PS 151

OF 696
only copy

SLAVE POINT DATUM PROJECT

PHASE I INVESTIGATION OF OUTCROPS

RAASCH and ASSOCIATES, LTD.

SLAVE POINT DATUM PROJECT

PHASE I INVESTIGATION OF OUTCROPS

Table of Contents

Table of Contents

Appendix 1

Notes on Significant Undescribed Species

Foreword

Table of Contents page II

Illustrations

SLAVE POINT DATUM PROJECT

Raasch and Associates Limited

PHASE 1. INVESTIGATION OF OUTCROPS

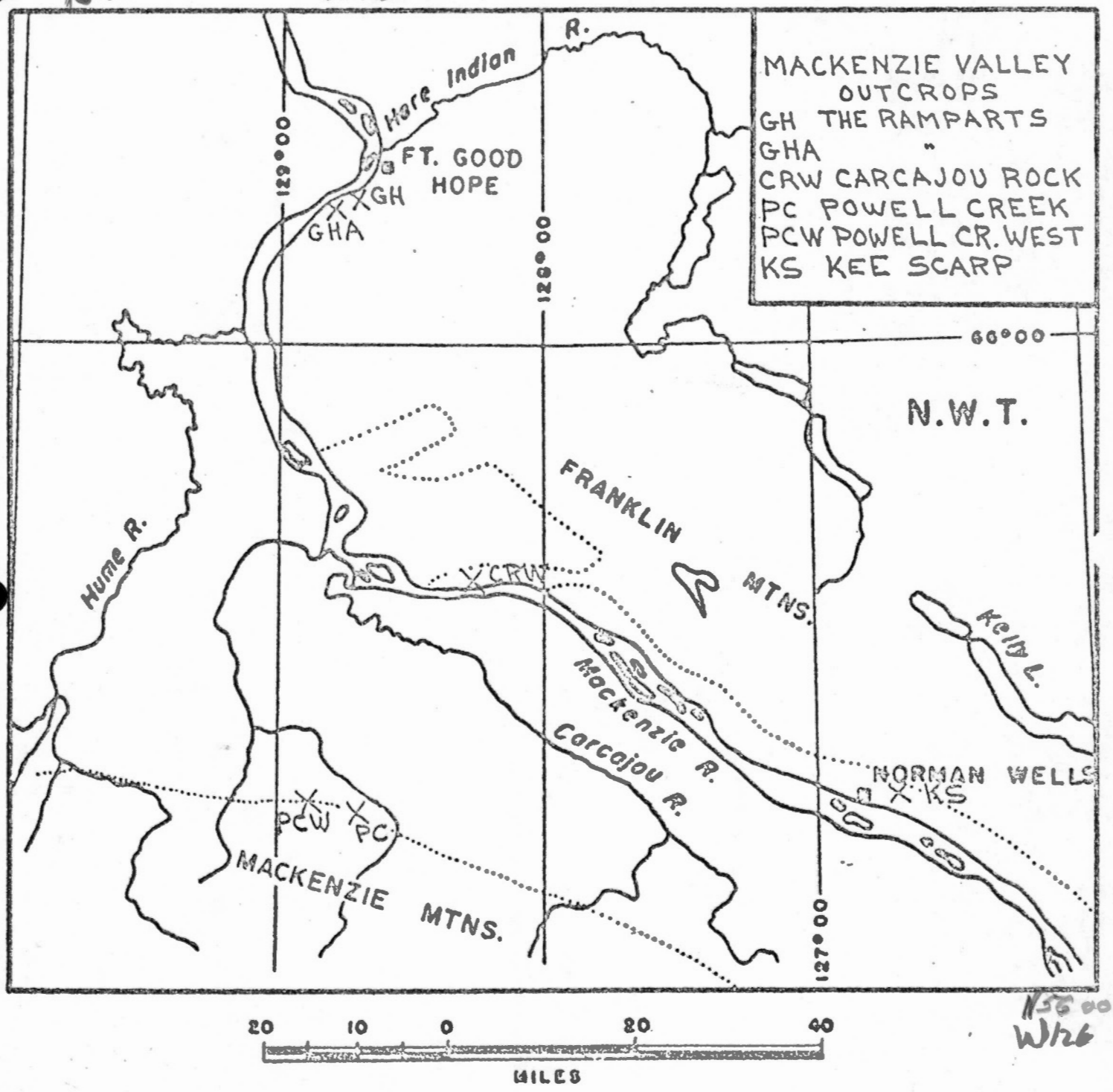
PROBLEM AND OBJECTIVE

The interval between the Canol Shale and the Hume-Nahanni-Lower Keg River datum, an interval of high potential for oil and gas discoveries, is also one beset by a high degree of stratigraphic complexity. As a consequence, exploratory interpretations, whether based on direct geological methods or geophysical ones, are here especially difficult.

These difficulties arise principally because rapid facies changes are complicated by the presence of several unconformities of regional scope. As a consequence, the tracing of datum horizons within this complex by purely physical means over more than local, circumscribed areas, becomes difficult, uncertain, and in some cases impossible.

In a situation of this kind, an additional element needs to be introduced. Preliminary investigations have indicated to us that such an additional element is available and feasible. This element is the application of biostratigraphic criteria, by means of which the contemporaneity, or non-contemporaneity, of different

N 63 00 W 130 00



N 56 00 W 126

faciescan be established, and the presence, magnitude, and behavior of unconformities can be evaluated.

Within these terms of reference, the present investigation has been concentrated on that part of the stratigraphic section bounded below by the top of the Stringocephalus-bearing strata of Givetian age and above by the Canol Shale. This interval involves strata variously designated as Fort Vermilion, Slave Point, Waterways, Beaverhill Lake, Swan Hills, Beavertail, Kee Scarp (in its original sense), Upper Ramparts, "unnamed beds", Fort Creek (in part), etc.

The very variety of names, and the wide range of lithologies which their invocation calls to mind, demonstrates the complexities involved. This complexity is vastly compounded in those areas where the Stringocephalus-bearing carbonates are absent or lose their identity; so that the lower limits of the complex are no longer demonstrable on purely physical grounds.

For this reason, in attacking this problem, we have selected as our initial step, certain areas of outcrop, where the target interval is clearly bounded by the Stringocephalus carbonates on the one hand and by the Canol Shale on the other.

STRATIGRAPHIC BOUNDARIES

Within the target complex, it has become evident in the course of our investigation, that we are dealing with three different categories of stratigraphic boundaries. Each of these categories needs to be clearly defined, discriminated, and applied independently of the other two.

The three categories of stratigraphic boundary are as follows:

Lithostratigraphic boundaries

Biostratigraphic boundaries

Tectostratigraphic boundaries

Lithostratigraphic boundaries delimit deposits of like lithologic character and similar lithofacies. They may, and generally, do transgress time lines.

Biostratigraphic boundaries delimit faunal zones and, when properly discriminated, constitute penicontemporaneous "time" lines. A faunal zone, as we conceive it, may and generally does, involve several contemporaneous fauni-facies. It is distinguished more reliably on the basis of the combined ranges of a number of species, than on the range of a designated index species.

We propose the term "tectostratigraphic boundary" for those which coincide with regional unconformities. Since such unconformities involve some type of crustal movement, whether on the site or remote form it, the prefix "tecto" is applied.

While biostratigraphic boundaries may cross lithostratigraphic boundaries, and conversely, neither of these, properly discriminated, crosses a tectostratigraphic boundary.

STRATIGRAPHIC NOMENCLATURE

The stratigraphic nomenclature adopted for the target interval follows the principles outlined above. As a result it was found necessary to propose several new terms for the purpose of this report. Others are not so much redefined as returned to the pristine use of the original authors. In addition to the deposits of the target interval, those of the bounding strata also require definition. The terms proposed are as follows.

HARE INDIAN FORMATION (Kindle & Bosworth, 1921)

Studies made by us in other areas reveal that the Hare Indian Formation is a contemporaneous facies equivalent for a part or in some cases the whole of the Stringocephalus-bearing bank or reef carbonates.

Our observations in the Central Mackenzie Region, including the type locality at Fort Good Hope, indicate that the lithology of the Hare Indian Formation reflects a progressive shoaling and gradation from a deeper-water, off-shore, less well-aerated environment expressed by dark shales with a limited, largely pelagic fauna, to a shallower water, well-aerated environment reflected in a lithology of inter-bedded, less bituminous shales and thin-bedded limestones, carrying a rich and varied benthonic fauna.

The progression continues into the bank carbonates with a stromatoporoidal and Stringocephalus facies-fauna, which we designate the Fort Good Hope Formation. The proposed formation corresponds to the Lower Ramparts or Lower Kee Scarp of current usage. The Hare-Indian-Fort Good Hope contact at the localities visited is in all cases sharp, but conformable.

FORT GOOD HOPE FORMATION (new)

The term Fort Good Hope Formation will be used for that aprt of the Ramparts Formation generally designated the Lower Ramparts, namely that main portion of the "unit" which is massive, buff-weathering, stromatoporoidal, and bears the Stringocephalus fauna. Originally, as reflected on some of the appended distribution charts,

it was considered sufficient to use Fort Good Hope as a member term for a part of the Ramparts Formation. However, since the "Upper Ramparts", although also a carbonate, is readily distinguished on lithologic grounds, and moreover is separated from the Lower Ramparts by a calcareo-argillaceous clastic zone corresponding in age and position to the Watt Mountain Formation, separation of the "Lower Ramparts" as an independent formation is called for. A part of the confusion in stratigraphic discrimination in the Middle Mackenzie Region has been because of the lumping of the two independent units, "Lower" and "Upper Ramparts", as a single formation.

CARCAJOU ROCK FORMATION (new)

The Carcajou Rock Formation is used to replace the term "Upper Ramparts", or "Beavertail" in the sense of Warren & Stelck. This "Upper Ramparts" unit is readily distinguished from the underlying by its light grey, grey-weathering character, relatively thin bedding between substantial partings of light grey shale, and close blocky jointing, resulting in a step-like recessive outcrop over the massive, bluff-forming Fort Good Hope Formation. As demonstrated at Powell Creek, Carcajou Rock, and The Ramparts, it is separated from the underlying by a relatively unconsolidated band of clay full of lime sand, which at the former two localities, is shown

to be correlative on comparison of their rich ostracod faunas. This clay & lime-sand band corresponds in stratigraphic position and relationsips to the base of the Watt Mountain Formation of other regions.

The upper boundary of the Carcajou Rock Formation is marked by more or less gradational passage to much more highly argillaceous and bituminous beds belonging to the Beavertail Formation. The Beavertail-Carcajou Rock boundary is diachronic and crosses faunal zone boundaries.

Warren and Stelck recognized the faunal zone (Cyrtina panda Zone) which dominates the Carcajou Rock Formation, but misapplied the term Beavertail Formation to the unit. Although equivalent to at least a part of the Beavertail, it is quite different in lithofacies character.

The Carcajou Rock Formation is in a lithofacies expression characteristic of relatively well-aerated, shallow water, open-marine conditions, with a rich and varied benthonic fauna. In this respect, it is analogous in facies to the upper part of the Hare Indian Formation in the central Mackenzie Region.

BEAVERTAIL FORMATION (Kindle & Bosworth, 1921)

Although logistic difficulties prevented our visiting Beavertail Rock, the type locality of the Beavertail Formation, the unit at that place is adequately described as consisting of "hard, thick-bedded, bituminous limestones, with some shaly partings. They are so bituminous that their color generally is almost black "(M. P. Woodhead & Lexicon Committee, in "Lexicon of Geological Names...," A. S. P. G. Pub., 1960).

The Beavertail is obviously a deeper water, open-marine facies, i. e. dark limestones and shales; and this is the only stratigraphic term extant for beds of this facies in this interval. Therefore, any discussions as to the xact age and faunal-zone position at Beavertail Rock is beside the point. Used in a purely lithostratigraphic sense (as is proper) the Beavertail Formation, like its contemporaneous lithofacies analog, the Carcajou Rock, is diachronic in expression.

In part, beds of this facies have been assigned to the Fort Creek Formation, a loose term involving dark shales of several lithologic types and age equivalencies, or referred to(Braun, 1966) as "unnamed beds".

In conclusion, we feel it necessary to point out that our use of the term Beavertail corresponds with that of the original authors,

but differs from its application either by Warren and Stelck, 1954, or by Crickmay, 1970, both of whom attempt to use it simultaneously in a time-stratigraphic (biostratigraphic) and lithostratigraphic sense.

KEE SCARP FORMATION (Stelck, 1942-43)

Whereas the terms Carcajou Rock and Beavertail are applied, in the target interval, to shallow and deeper water open-marine facies respectively, we retain the term Kee Scarp to express the reef and/or carbonate bank facies of this interval. Fossils found by us at the type locality as well as those found by others (Warren & Stelck, 1956; Pedder, 1963; Crickmay, 1968) demonstrate that the outcropping beds, now extensively quarried, fall within the target interval.

It is obvious from the fore-going that we do not accept Bassett's (1961) proposed usage of the term Kee Scarp for Ramparts (Isbister, 1855).

CANOL FORMATION (Bassett, 1961)

The term Canol Formation is used in the sense of Bassett's original description for a non-calcareous, highly fissile, hard dark shale, which on outcrop develops rusty surfaces, resists weathering, and

and does not break down to clay.

FORT VERMILION FORMATION (Law, 1955)

The term Fort Vermilion is used in the sense of Law (1955), for evaporite beds which grade through a short transition to the basal beds of the Slave Point Formation.

SLAVE POINT FORMATION (Cameron, 1922)

Slave Point is used in the revised sense of Law (1955). Campbell (1957) divides the formation into three members, the lower of which is "grey or brown, fine to dense limestone in part thinly bedded and argillaceous, and in part richly fossiliferous" (Norris, 1965, p. 74). The fauna is essentially limited to a single brachiopod, Ladjia landesi (Crickmay), and both this fact and the general lithology indicate a restricted marine environment. Since the member is readily distinguished from the overlying, we propose to designate it as the Wood Buffalo Member. Typical outcrops may be observed at Miles 79 to 80 of N. W. T. Highway No. 5 in Wood Buffalo National Park.

The relation between Campbell's upper two members seems to be gradational in the direction of increasingly improved marine

circulation, culminating in a high proportion of stromatoporoidal elements, along with a notable increase in variety of brachiopods and ostracods. Since the members appear to constitute a single stratigraphic unit, we propose to designate it as the Mellor Rapids Member, from outcrops in the vicinity of the rapids on Buffalo River.

HORN PLATEAU FORMATION

The Horn Plateau Formation was described by Norris, 1964, from a single outcrop of "about 40 feet of strata" 2.5 miles west of Fawn Lake, 62° 08'N; 117° 39'W. On our visit to the type locality, we estimated a somewhat greater thickness and, on the basis of float, received the impression of a shale interval existing between the "lower, thin-bedded unit" and the "upper massive unit". In any event, the two units are very different in lithologic character, with very different types of faunas. The lower unit has the characteristics of a shallow-water, open marine environment, but is unusual in its high proportion of dwarf fauna. Absence of shale may be a result of fore-reef conditions.

The upper unit appears to be massive biohermal accumulation of a large species of Atrypa. No stromatoporoids are reported by Norris nor did we observe any.

FAUNAL ZONES AND ASSEMBLAGES

Middle Mackenzie Region

STRINGOCEPHALUS ZONES

Crickmay (1963, p. 28) recognizes five zones comprising the Stringocephalus succession of western Canada. We feel however that there are only three. Our upper zone corresponds to his Stringocephalus aleskanus Zone, and the lower to his Stringocephalus sapiens-S. glaphyrus Zone. His Stringocephalus axius Zone, based on outcrops in northeastern British Columbia, we are convinced lies, not above the S. aleskanus Zone, but below it; i. e. it represents the middle zone of the tri-zone Stringocephalus sequence.

We base this conclusion on our discovery of S. asteius Zone fossils (i. e. Rensselandia laevis) in the Mt. Burden area of British Columbia, and of S. axius zone fossils (Geranocephalus inopinus) in the S. asteius Zone at the Ramparts. In the Mt. Burden area, moreover, we find the S. axius Zone beneath beds which bear Stringocephalus aleskanus.

As for the S. vernaculus Zone, we suspect that fossil to be a synonym for S. axius and to belong in the S. axius Zone.

TABLE I

CARCAJOU ROCK W.

65°37'N, 128°22'-25'W

Faunal Range Chart - CRW

SLAVE POINT DATUM PROJECT

RAASCH & ASSO., Ltd.

OCCURRENCE ELSEWHERE			FAUNA
	n.d.	S	Amphipora sp. unident.
	n.d.	R	Woody fragments
	new	O	Bythocypris sp undet.
	n.d.	Ct	Tentaculites sp. unident.
	new	A	Anaptychus sp undet.
	n.d.	X	Conodonts
L. Slave Point to Mildred. Upper Slave R.		B	Devonoproductus minimus/secundus
Throughout Waterways		B	Lingula cf. spatulata
	n.d.	B	Petrocrania sp. undet.
	PC: L. hippocastanea Z	B	Ambocoelid genus CRW10
Tully equivalents	P.C. L. hippocastanea Z	A	Ponticeras tschernyschewi
	GHA; PC. L. hippocastanea Z	B	Leiothynchus hippocastanea
	p.d	O	Ostracods, unident.
	n.d	Ct	Stylolina fissurella/spica
Middle Cedar Valley (Iowa)		B	Choneles cf. buchananensis
	PCW, PC: C. panda Z	B	Warrenella occidentalis
Dawson Bay & Souris R. (Manitoba)		G	Straparollus cf. subtrigonalis
	new	G	Omphalocirrus CRW8
Firebag.	U. Slave Pt, PCW: C. panda Z	B	Ladogioides pax
	PC, PCW: C. panda Z	B	Leiorhynchus rhabdotum
N.e. B.C.	PC, PCW: C. panda Z	B	Ladjia cf. caligatae
Stringocephalus, panda, hippocastanea Z's		B	Lingula minuta
L. Horn Plateau, Arch Scarp		B	Aulacella? (n. sp) "Key Scarp"
L. Horn Plateau, U. Slave Point		B	Ambocoelia cf. umbonata
	new	B	Spinatrypa CRW8
U. Slave Pt. to Mildred	CRW: C. panda Z	B	Cyrtina triquetra
	new	Br	Rhombopora? sp. undet.
	new	Br	Lioclema sp. undet.
	new	br	Hederella sp. undet.
	n.d.		Spirorbis sp. undet.
	GHA: C. panda Z	P	Paracyclas CRW
	n.d	V	Ptyctodus sp undet.
	GH: Stringocephalus Br's	T	Scutellum CRW8
	new	O	Ostracod CRW8a
	new	P	Productella gutasi
	new	B	Spinulicosta sp.
L. Horn Plateau	GHA: C. panda Z	B	Hypothyridina GHA cameroni
	PCW, GHA: C. panda Z	P	Paracyclas GHA
	local	B	Hadrorhynchia "sandersoni"
Tully (N.Y.) Frobisher Welle.	GHA: C. panda Z	B	Nervostrophia tulliensis
(Repetitious entry; see below)		B	Cyrtina panda
	n.d	G	Gastropod unident.
Firebag, Flume, N.e. B.C.	PC, GHA: C. panda Z	B	Schizophoria meeki
	n.d	B	Spinatrypa (fragments)
	PC, GHA: C. panda Z	B	Atrypa percrassa
S	new	O	Ostracod CRW5c
	new	O	Ostracod CRW5a
	new	O	Ostracod PCW5h
	PC, PCW: C. panda Z	O	Ostracod PC4b
Stringo., panda, hippocastanea Z's	PC, PCW, GHA	O	Coenites PC5
	PC: C. panda Z	C	Thamnopora PC5
Waterways: N.e. B.C., GHA, PC, PCW		C	Alveolites tabular
	n.d	E	Crinoid ossicles
	new	B	Schizophoria sp. undet. B
	PCW: C. panda Z	B	Ladjia (n. sp) "Mackenzie"
	N.e. B.C., GHA, : C. panda Z	B	Cyrtina panda
	n.d.	T	Scutellum (fragments)
	PC, PCW: C. panda Z	O	Ostracod PC3-3
	PCW: C panda Z	O	Ostracod CRW4a (Marginia 750)
	PCW: C. panda Z	O	Ostracod CRW4b (Bythocypris 783)
	new	O	Ostracod CRW4c
	new	O	Ostracod CRW4d (Bythocypris 785)
	new	O	Ostracod CRW4e (Bythocypris?)
	new	O	Ostracod CRW5f (Paraparchites 547)
	new	O	Ostracod CRW4g (Schmidtella 657)
	new	O	Ostracod CRW4h (Paraparchites 567)
	PC, PCW: C. panda Z	O	Ostracod CRW4m (Orthocypris 517)
	PC, PCW: C. panda Z	O	Ostracod CRW4n (Microcheilenella 486)
	new	O	Ostracod CRW4o
	PCW: C. panda	O	Ostracod CRW4p (Bythocypris (79)
	new	O	Ostracod CRW4q (Bythocypris)
	new	O	Ostracod CRW4r (Bairdia cf. 794)
	new	O	Ostracod CRW4s (cf. Acratia)
	new	O	Ostracod CRW4t
	PCW; C. panda Z	O	Ostracod CRW4u
	n.d	S	Stroms, tabular.
	n.d	S	Stroms, massive
	long-ranging	C	Alveolites suborbicularis
	Stringocephalus Zone	C	Thamnopora, finger-size
	n.d	T	Trilobites, dechenellid
	Lower Horn Plateau	P	Grammysia sp. FL/TO
	Lower Horn Plateau	B	Cranaena? cryptonelloides
	new	B	Schizophoria sp. undet. A
Carcajou Ridge: Hare Ind.		B	"Echinocoelia sp" (Caldwell, 1967)
PC: Stringoceth. aleskanus Z		B	Atrypa hormophora
Presqu'ile, N.e. B.C.	Stringocephalus aleskanus Z	B	Stringocephalus aleskanus
	new	O	Ostracod CRW1a
	new	O	Ostracod CRW1b
	new	O	Ostracod CRW1c
	new	O	Ostracod CRW1d
PC	C. panda + Stringocephalus aleskanus Z's	O	Ostracod CRW4j (Marginia 394)
PCW PC	C. panda + Stringo. aleskanus Z's	O	Ostracod CRW4k (Kloedenella 786)
	new	O	Ostracod CRW1g
	new	O	Ostracod CRW1h

n.d = not definitive

PCW	Powell Creek West	A	GONIATITES
PC	Powell Creek	B	BRACHIOPODS
GHA	Ramparts	Br	BRYOZOA
CRW	Carcajou Rock	C	CORALS
N.e. B.C.	Gayhq Ridge, Peace R.	Cr	CRICOCONARIDS
		E	CRINOIDS
		G	GASTROPODS
		O	OSTRACODS
		P	PELECYPODS
		P	PLANTS
		S	STROMATOPOROIDS
		T	TRILOBITES
		V	FISH
		X	CONODONTS

x spot collection
— interval collection
• spot collection; fossil not definitive
---- interval collection; fossil not definitive

VERTICAL SCALE: 20 ft

0 20 40 60 80 100 120 140 160 180 194

Lower Ramparts (Stringocephalus aleskanus Zone)
unexposed
Lower Ramparts (Stringocephalus elegans Zone)
basal detrital
Cyrtina panda Zone
Upper Ramparts "Carcajou Member" (proposed)
hippocastanea Zone
Beavertail (Ponticeras tschernyschewi Zone)

Comparison of our zonation with that of Crickmay is shown in Figure 1.

The S. aleskanus beds reach a thickness of 86 feet at the Ramparts, and comparable thickness at Carcajou Rock, and are present in the Presqu'ile/Sulphur Point on Great Slave Lake (where the zone's thickness is not determinable). At these places, therefore, post-Stringocephalus (i. e. post-Fort Good Hope) erosion was of a moderate but undeterminable amount.

At Powell West, unfortunately the Stringocephalus present in the Fort Good Hope remnant is not definitely known from other localities. It recalls an undescribed species which occurs in the S. aleskanus Zone near Mt. Burden, B. C., but specimens from that locality are not currently available for comparison.

The ostracod fauna occurring with the large brachiopods is also distinctive, although a few species range both lower and higher.

CYRTINA PANDA ZONE

The Cyrtina panda Zone is the lower of the two faunal assemblages which occur in the target interval (i. e. between the Stringocephalus Beds (Fort Good Hope Formation) and the Canol Shale). The fauna

SLAVE POINT DATUM PROJECT, RAASCH & ASSA, 1964.

OCCURRENCE	ELSEWHERE	BIOTA
	new	Helioliteo? sp undet
	new	Paracyclas sp undet
	n.d.	Schizophoria (fragments)
	n.d	Cyrtina (fragments)
	new	Ostracod GHA)
Stringocephalus, C. panda, ? hippocastanea Zones		Lingula minuta
PC, CRW: hippocastanea Z		Leiorhynchus hippocastenea
	n.d	Spirorbis sp undet
CRW: C. panda Z.		Rhombopora? sp.
	new	Aulopora aff munda
Stringocephalus, C. panda, hippocastanea Zones		Coenites PC5
Waterways. PCW: C panda Z		Coenites verruculosus
Waterways. PC, PCW, CRW: C. panda Z.		Alveolites, tabular
long-ranging		Alveolites suborbicularis
	n.d.	Crinoid ossicles
	n.d	Styliolina spica
	new	Bellerophon sp undet.
Cedar Valley equiv (WIS)		cf. Palaeoneilo maxima
CRW, GHA: C. panda Z.		Paracyclas CRW
CRW, GHA. C. panda Z.		Paracyclas GHA
NE.B.C; CRW. C. panda Z		Cyrtina panda
	new	Spinatrypa GHA 2
L. Cedar Valley. Firebag. PCW, CRW. C. panda Z.		Spinatrypa mascula
PC, CRW: C. panda Z.		Atrypa percrassa
L. Hunkata CRW: C. panda Z		Hypothyridina (GHA 2) cameroni
PCW, CRW: C. panda Z		Productella gulosi
Tully (N.Y.) Fishers Wells. CRW: C. panda Z		Nervostrophia tulliensis
	new	Schizophoria sp. dwarf
Firebag, Flume, NE.B.C. PC, CRW C. panda Z.		Schizophoria meeki
Pass Ville. CRW: Stringo. aleskanus Zone		Stringocephalus aleskanus
	n.d	Gypidula sp.
	n.d	Paracyclas sp.
	n.d	Amphipora sp. unident.
	n.d	Clathrodictyon sp. unident.
	n.d.	Idiostroma sp. unident.
	n.d.	Actinostroma sp. unident.
	n.d	Stromatopora sp. unident.
	n.d.	Caunopora? sp unident.
	n.d	Bryozoan, fenestellid
CRW: C. panda Z.		Scutellum CRW 8
	n.d	Bellerophon sp. unident.
	new	Serpulispira (n. sp) Good Hope
	new	Grammysia (n. sp.) Good Hope
	new	Conocardium (n. sp) Good Hope
	new	Aulacella? sp. undet.
	new	Ladjia (n. sp) Ramparts
	new	Ladjia (n. sp) Good Hope
	new	Reticulariopsis (n. sp) Good Hope
He B.C. Stringo. asius/Rensselandia Zone		Geranocephalus inopinus
He B.C. Stringo. asius/Rensselandia Zone		Rensselandia laevis
Stringo. asius/Rensselandia Zone		Stringocephalus asteius
	new	Atrypa GH
	new	Spinatrypa GH
Stringo. asius/Rensselandia Zone		Arguitastraea arguta
	new	Heliophyllum GH
	n.d	Ceratophyllum sp. unident.
	n.d	Stringophyllum sp. unident.
	n.d	Mesophyllum sp. unident.
	new	Thamnopora GH
	n.d	Alveolites sp. unident

HARE INDIAN (fauna not studied)

LOWER RAMPARTS (Rensselandia/Stringocephalus asteius Zone)

LOWER RAMPARTS (Stringocephalus aleskanus Zone)

UPPER RAMPARTS CARCAJOU MEMBER (proposed) (Cyrtina panda Zone)

n.d. = not definitive

CRW Carcajou Rock
PC Powell Creek
PCW Powell Creek West
GHA Ramparts
NE. B.C. Gas Key Ridge, B.C.

— Interval collection;
..... Interval collection; fossil not definitive.

Scale: 20 feet

RAMPARTS OF THE MACKENZIE
66°, 14' N.; 128°, 42' W
Faunal Range Chart - GH, GHA

TABLE II

is most richly developed in the shallow, well-aerated open-marine facies (Carcajou Rock Formation) occurring at Carcajou Rock and The Ramparts. (see Faunal Range Charts, appended). A number of the species extend their distribution laterally into the somewhat different facies occurring in the Beavertail Formation. Some of the more important species which assist in the recognition of this zone are as follows. Initials at right indicate localities.

CORALS

Coenites verruculosus Crickmay GHA, PCW

BRACHIOPODS

Atrypa percrassa Crickmay CRW, GHA, PC

Aulacella? (n. sp.) "Kee Scarp" CRW?, PC? KS, FL

Cyrtina panda Meek CRW, GHA

Hypothyridina cameroni Warren CRW, GHA, FL

Ladogioides pax McLaren CRW, PCW

Ladjia cf. caligatae Crickmay CRW, GHA, PCW, PC

Leiorhynchus rhabdotum Crickmay CRW, PCW, PC

Nervostrophia tulliensis (Hall) CRW, GHA

Productella gulosi Crickmay CRW, GHA, PCW

Schizophoria meeki F&F CRW, GHA, PC

Spinatrypa mascula (Stainbrook) GHA, PCW

Warrenella occidentalis (Merriam) CRW, PCW? PC

TABLE III

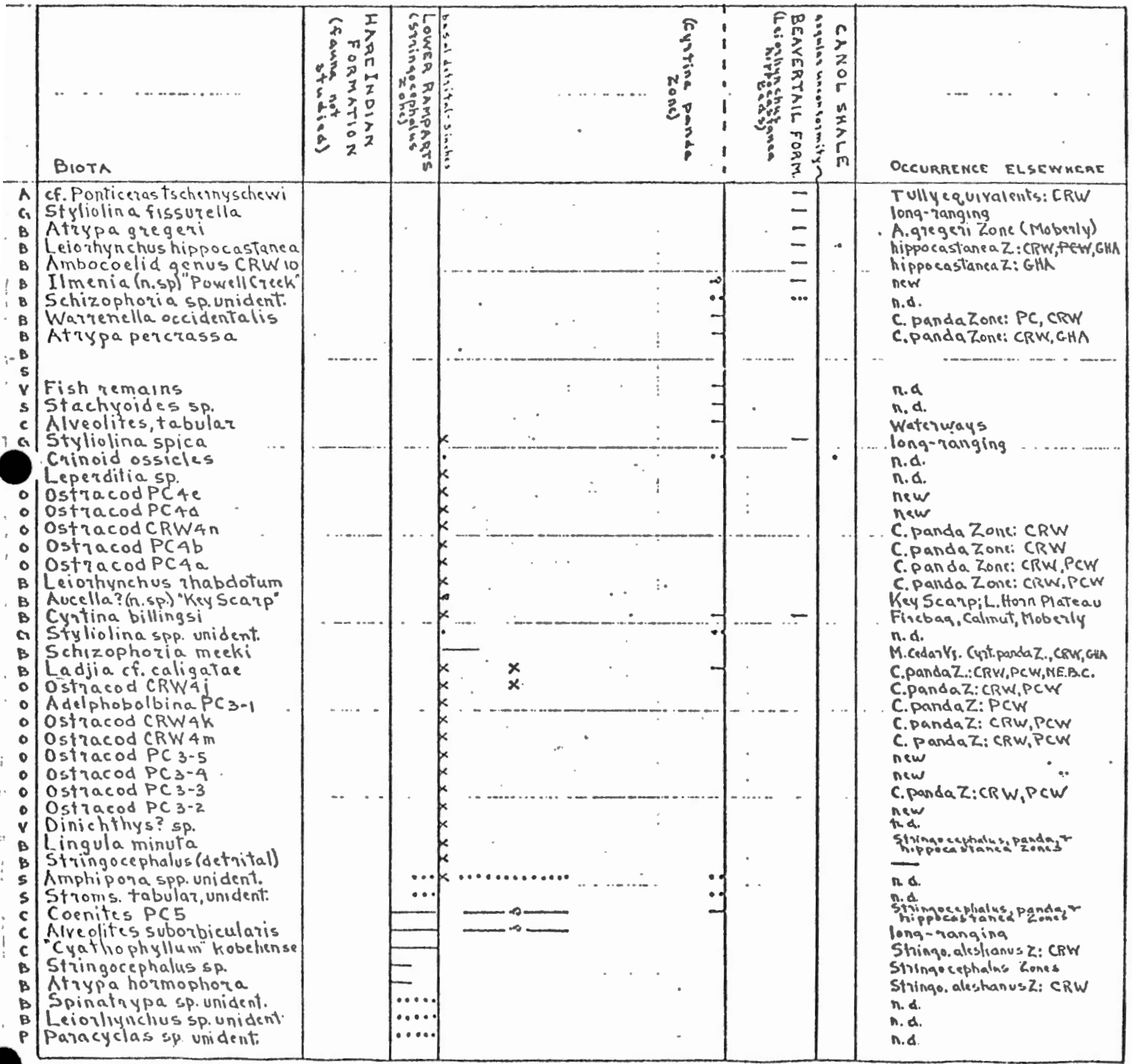
POWELL CREEK

65°, 16' N; 128°, 47' W

Faunal Range Chart - PC

SLAVE POINT DATUM PROJECT

RAASCH & ASSO., Ltd.



	BIOTA	OCCURRENCE ELSEWHERE
A	cf. Ponticeras tschernyschewi	Tully equivalents: CRW
Cr	Styliolina fissurella	long-ranging
B	Atrypa gregeri	A. gregeri Zone (Moberly)
B	Leiorhynchus hippocastanea	hippocastanea Z.: CRW, PCW, GHA
B	Ambocoelid genus CRW 10	hippocastanea Z: GHA
B	Ilmenia (n.sp) "Powell Creek"	new
B	Schizophoria sp. unident.	n.d.
B	Warrenella occidentalis	C. panda Zone: PC, CRW
B	Atrypa percrassa	C. panda Zone: CRW, GHA
B		
S		
V	Fish remains	n.d.
S	Stachyoides sp.	n.d.
C	Alveolites, tabular	Waterways
Cr	Styliolina spica	long-ranging
E	Crinoid ossicles	n.d.
	Leperditia sp.	n.d.
O	Ostracod PC 4e	new
O	Ostracod PC 4a	new
O	Ostracod CRW 4n	C. panda Zone: CRW
O	Ostracod PC 4b	C. panda Zone: CRW
O	Ostracod PC 4a	C. panda Zone: CRW, PCW
B	Leiorhynchus rhabdotum	C. panda Zone: CRW, PCW
B	Aucella? (n.sp.) "Key Scarp"	Key Scarp; L. Horn Plateau
B	Cystina billingsi	Firebag, Calmut, Moberly
Cr	Styliolina spp. unident.	n.d.
B	Schizophoria meeki	M. Cedar Vs. Cyst. panda Z., CRW, GHA
B	Ladjia cf. caligatae	C. panda Z.: CRW, PCW, NE B.C.
O	Ostracod CRW 4j	C. panda Z: CRW, PCW
O	Adelphobolbina PC 3-1	C. panda Z: PCW
O	Ostracod CRW 4k	C. panda Z: CRW, PCW
O	Ostracod CRW 4m	C. panda Z: CRW, PCW
O	Ostracod PC 3-5	new
O	Ostracod PC 3-4	new
O	Ostracod PC 3-3	C. panda Z: CRW, PCW
O	Ostracod PC 3-2	new
V	Dinichthys? sp.	n.d.
B	Lingula minuta	Stringocephalus, panda & hippocastanea Zones
B	Stringocephalus (detrital)	
S	Amphipora spp. unident.	n.d.
S	Stroms. tabular, unident.	n.d.
C	Coenites PC 5	Stringocephalus, panda & hippocastanea Zones
C	Alveolites suborbicularis	long-ranging
C	"Cyathophyllum" kobehense	Stringo. aleshanus Z: CRW
B	Stringocephalus sp.	Stringocephalus Zones
B	Atrypa hormophora	Stringo. aleshanus Z: CRW
B	Spinatrypa sp. unident.	n.d.
B	Leiorhynchus sp. unident.	n.d.
P	Paracyclas sp. unident.	n.d.

n.d = not definitive

A GONIATITE
B BRACHIOPOD
C CORAL
Cr CRICOCONARID
E CRINOID
O OSTRACOD
P PELECYPOD
S STROMS.
V FISH

× spot collection
—— interval collection
..... not definitive

CRW Carcajou Rock
GHA Ramparts
PCW Powell Creek West

Vertical Scale: 20 ft

PELECYPOD

Paracyclas CRW	GHA, CRW
Paracyclas GHA	CRW, GHA, PCW

OSTRACODS

Ostracod PC 3-1	PC, PCW
Ostracod PC 3-3	PC, CRW, FL
Ostracod PC 4b	PC, PCW, CRW
Ostracod CRW 4a	CRW, PCW
Ostracod CRW 4b	CRW, PCW
Ostracod CRW 4f	CRW, PCW
Ostracod CRW 4j	CRW, PCW, PC*
Ostracod CRW 4k	CRW, PCW, PC*
(Ostracods CRW4j and 4k also range lower)	
Ostracod CRW 4m	CRW, PCW, PC
Ostracod CRW 4n	CRW, PCW, PC
Ostracod CRW 4b	CRW, PCW
Ostracod CRW 4u	CRW, PCW

Except for a few long-ranging tabulate corals, the two ostracods indicated above, a new species of the trilobite Scutellum, and possibly Hypothyridina cameroni, none of the scores of species in the Cyrtina panda Zone range lower, and very few range higher.

TABLE IV

SLAVE POINT DATUM PROJECT

POWELL CREEK WEST

65° 14' N, 128° 52' W

OCCURRENCE	ELSEWHERE	
	n.d.	Amphipora spp.
	n.d.	Stromatopoids, massive
	n.d.	Crinoidal remains
	CRW: C. panda Z.	Ostracod CRW4v
	CRW: C. panda Z.	Ostracod CRW4b
	CRW: C. panda Z.	Ostracod CRW4f
	PC, CRW: C. panda Z.	Ostracod CRW4j
	PC, CRW: C. panda Z.	Ostracod CRW4k
	PC, CRW: C. panda Z.	Ostracod CRW4m
	PC, CRW: C. panda Z.	Ostracod CRW4n
	CRW: C. panda Z.	Ostracod CRW4p
	CRW: C. panda Z.	Ostracod CRW4u
	PC: C. panda Z.	Ostracod PC 3-1
	CRW, PC: C. panda Z.	Ostracod PC 3-3
	CRW, PC: C. panda Z.	Ostracod PC4b
	new	Ostracod PCW5f
	new	Ostracod PCW5g
	new	Ostracod PCW5h
	new	Ostracod PCW5k
	new	Ostracod PCW5m
	n.d.	Fish remains
	n.d.	Gastropod, unident.
	CRW, GHA: C. panda Z.	Ponocella? GHA
Strimocephalus, C. panda, M. hippocastanea Zones		Lingula minuta
	new	Athyris? PCW5
	PC, CRW: C. panda Z.	Warrinella cf. occidentalis
	PC, CRW: C. panda Z.	Ladjia cf. caliguitae
	CRW: C. panda Z.	Ladjia (Lispi) 'Mackenzie'
Flume, Wolf Creeks	CRW: hippocastanea + panda Z....	Cyrtina cf. triquetra
L. Cedar Valley, Fire Bay	CRW, PCW: C. panda Z.	Spinatrypa masculata
	new	Spinatrypa PC5
Upper Slave R., Fire Bay.	CRW: C. panda Z.	Ladogioides cf. pax
	PC, CRW: C. panda Z.	Leiorhynchus 'rhabdotum'
	GHA, CRW: C. panda Z.	Productella gutosa
	n.d.	Schizophoria sp. undet.
	n.d.	Cystophyllum? sp. undet.
Waterways No. B.C.	GHA, CRW, PC: C. panda Z.	Alveolites, tabulate
Strimocephalus, panda, hippocastanea Z.	CRW, CHIPS	Cornites PC5
Waterways	GH: C. panda Z.	Cosnites verruculosus
	n.d.	Stromatoporoids, tabulate
N.B.C.?	Upper Strimocephalus Zone	Strimocephalus cf. postnuc

n.d. = not definitive

CRW Carcajou Rock
PC Powell Creek
GHA Ramparts

HARE INDIAN (Stromatoporoids not identified)

LOWER RAMPARTS (massive, buff-weathering) Strimocephalus Zone

BEAVERTAIL

Cyrtina panda Zone

KEE SCARP

BEAVERTAIL

carbonate bank

KEE SCARP

broad complex of reefs and banks

Massive reefs of generally basic carbonate, Stromatoporoidal

Massive reefs of basic carbonate, Stromatoporoidal

concealed interval at head of creek

IMPERIAL Sandstone and siltstone

X spot collection, definitive fossil
• spot collection, fossil not definitive
interval collection, definitive fossil
interval collection, fossil not definitive

Scale: 20 feet

RAASCH & ASSO., Ltd.

The latter exceptions are Cyrtina triquetra, C. billingsi and Lingula minuta.

At two localities, Carcajou Rock and Powell Creek West, the large brachiopod Warrenella occidentalis, at one time considered a suitable designate of the zone, occurs only in its top few feet, (the third occurrence, at Powell Creek, s a tentative identification).

The brachiopod was not found at The Ramparts, where the C. panda interval is much reduced. The possibility that the upper part of the C. panda beds was here eroded before the deposition of the succeeding Ponticeras Zone strata should not be overlooked.

PONTICERAS ZONE

The upper of the two faunal zones comprising the target interval in the Middle Mackenzie Region is designated the Ponticeras Zone, on the basis of the occurrence there of the early Upper Devonian species P. cf. tschernyschewi (Holzapfel). House and Pedder (1963), who identified the fossils, place them in the Pharciceras lunulicostata subdivision of the Frasnian Manticoceras Zone.

At the base of the Ponticeras Zone succession at Carcajou Rock and The Ramparts are several feet of limestone carrying an abundance of the brachiopod Leiorhynchus hippocastanea (Crickmay). These

beds have been referred to as the "L. hippocastanea Zone" and it is a popular misconception that the hippocastanea beds underlie the strata bearing the goniatites. The fact is that dark shales with goniatites are interbedded with the brachiopod-bearing limestones and go as low as the basal shale lying between the C. panda and L. hippocastanea limestone layers. Conversely shales above the hippocastanea bed bear large numbers of a flattened Leiorhynchus which may logically be regarded as dwarfed and compressed examples of L. hippocastanea. Some of the partings in the shale carry immense numbers of ostracods flattened beyond identification. Lingula cf. spatulata (Vanuxem) is abundant in shale partings among the limestone layers.

At Carcajou Rock, where over 60 feet of Ponticeras Zone beds are exposed, quite a variety of fauna has been recorded. This diminishes in abundance upward as increasingly euxinic conditions prevail, but limestone interbeds go as high as 35 feet above the base.

Thus Amphipora, Ponticeras, and ostracods occur as high as 35 feet, while such presumably planktonic to nektonic forms as Styliolina, Tentaculites, and conodonts range more or less throughout.

In the basal limestones, in addition to fossils already mentioned, we find the brachiopods Devonoproductus minimus-D. secundus*

(*hyphenated because we are not convinced these are distinct species), Cyrtina triquetra (also occuring in the underlying zone), a Petrocrania, and an undescribed ambocoelid brachiopod interesting in that it occurs in this same position on Powell Creek.

At Carcajou Rock, the basal limestone layers are different in lithology from those of the Cyrtina beds below and are interbedded with shales like those which overlie them. Therefore we place the limestones with the overlying shales in the Beavertail Formation. At The Ramparts on the other hand, the hippocastanea limestones, which form the top of the bluff (at Locality GHA) are not physically distinct from the beds below. Although they are separated from these by a thick bituminous shale band, they are included, tentatively, along with the C. panda beds, in the Carcajou Rock Formation.

At Powell Creek, where the C. panda beds are in the Beavertail facies, they are overlain by still more argillaceous beds, 20 feet thick. No fossils were found in place except for a fossiliferous band 3 to 6 feet below the top. Goniatites, not showing suture, but identical in appearance to the Ponticeras of Carcajou Rock were collected from in-situ float. In the fossiliferous band, notable fossils are Leiorhynchus hippocastanea and the undescribed ambocoelid familiar from the Mackenzie River occurrences. In addition there is an abundance of an undescribed brachiopod of the genus

Ilmenia, a genus not previously reported from North America, but occurring in the Middle and Upper Devonian of the Old World. Another significant brachiopod is Atrypa gregeri Rowley, which elsewhere occurs in the Flume Formation and in the Moberly Member, high in the Waterways Formation. A micro-coquinoid matrix is supplied by overwhelming numbers of Styliolina. At Powell Creek, the Ponticeras Beds are overlain, with visible unconformity, by the Canol Shale.

Eastern Region

LADJIA LANDESI ZONE

The lower, or Wood Buffalo Member of the Slave Point Formation carries a fauna very limited as to species, consisting almost wholly of the brachiopod Ladjia landesi Crickmay (Emanuella vernilis Crickmay may be a synonym). The brachiopods occur in coquinoid bands at nearly all localities. In harmony with a restricted marine environment is the occasional occurrence of Leperditia. The odd stray fragment of Amphipora has back-reef implications. Dendroid graptolites and a very rare pelecypod, Sphenotus? R71, are shared with the overlying zone.

The Ladjia landesi Zone was found at Sulphur Point and at numerous shallow outcrops along Northwest Territories Highway No. 5, in

	Biota	HB-17 Sulphur Point	R-92 (Sulphur Pt.)	KD 14R	KD 3	KD 4	R-99	R-1	HB-2	HB-3	K-15 Bryant Point	R-100	R-101	R-102	R-103	HY5/79	HB-6	HB-14	R-31	R-30	R-4	R-70	R-71	Mellon Rapids	R-65	Occurrence Elsewhere
B	Nucleospira sp. undet.																								x	
B	Ladogioides par																							x		Firebag C. panda Zone: CRW, PCW
B	Eleutherokomma cf. implana																							x		L. Horn Plateau; C. panda Zone: CRW
B	cf. Ambocoelia umbonata																							x		
B	Schizophoria cf. allani																							x		Waterways
B	Cyrtina triquetra																							x		C. panda Zone: PCW. Flume
B	Devonoproductus cf. minimus																							x		Lower Slave Pt. to Milared (D. "secundus")
T	Trilobite, dechenellid																							x		
P	Mytilarca (n. sp.) "Slave Point"																							x		
G	Platyceras? sp.																							x		
o	Pentocyprus? sp.																					x				
o	Ostracod 70a																					x				
o	Bairdia 4a																				x					
G	Gastropod genus R4																				x					
G	"Natica" R4																				x					
G	Straparollus FL/70																				x					
P	Sphenotus? R4																				x					
P	Ilionia? R4																				x					
	Bryozoan																				x					
G	Euomphalus R30																			x						
B	Ladjia (n. sp.) R30																			x						
o	Paraparchites 814																			x					x	
o	Bairdia 889																			x						
o	Bairdia? 137																			x						
o	Bythocypris 181																			x						
o	Ostracod 740																			x						
o	Orthocypris 517																			x						
o	Bythocypris 177																			x						
o	Acratia 30e																			x						
o	"Healdianella" 277																			x						
o	Panaparchites? 30h																			x						
o	Ostracod 810																			x						
o	Microcheilinella 30k																			x						
o	Marginia 30o																			x						
o	Marginia 30p																			x						
o	Marginia? 30q																			x						
o	Ostracod 30r																			x						
o	Baindianella?? 30s																			x						
o	Ostracod 30t (Bairdia)																			x						
o	Ostracod 30u																			x						
o	Ostracod 30v																			x						
o	Ostracod 30w																			x						
o	Ostracod 30x																			x						
o	Ostracod 30y																			x						
N.	Potirioceras? sp.																			x						
P	Megambonia? R31																			x			x			
	Crinoid ossicles																			.						
	Spicules, calcareous																			.						
	Gastropods undet.																			.						
C	Alveolites HB14																			x						
C	Cornites HB14																		x	x						
C	Thamnopora sp. undet.																	x				x				
S	Stachyoides sp.																	x		x						
	Pelecypod undet.																			.						
B	Atrypa (n. sp.) "Slave Point"											x	o		x	x	x	x	x			x	x	x	x	
B	Atrypa cf. sculiformis											x			x		x		x							Waterways. Firebag to Calmut.
B	Ladjia (n. sp) "Slave Point"											x	?	x	x	x	x	x	x	x	x	x	x	x	x	
S	Stroms., massive											.		.	.	.	.	.	.	.	.	.	.	.	.	
B	Ladjia aff. landesi											x														
	Graptolite, dendroid				x											x					x	x				
S	Amphipora spp.																									
P	Sphenotus? R71		x																					x		
B	Ladjia landesi		x	x	x	x	x	x	x	x						?										
O	Leperditia sp. undet.		x	x																						
G	Loxonema HB19	x																								
		LADJIA LANDESI ZONE "WOOD BUFFALO MEMBER" (proposed)									LADJIA (n. sp.) "SLAVE POINT" ZONE "MELLOR RAPIDS MEMBER" (proposed)																

B Brachiopod
C Coral
G Gastropod
N. Cephalopod
O Ostracod
P Pelecypod
S Stromatoporoid
T Trilobite

x definite fossil occurrence
. fossil not definitive

CRW Carcajou Rock
PCW Powell Creek West

GREAT SLAVE - WOOD BUFFALO REGION

Faunal Distribution by Locality

TABLE V

SLAVE POINT DATUM PROJECT, R.A.S.C.H. & A.G.S.D., Ltd.

Wood Buffalo National Park at least as far as Mile 80.

LADJIA (n. sp.) "SLAVE POINT" ZONE

Of the 65 fossil taxa which we identified from the Slave Point Formation, all but three occur in the L. (n. sp.) "Slave Point Zone" or Mellor Rapids Member. Nevertheless, of these only two or three species of brachiopods range in significant members throughout the zones. These fossils are undescribed species of Ladjia (L. (n. sp.) "Slave Point") and Atrypa (A. (n. sp.) "Slave Point) and A. cf. scutiformis Stainbrook).

Of the remaining large number of fossils the majority are confined to the upper part of the Mellor Rapids Member, presumably that part corresponding with Campbell's (1957) "upper member" of the Slave Point. Here the list is augmented by the discrimination of more than two dozen ostracod species, plus the appearance in the uppermost beds of the brachiopods Devonoproductus minimus-D. secundus (probably a single species), cf. Ambocoelia umbonata (Conrad) Schizophoria cf. allani F. & F., Cyrtina triquetra Hall, Ladogioides pax McLaren, and Eleutherokomma implana Norris - species which have a Waterways and/or Horn Plateau affinity. Massive stromatoporoids, Amphipora, and dendroid graptolites range throughout. Gastropods, pelecypods, nautiloid cephalopods, trilobites, bryozoa, calcareous sponge spicules and crinoid ossicles are confined to the upper

part of the member. Corals are represented by branching tabulates, in the stromatoporoidal reefs.

The appearance of a rich benthonic fauna in the form of various brachiopods, large numbers of ostracod species, gastropodsand pelecypods, and crinoid remains suggests approach to normal marine conditions, and the abundance of stromatoporoids suggests carbonate bank or reef environment. Brachiopods of Waterways-Fawn Lake-Carcajou Rock affinity in the highest beds verge on an open-marine, shallow water, well-aerated facies.

Fawn Lake Knob Area

SPINATRYPA HORNENSIS ZONE

Our knowledge of the faunas of the Horn Plateau Formation is based upon the figures and descriptions by McLaren and Norris, published (1965) as Memoir 322, Geological Survey of Canada, augmented by collections made by us during a brief visit in July, 1970.

The faunas from Fawn Lake Knob, the type locality and unique occurrence of the Horn Plateau Formation, are enigmatical, because whatever one may condlude as to their correlative relationships, the bulk of the fauna is unknown away from the type locality.

TABLE VI

FAWN LAKE KNOB.

Faunal Range Chart - FL

SLAVE POINT DATUM PROJECT — RAASCH & ASSO., LTD.

USGN BIOTA	McLaren & Norris Bull. 114, 1964	Raasch & Asso. Collection 1970	OCCURRENCE ELSEWHERE
UPPER MASSIVE UNIT ?			
C Favosites sp.	X		
C Siphonophrentis? sp.	X		
C Disphyllum salicis McLaren	X		
C Cylindrophyllum gruensis McLaren	X		
C Gypophyllum cornus McLaren	X		
C Neostringophyllum craigi McLaren	X		
C Heliophyllum borealis McLaren	X		
C Cyathophyllum (Parapaedium) gaetheri McLaren	X		
C Sinospongophyllum cf. planotabulatum Yoh	X		
C Sociophyllum redactum McLaren	X		
C Lekanophyllum cf. punctatum Weedkind	X		
C Cystiphylloides spinosum McLaren	X		
C Atelophyllum nebraeis McLaren	X		
UPPER MASSIVE UNIT, UPPER PART			
C Australophyllum cf. thomasi (Hill & Jones)	X	1	
B Atrypa nasuta Norris	A	A	
B Athyris aquilonius Norris		1	
B Schizophoria fasciscostella Norris		1	
G Euomphalus sp. "Fawn Lake"		C	
O Ostracod PC 3-3 (no 165)		1	C. panda Z: PC, CRW, PCW. Slave Point
UPPER MASSIVE UNIT, LOWER PART			
B Atrypa nasuta Norris	A		
B Spinatrypa hornensis Norris	R		
B Cymostrophia sp.	R		
B Longispina whittakeri Norris	R		
B Pentamerella sclavus Norris	U		
B Schizophoria fascicostella Norris	U		
T Drchanella (Basidechanella) sp.	R		
LOWER THIN-BEDDED UNIT			
C Alveolites, tabulat		C	PC, PCW, CRW, GHA, Waterways sq. N.C.B.C.
C Cladopora sp. "Fawn Lake"		A	CRW: C. panda Z. em.; U. Slave Point
Bi Suleonetepora sp. "Fawn Lake"		A	
Bi Bryozoan, treptostome		R	
Bi Bryozoan, fenestellid		U	
B Ambocoelia cf. umbonata (Conrad)	C	C	CRW: C. panda Z. U. Slave Pt.
B Athyris aquilonius	R	A	
B Aulacella? (n. sp.) "Key Scarp"		U	C. panda Z: IKS
B Cranaena cryptonelloides Norris	C	C	
B Cassidirostrum? n. sp. (minute)		A	
B Eleutherokomma implana Norris	U		U. Slave Pt.
B Hypothyridina cameroni Warren	U	1	C. panda Z: GHA, CRW. "Presqu'ile" (Wainio)
B Ladjia (n. sp.) "Slave Point" (Emanuella? sp.)	U		U. Slave Point
B Leiorhynchus? matonabbee Norris	U	1	
B Leptagonia? rhomboidalis (Wilckens)	A	2	
B Longispina whittakeri Norris	R		
B Schuchertella sp.	U	?	
B Spinulicosta sp.	U		
B Schizophoria fascicostella Norris	U		
B Spinatrypa hornensis Norris	C	C	
P Buchiola sp. undet.		2	
P Conocardium sp. (C. sp. "Fawn Lake")	R	C	
P Cornellites? sp.		1	
P Grammysia sp. "Fawn Lake"		U	Stringo. alaskamazonai CRW
G Euomphalus sp. "Fawn Lake"		1	
G Straparollus sp. "Fawn Lake"		1	
G Styliolina fissurella Hall		A	
T Crassiproetus? n. sp. (minute)		C	
T Scutellum sp. "Fawn Lake"		1	
O Ostracod PC 3-3 (Ostracod 165)			

B BRACHIOPOD — G GASTROPOD
Bi BRYOZOAN — O OSTRACOD
C CORAL — P PELECYPOD
Ci CRICOCONARID — T TRILOBITE

A Abundant
C Common
U Uncommon
R Rare

SCALE

In the "lower thin-bedded unit" (Fawn Lake Member) the most conspicuous fossil, because it is not only common but is of normal size, is Spinatrypa hornensis Norris. Except for densely packed bands of the bryozoan Sulcoretepora and the tabulates Alveolites (laminar) and Cladopora, the remainder of the fauna is composed of diminutive forms.

Of special significance is a brachiopod which, from Norris' description, is probably our Ladjia sp. "Slave Point" from the upper Slave Point, or L. cf. caligatae from the Cyrtina panda Zone of the Middle Mackenzie Region. Other species held in common by the Atrypa hornensis and Cyrtina panda Zones are Ambocoelia cf. umbonata, Aulacella? sp. "Key Scarp", and Hypothyridina cameroni. The latter is also recorded by Warren as occurring in Stringocephalus Beds on Presqu'ile Point. Although we have not seen the zone fossil, S. hornensis, from other localities, Norris (p. 56) states it "most closly resembles an unnamed coarsely costate Spinatrypa present in the lower part of the Firebag Member of the Waterways Formation of northeastern Alberta. A second species suggesting relationship with the Slave Point south of Great Slave Lake is Eleutherokomma implana, recorded tentatively from the uppermost beds at Mellor Rapids. In any case, Eleutherokomma is unknown in beds older than Slave Point-Waterways.

Shells like those referred to by Norris as Leptagonia? rhomboidalis were found at a depth of 4383' in a core from Steen River 2-22-117-5W6, in which the Upper Slave Point brachiopod Ladjia (n. sp.) "Slave Point" occurs at intervals between 4287' and 4408'.

The remainder of the assemblage, consisting mainly of indigenous species of minute brachiopods, pelecypods, gastropods and trilobites, is shown on the chart, Table VI. Among them is an unnamed species of Grammysia similar to one found in the Stringocephalus aleskanus Zone at Carcajou Rock.

ATRYPA NASUTA ZONE

The Atrypa nasuta Zone assemblage has few species, other than the zone fossil, which is present in overwhelming numbers. We cannot agree with Norris (p. 54) that it has a significant affinity with the brachiopod Warren and Stelck (1956, pl. V) figure as "Atrypa cf. pechiensis Grabau". It is close to a group of Atrypas typified by Atrypa gigantea Webster, which occur in the Middle or Rapid Member of the Cedar Valley Formation. These beds are about equivalent to the middle portion (Calmut) of the Waterways Formation.

Two other fossils in the zone have associations with other areas. One of these is the ostracod Bekena homolibera McGill (our PC3-3), abundant in the Cyrtina panda Zone at several localities in the Middle Mackenzie Region. This occurrence corresponds with that of the upper part of Braun's (1966) Zone e-4 but he also shows it to occur in his zone f, corresponding to the Upper Slave Point.

The second fossil is that to which Norris refers as "Cymostrophia sp.", which has a very distinctive ornamentation that we have seen on similar brachiopods from California Standard Steen River #2-22, 2-22-17-5W6 at 4383' in core which is a part of Law's (1955) supplementary type section of the Slave Point Formation.

Waterways Faunas

In what we have referred to above as the "target interval" between carbonates of the Stringocephalus facies below and Canol equivalent above, belong the Waterways as well as the Slave Point assemblages. It has been generally assumed (an assumption in which we have concurred) that the oldest Waterways strata, the Firebag Member or Lingula cf. spatulata Zone of Warren and Stelck was younger than the youngest Slave Point beds. In our investigations of the last five years, we have witnessed increased numbers of Waterways species turning up in beds of Slave Point "age" as well as in beds in the target interval of the Central Mackenzie Region which others (probably rightly) have correlated with the Slave Point.

At this stage in the project we have no firm convictions in this matter, but the hope that more light may be thrown upon it as we go on to study the cores. In any event, although it is peripheral to our stated objective, it deserves to be made the subject of a further investigation, one that must center in the surface and

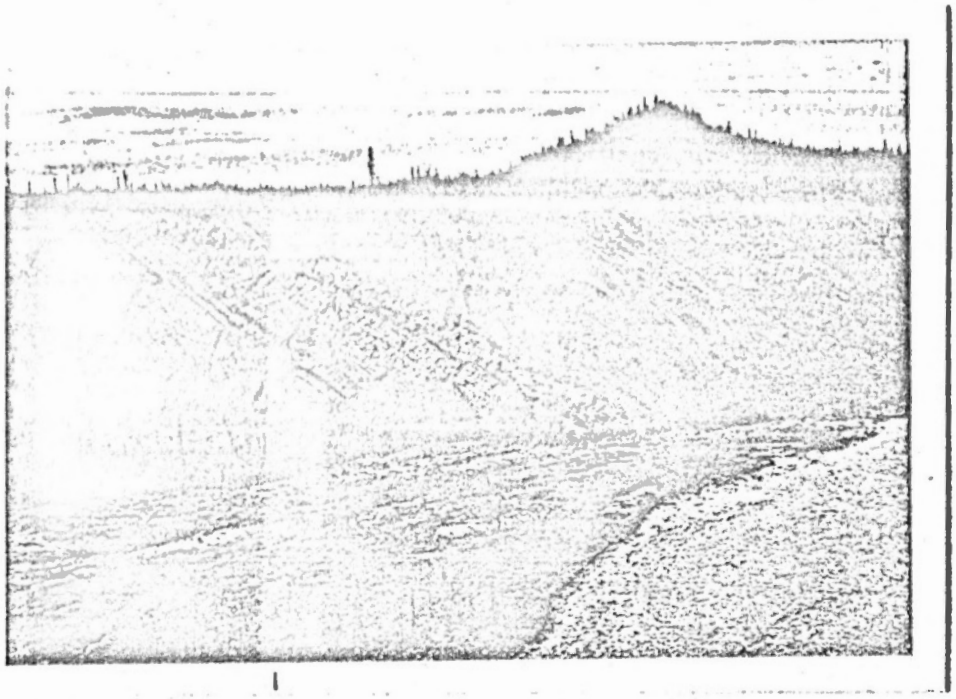


Figure 2. Powell Creek section, general view Beavertail-Canol contact near centre; Fort Good Hope base is near top, left.

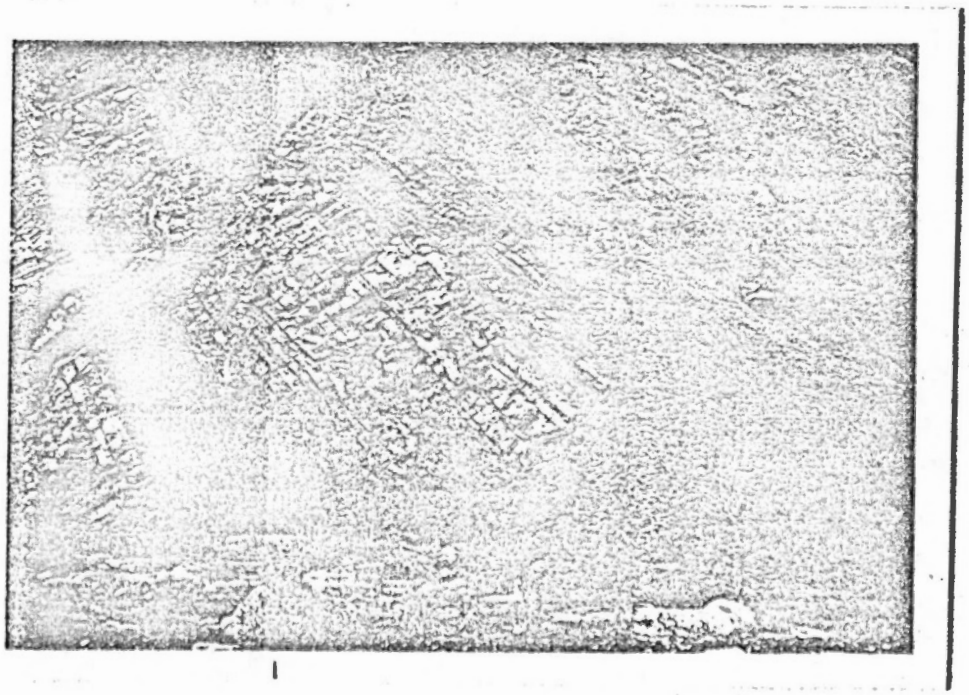


Figure 3. Powell Creek section, Beavertail-Canol Unconformity

subsurface of northern Alberta.

NOTES ON MACKENZIE VALLEY SECTIONS

Our interpretation of the Mackenzie Valley sections visited is presented graphically as Table VII. The following brief comments are aimed at supplementing the chart.

POWELL CREEK

In the section at Powell Creek, the lower 150 feet of exposure consists of Hare Indian strata similar to those at the type locality, in the base of the bluff at the lower end of The Ramparts. As at that locality, the proportion of limestone to shale increases upwards as does the benthonic fauna. Contact with the Stringocephalus-bearing Fort Good Hope limestone is sharp but conformable, with no features suggestive of an unconformity or hiatus.

The Fort Good Hope limestone, distinguished by massive bedding, buff weathering, and thick-shelled fossil fragments (Stringocephalus) is here reduced to an 11-foot feather edge.

Three inches of dark plastic clay, full of organic lime sand with Stringocephalus fragments as pebbles, overlie the Fort Good Hope

Formation. This clastic zone carries a rich ostracod assemblage corresponding to Braun's upper e-4 zone (his lower e-4 zone we regard as an entirely separate zone). It lies in a position analogous to the Watt Mountain unconformity.

The upper e-4 ostracods continue in the overlying 23-foot unit (PC-4), of Beavertail Facies. It carries a Cyrtina panda Zone macrofauna.

Between the PC4 beds and the Canol Shale, there intervene 55 feet of dark limestone and shale with lenses of black chert. Macrofossils collected 32 to 35 feet above the base show a Cyrtina panda Zone affinity.

35 to 37.5 feet above the base is a black brown, hard, fissile shale recalling the shale which lies beneath the L. hippocastanea Beds at Carcajou Rock and the Ramparts. Here, as at Carcajou Rock, the beds immediately beneath the shale carry the brachiopod, Warrenella occidentalis.

Braun (1956, Fig. 2) reports a Zone f ostracod fauna from about the horizon of the shale. The occurrence of this micro-fauna in or just above the shale, clearly demonstrates that his Zone f,

essentially an Upper Slave Point assemblage, post-dates the upper Zone E-4 assemblage which marks the Cyrtina panda Zone.

From the upper part of the 17.5 feet of dark cherty limestones and shales which lie between the shale bed below and the Canol Shale above, we obtained Leiorhynchus hippocastanea and other Ponticeras Zone fossils. Goniatites, presumably Ponticeras but not showing sutures, were found on the slope of the 17.5 interval. They may have come from the same bed as L. hippocastanea, but the lithology of the matrix suggests they came from slightly lower in the interval.

Finally, the Beavertail strata are overlain with visible unconformity by the Canol Shale (see photograph, fig. 3).

In summary, at Powell Creek we have in ascending order, 1) a lithostratigraphic boundary between Hare Indian and Fort Good Hope; 2) a tectostratigraphic boundary between Fort Good Hope and Beavertail; 3) a biostratigraphic boundary within the Beavertail, between the Cyrtina panda and Ponticeras zones; and 4) a tectostratigraphic boundary between Beavertail and Canol.

POWELL CREEK WEST*

(*This section, located at lat. 65° 17.5' N., long. 128° 52'W., is not the same as that referred to by Braun (1966, p. 261) as

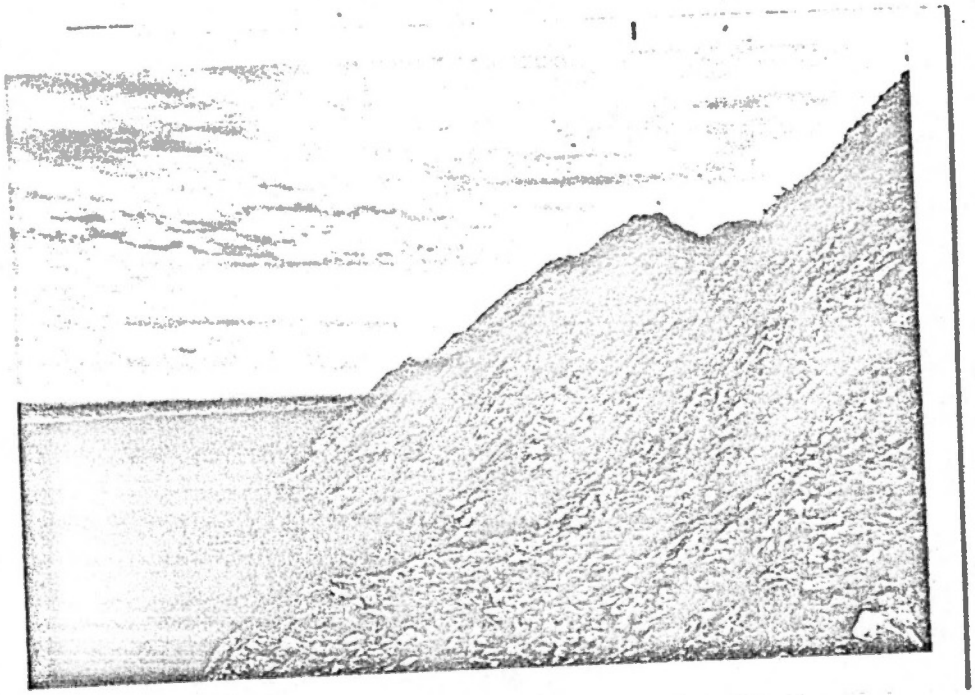


Fig. 4.
Powell Creek West
Kee Scarp reef in middle distnace

"West Powell Creek", which lies at 65° 18'N; 128° 48'W, close to our Powell Creek section).

The lower part of the Powell Creek West section resembles that at Powell Creek in so far as the Hare Indian Formation and its relation to the Fort Good Hope Formation are concerned. The contract is well exposed and, as at Powell Creek, is sharp but conformable.

With respect to the Fort Good Hope, we assign 32 feet to the formation here (in contrast to 11 feet at Powell Creek), on the basis of thick-bedded to massive character, prominence of outcrop, buff-weathering, and the presence of thick shells (Stringocephalus) as a major lithologic component in the lower portion.

This having been the first locality visited, the importance of the clay-cum-biocalcarenite that overlies the Fort Good Hope elsewhere was not appreciated and it was not sought.

64 feet of recessive dark limestones and shales above the Good Hope Formation carry the Cyrtina panda Zone fauna, in a Beavertail lithofacies. The major collection of both macro-and microfauna were obtained from a 10-inch dark limestone band 17 feet above the base. Nothing in situ or float was found to suggest the presence of the Ponticeras Zone. The ostracod fauna of 17 species is close to that of the basal Beavertail clastic zone at Powell Creek and

Above the 179-foot carbonate-bank development at the Powell Creek West locality lies 256 feet of thick-bedded to massive "reefal" carbonate, with a 17 foot conglomerate at the base. The conglomerate forms a single unit with graded bedding, and seems clearly to be of tectostratigraphic significance.

If our tentative, and most conservative, interpretation is accepted, the conglomerate corresponds to the sub-Canol unconformity, and the reef is equivalent to that formation and to a part of the overlying Imperial Formation.

If we interpret in terms of the ostracod evidence from West Powell Creek, the reef is Ponticeras in age. This greatly increases the stratigraphic discordance. We have here a picture of reef standing more than 400 feet above the surrounding sea bottom, which was the site of deposition of the Beavertail facies. If this was the case, the "soft-rock deformation" in the Ponticeras beds at Powell Creek is readily explicable.

CARCAJOU ROCK

At Carcajou Rock, the measured section begins with 64 feet of Fort Good Hope strata bearing the Stringocephalus Aleskanus Zone.

Figure 5. Carcajou Rock
Downwarp in Fort Good Hope beds, with
overlying basal clastic band (near top center)

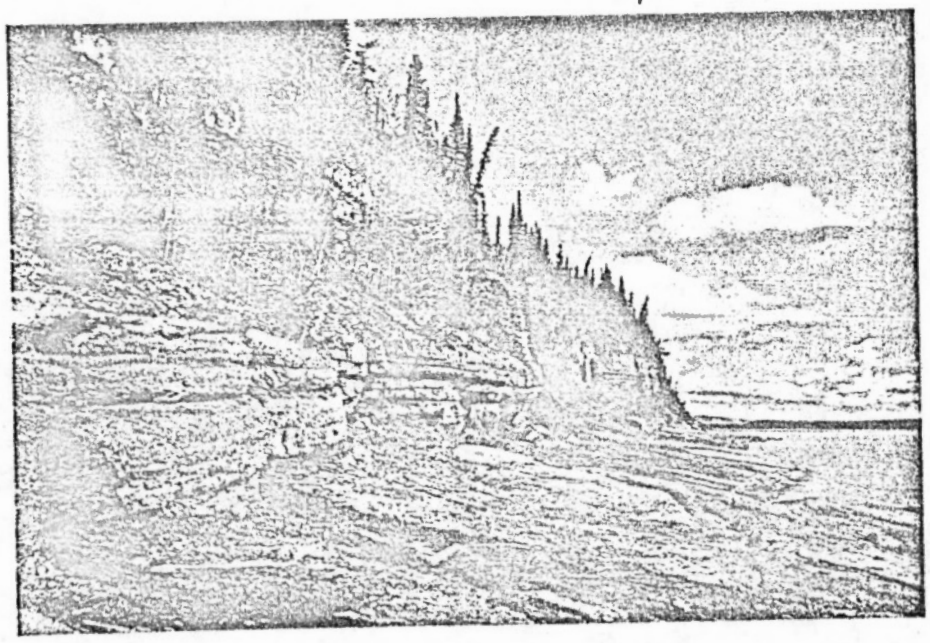


Figure 6. Carcajou Rock
Type section of Carcajou Rock type section

As at Powell Creek, this is overlain by a band of dark clay-cum-bioclastic lime sand with a rich ostracod fauna comparable to that at Powell Creek. From this zone, here two feet thick, 20 species of ostracods belonging to Braun's upper e-4 fauna have been recovered. In the underlying Stringocephalus aleskanus Zone, we distinguish 8 ostracod species, belonging to Braun's lower e-4 assemblage. Between the two assemblages, totalling 28 species, only 2 are held in common.

Above the "basal clastic band", 64 feet of strata belonging to the Cyrtina panda zone, in shallow, well-aerated, open marine facies, constitute the type occurrence of the proposed Carcajou Rock Formation. Five of the ostracods recorded from the basal clastic zone range through the bulk of the formation. In addition to the ostracods, 19 definitive fossil species are recorded. Most of these are brachiopods and other organisms which occur not only through most of the zone but in time-equivalent beds at other localities (see chart, Table I). Only one, a species of the trilobite Scutellum (pygidium only) occurs also in the underlying Stringocephalus aleskanus Zone. Only 3 continue into the lower part of the succeeding Ponticeras Zone, and all of these are known to be long-ranging forms.

At Carcajou Rock, as at Powell Creek, the uppermost beds of the Cyrtina panda Zone bear the brachiopod Warrenella occidentalis

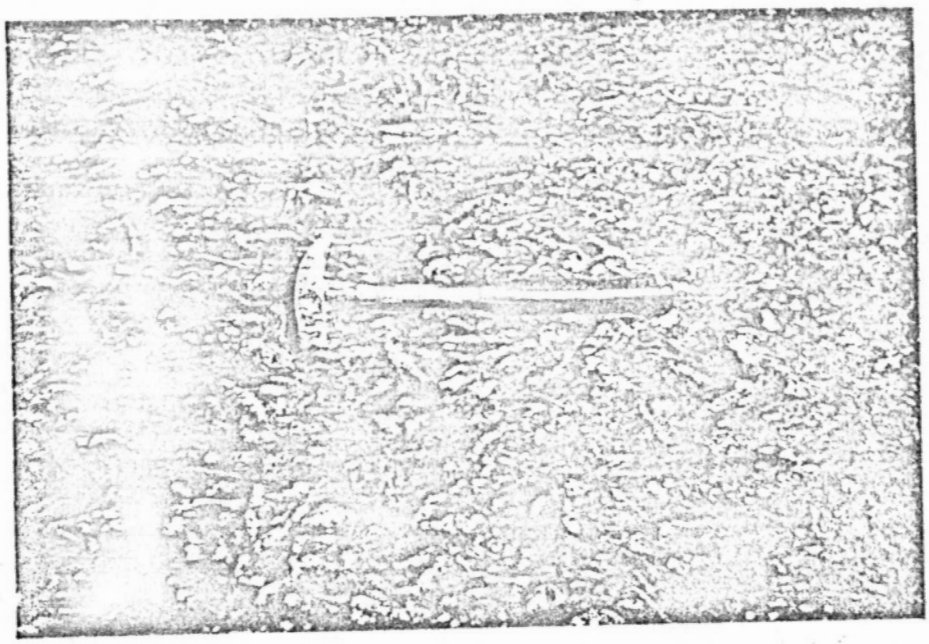


Figure 7. Carcajou Rock
"Cladopora Beds", which form biostromal buildups in lower part of Carcajou Rock Formation.

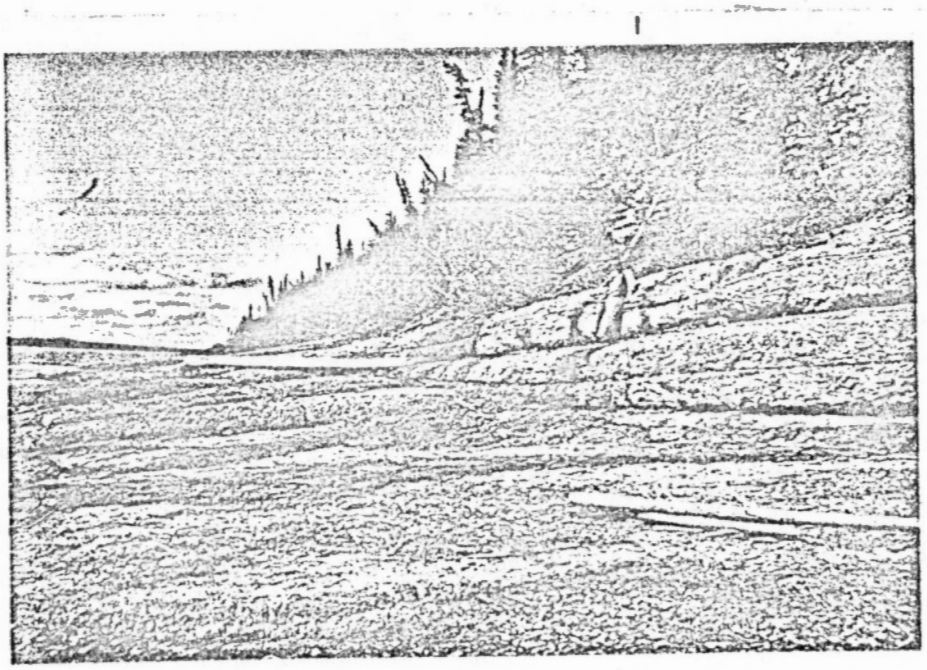


Figure 8. Carcajou Rock
Carcajou Rock Formation in beach; Beavertail Formation in brushy cliff.

(Merriam) (Tinzella timetea & Reticulariopsis timetea of Crickmay). If this bed is, in fact, restricted to the top of the C. panda Zone succession, its absence at some localities might indicate that the upper beds of the zone suffered pre-Ponticeras Zone erosional truncation.

A strong shale parting, lithologically like shales above that are interbedded with sparry-textured limestones of the Leiorhynchus hippocastanea Beds, separates the Cyrtina panda and Ponticeras zones. In this basal shale there are present goniatites indistinguishable from Ponticeras, but, because of compression, not showing diagnostic sutures. The overlying "hippocastanea" beds are concordant, but not necessarily conformable, with the beds of the underlying C. panda Zone.

About 60 feet of strata above the hippocastanea beds are dominantly calcareous and bituminous shale with interbedded dark limestone, bearing a Ponticeras fauna. These beds are in the Beavertail lithofacies and quite unlike the Canol Shale. The section apparently terminates short of the Canol horizon, but a more intensive search might reveal its presence and its relative stratigraphic position.

In summary we have, in ascending order, a tectostratigraphic boundary between Fort Good Hope and Carcajou Rock formations, and a litho- and biostratigraphic boundary between the Carcajou Rock (Cyrtina panda Zone) and Beavertail (Ponticeras Zone) units.

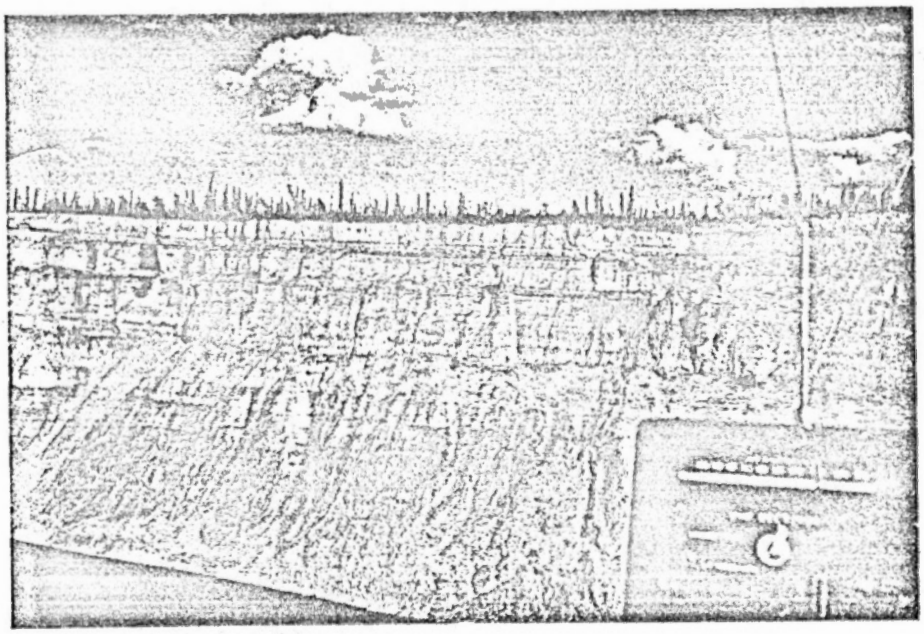


Figure 9. The Ramparts, downstream Bluff
Type locality of the Fort Good Hope Formation;
base just above control panel at right;
top below highest shale zone, top-right.

THE RAMPARTS

As at Powell Creek and Powell Creek West, the Hare Indian Formation at the Ramparts becomes increasingly calcareous and fossiliferous upward, and the contact with the Fort Good Hope Formation is sharp but conformable.

The Fort Good Hope Formation has increased, diachronically at the expense of the Hare Indian, to a total thickness of 130 feet. With this increase the formation here embraces two faunal zones of the Stringocephalus sequence, a lower 56-foot zone with Stringgocephalus asteius, Rensselandia laevis, and Geranocephalus inopinus, and an upper 70-foot zone with Stringocephalus aleskanus.

A shale band similar to those at Powell Creek and Carcajou Rock separates the Fort Good Hope Formation (Stringocephalus aleskanus) Zone) from the overlying Carcajou Rock Formation (Cyrtina panda Zone).

The fauna of the Cyrtina panda beds is composed largely of brachiopods and other fossils known to also occur either at Carcajou Rock, at Powell Creek (PC and PCW), or at both.

The Cyrtina panda Zone is here much thinner (23 feet) than at the other three localities (64 feet in each case) and the Warrenella

bed is not present at the top of the sequence. Whether this implies post-C. panda Zone erosion, existing evidence is inadequate to determine.

A substantial parting of brown bituminous shale separates the L. hippocastanea Beds of the Ponticeras Zone from the underlying Cyrtina panda Zone strata. The hippocastanea beds form the top of the bluff. Under the circumstances it is difficult to understand where Crickmay (1970, p. 71) found his "foot or so of limestone conglomerate" plus "20 ft. or more of Amphipora-platform beds and porous reefal limestones...", unless reference is made to a conglomeroid bed full of cobble-sized masses of Alveolites suborbicularis Lamarck (his Alveolites vallorum Meek; see top of his page 22). This Alveolites bed lies some distance below the beds with Leiorhynchus hippocastanea.

In summary, the Hare Indian-Fort Good Hope boundary is lithostratigraphic; the Fort Good Hope-Carcajou Rock boundary is tectostratigraphic, and the Cyrtina panda Zone-Ponticeras Zone boundary is biostratigraphic.

KEE SCARP QUARRY

As indicated in another section above, about 110 feet of light

Kee Scarp Quarry, northwest end. Nonconformity between Kee Scarp limestone and Canol Shale. Red color of Canol scree may be due to forest fires.

brown, porous, massive-bedded limestone, strongly stromatoporoidal in the upper and lower portions are currently exposed in the Kee Scarp Quarry, northeast of the Norman Wells airport. The middle portion is relatively stromatoporoid-free and from it we collected the following; BRACHIOPODS: Aulacella? sp. "Kee Scarp", Ladjia cf. caligatae, Atrypa sp. (similar to that figured by Warren and Stelck, 1956, pl. XV). GASTROPOD: Euomphalus sp.

Among the fossils illustrated by Warren and Stelck on plate XV, we recognize their "Productella belanskii" as P. gulosi, "Coenites sp." as our Thamnopora PC5, their "Thamnopora sp." as our "Coenites PC5"; "Ambothyris? sp." our Ladjia cf. caligatae, while their Cyrtina triquetra and Schizophoria sp. are acceptable as they stand.

All of these support a Cyrtina panda Zone correlation, although a few are longer ranging.

Pedder (1963) rejects Warren and Stelck's identification of "Indospirifer sp." (the specimen is too incomplete for identification but certainly is not that Middle to Late Frasnian genus), and we do not accept their identification of "Atrypa cf. owenanus", a latest Frasnian species from Iowa.

A very important fossil initially described from the Kee Scarp

locality is Alaiophyllum mackenziense Pedder 1963, which has also been reported from numerous subsurface occurrences in Slave Point and Lower Swan Hills beds (see Crickmay, 1968; Pedder, 1963) of northern Alberta and the Great Slave Lake region.

Other fauna recorded from the locality, principally stromatoporoids and tabulate corals, have not been sufficiently studied at other localities to be of diagnostic value.

In conclusion, the beds at Kee Scarp are in a reef facies correlative with the Cyrtina panda zone. The limestone is overlain, with an angular unconformity of more than 10 degrees, by typical Canol Shale.

SUMMARY OF INTERPRETATIONS

In the Central Mackenzie Region the interval between the Fort Good Hope Formation ("Lower Ramparts") below and the Canol Shale above, referred to as the "target interval", is occupied by deposits which comprise two faunal zones, the Cyrtina panda Zone below and the Ponticeras Zone above. Either of these zones may occur in a variety of lithofacies: 1) reef or carbonate bank facies, (Kee Scarp Formation), 2) shallow-water, open-marine, well-aerated

LATE MIDDLE – EARLY UPPER DEVONIAN CORRELATIONS

NORMAN WELLS AREA

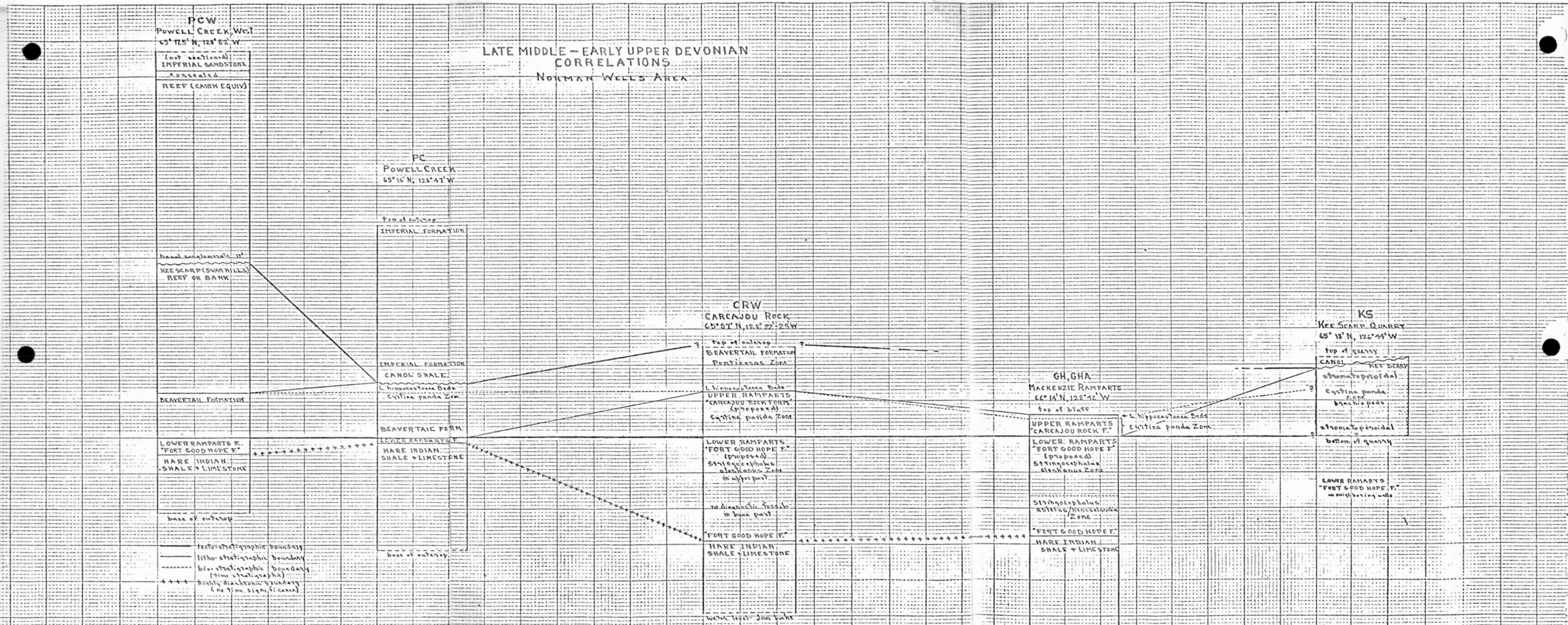


TABLE VII

SLAVE POINT DATUM PROJECT
RAASCH & ASSOCIATES, LTD. 1970

facies with a rich benthonic fauna (Carcajou Rock Formation), and 3) deeper water, less well aerated, open-marine deposits (Beavertail Formation). The lithostratigraphic boundaries between these environmental facies are diachronic and operate independently of time lines.

In the Great Slave-Wood Buffalo Region, the Slave Point Formation breaks down faunally into an older Ladjia landesi Zone and a younger Ladjia (n. sp.) "Slave Point" Zone. The lower zone corresponds to Campbell's (1957) "lower member" of the Slave Point Formation, which we have designated as the Wood Buffalo Member. His middle and upper members we combine as the Mellor Rapids Member.

Beneath the Wood Buffalo Member, the Fort Vermilion Anhydrite represents an evaporitic facies, followed by the Wood Buffalo Member representing a restricted-marine facies, and terminating with the Mellor Rapids Member, a carbonate bank or reefoid facies.

Above the Mellor Rapids Member, shallow-water, open-marine, well-aerated strata with a rich benthonic fauna are equivalent to at least the later part of the Waterways Formation and to the post-Swan Hills portion of the Beaverhill Lake Formation. Whether Beaverhill Lake/Waterways vs. Slave Point relations are entriely

successive, or whether these formations are in part contemporaneous equivalents is a question which has come to mind in the course of our investigation. Since the subsurface portion of this investigation remains to be carried out, it is expedient to leave the question open at this time.

The similarity of the ostracod faunas from the upper part of the Mellor Rapids Member of the Slave Point Formation and from the Ponticeras Zone on Powell Creek suggests equivalency of the Ladjia sp. "Slave Point" Zone and the Ponticeras Zone. As a logical corollary, the subjacent Ladjia landesi and Cyrtina panda zones should also be equivalent. In the latter case, the facies are so different that direct faunal comparisons cannot be made, except, hopefully, via the intervening subsurface.

The problem of the Horn Plateau Formation is peripheral to our originally stated frameof reference. Nevertheless, since we visited the type locality during our brief field investigations, and since it is relevant to the problem, we may say in passing that, among those few elements that are not purely local in occurrence, the majority indicate on equivalency of the lower beds (Fawn Lake Member) with the Cyrtina panda Zone (and inferentially the Ladjia landesi Zone of the Lower Slave Point).

The "upper massive member" at Fawn Lake has even fewer elements on which to base an interpretation. However, the Cymostrophia seems to be the same as that we have found with Ladjia sp. "Slave Point" in the Slave Point "type" well, Cal-Standard Steen River 2-22 cores from 4287' to 4408'.

The sole ostracod collected by us, Bekena homolibera McGill, is not known to go higher than the Ponticeras Zone or the Upper Slave Point. The dominant Atrypa is of a type suggestive of Middle Waterways.

Since our investigation is far from complete at this time, any interpretations submitted herewith remain tentative.

APPENDIX 1

NOTES ON SIGNIFICANT UNDESCRIBED SPECIES

Foreword

Thanks to a number of paleontologists, but most notably P. S. Warren and C. H. Crickmay, much of the megafauna with which we have to deal in the course of our investigation has been described. A few, some newly discovered in the course of our field work, are new species and even genera. Examples of these are available for examination by our participants, for whom we hold the collections in trust. However, to further assist the reader in an understanding of our presentation, we include the following notes.

Genus Ladjia Veevers 1959

Ambocoelids having quincuncially-arranged microspinule bases were observed during studies of the Slave Point Formation made in the mid-"sixties", and subsequently observed in well cores taken from the Slave Point Formation and its presumed equivalents. We considered these shells to belong to an undescribed genus close to Ilmenispina. Subsequently (1967), C. H. Crickmay described four species which would appear to fall within this group of brachiopods These are:

Emanuella caligatae

Emanuella sluzari

Emanuella vernilis

Ladjia landesi

Although the first three are referred by Crickmay to Emanuella, in his "Remarks" (top of page 9) he indicates close relationship of E. vernilis to Ladjia on the basis of internal characters. In fact, the four species have similar internal characters, and generic distinction is based wholly on the surface ornament, i. e. microspinules and microfilae, one or both of which may not be apparent in individual specimens, depending on the nature of the preservation. Moreover, certain layers of shell tend to show the one, others the other, and the whole population must be examined carefully with this in mind.

In the light of the foregoing, we suspect that Crickmay's Emanuella vernilis and Ladjia landesi are the same species. What appears to be his E. caligatae, we have found to be common in the Cyrtina panda Zone. We have been unable to recognize in surface collections his fourth species, E. sluzari, which he records from a well core ("Imperial et al Faust No. 6-2, at 6823') which he places in his "jasperensis zone", i. e. Moberly Member equivalent.

On the other hand, we discriminate a number of new species.

Ladjia (n. sp.) "Slave Point" is wide spread in the upper member of that formation. It is a small species, the external surface of which is smooth except for incised lines separated by much wider interspaces and marked by a row of tear-shaped microspinule bases, the bases having a quincuncial arrangement relative to those of adjoining rows. Ventral sinus present but not strongly developed. Ventral beak moderately incurved above apsacline cardinal area.

In Ladjia (n. sp.) "Mackenzie" the small shell is externally smooth, except for two sizes of microspinule bases, in a combined radial and quincuncial arrangement. Microfilae are internal, and show also on internal impressions at the anterior margin. The shell is much shorter and wider than other species, ventral beak is strongly recurved, and ventral sinus is essentially lacking. It occurs in the Cyrtina panda Zone of the Middle Mackenzie Region and in the Peace River area of British Columbia.

Two species were discovered at a much lower horizon, the Rensselandia laevis/Stringocephalus asteius Beds, in the Ramparts section above Fort Good Hope.

One of these, Ladjia n. sp. "Lower Ramparts", is an obese, rotund species with two sizes of microspinule bases radially arranged on the older part of the shell, whereas only the smaller size is

present on the younger portion. The cardinal area is high and subtriangular; ventral beak recurved; dorsal area well-developed. Radial microfilae are distantly spaced on the interior of the shell and do not appear on either surface. Concentric growth lines are relatively conspicuous.

The shell is closest to L. (n. sp.) "Mackenzie", but is much narrower and much more inflated, and the microspinule bases are much finer and denser.

The second Stringocephalus Zone species Ladjia (n. sp.) "Good Hope" is unlike all others in its Cyrtinoid shape; the radiating filae are relatively coarse with spear-shaped spine bases between the plications. Both valves are faintly sinuate.

Ambocoelid Genus CRW 10

Ventral valve subtriangular, highly convex, beak strongly incurved over high cardinal area; internally a long, low but thick median septum is prominent, and shows through the surface of some shells.

Dorsal valve has very low convexity, a long median septum, and a strongly developed septalium, as in Ilmenispina. Surface marked

by extremely fine concentric filae which show rows of microspinules.

The shell occurs at two localities in the Leiorhynchus hippocastanea Zone.

Ilmenia (n. sp.) "Powell Creek"

Our specimens, which superficially resemble Schizophoria (see Braun, 1966, p. 261, 1st para. under "Unnamed Beds") form a coquina near the top of the Beavertail sequence on Powell Creek, where they are associated with Leiorhynchus hippocastanea. They satisfy the generic characters of the Old World genus Ilmenia (Nalivkin, 1946) in having "micro-ornament consisting of both capillae and concentric growth lamellae; pedicle valve interior with distinct dental plates;"

Atrypa sp. "Slave Point"

This small species is readily distinguished by its external ornament, consisting of slender, rounded plications separated by furrows of almost equal width and crossed at right angles by very fine, closely spaced, raised concentric microfilae, more prominent in the interspaces. As in A. gregeri Rowley or A. clarkei Warren (a synonym for A. gregeri), major lamellae or frills are lacking. In addition to the surface ornamentation and small size, the slender, lenticular profile, about equally biconvex, with moderately prominent erect beak, is diagnostic.

Adacella? sp. "Key Scarp"

A very small species of this orthid genus with radial hollow plications. Well preserved examples show about every fifth plication to be stronger than average. Cardinal area, on ventral valves only, is broad, moderately high, with a projecting beak and narrow, open delthyrium.

Paracyclas GHA

Is a small, subcircular, rather narrowly lenticular species about 3 cm. in diameter. It is slightly wider than long.

Paracyclas CRW

Is the same size as the preceding, but is transversely ellipsoidal, a typical specimen measuring 27mm. in width and 19mm. in length.

Coenites PC5

For description see Paleo Report Card for PC 5/70 (113'-175') cat. no. R7.

Thamnopora PC5

Diameter of branches 3-4 mm., corallites about 0.8mm. diam., opening more or less at right angles to the surface; walls 0.5-0.8 in axial area, 0.2-0.3 at periphery. Similar to Warren and Stelck's (1956, pl. XV) "Coenites sp." but slightly smaller.

Devonoproductus species by Crickmay, 1963

We find it impossible to distinguish between three of Crickmay's species of Devonoproductus, D. minimus from the east side of Sulphur Point, D. secundus from Mt. Wallbridge, in the Atrypa greneri Zone of the Flume (Moberly equivalent), and D. tertius from the Calmut equivalent in Imperial Morse River #14-31-63-8W5. If these are taken as a single species, its range is from basal Slave Point through Waterways.

NOTE ON OSTRACOD FAUNAS

In 1966, P. McGill (Bull, of Canadian Petroleum Geology, Vol. 14, no. 1) described a number of ostracod species from the Upper Slave Point from two bore hole localities in northern Alberta. Comparison of these with the Amoco collection from the area between Lat. 60o and Great Slave Lake reveals the following equivalencies.

Raasch & Assoc. Ltd.	P. McGill
Bythocypris 181 R4, R30	Bairdiacypris cf. irregularis
Ostracod 30n (740) R30	cf. Geisina memeleyiana McG
Ostracod 30n (part) R30	cf. Ellesclavus fluitatus McG
Ostracod 30o R70, R4	Kloedenellita paxfluvii McG
Ostracod 30j R30	Microcheilinella boweni McG
Ostracod 30p R30	Margasaccus devini McG
Ostracod 30w R30	Velapezoides shaveri McG
Paraparchites 814 (part) R4	Rodzhdestvenskayites diaturna McG

Raasch and Associates
(Geological Consultants) Ltd.
CALGARY, ALBERTA

48 - 17 AVENUE S.W. TELEPHONE 245-4277

FIELD NOTES, SLAVE POINT PROJECT, 1970

Raasch & Spitzer, July 19, 1970

Locality PC/70
Cliff on west side of Powell Creek, 3 miles S. SW of junction with Mountain River, 65° 16'N; 128° 47'W, District of Mackenzie.

PC 1 85' (base to 85')
Shale, calcareous, and marlstone, dark grey; in bands 4"-6" thick; also marlstone zones of thick blunt lenses in upper 30'. Base not exposed.

PC 2 65' (to 150')
Limestone, medium grey, fine grained, light grey-weathering, thin-bedded 4"-8") with 1"-4" shale bands separating beds. Few brachiopods: Atrypa, Schuchertella.

PC 3 17' (to 167')
Limestone and shale, grey, grey-weathering, subdividing as follows:

a. basal massive limestone with sections of large, flattish Stringocephalus, Alveolites, Thamnopora, horn corals. 5'

b. shale and marlstone, resembling PC 1. 1.7'

c. limestone, massive, buff-weathering, full of macaroni Amphipora, Alveolites, Thamnopora, Cladopora (finger-sized) ?4'

d. shale, receding, full of bioclastic lime-sand, nearly unconsolidated. Fragments of large, flattish Stringocephalids. 0.3'

e. massive limestone, full of spaghetti Amphipora, branching tabulates, horn corals, as in 3c. Abundant Emanuella sublineata; rare large fish plates (Dinichthys). 6'

PC 4 23' (to 190')
Marly limestone dark, fine-grained, thin-bedded (4"-8") grey weathering; and thinner bands of shale, dark, hard, fissile. Spaghetti-Amphipora concentrated in a 3-foot massive bed 5' above base that resembles PC 3. Fossil collection at 185'.

PC 5 35' (to 225')
Succession similar to the underlying, but shale reduced to near partings; and rock is partially buff-weathering; finely bioclastic in part. Chert, black, blue-black weathering, occurs at intervals as long, thin lenses. Fossils common in top 3': tabular stroms., branching tabulates, brachiopods. Here rock is somewhat conglomeratic with small subrounded limestone pebbles.

PC 6 2.5' (227.5')
Shale, black brown, hard, highly fissile, rusty-weathering; Canol-type.

PC 7 17.5 (to 245')
Marly and cherty limestone, cryptocrystalline, medium to dark grey, laminated at some horizons. Much evidence of minor crumpling ("Soft-rock deformation"). Upper contact with Canol Shale sharp with an unconformable relief of several feet and slight angular divergence. Goniatites in scree from below top. Abundant fossils 3-6' below top include brachiopods Ladjia and Leiorhynchus castanea, in a matrix of Styliolina coquina.

PC 8 est. 30' (to 275')
Shale grey-black, very fissile, hard, rusty-weathering, Canol-type, grading upward into succession of calcareous shales and siltstones of Imperial-type.
4.5' above base of Canol is a 6" solid, rusty-weathering band of encrinite with pale ossicles in a black aphanitic groundmass.
Basal few centrimeters of PC 8 has interlaminated silt, following the distinctly unconformable contact.

Note: lower part of Imperial succession includes huge oblate concretions.

Locality PCW/70
Gorge of small creek, 3 miles W. NW. of Powell Creek. 65° 17.5'N; 128° 52'W, District of Mackenzie.

PCW1 39' (base of exposure to 39')
Limestone, very dark, microcrystalline, in beds 3" to 24" thick, or in thick, stubby lenses; separated by bands of grey black shale. Scattered very large Atrypa.

PCW 2 30' (to 69')
Limestone, dark, finely crystalline with bioclastic fraction; thick-bedded with minor bands and lenses of grey black shale. Good brach. fauna includes large Atrypa, Spinatrypa, and Gypidula "comis"; corals Alveolites and Thamnopora also common.

PCW 3 12' (to 81')
Resembles PCW 1 but limestone is marly, in bands 4" to 8" thick, separated by bands of equal thickness, of brown-black oily shale. Cobble-sized massive stroms. fairly common. Brachiopods include Emanuella and Atrypa. Recessive.

PCW 4 32' (to 113')
Limestone, light to dark grey-brown, sucrosic and vuggy to darker, compact aphanitic, mainly thick-bedded, buffy weathering. Lower portion a Stringocephalus coquina.

PCW 5 62' (to 175')
Limestone, marly, brown-black, aphanitic, compact, medium-bedded in regular beds grading to hard calcareous interbeds. Recessive. Some layers full of finger-thick Cladopora, others with slender Cladopora; fish scales and crinoid ossicles in shaly interbands. A band of brachs. at 130' include Leiorhynchus and a very coarsely plicated Spinatrypa. Laminar stroms. and Amphipora spaghetti-stone observed in scree.

PCW 6 162' (to 337')
Limestone, light brown, finely crystalline, irregularly sucrosic, buff-weathering; very massive and grading upward to more compact, medium brown-grey limestone. Bedding planes 15-18' below top have Amphipora, small massive stroms., and crinoid remains (including branching arms).

PCW 7 17' (to 354')
Conglomerate; matrix medium grey, sucrosic limestone, with subrounded pebbles and cobbles, some of which are strom. fragments and some fragments of rock like top of underlying. A single bed having the appearance of a turbidite, with pebbles diminishing in size and abundance upward to absence in the upper part.

PCW 8 256' (to 610')
Limestone, dark grey-brown, cryptocrystalline, compact, very thick-bedded to massive. Zones of Amphipora spaghetti-stone common throughout; packed bands of Cladopora within 100' of top.

Concealed interval 17' (to 627')

PCW 9
Thin-bedded sandstone, siltstone and shale, typical Imperial lithology with no Canol-type shale in evidence. Not measured.

Raasch & Spitzer, July 20, 1970

Locality KS/70
Quarry in Kee Scarp, east of Norman Wells airport, 65° 18'N; 126° 44'W, District of Mackenzie.

About 110' of rock is exposed in the quarry, and shows dips of 5°-10° away from hill with a slight easterly (longitudinal) component.

Rock is fairly uniform throughout, consisting of limestone, light brown-grey, mixed fine crystalline (sparry) and micro-crystalline (earthy), and extremely porous; in thick beds with well defined bedding planes. Upper 10' more thinly bedded, possibly dull to weathering effects.

Many large have abundant spaghetti or macaroni Amphipora; in other massive stroms. (up to 2' diameter) are dominant; but no biohermal features were observed.

Non-stromatoporoidal limestone 40' to 50' above the quarry floor yielded sparse Emanuella and a single poor Atrypa. Associated are flat carbonaceous markings several inches wide and up to several feet thick resembling modern Kelp. Also very rare gastropods, medium-sized, of several types.

In the western end of the quarry, typical platy, hard, rusty-weathering Canol Shale overlies the limestone with an unconformity of 20 feet of relief, the plane of unconformity dipping away from the quarry face). Embedded at haphazard angles in the shale are several large masses of yellow-buff sandstone, completely un-waterworn.

In the northwest corner of the quarry, the shale descends deep into the limestone into a solution-enlarged joint, which appears to be post-Canol in age. The solution-etched walls of this joint show crinoid ossicles not evident in the fresh rock.

The deep red color of some of the shale may be the result of recent forest fires.

Raasch & Spitzer, July 21, 1970

Locality CRW/70
Outcrop in Mackenzie River bluff and beach, 2 to 4 miles west of west end of Carcajou Ridge; 65° 37'N; 128° 22' to 25'W, District of Mackenzie.

This line of outcrops forms the end of a west-plunging anticline of sharp homocline, so that beds high in the cliff to the east descend to the river beach westward. The section was arbitrarily begun in the upper part of the Stringocephalus Beds.

CRW 1 18' (base of exposure to 18')
Limestone, grey, mixed micritic and finely crystalline, buff-weathering, resistent, very massive but breaking on weathering to medium-thick layers. Stringocephalus, large massive stroms., remarkably complete branches of a thick Thamnopora, massive Alveolites, horn corals, etc.

CRW 2 Covered interval 37' (to 55')

CRW 3 13' (to 68')
Limestone, dark grey, mixed finely crystalline and bioclastic, very massive, buff-weathering. A few horn corals, fragments of Atrypa; and a zone of branching tabulate corals 3'-4' below the top. A 3-inch zone of fissile black shale lies 11.5' below top.

CRW 4 2' (to 70')
Shale, black, subfissile, bituminous and calcareous, with scattered small-diameter Cladopora.

CRW 5 15' (to 85')
Limestone, light grey-brown, sub-lithographic; greyish weathering, thin-bedded, in layers 6" to 30" thick, separated by partings of brown-black fissile shale. Few fossils include brachiopods Nervostrophia, Atrypa, Schizophoria.

Note: beds at this horizon in the beach about ¼ mile west are jammed with large diameter Cladopora, apparently a local biostromal development.

CRW 6 18' (to 103')
A succession of limestone bands 1' to 4' thick, separated by shaly interbands 6" to 12" thick. Limestone is medium grey, mixed finely crystalline, bioclastic-calcarenitic, and cryptocrystalline; shale is brown-grey, soft, marly. Fossils are most common in the shaly interbeds.

Note: about ½ mile farther west, these beds comprise a Cladopora reef.

CRW 7 4' (to 107')
Note: section continues in beach ½ mile west of preceding location.

Limestone, medium brown-grey, finely crystalline, a microsparite, buff-weathering and fairly massive. (A useful key bed for lateral tracing along the outcrops.

CRW 8 21' (to 128')
Limestone, light-medium grey, cryptocrystalline, compact but much shattered; nodular in places; shaly to marly interbeds, from which bulk of the fauna was collected about ½ miles to the east.

CRW 9 4' (to 132')
Limestone, dark grey, microcrystalline micro sparite, with dark bituminous shale partings. Well exposed in beach where Warrenella occidentalis, and chonetids in thin coquinoid bands were collected. Amphipora also present.

CRW 10 4' (to 136')
Limestone, brown-black, fine-medium crystalline, sparry, in 1-foot beds separated by slabby black shale full of Lingula spatulata. Leiorhynchus hippocastanea abundant in the limestone. From the shale at base of bed, goniatites have been reported. Others I have observed inter-bedded with the L. hippocastanea resembled but sutures were not preserved.

CRW 11 (not measured)
Shale, slabby, brown-black, hard, calcareous, with thin bands that are marly. Forms top of section. Some surfaces show numerous flattened Leiorhynchus presumably dwarfed and flattened examples of L. hippocastanea.

Raasch & Spitzer, July 22, 1970

Locality GH/70
Ramparts of the Mackenzie River, right bank 2.5 miles upstream from mouth of Jackfish Creek, Fort Good Hope. 66° 14'N; 128° 42'W; District of Mackenzie.

Section begins at base of Ramparts Cliff at downstream end of first bluff above Fort Good Hope and follows small ravine to top of bluff.

GH X exposed, 10'
Limestone, dove grey, cryptocrystalline, with bioclastic fraction, thick-bedded, buff-weathering; prominent bedding plane at top. Rensselandia abundant, horn corals common.

GH 1 25' (to 35')
Limestone similar to underlying (GHX), but more earthy, medium-thick beds, fractured, major bedding plane at top. Fossils common, especially at 20-25' above base: Stringocephalus, horn and phacelloid corals, small brachs., gastropods, proetid trilobites and a Goldius.

GH 2 20' (to 55')
Similar massive, buff-weathering limestone, but biostromal, full of massive stroms. up to 1.5' in diameter. Matrix rock is earthy, medium brown, microcrystalline, buff-weathering.

Top of bluff.

Note: Upstream from the ravine section, GH, the bluff is unscalable without special climbing equipment. Higher beds were examined by walking about 1 mile upstream along the top of the bluff where higher beds are present, and where it is possible to descend the bluff for 23 feet of beds constituting the "grey Ramparts", to close to the top of the "brown Ramparts", i. e. the massive, buff weathering beds like those sectioned at Locality GH.

It is estimated that 60-65' of "brown Ramparts" strata intervene between the top of the ravine section GH and the base of the "grey Ramparts". These beds are described and their fauna listed by Crickmay, 1970, p. 71, who assigns them a thickness of 66 feet.

Raasch & Spitzer, July 22, 1970

Locality GHA
Summit and highest point in first long bluff upstream from Fort Good Hope, and about 1 mile upstream from Locality GH.

GHA 1 estimated 50-60'
Limestone, massive, buff-weathering, similar to Stringocephalus beds at Locality GH, and a continuation thereof. Inaccessible. A dark shale intervenes between the massive limestone and the base of GHA 2. From the GHA 1 interval, Crickmay (op. cit.) reports: Stringocephalus aleskanus, indicative of the uppermost faunal zone of the Stringocephalus succession.

GHA 2 23' (60-83')
Limestone, aphanitic, dull grey, grey weathering, thin-bedded, with calcareous shale interbeds. Recessive. Upper and lower fossiliferous beds are separated by a poorly indurated but massive, 2 foot biostromal bed full of globular, cobble-sized Alveolites colonies, giving it a superficial resemblance to a conglomerate. However, none of the corals show an evidence of abrasion. Lower beds show a dominance of Nervostrophia, Schizophoria, and a very coarsely plicate, large Spinatrypa. Upper beds have small branching tabulates and a small Paracyclas.

GHA 3 3' (83-86')
Limestone, buff-weathering, pale grey, cryptocrystalline, with sparry mottling, in firm, regular beds about 1' thick. Separated by GHA 2 by several inches of deeply weathered dark shale. Leiorhynchus hipposcastanea abundant.

Top of bluff and of the outcrop.

G. O. Raasch, July 25, 1970

FL/70

Rocky knob, 1 mile SW of small lake, Fawn Lakes Area, N. W. T.

This locality is very difficult to reach via float plane from southwest extension of Fawn Lake. Recommend use of very small (185) float plane that could land on the small lake at 62° 09'N; 117° 39'W. From the middle of this lake a cut-line extends WSW to the top of the knob.

A shale sample was taken at the casing head about ½ mile from the Knob, from a core drill site.

On the north-east side of the knob, light-colored, pale-weathering, bioclastic ls. is present from 0-20'. Large sample was taken which included many small brachiopods, evidently the lower fauna reported by McLaren & Norris (1962). About 40' higher begins outcrop of limestone, which weathers into large masses as observed on the northeast corner of the knob. These are estimated to run from 60' to 80' above base of section. This evidently was the horizon from which most of the corals described in the publication cited were obtained. At present, however, little was obtainable here other than a large Atrypa which makes a virtual coquina. Fossil collection and micro sample were obtained here.

Above this, shale shows in float between 80' and 90' which is the level of the well drilled on the summit of the mound.

West of the well, the summit rises to 95' in bouldery glacial deposits.

G. O. Raasch, July 27, 1970

Locality 1WB/70
Shallow quarry of SW side of N. W. T. Highway 5, Mile 80, Wood Buffalo National Park, 60° 16'N, 114° 04'W, N. W. T.

Shallow quarry exposing about 10' of thin-bedded dolomite, light brown, micritic, compact or vuggy by solution of mineral inclusions. Some beds gypsiferous. Zones of small brachiopods.

Locality 2WB/70
Shallow quarry on SW side of N. W. T. Highway 5, Mile 79, Wood Buffalo National Park, 60° 17'N; 114° 05'W, N. W. T.

Shallow quarry, exposing about 8' of section similar to that at 1WB, with brachiopods abundant in laminated limestone beds.

Locality 3WB/70
Drainage ditch leading northeasterly from N. W. T. Highway 5, at mile 78.3, Wood Buffalo National Park, 60° 17.5'N; 114° 06'W, N. W. T.

Exposes about 6' of thin-bedded limestone similar to that 1WB and 2WB. The upper, laminated layers have well-preserved brachiopods.

Locality 4WB/70
Shallow roadcuts at Mile 72, N. W. T. Highway 5, Wood Buffalo National Park, 60° 22'N; 114° 12'W, N. W. T.

Exposed thin-bedded limestone, light grey, micritic, pale-weathering, compact, with abundant brachs. in some layers.

Locality HY5/70
Shallow roadcuts and ditches on N. W. T. Highway 5, 5 miles SE of junction with N. W. T. Highway 6, west of Pine Point, N. W. T., 60° 42'N; 114° 41'W, N. W. T.

Limestone, medium brown-grey, finely crystalline to nodular, buff-weathering; full of massive and branching stroms., and with brachiopods of several types. About 5' exposed.

Locality BR/70
Low cliffs on Buffalo River about 2 miles below (north of) bridges of Pine Point railway and highway, N. W. T., 60° 44'N; 114° 56'W, N. W. T.

River bank on west side exposes about 15' of Slave Point beds. The beds slope at an angle of a few degrees, as broad lows and highs.

BR 1 5' (base to 5')
Limestone, microcrystalline to cryptocrystalline, light grey to grey brown, rather dull, pale-weathering, thin-bedded, bearing composite massive stroms. several feet across; these are rather distantly spaced.

BR 2 3' (to 8')
Limestone, conglomeratic; matrix sucrosic, brown grey, medium crystalline, somewhat bitumen-stained; pebbles small, scattered greenish grey chalky limestone. Probably intraformational and related to the stromatoporoidal reefs.