rouge Mtn. Area	Cladopora	42741	Beavertail
	----	----	Alveolites	42742	"
	"	"	Prismatophyllum	42743	"
3689	Jul. 21	-------- Rouge Mtn. Area	Paleocyclas	42744	Ramparts
	----		Productella	42745	"
			Actinopteria	42746	"
			Fenestella	42747	"
			Crinoid segment	42748	"
			Gastropod	42749	"
			Atrypa reticularis	42750	"
3687	Jul. 19	-------- Rouge Mtn. Area	Coquina	42751	Hay River
	----		Pecten	42752	----
3680	Jul. 14	Sta. 34, Rouge Mtn. Area	Pelecypods	42753	----
	----	-------- "	Cystiphyllum	42754	"
	"	"	Orthoceras	42755	"
3667	Jul. 13	Sta. 31, Rouge Mtn. Area	Syringopora	42756	Beavertail
			Prismatophyllum	42757	"
3662	Jul. 7	Sta. 8, Rouge Mtn. Area	Favosites	42758	Silurian
			Algae ?	42759	"
			Cup corals	42760	"
			Zaphrentis	42761	"
			Halysites	42762	"
			Syringopora	42763	"
3663	Jul. 9	Sta. 8, Rouge Mtn. Area	Syringopora	42764	Silurian
			Conchidium	42765	"
3678	Jul. 14	Sta. 34, Rouge Mtn. Area	Atrypa	42766	----

Fossil Identification

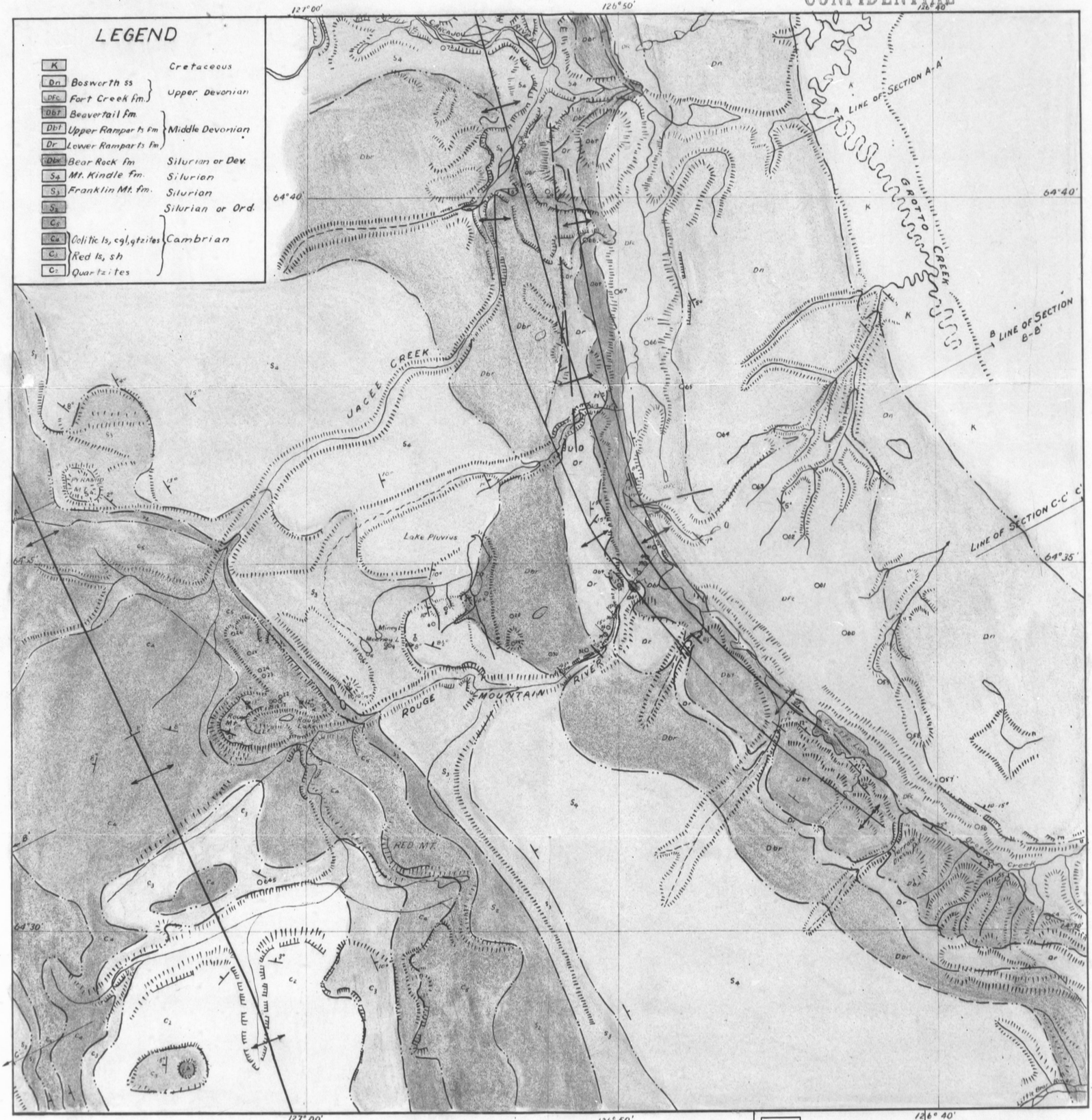
Suite No.	Date 1943	Location	Fossil	Accession No.	Age
3678	Jul. 14	Sta. 34, Rouge Mtn. Area	Acervularia	42767	Silurian
	----	"	Cystiphyllum	42768	"
			Alveolites	42769	"
			Stromatoporoid	42770	"
			Schuchertella	42771	"
			Martinia	42772	"
3671	Jul. 13	Sta. 31, Rouge Mtn. Area	Halysites	42773	Silurian
3677	Jul. 14	Sta. 34, Rouge Mtn. Area	Actinopteria	42774	Ramparts
	----	---- "	Odontocephalus	42775	"
	"	"	Schuchertella	42776	"
			Bryozoan	42777	"
			Martinia	42778	"
			Tentaculites	42779	"
----	----	Rouge Mtn. River (Rouge Mtn. Area) float or talus	Trilobite fragments	42780	Cambrian ?
3670	Jul. 13	Sta. 31, Rouge Mtn. Area	Actinopteria	42781	Ramparts
			Schuchertella	42782	"
			Pelecypod	42783	"
			Cyathophyllum	42784	"
			Coquinoid ls.	42785	"
			Odontocephalus	42786	"
3684	Jul. 18	Sta. 233, Rouge Mtn. Area	Bituminous shale	42787	Ft. Creek
3669	Jul. 13	Sta. 31, Rouge Mtn. Area	Conchidium	42788	Silurian
			Dawsonoceras	42789	"
			Diphyphyllum	42790	"
3668	Jul. 13	Sta. 31, Rouge Mtn. Area	Zaphrentis	42791	Silurian
3665	Jul. 7	Sta. 8, Rouge Mtn. Area	Favosites	42792	Silurian
			Syringopora	42793	"
3692	Jul. 25	-------- Rouge Mtn. Area	Zaphrentis	42794	Silurian
			Syringopora	42795	"
			Halysites	42796	"
			Stromatoporoid	42797	"
3672	Jul. 13	Sta. 33, Rouge Mtn. Area	Modiola	42798	Ramparts
			Ostracods	42799	"
			Martinia	42800	"
3673	Jul. 13	Sta. 33, Rouge Mtn. Area	Modiola ?	42801	Ramparts
3661?	Jul. 7	Sta. 8, Rouge Mtn. Area	Conchidium	42802	Silurian
			Cladopora ?	42803	"
			Syringopora	42804	"

Fossil Identification

Suite No.	Date 1943	Location	Fossil	Accession No.	Age
3685	Jul. 18	Sta. 236, Rouge Mtn. Area	Cyrtospirifer	42805	Hay River
			Martinia ?	42806	"
			Lingula	42807	"
			Productella ?	42808	"
3675	Jul. 14	Sta. 34, Rouge Mtn. Area	Pelecypods	42809	Ramparts
3675	Jul. 14	Sta. 34, Rouge Mtn. Area	Productella	42810	Ramparts
			Gastropod	42811	"
3693	----	-------- Rouge Mountain	Favosites	42929	Silurian
			Halysites	42930	"
			Zaphrentis	42931	"
			Diphyphyllum	42932	"
3692	----	-------- Rouge Mountain	Favosites	42933	Silurian
			Zaphrentis	42934	"
			Diphyphyllum	42935	"
			Syringopora	42936	"
			Halysites	42937	"
			Syringopora	42938	"

CONFIDENTIAL

PLATE II



Formation Boundary
Anticline (known)
Anticline (inferred).
Fault, overturned (inferred)
Cross Section line
Strike and Dip
Photo Center
Scarp face

FEB. 1944

AREAL GEOLOGY
LITTLE BEAR-CARCAJOU RIVER DIVIDE

ASSIGNMENT No. 28
JULY 1943
C.R. STELCK
J.L. CARR

SCALE 1 INCH TO 1 MILE

F 2.176

27

PLATE III

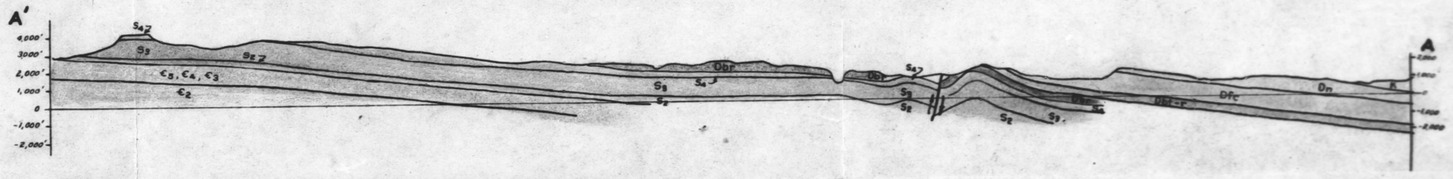
LEGEND

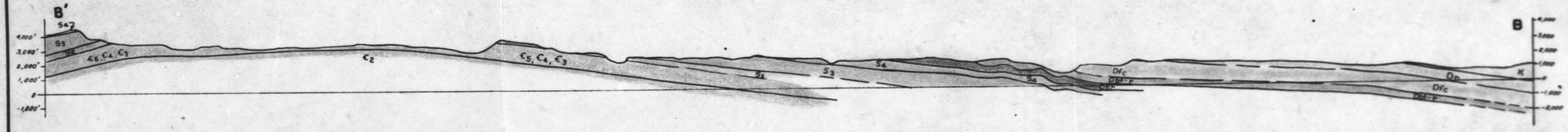
K		Cretaceous
Dn	Bosworth ss	Upper Devonian
Dfc	Fort Creek fm.	
Dbt	Beavertail fm.	Middle Devonian
Dbr	Upper Ramparts fm	
Dr	Lower Ramparts fm	
Sbr	Bear Rock fm	Silurian or Dev.
S_4	Mt. Kindle fm.	Silurian
S_3	Franklin Mt. fm.	Silurian
S_1		Silurian or Ord.
C_5		Cambrian
C_4	Oolitic ls, cgl, qtzites	
C_3	Red ls, sh	
C_2	Quartzites	

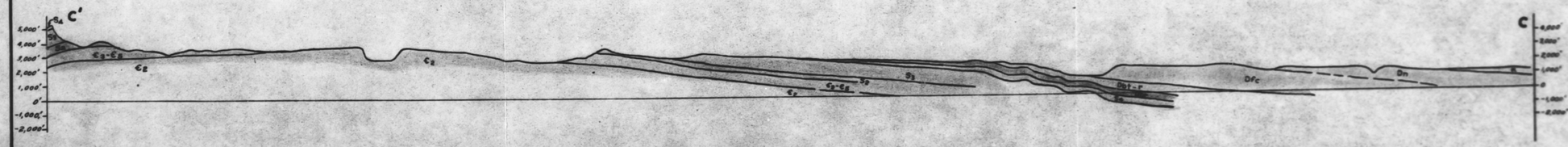
STRUCTURE PROFILE SECTIONS
CARCAJOU - LITTLE BEAR DIVIDE AREA

SCALE (BOTH VERTICAL AND HORIZONTAL) 1" = 1 MILE

ASSIGNMENT NO. 28
PARTY B
C. R. Stelck, J. L. Carr
July, 1943







F 2.178

PLATE IV.

CONFIDENTIAL

COLUMNAR SECTION

LITTLE BEAR - CARCAJOU RIVERS DIVIDE.

ASSIGNMENT NO. 28.
JULY 1943
Party B
C. R. STELCK
J. L. CARR

SCALE 1" = 100'