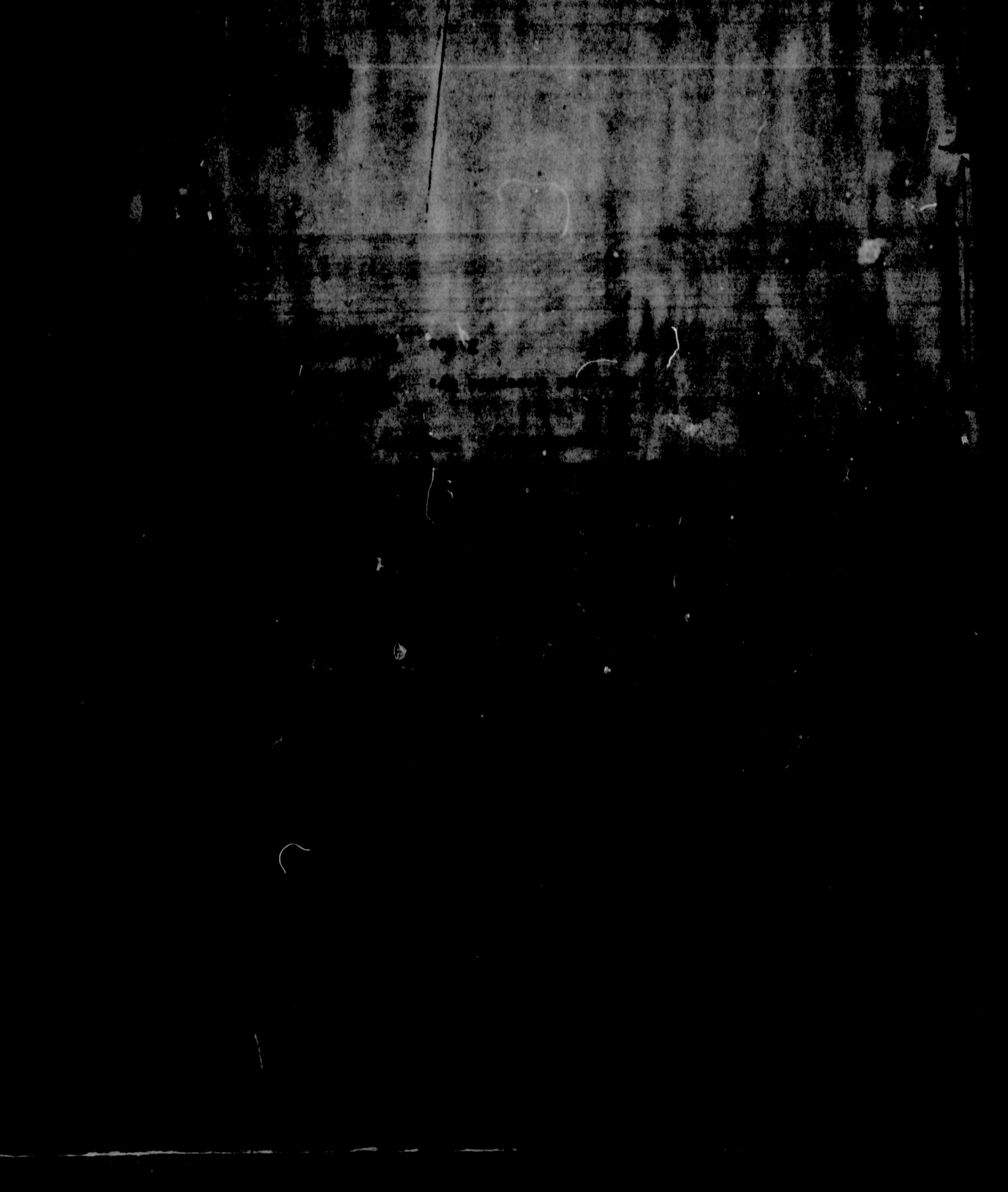

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Photo No. 14. [illegible]

Photo No. 15. Looking [illegible] west along the Arkansas [illegible] front, across [illegible] River.

FINAL GEOLOGICAL REPORT

on

"THE UPPER CARCAJOU - IMPERIAL RIVER AREA"

N.W.T. (Canada)

A B S T R A C T

In the Upper Carcajou-Imperial River area, on the edge of the Mackenzie Mountains, one of the thickest sections of sediments in the Mackenzie Basin is exposed. Cambrian, Silurian, Devonian, and Cretaceous strata, having a total thickness of 10,000 feet, exhibit petroliferous beds at various horizons. Bituminous shales occur in the Cambrian; petroliferous dolomite at the top of the Silurian; and oil-bearing limestones, shales and sandstones in the Devonian. No reef limestone occurs in the area. The Macdougal anticline forms the first range of the Mackenzie Mountains, and the rocks dip as much as forty five degrees on its flanks. The southeastern end of the anticline is a dome, on the crest of which Cambrian strata are exposed, and oil prospects in younger beds are therefore not good. The Imperial anticline, which lies northeast of Macdougal anticline and sub-parallel to it, has Bear Rock (Upper Silurian) petroliferous dolomite exposed at its highest point. It plunges southeastward at [illegible] one degree and near the southeast end the prospective reservoir limestones and dolomite have a cover of shale on the crest of the anticline. Between the southeast end of the Imperial anticline and the Macdougal anticline the [illegible] structure [illegible] square mile in area, has [illegible] cover of [illegible] over the reservoir limestones. These [illegible] [illegible] lies from the Norman-Whitehorse [illegible] line.

INTRODUCTION

The area discussed in this report comprises a strip about ten miles wide and forty miles in length, lying along the Carcajou River from Carcajou Forks, where the Little Keele joins the main river, to and including Imperial River (Plate I).

On June 21, Party "I", consisting of A. W. Nauss, H. K. Reidford and W. L. Clemis was landed by airplane on Mirror Lake, which lies along the Mackenzie Mountain front 32 miles south of Norman Wells. A short portage was made to transfer all equipment and supplies over a low divide to the Carcajou River. The river was descended by canoe to its mouth on the Mackenzie River a few miles above Sans Sault Rapids. The survey was completed July 27th. During the first two weeks in October a plane table traverse of Imperial River (Assignment 18A) was made by J. M. Parker, H. K. Reidford and the writer.

The Upper Carcajou River area was mapped by pace and compass traverses with the aid of aerial photographs and by plane table surveys.

Accessibility

The non-mountainous parts of the area are readily reached from the Norman-Whitehorse pipeline highway, which is not more than 15 miles in a straight line from any part of the area. By following well-drained [illegible] and winter [illegible]

The Katherine [illegible] and sharp canyons into [illegible] plateau (Photo No. 2 and [illegible]). The tributaries which join the Carcajou in the mountains plunge precipitously into the canyon and have built up boulder fans whose growth deflects the river against the opposite bank of the valley.

The higher mountains are formed of hard Rounning dolomite. Several prominent cuestas, on the southwest side of Macdougal Range, are composed of a resistant limestone formation in the Macdougal group.

The northeastern part of the area is a muskeg-covered plain into which the Carcajou and its tributaries have cut valleys as much as 500 feet deep.

For considerable distances along the mountain front, especially northwest of Katherine River, a wide valley occupies the outcrop band of the Fort Creek shale (Photo No. 15). This valley has been partially filled with alluvial fans to which gravel is still being added. It has been suggested that this is a glacial valley (Laudon 1943 P. 4). An alternative interpretation is that it was caused by stream erosion in a previous drainage cycle.

Chapter III

S T R A T I G R A P H Y

General

Sedimentary rocks ranging in age from Cambrian to Cretaceous outcrop in the Macdougal Range and the adjoining plains. The generalized stratigraphic sequence is shown on Plate II. The distribution of each formation is shown on Plate III.

CAMBRIAN

[illegible] Group

[illegible]

Type locality and definition. The type locality of this unit is in the Macdougal River Valley (Echo Canyon) where it is well exposed (Photo No. 4 and 5). It was named by T. A. Link (1921, p.18). In the stratigraphic column of the Carcajou area Link places the base of this unit at the bottom of 130 feet of chocolate-colored nodular calcareous shale, and the top of the unit at the top of 80 feet of evenly bedded greenish limestone with shale partings. These members can be readily recognized in Macdougal Canyon. In the present report the name Macdougal group is used for all beds lying between these two horizons. It is called a group because it comprises 5 or 6 mapable units which have been given formation names for the sake of reference in this report.

Lithology The lowest formation of the Macdougal group (Plate IV) is the "Dead End shale", named from exposures on Dead End Creek. The shale is mostly chocolate-colored, but beds of greenish color are common. Ellipsoidal nodules are abundant and lie along the bedding planes giving the formation a well bedded appearance. The nodules range in size from two to six inches in diameter. This formation has a uniform thickness of about 130 feet.

The "Echo Canyon" limestone overlies the Dead End shale. It is a hard grey scarp-forming smooth limestone (Photo 5). It has a maximum thickness of over [illegible] feet and is absent at some localities in the [illegible] area. [illegible] may be explained by [illegible] the base [illegible] Plate IV) [illegible]

[illegible]

[illegible]

greatest thickness measured [illegible] These gypsiferous beds are usually [illegible] identified [illegible] red color

The "Bodo formation" overlies the Langstine gypsum. It consists of 50 feet of interbedded, grey, greenish grey, and chocolate-colored shale with some siltstone, overlain by 50 feet of [illegible] grey limestone. The outcrop band of these beds has a conspicuous dark grey color.

Paleontology - The following fossils have been collected from the Dead End shale: Ptychoparia and Paterina (Hume 1923 p. 53). Micromitra superba (Link 1921, p. 18) was collected from the Clemis formation. Micromitra is a subgenus of Paterina so the Micromitra mentioned by Link is probably the same brachiopod as the Paterina mentioned by Hume. It was on the basis of these fossils that Link assigned the Macdougal group to the Cambrian.

SILURIAN

Ronning dolomite

Lithology - This formation is predominantly hard massive-bedded dolomite (Photo No. 6) which does not react with dilute hydrochloric acid. It may be divided into a lower thin bedded light grey siliceous dolomite and an

upper medium grey sugary dolomite. Near the southeast end of Macdougal Range, a coarse quartz sandstone was observed in the lower part of the medium grey member. The talus from the Ronning dolomite is made up of large blocks as much as 20 feet in length. The upper contact is sharp (Photo No. 7) and in places irregular.

Paleontology - The following Silurian fossils were collected from the upper part of the medium grey member:

Halysites catenulatus

Favosites

Bear Rock dolomite

Lithology - Angular blocks of granular brown laminated highly petroliferous dolomite, in a light grey calcite matrix with numerous veins of calcite, constitutes the Bear Rock breccia (Photo Nos. 8 and 9). The blocks range in size from that of a pea up to thirty feet in length. In places the calcite occurs almost entirely in small veins, in others [illegible] between the blocks. [illegible] The amount of movement [illegible]

several localities, most notable of which is [illegible] out of the Mackenzie Mountains. This formation would probably be an ideal reservoir rock in closed structures.

Thickness - The thickness of the Bear Rock is relatively constant. All measurements of thickness in this area were between 400 and 425 feet. The Upper contact is marked by a bed of highly slickensided and mashed grey shale about one foot thick. This shale resembles a fault gouge.

Paleontology - No fossils were found in the Bear Rock breccia in the area described in this report. Laudon (1943 p.4) reports a coral "similar to Diphyphyllum" from the Bear Rock on Imperial River.

Origin - Two theories of origin have been advanced to explain how this formation attained its present characteristics:

1. The formation was laid down as a fanglomerate.

2. Dolomite beds were brecciated by the forces resulting from the increase in volume accompanying the change from anhydrite to gypsum. (Hume 1923 p. 54).

Objections to the first theory are:

1. Fanglomerates are restricted to mountainous regions. No unconformity occurs at the base of the Bear Rock with sufficient angular discordance to show that the Ronning dolomite was folded into mountain ranges prior to the deposition of the Bear Rock, nor is there mountainous relief on the top of the Ronning.

2. No rapid changes in thickness, such as accompany conglomerate formations occur in the Bear Rock. The thickness of shore line conglomerates can be fairly constant, but their boulders are well rounded.

3. The initial [illegible] now forming on the [illegible] Mackenzie Mountains, and having boulders as large as those in the Bear Rock breccia, is [illegible] [illegible] that limestones are deposited with very little [illegible] and the [illegible] between the bedding [illegible] and [illegible] within the Bear Rock would [illegible] the bedding [illegible]

[illegible] anhydrite to gypsum [illegible] [illegible] of gypsum [illegible] [illegible] of breccia or are not small in quantity to cause the [illegible] brecciation observed. The gypsum occurring north of Norman Wells in the same stratigraphic interval as the Bear Rock is more than 50 miles from known outcrops of the Bear Rock in the Mackenzie Mountains. The amount of gypsum occurring in the breccia itself is so small that it is not commonly found in outcrops of that formation. This argument is not conclusive but the following theory of origin is thought to be in closer agreement with the facts:

The brown Bear Rock dolomite was brecciated during the folding which caused the mountains, and by the same forces. This dolomite, being brittle and massive, was brecciated while it was being sheared between the competent Beavertail and Ronning formations. Later the interstices were filled with calcite. The lower Ramparts yielded to this stress by being contorted and folded. The occurrence of a few fragments of black shale in the breccia is not an argument against the above theory. A thin bed of shale interbedded with the original

Ramparts-Beavertail [illegible]

Lithology - The Ramparts-Beavertail [illegible] the Upper Carcajou Area. It consists of four members as shown on Plate VI. The top of the Beavertail is resistant to erosion and forms the Mackenzie Mountain front (Photo No. 10 and 11).

Thickness - The total thickness of these limestones decreases toward the northwest. Adjacent to Mirror Lake the thickness is 670 feet. Near the mouth of Macdougal River it is 310 feet. The upper contact is sharp, and the disconformity at this horizon in the Lower Mackenzie Valley may extend to the Upper Carcajou River, but no proof of its existence here has yet been found (Photo No. 12).

Paleontology - The following fossils were found in the Ramparts-Beavertail limestones:

Brachiopods

Atrypa reticularis

Atrypa spinosa

Corals

Cladopora

Heliophyllum

Phillipsastrea

Prismatophyllum *

Fort Creek Shale

Lithology - The Fort Creek shale has two main subdivisions; an upper soft grey crumbly part and a lower hard columnar and platy part. The section shown on Plate VII was measured with a plane table near the mouth of Macdougal River. The upper contact of the Fort Creek shale is gradational (Photo No. 13). Sandstone beds become more prominent and numerous upward, until the section is predominantly sandstone. The contact is placed where sandstones begin to make up an appreciable part of the section.

Paleontology - The following fossils were found in the lower ten feet of the Fort Creek shale:

Hypothyridina castanea

Tentaculites mackenziensis

Bosworth Formation

Lithology - The Bosworth formation consists of an upper part of grey shale, and a lower part of interbedded fine grained greenish grey and buff sandstone and grey shales. Sandstones are ordinarily [illegible] and fossiliferous. [illegible]

relief on top of the Bosworth in this area.

Paleontology - The following fossils were found in this unit:

Atrypa *

Camarotoechia *

Conularia *

Cyrtospirifer *

Paracyclas *

Tentaculites

* Identification by C. R. Stelck.

Correlation - The Bosworth beds are correlated by C. R. Stelck with the Hay River limestones of the Liard Rapids. The writer agrees with this and correlates them with the interbedded sandstones and shales which were formerly mapped as Cretaceous in the Lower Mackenzie Valley.

CRETACEOUS

Lithology- In the Upper Carcajou-Imperial River area, sedimentary rocks of Cretaceous age consist of grey and dark grey shales with interbedded fine and medium grained sandstones. In general, the rocks [illegible] from the Bosworth limestone to the [illegible] more chert, calcarite, more [illegible] so fossil [illegible] contain [illegible]

the formations [illegible]

the Liard [illegible]

these formations are: "Sans Sault", [illegible] "Sperry shale", and "Link formation" of interbedded shale and sandstone (Plate IX).

The "Sans Sault" and "Sperry" formations were named by Taylor from outcrops of these formations at Sans Sault Rapids and Sperry Creek on Mountain River. The "Link Formation" is named from outcrops at Link Bend on Imperial River, where the formation is well exposed. In this locality, 620 feet of sandy shales and thin sandstone beds are exposed. The top is eroded. The base of the formation is herein defined as being at the base of the twenty foot bed of hard, scarp-forming coarse light grey salt and pepper sandstone (Plate 14).

The total thickness of Cretaceous beds on Imperial River is 2800 feet. On Carcajou River, northeast of the mouth of Macdougal River, a similar thickness of these rocks is exposed.

Paleontology - The following fossils have been found in the Cretaceous formations:

"Sans Sault formation"

Beudanticeras

Inoceramus (of small size)

"Link formation"

Inoceramus [illegible]

[illegible]

[illegible]

[illegible]

(Aptian) [illegible]

flank and abo[illegible] degrees [illegible] the southwest flank (Plate II). On the southeastern end [illegible] in a pattern of keystone block faulting (Plate II). One of these blocks, however, is bounded by faults of sufficient displacement that Gort Creek shale is in contact with Ronning dolomite.

Normal and strike-slip faults with little dislocation are not uncommon in all areas investigated on the Macdougal anticline. Small wrinkles superimposed on the major structure occur on Alder and Gopher Creeks.

The oldest beds exposed on the crest of the anticline are quartzites of the Katherine group. Just west of Macdougal Canyon these rocks are below the surface because of the northwestward plunge (Plate III). They reappear next in the valley of Katherine River. It is thus seen

but because it is so [illegible]
of obtaining oil from it in [illegible]

Imperial Anticline

The Imperial anticline which occupies the northeastern part of the area, roughly parallels the Carcajou River. The general direction of the axis is N. 35° W. The structure is shown on Plates [illegible]. Plate XI is a cross-section from the mountain front to the Carcajou River along Imperial River.

In the bottom of Imperial River Valley, at the crest of the anticline, the Fort Creek shale outcrops with blocks of limestone containing Hypothyridina castanea. Such limestones have been observed only in the lower 110 feet of the Fort Creek shale. Hence, the Beaverhill limestone probably occurs at a depth not greater than 150 feet (Plate XI).

This anticline plunges very gently to the southeast from Imperial River. Barometric elevations were obtained on the massive basal sandstone of the Bosworth at Hopkin's Lake and farther to the southeast. These elevations were compared with those obtained on Imperial River and indicate an average plunge of slightly more than one degree for eight miles southeast of Imperial River. Such an even plunge would allow oil to migrate northwestward up the plunge. There are, however, four possibilities of closure southeast of Imperial River:

First - The low angle of plunge mentioned above would have to be especially consistent for eight miles to prevent a reversal in plunge. Such a reversal would provide the necessary closure.

Along the southwest edge of Hopkin's Lake good outcrops of Lower Bosworth sandstone occur. The dip is 15 to 28 degrees to the southwest (Plate III). These dips are steeper than those northwest or southeast

of Hopkin's Lake and may be interpreted to mean that the crest of the [illegible] structurally higher at it is [illegible] than at Imperial River.

Second - Cross faulting could provide the necessary closure to [illegible] west [illegible] as evidenced by the sharp change in dip [illegible] from the axis of the Imperial [illegible]

Third - The [illegible] of the main anticline might bear an en echelon relationship to that part which is observed on Imperial River. However it is possible to follow the basal Bosworth sandstone from Imperial River to Hopkin's Lake in a more or less straight, unbroken line, and no syncline was observed. Hence, if any syncline separates two anticlines en echelon it occurs southeast of Hopkin's Lake.

Fourth - A decrease in permeability in the prospective producing horizon could supply the required closure. On this possibility, no information is available.

At the west end of Imperial anticlinorium, Parker (1944) reports 500-600 feet of reef limestone at the base of the Fort Creek shale. Louis Desjardins * says that he is able to trace these beds over much of the Imperial Range on the aerial photographs. This thick section of reef limestone is not present at the Mackenzie Mountain front on Imperial River, but the lower 30 feet of the Beavertail is a coral limestone which may be porous in the subsurface. Still farther southeast, the Beavertail is more dense and massive. The Beavertail, on the southeastern end of Imperial anticline, would probably be a somewhat porous coral limestone similar to that exposed in the reefal limestone outcrops on the Mackenzie Mountains.

---

* Imperial Oil Limited - Canol Project Photogrammetry Department.

lying as it [illegible]
[illegible] be a [illegible]
of structure to [illegible]. The exposed rock can be interpreted [illegible]
of ways, the simplest being that these outcrops are on the south [illegible]
of an anticline (Plate XII). It is believed that the structure is [illegible]
what more complicated and involves several faults (Plate XII).

This structure is small, but because it is near the pipeline, even a small field would be worth exploiting. The chances of closure are good and a detailed seismic survey should be made to determine the shape of the structure. However, sufficient information is not at hand to suggest a drilling site on it.

calcite which fills the interstices between these blocks is dense and probably impermeable. Therefore, it may be that some wells drilled into the Bear Rock might have only a small volume draining into it. How many of these calcite partitions, which can be broken down with acid to form a larger volume of drainage, is a question only acidization itself can answer. The strong flow of salt water obtained from the Bear Rock breccia in Hoosier No. 2 well proves that the breccia has a high porosity in that area.

The upper ten feet of the Beavertail is usually highly petroliferous, and where these beds are porous they may be expected to contain oil on closed structures.

The limestones of the Ramparts-Beavertail and the shales of the Cretaceous, Bosworth, and Upper Fort Creek would, if suitable, provide

an abundant supply of raw materials for the manufacture of cement. These could be readily mined on Macdougal River (Dodd Canyon).

No bed of pure gypsum thicker than six inches was observed in the Sanguine gypsum. This formation has a high percentage of black, red, and green shales. However, the formation is nearly always poorly exposed, and excavations into it might reveal beds of gypsum sufficiently thick and pure to be mined economically for local use.

The Imperial anticline and the Snake Mountain structure are the only structures which may be considered as oil and gas prospects in the Upper Carcajou-Imperial River area. The fact that Bear Rock dolomite and Beavertail limestone are exposed on this structure seven miles or more northwest of Imperial River detracts considerably from its prospects as a petroleum trap.

At Imperial River, on the Imperial anticline, the Beavertail is calculated to be at a depth of less than 150 feet. In view of the brittle, platy and blocky nature of the overlying Fort Creek shale this amount of cover is probably insufficient to retain oil in the Beavertail. Therefore, any test well expecting to obtain oil from that horizon should be drilled farther to the southeast, where there is a greater cover over the Beavertail, and where the surface geology suggests more favorable structural conditions, preferably at the proposed location shown on Plate III. This well should penetrate at least to the base of the Bear Rock formation, since an additional four hundred feet of limestone and shale covers this formation, and because of the highly petroliferous character of the Bear Rock. The petroliferous beds in the Macdonald and Katherine groups may also be considered as oil prospects on this structure.

It is recommended that the present seismic survey [illegible]
cover the southeastern [illegible]
surrounding the Snake [illegible]
where [illegible]

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

[illegible], [illegible] 1923 - Geology of the Norman Oil Fields and a reconnaissance of a part of Liard River. Geological Survey Canada Summary Report for 1922, part B, pp.47-64, pls. I & II, map

[illegible], [illegible] 1924 - Mackenzie River area, District of Mackenzie, Northwest Territories; Geological Survey Canada, Summary Report for 1923, part B, pp. 1 - 15, map

[illegible], [illegible] 1943 - Imperial River area; Imperial Oil Ltd., Canol Project, Preliminary report on Assignment No. 18.

[illegible], [illegible] 1921 - Geological report on the Fort Norman area; Imperial Oil Report. pp. 1-81, 17 pls., photographs.

[illegible], [illegible] 1943 Upper Carcajou River from Carcajou Forks to Imperial River. Imperial Oil Ltd., Canol Project, Preliminary Report on Assignment No. 10, pp.1-3, pls.1-3.

[illegible], [illegible] 1944 - Geological Report on the Mountain River area. Imperial Oil Ltd., Canol Project, Final Report on Assignment No. 19.

[illegible], [illegible] 1943. Carcajou River - Little Bear River Divide area. Imperial Oil Ltd., Canol Project, Preliminary Report no. 34, pp. 1-8, 3 pls.

[illegible], [illegible] An Aptian horizon in the Cretaceous of the Lower Mackenzie Valley. Journal of Paleontology, Vol. 11, No. 1, pp. 62-72, [illegible] 1-3.

Photo No. 1

Looking south from the top of Macdougal Range, showing subdued character of the mountains.

Photo No. 2

Looking northwest across the Carnajou near its outlet from the mountains, showing the Cretaceous plain and the characteristic topographic expression of the Ramparts-Dovertail and Bear Rock formations.

Photo No. 3

Looking southeast along the north limb of Macdougal anticline, showing the plateau-like character of the topography and the sharp canyon cut by the Carcajou River at the right. The total thickness of 400 feet of Bear Rock can be seen together with its basal contact with the Mount Ronning dolomite.

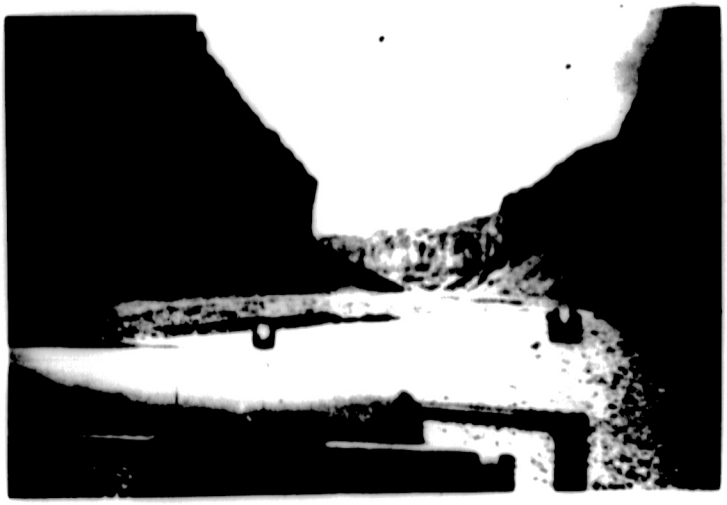

Photo No. 4

Looking south along Macdougal Canyon, showing the scarp-forming Echo Canyon limestone of the Macdougal group.

Photo No. 5

Looking northwest from near the mouth of Boho Canyon, showing Boho Canyon limestone. Mountain of Nunning dolomite in the background.

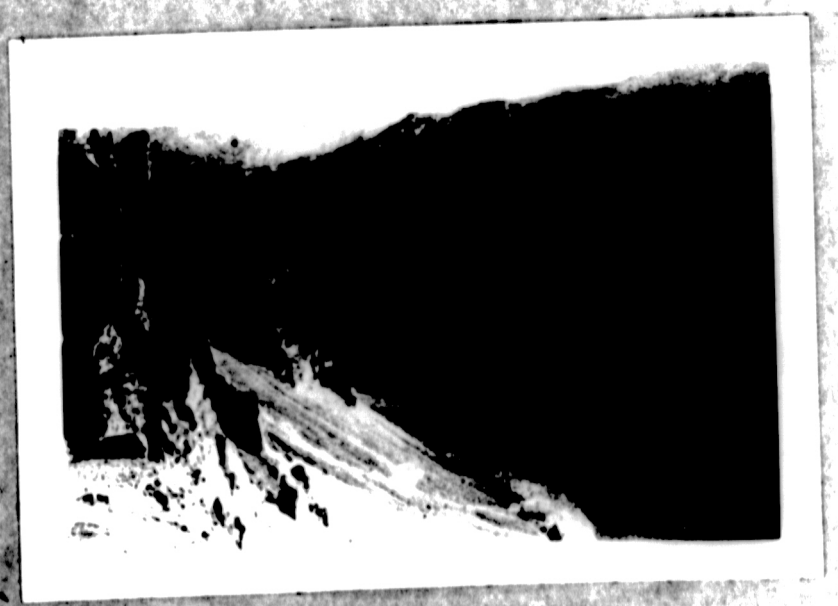

Photo No. 6

Looking [illegible] Canyon River from a point [illegible] Canyon. Capitol-[illegible] Nunning [illegible]

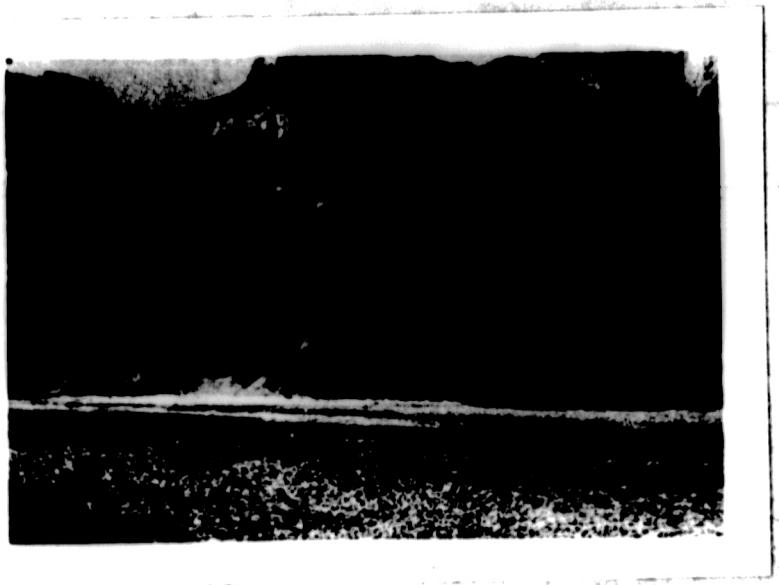

Photo No. 7

Looking northwest from a point in the bottom of the valley of the Carcajou near its exit from the mountains, showing the contact between the Bear Rock breccia and Roaring dolomite.

Photo No. 8

Cliff of Bear Rock breccia, on Carcajou River southwest of Portage lake.

Photo No. 9

Looking down MacDougal Canyon, showing cliff of Bear Rock breccia.

Photo No. 10

Looking along Mirror lake from the southeast end, showing mountain front of Beavertail limestone.

Photo No. 11

Looking towards the mountains from the south-east end of Mirror Lake, showing Beavertail limestone.

Photo No. 12

Looking northwest from the south end of Portage Lake, showing Fort Creek - Beaver-tail contact.

Photo No. 13

Looking north from a point 5 miles up the Katherine River, showing Bosworth sandstones overlying Fort Creek shale. Two small faults can be seen.

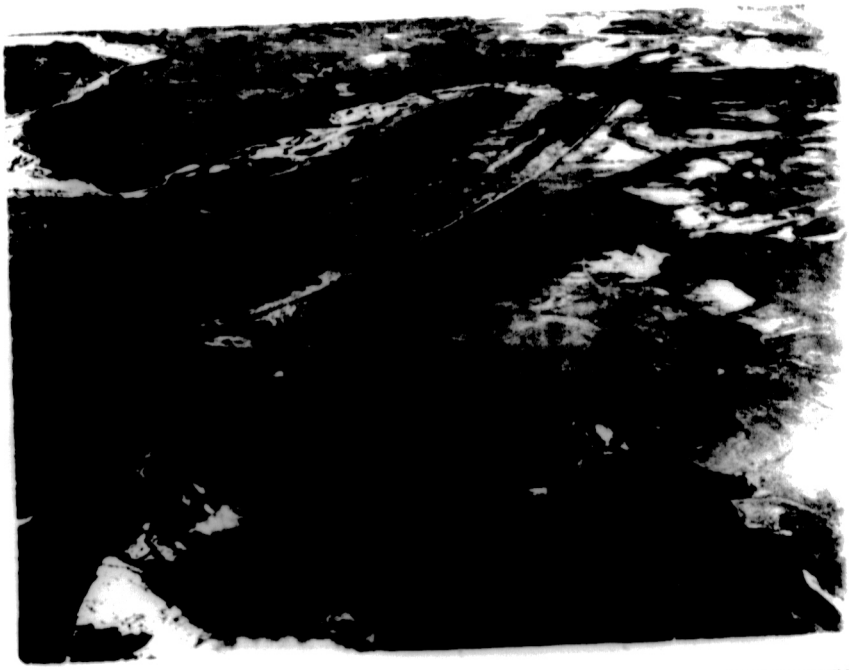

Photo No. 14

Looking northwest across Imperial River, showing scarp-forming sandstone at base of "Link formation", and the Imperial syncline.

(Photograph by T. A. Link)

Photo No. 15

Looking northwest along the Mackenzie Mountain Front, across Imperial River, showing Silurian dolomite and Devonian limestone in the mountains, the longitudinal valley on the outcrop band of the Fort Creek, and the Bosworth and Cretaceous terrain at the upper right. Note the alluvial fans.

(Photograph by T. A. Link)

APPENDIX

MEMORANDUM

December 21, 1945

TO: Dr. T. A. Link.

RE: Fossil Identification

The attached is a tentative identification of fossils, collected by Dr. A. W. Krusa on Assignment No. 10 - Upper Caranjos River.

C.H. Stolk.

MH/cm
Attach.

c.c. PWL
JMM
TAL
WLP

FOSSIL IDENTIFICATIONS - UPPER CARCAJOU RIVER

Dr. A.W.Bruce

Date	Suite No.	Fossil	Location	Accession No.	Age.
June 23	YE-749 14.7/10/8	Atrypa	W.end Mirror L. Carcajou River	42112	Beaverhill - Hamarta
"	"	Proetus	"	42113	"
July 9	17A	Cyrtospirifer	Katharine River Upper Carcajou	42114	Highest ss. Beaverth
"	"	Fossil	"	42115	"
July 18	YE-726 16.8/8.8	Atrypa	Grafe River Upper Carcajou	42116	Beaverth.
"	"	Paracyclas	"	42117	"
"	"	Cataria	"	42118	"
"	"	Spirifer (flat sulcus)	"	42119	"
"	"	Camarotoechia	"	42120	"
"	"	Conularia	"	42121	"
"	"	Spirifer	"	42122	"
"	"	Camarotoechia	"	42123	"
June 26	YE-749 14.8/10.1	Atrypa	W.End Mirror L. Upper Carcajou	42124	Beaverhill - Hamarta.
"	"	Bucanalus	"	42125	"
July 18	YE-726 17.6/7.7	Cyrtospirifer	Grafe River Upper Carcajou	42126	Beaverth
----	1076-21.8/8	Atrypa	Upper Carcajou	42127	Beaverth.
----	-------	Cyrtospirifer	----- ------	42128	---------
----	-------	Bryozoa	Stn. 66.B. Upper Imperial River.	42129	Cretaceous

INDEX MAP OF
NORTH WESTERN CANADA SHOWING
LOCATION OF LOWER MACKENZIE RIVER AREA