

- | LOCALITY NO. | LOCALITY NAME |
|--------------|---|
| ① | UNNAMED NORTHWEST TRIBUTARY TO POWELL CREEK |
| ② | POWELL CREEK |
| ③ | GAYNA RIVER |
| ④ | DODO CREEK |
| ⑤ | CARCAJOU CANYON |
| ⑥ | CARCAJOU RIVER |
| ⑦ | MAC KAY RANGE |
| ⑧ | KEE SCARP QUARRY |
| ⑨ | WRIGLEY PLATEAU |
| ⑩ | CAMSELL RANGE |
| ⑪ | CAMSELL RANGE |
| ⑫ | CAMSELL RANGE |
| ⑬ | S.E. WHITTAKER ANTICLINE |
| ⑭ | DELORME SYNCLINE |
| ⑮ | LANDRY CREEK |
| ⑯ | N.W. WHITTAKER ANTICLINE |

- ② SECTION LINE
W-1,2 COMPANY SAMPLES
CAMP 1 FIELD CAMP LOCATION

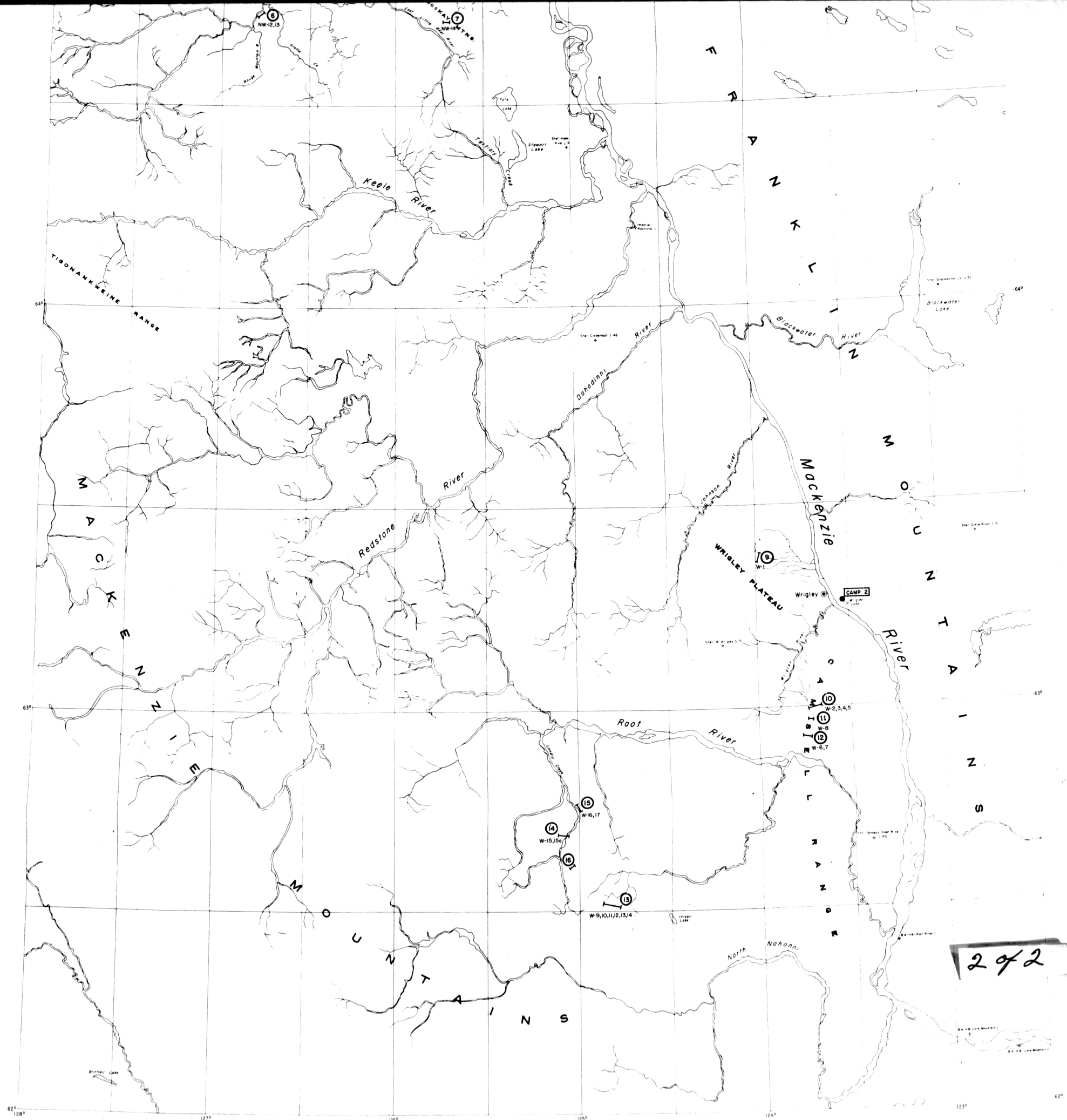
PLATE I

UNITED CANSO OIL & GAS LTD.

NORMAN WELLS-WRIGLEY AREA
NORTHWEST TERRITORIES

SAMPLE LOCATION MAP

DRAWN BY H.L. WILLIAMS	GEOLOGY BY	SCALE	DATE OCT. 1966
CHECKED BY	TRACED BY	FILE	REVISED



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GEOLOGICAL FIELD RECONNAISSANCE
OF THE DEVONIAN SUCCESSION
BETWEEN MOUNTAIN RIVER AND
NORTH NAHANNI RIVER,
NORTHWEST TERRITORIES

R.L.Williams

December, 1966



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DEVONIAN SUCCESSION
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NORTHWEST TERRITORIES

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GEOLOGICAL FIELD RECONNAISSANCE OF THE
DEVONIAN SUCCESSION BETWEEN
MOUNTAIN RIVER AND NORTH NAHANNI RIVER,
NORTHWEST TERRITORIES

ABSTRACT

This report deals mainly with the stratigraphy of the Devonian system between Mountain and North Nahanni Rivers. During August 1966 a brief field program was conducted to become familiar with and supplement published descriptions of the Devonian succession. Formational nomenclature, boundaries and correlations have been made to appear overly complicated primarily because of the failure of some geologists to recognize major regional unconformities that occur between probable Early and Middle Devonian and between Middle and Late Devonian. By recognizing these unconformities and diagnostic fossil horizons it is possible to establish practical correlations of the Devonian succession from the Mackenzie Mountain front to the Great Slave Lake and Arrowhead River areas.

The Chinchaga, Arnica, Funeral, Manetoe and Landry formations are considered to be either partial or complete facies equivalents of the Bear Rock formation and are provisionally assigned to the Early Devonian.

The Middle Devonian succession in the Norman Wells area is represented in ascending order by the Hume, Hare Indian and Kee Scarp formations. The Headless formation of the upper Mackenzie River area appears to be a facies equivalent of the basal Hume but may be a slightly older Middle Devonian unit of restricted distribution. The Headless is overlain by the Nahanni formation. The Leiorhynchus castanea zone and older carbonates of the Nahanni are time equivalents of the Hume formation. These units also correlate with the Leiorhynchus-bearing limestones on Clive River and the Lonely Bay to lower Pine Point formations of the Arrowhead River to Great Slave Lake area. The Hare Indian formation of the Norman Wells area is correlated with the Buffalo River shale as occurs at Great Slave Lake in the interval 172 to 358 feet at Cominco Sulfur Point core hole G-4. At other localities around

Great Slave Lake and west to the Arrowhead River area the Buffalo River shale is not developed. In these areas the Hare Indian is a time equivalent of the middle Pine Point. The basal part of the Kee Scarp formation, including the Stringocephalus burtini and Rensselandia laevis horizons, is a time equivalent of the Sulfur Point formation at Great Slave Lake. Where the Sulfur Point formation is not differentiated from the Pine Point, as at Arrowhead River, the lower Kee Scarp is correlated with the pre-Watt Mountain uppermost Pine Point. The upper part of the Kee Scarp formation is time equivalent to the Slave Point formation of the Great Slave Lake to Arrowhead River area. The Horn Plateau reef is provisionally correlated with the Slave Point.

The Upper Devonian of the Norman Wells area consists of the Canol and Imperial formations. They are at least partial time equivalents of the Fort Simpson formation of the Upper Mackenzie River area. Biostromal reefs of the Wrigley area are time equivalent to part of the early Upper Devonian Grumbler group of the Great Slave Lake area.

INTRODUCTION

From August 7th through August 13, 1966, United Canso Oil & Gas Ltd. sponsored a geological field reconnaissance along the Mackenzie Mountain front between Mountain River and North Nahanni River, Northwest Territories. Objectives of the program were to observe at outcrop in the Mackenzie Mountains the stratigraphic equivalents of the Devonian rocks mapped earlier in the Great Slave Lake and Arrowhead River areas and thus substantiate critical unconformities and facies changes suggested by the previous subsurface and surface work and establish practical correlations of the sections in the three areas. Clarification of these stratigraphic relationships is considered essential to an accurate evaluation of the petroleum potential of Canso Permits 4611 and 4612.

Camp facilities were provided by V. Zay Smith Associates Ltd. of Calgary. Two employees of this firm served as cook and camp attendant. Aircraft used during the field program were an Associated Bell G-2 helicopter

and a Great Northern Aviation float-equipped Beaver. Two pilots and a helicopter engineer operated and serviced the aircraft and stayed at the field camps. Aircraft and camp facilities were shared with two employees of French Petroleum Company of Canada Ltd., who were conducting a similar, but independent, field reconnaissance. The writer was accompanied in the field by Dr. Horst Scherp of Newark State College, who was on a retainer to V. Zay Smith Associates Ltd. for summer field work and was assigned to United Canso Oil & Gas Ltd. for the program. The writer is indebted to Dr. Scherp for his invaluable assistance in the field and for supplying the color photographs used in this report.

Acknowledgement is also due Mr. Harvey Schwartz of United Canso for drafting of illustrations and Mr. William Clow, Exploration Manager of United Canso, for authorizing the program and providing constructive suggestions during preparation of the report.

PREVIOUS WORK

The earliest publication of regional significance to the subject area is by Kindle and Bosworth (1921) wherein they assign formation names to the Devonian succession in the lower Mackenzie River region. This was immediately followed by Williams' report on the geology of the Wrigley area (1922), Hume's discussion of Root River area stratigraphy (1922), and Dowling's summary of known structure of the Mackenzie River region (1922). Hume and Link published findings of the Canol Investigations (1945) in the Norman Wells-Wrigley area and revised the Devonian formational subdivisions of Kindle and Bosworth. The area was further discussed by Hume in a subsequent report (1954). Papers by Warren and Stelck (1949, 1950, 1956, 1962), McLaren (1962) and Crickmay (1957, 1960a, 1960b) have contributed to the understanding of Devonian biostratigraphy.

Recent works include a redefinition of the Devonian stratigraphy in the Norman Wells area by Bassett (1961), a summary of Devonian nomenclature by Caldwell (1964), and an important paper on Norman Wells Devonian biostratigraphy by Braun (1966). The first comprehensive reports on the geology of the Wrigley and Root River areas are by Douglas and Norris (1961, 1963).

SCHEDULE AND MEANS OF ACCESS

Localities visited are designated on the accompanying sample location map (Plate I). Localities one through eight were reached directly by helicopter on August 7th and 8th from base camp 1 established at Norman Wells. Because of inclement weather no field work was conducted August 9th and 10th, and the base camp was moved from Norman Wells to Wrigley. On August 11th localities nine through twelve were reached directly by helicopter from base camp 2. On August 12th a fly camp was established by Beaver at Iverson Lake and the helicopter was utilized to visit localities thirteen through sixteen. On August 13th an aerial reconnaissance was flown between Wrigley and Yellowknife to terminate the Company's phase of the field program.

STRATIGRAPHY

Due to limited time available for reconnaissance no attempt was made to measure stratigraphic sections. Representative sections from some of the localities visited are in publications or open company reports filed with the Department of Northern Affairs. The four potential reservoir horizons at Arrowhead River Permits 4611 and 4612 occur in the Devonian, therefore this section received major attention. Sections were examined at selected localities and important horizons were traced by air along the mountain front to adjoining stream cuts. Emphasis was placed upon formation contacts, facies relationships, and sampling of diagnostic fossil horizons. The fossils described were identified by the writer.

The formation terminology proposed by Bassett (1961) is used in this report. Age designations follow either Bassett or Braun (1966) and are reviewed along with probable correlations in the summary following descriptions of the individual localities visited. Localities and sample numbers are shown on Plate I.

Powell Creek Area (Localities 1, 2)

The Powell Creek area is located 55 miles west of Norman Wells. Bassett refers frequently to this locality in his paper proposing subdivision of the Kee Scarp formation into a basal platform member and an overlying reef member (1961, p. 493). The platform member of the Kee Scarp is well exposed at Powell Creek (Locality 2) and an unnamed tributary west of Powell Creek (Locality 1). The overlying reefoid Kee Scarp is exposed in a hogback due west of the same tributary. Braun (1966) describes these sections in detail and presents a sound argument for placing the boundary between Middle and Upper Devonian at an erosional unconformity on top of the Kee Scarp formation.

At West Powell Creek the Middle Devonian Hare Indian formation consists of about 200 feet of dark grey calcareous shale with occasional interbedded argillaceous limestone. As shown by Fig. 1 limestone becomes progressively more abundant at the top of the formation as the Hare Indian grades transitionally into the overlying platform facies of the lower part of the Kee Scarp formation. Braun places the contact between the Hare Indian and Kee Scarp formations at the top of his e_1 ostracod fauna assemblage (op. cit., p. 251). Without the benefit of fossil evidence it is common practice to place the contact where the limestone facies becomes predominant. In the Powell Creek area the lithologic break apparently occurs about 80 feet higher in the section than the microfauna contact proposed by Braun and probably within his e_3 ostracod zone.

Braun's West Powell Creek section was measured from the hogback west of the creek and includes a complete succession of platform and reefoid Kee Scarp (Fig. 2). Only about 50 feet of platform is exposed along the stream cut. It consists of medium brown to dark grey, hard, dense calcilutite and calcarenite interbedded with porous oil-stained organic limestone and thin dark brown to black bituminous and petroliferous shale. Megafossils include solitary rugose corals, trilobite pygidia and the brachiopods Atrypa arctica (Warren), Atrypa spp. and Cyrtina spp. (Samples NW-1, 2, 3). The latter may be Cyrtina panda (Meek) which Warren and Stelck (1956, p. 8) believe occurs above Stringocephalus burtini (Defrance). Stringocephalus has not been recognized at West Powell

PLATE II - INDEX MAP

Creek although the genus reportedly occurs in talus on Powell Creek (Braun, 1966, p. 261). Stringocephalus burtini does occur above Rensselandia laevis (Meek) in the lower Kee Scarp near the mouth of Carcajou River 25 miles north of Powell Creek (op. cit.). These two fossils are the key index brachiopods of the lower Kee Scarp. Braun and Bassett (1961, p. 493) both place the boundary between lower and upper Kee Scarp on the "Cladopora horizon".

At Powell Creek the Middle Devonian is represented by the Hume and Hare Indian formations and the lower platform facies of the Kee Scarp formation (Fig. 5). The lower two-thirds (approximately 200 feet) of the Hume formation consists of grey to brown, massive, argillaceous, organic limestone. Fossils collected from the talus slopes include solitary septate corals and the brachiopods Atrypa andersonensis (Warren), Spinatrypa coriacea (Crickmay), Spinatrypa lata (Warren), Atrypa arctica (Warren), and fragments of possible Schuchertella spp. (Spl. NW-4). The upper 100 feet of the Hume is composed primarily of shale with occasional interbedded limestone. The top of the Hume formation is defined by a fifteen-foot thick evenly-bedded limestone unit containing Leiorhynchus castanea (Meek) (Fig. 3, Spl. NW-5). It is overlain conformably by about 250 feet of Hare Indian calcareous shales and limestones which grades into the lower limestone platform facies of the Kee Scarp formation (Spl. NW-6).

Braun (op. cit.) recognizes four separate stratigraphic units above the Hare Indian formation at Powell Creek. In ascending order these are the Middle Devonian platform Kee Scarp separated by a postulated erosional unconformity from the overlying Upper Devonian "Unnamed beds", the Canol formation and the Imperial formation. He includes ostracod assemblages e_1 , e_2 , e_3 , e_4 , and f in the lower Kee Scarp. Ostracod assemblage g of the "Unnamed beds" is different from the underlying e and f assemblages and for this reason these beds are provisionally assigned by Braun to the Upper Devonian. However, he notes the g assemblage also differs markedly from the unquestionably Upper Devonian ostracod assemblages of the overlying Canol and Imperial formations.

Gayna River (Locality 3)

Gayna River is a tributary to Mountain River located 18 miles west of Powell Creek. The section examined consists of Hume, Hare Indian and Lower Kee Scarp rocks which dip about 35 degrees north-northeast into the syncline separating Imperial anticline from the mountain front.

The basal contact of the Hume formation was not observed at this locality. The upper part of the lower Hume consists of light grey massive rubbly organic limestone. Identified brachiopods include Spinatrypa coriacea (Crickmay), Atrypa arctica (Warren), Atrypa spp. and probable Carinatina dysmorphostrota (Crickmay). Other fossils include solitary septate corals, Aulopora spp., Favosites spp. and an occasional trilobite pygidium (Spl. NW-8). Limestones of the Upper Hume formation are evenly-bedded and argillaceous. Dark grey to black shale is interbedded with the limestone near the top of the formation. The contact between the Hume and the conformably overlying Hare Indian formation is placed at the top of a resistant limestone bed containing Leiohynchus castanea (Spl. NW-9).

The Hare Indian formation along Gayna River is several hundred feet thick and consists of grey to greenish-grey, occasionally slightly calcareous shale. Thin limestone beds are increasingly abundant near the transitional contact with the overlying Kee Scarp formation (Fig. 6).

Only the lower part of the platform member of the Kee Scarp formation is preserved along Gayna River. It consists of about 40 feet of resistant evenly-bedded brown argillaceous limestone with occasional interbedded shale near the base. The basal limestones contain Rensselandia laevis (Spl. NW-7). The Kee Scarp at Gayna River forms a prominent escarpment striking N. 75° W. It is evident from aerial photographs that the platform limestone is not present three miles west of Gayna River suggesting non-deposition or, as is more likely, post-Kee Scarp erosion.

Dodo Creek (Locality 4)

Dodo Creek emerges from the Mackenzie Mountain front 45 miles east-southeast of Powell Creek. The upper

part of the Hume formation is well exposed along the creek two miles upstream from its junction with Carcajou River. The Upper Hume consists of buff to grey, massive and evenly-bedded argillaceous limestone (Fig. 7). Leiorhynchus castanea are abundant in the top of the formation (Spl. NW-10). The Hume is overlain by several hundred feet of black fissile shale which is in turn overlain by the Upper Devonian Imperial formation. The black shale sequence is provisionally mapped as undifferentiated Middle Devonian Hare Indian and Upper Devonian Canol formations because microfossil identification is the only valid method of separating these two lithologically similar formations when they are in juxtaposition due to absence of the Kee Scarp formation.

Carcajou Canyon (Locality 5)

An aerial reconnaissance was flown up Dodo Canyon and over to Carcajou Canyon to observe the Early Paleozoic sequence. The type section of the Cambrian Macdougall Group, described in Hume and Link (1945, p. 7), is well exposed in Dodo Canyon. The best section of the overlying Ordovician-Silurian Ronning Group occurs in Carcajou Canyon. The Ronning included dolomites of the Franklin Mountain and Mount Kindle formations. The evenly-bedded Mount Kindle dolomites are overlain by a brecciated facies of the Late Silurian and/or Early Devonian Bear Rock formation (Fig. 8). The contact between the Mount Kindle and Bear Rock formations is sharp and is believed to be disconformable (op. cit., p. 12). At Carcajou Canyon the uppermost dolomites of the Bear Rock formation are very petroliferous (Spl. NW-11) and are overlain by a massive reefoid facies of the lower Hume formation (Fig. 9, Spl. NW-10a). The contact between the Bear Rock and Hume formations is also sharp and irregularities along it lead the writer to concur with Hume and Link (op. cit., p. 17) and Bassett (1961, p. 484) that it is at least a disconformity.

Carcajou River (Locality 6)

Along the east bank of Carcajou River, about one mile upstream from the mouth of Grotto Creek, a section of Middle and Upper Devonian rocks is exposed similar to that described at Locality 4 (Dodo Creek). The Hume formation is highly brecciated at this locality. However, the Leiorhynchus castanea zone is present at the top of the formation (Spl. NW-12). It is overlain by about 100 feet of black fissile shale (Spl. NW-13) which grades upward into rusty siliceous shale. As at Locality 4 the Kee Scarp formation is absent and the entire shale sequence is provisionally assigned to the Hare Indian and/or Canol formations. The undifferentiated shales are overlain by sandstone and shale of the Imperial formation. The Carcajou River section dips about 30 degrees northeast into the Mackenzie Plain.

MacKay Range (Locality 7)

The MacKay Mountains were visited at a locality seven miles south-southwest of Fort Norman to examine the Ordovician-Silurian Ronning to Middle Devonian Hume sequence. Only the Franklin Mountain formation of the Ronning Group is present at this locality. The Mount Kindle formation pinches out in the Little Bear River area northwest of the MacKay Range due to non-deposition or, as is more likely, erosional truncation. The Franklin Mountain formation at the MacKay Range is overlain by the brecciated facies of the Bear Rock formation. The Bear Rock is overlain, with probable disconformity, by the Hume formation. The Hume can be subdivided here into a basal organic limestone, a medial unit consisting mostly of shale with a few thin limestone beds containing Schuchertella adoceta (Crickmay) (Spl. NW-14) and a remnant of the upper evenly-bedded argillaceous limestone.

Kee Scarp Quarry (Locality 8)

Kee Scarp Quarry is located along the southwest flank of the Norman Range three miles east of Norman Wells. Only the upper reefoid facies of the Kee Scarp is exposed at the quarry. The core of the reef is composed of massive buff to light grey organic limestone. The fauna are poorly preserved and appear to be mainly branching corals and stromatoporoids (Spl. NW-14A, 15). The reef is overlain by and grades laterally into dense evenly-bedded limestone. Exposures at the northwest edge of the quarry are separated from the reef core by a small normal fault (Fig. 10). The rocks on the down-thrown side of the fault consist of dense evenly-bedded off-reef upper Kee Scarp limestone overlain by reddish burnt shales which may be equivalent to the Canol formation. The erosional unconformity at the top of the Kee Scarp is not distinguishable at this locality.

Wrigley Plateau (Locality 9)

The reef facies occurring within the middle part of the Upper Devonian section in the Wrigley area has been described briefly by Douglas and Norris (1963, p. 22). The reefoid section was examined by the writer at a locality seven miles northwest of Wrigley. The biostromal reef core and off-reef limestones are well exposed at a deep cut along the northwest side of the outcrop. The exposed reef core consists of about 45 feet of light brown to grey brecciated and massive limestone. Organic remains comprise about 90 percent of the rock and consist of solitary and colonial corals, stromatoporoids, crinoids, brachiopods and gastropods (Spl. W-1). Very coarse calcite crystals fill voids in the breccia. The biostrome grades laterally into a dense very evenly-bedded off-reef calcilutite facies. The sandy limestone facies reported by Douglas and Norris (op. cit) to underlie the reef limestone at other localities is not exposed here.

Camsell Range (Localities 10, 11, 12)

The Camsell Range is an overthrust fault block which rises 3,000 feet above the Mackenzie River flood plain south-southwest of Wrigley. It is composed of Early to Middle Devonian rocks which have been thrust eastward across less resistant Late Devonian shales. The east face of the Camsell Range is a precipitous escarpment cutting across a section of intertonguing probably Early Devonian Arnica and Bear Rock formations. The west flank is composed of steeply-dipping differentially eroded Middle Devonian limestone, argillaceous limestone and limy shale which are overlain along adjoining Root River valley by recessive-weathering Late Devonian shale and occasional sandstone.

Douglas and Norris have provisionally assigned 540 feet of brecciated dolomite and silty dolomite near the base of the escarpment to the Silurian Delorme formation (1963, p. 13). Several hundred feet of breccia was observed from the air in the top of the lower third of the section exposed along the escarpment that may be the "Delorme" unit described by Douglas and Norris. The breccia is underlain by bedded grey and mottled dolomite typical of the Arnica formation and is concluded to be a Bear Rock tongue in the Arnica. The Bear Rock intertongues with the Arnica on Dahadinni Range (op. cit., p. 16) and the northern end of the Camsell Range probably represents the southwestern limit of the former facies.

The upper part of the Arnica formation was examined at three localities in the Camsell Range north of Root River. It consists of buff, dark brown, dark grey and black, crypto- to microcrystalline, dense and generally massive fetid dolomite. Color banding imparts a laminated appearance to the dolomite. About 2,500 feet of intertonguing Arnica and Bear Rock formations are exposed in the Camsell Range escarpment above the basal talus cover.

At Locality 10 the Arnica grades upward into several hundred feet of porous coarsely-crystalline and occasionally brecciated dolomite which is assigned to the uppermost Early Devonian Manetoe formation (Spis. W-2, 3, 5). Link, Downing, Cooke & Company, in a report submitted to the Department of Northern Affairs (1961, p. 27), describe 500 feet of typical Manetoe dolomite at a section immediately north of Locality 10. Douglas and Norris (1963, p. 17)

describe 135 feet of Manetoe in a partial section at the northern end of the Camsell Range. At Locality 10 the upper 30 feet of coarsely-crystalline Manetoe type dolomite contains interbedded dark grey to black dense limestone (Spl. W-4). This interval represents a transition facies between the Manetoe and the laterally at least partially equivalent Landry formation. The Landry limestone facies completely replaces the Manetoe in Iverson Range 30 miles west of Camsell Range (op. cit. and Fig. 11).

The Manetoe-Landry transition facies at Locality 10 is overlain by about 50 feet of the lower Middle Devonian Headless formation. Due to recessive weathering of the Headless shale and argillaceous limestone, the nature of the contact between Early and Middle Devonian could not be determined at this locality. The Headless is overlain, probably conformably, by about 400 feet of resistant limestone and interbedded shale. Link, Downing, Cooke & company have collected *Schuchertella adoceta* from the top of this latter sequence north of Locality 10 (1961, p. 30) indicating correlation with the lower and middle parts of the Hume formation.

At Localities 11 and 12 the Arnica to Hume section is similar to that described at Locality 10 (p. 14). However, at the two southern localities the Manetoe-Landry transition zone is overlain by about 40 feet of extremely brecciated coarsely-crystalline dolomite (Spl. W-8) which is in turn overlain by the Headless. The breccia was apparently caused by weathering and solution of the uppermost Manetoe during an interruption in sedimentation near the close of Early Devonian time. Lack of disturbance in the underlying beds indicates neither structure nor collapse were instrumental in forming the breccia.

Whittaker Anticline (Localities 13, 16)

West of Iverson Lake the Early Paleozoic section is well exposed in the core and flanks of Whittaker anticline. The formations are described by Douglas and Norris (1963, pp. 6-15) in ascending order as Ordovician Sunblood (1,615 feet) and Whittaker (4,070 feet), Silurian Delorme (3,800 feet), Camsell (1,400 feet) and Sombre (1,600

describe 135 feet of Manetoe in a partial section at the northern end of the Camsell Range. At Locality 10 the upper 30 feet of coarsely-crystalline Manetoe type dolomite contains interbedded dark gray to black dense limestone (Spl. W-4). This interval represents a transition facies between the Manetoe and the laterally at least partially equivalent Landry formation. The Landry limestone facies completely replaces the Manetoe in Iverson Range 30 miles west of Camsell Range (op. cit. and Fig. 11).

The Manetoe-Landry transition facies at Locality 10 is overlain by about 50 feet of the lower Middle Devonian Headless formation. Due to recessive weathering of the Headless shale and argillaceous limestone, the nature of the contact between Early and Middle Devonian could not be determined at this locality. The Headless is overlain, probably conformably, by about 400 feet of resistant limestone and interbedded shale. Link, Downing, Cooke & company have collected Schuchertella adoceta from the top of this latter sequence north of Locality 10 (1961, p. 30) indicating correlation with the lower and middle parts of the Hume formation.

At Localities 11 and 12 the Arnica to Hume section is similar to that described at Locality 10 (op. cit. p. 30). However, at the two southern localities the Manetoe-Landry transition zone is overlain by about 40 feet of extremely brecciated coarsely-crystalline dolomite (Spl. W-8) which is in turn overlain by the Headless. The breccia was apparently caused by weathering and solution of the uppermost Manetoe during an interruption in sedimentation near the close of Early Devonian time. Lack of disturbance in the underlying beds indicated neither structural nor collapse were instrumental in forming the breccia.

Whittaker Anticline (Localities 13, 16)

West of Iverson Lake the Early Paleozoic section is well exposed in the core and flanks of Whittaker anticline. The formations are described by Douglas and Norris (1963, pp. 6-15) in ascending order as Ordovician Sunblood (1,615 feet) and Whittaker (4,070 feet), Silurian Delorme (3,800 feet), Camsell (1,400 feet) and Sombre (1,600

feet) and the probably Early Devonian Arnica (2,100 feet). Douglas and Norris (op. cit. p. 14) suggest that the only unconformities within this sequence occur at the bottom and top of the Sombre formation.

Due to adverse flying conditions only the Sunblood and lower half of the Whittaker formations were examined at Locality 13 (Spl. W-9 through W-14). The upper half of the Whittaker formation was observed at Locality 16. The lithology is as described by Douglas and Norris (op. cit.).

Delorme Syncline (Locality 14)

The southern end of Delorme syncline was visited to examine the Early Devonian stratigraphic sequence. This succession is composed, in ascending order, of the Arnica, Funeral and Landry formations. Black cryptocrystalline, slightly vuggy dolomites of the Arnica grade upward into dark grey to black dense shale and limestone of the Funeral. Intense contortion in the transition zone is attributed to differential resistance of intertonguing shales and carbonates to structural pressures. The overlying buff limestone is provisionally assigned to the Landry formation and appears to rest conformably upon the Funeral formation.

Douglas and Norris (1963, p. 17) suggest that the Funeral formation is a stratigraphic equivalent of the Landry, Manetoe and upper part of the Arnica formations. The contact between the Funeral and Landry formations is well exposed along Landry Creek between Localities 14 and 15. The Landry limestones clearly conformably overlie Funeral shales with no evidence of lateral transition between the two formations. It is concluded that the Funeral formation is here a facies equivalent of only the upper part of the Arnica formation. As suggested by observations in the Camself Range the Landry formation is a western stratigraphic equivalent of the probably uppermost Early Devonian Manetoe formation.

Landry Creek (Locality 15)

At Landry Creek, along the east limb of Delorme syncline, grey massive organic limestones (Spl. W-16) of the Nahanni formation grade upward into an evenly-bedded limestone facies which is in turn overlain by black fissile shale (Fig. 12). Leiorhynchus castanea occurs at the top of the bedded limestone (Spl. W-17) suggesting the Nahanni at this locality occupies the same stratigraphic position as the Hume formation further north. McLaren (1962, p. 84) has also identified Leiorhynchus castanea collected from the top of the Nahanni formation 32 miles northwest and 45 miles south of Locality 15.

The overlying black shales contain limestone concretions and have been mapped by Douglas and Norris as Upper Devonian (1963, map sheet 95K). It is also possible that the shales are equivalent to the earlier Hare Indian formation and that the break between Middle and Upper Devonian occurs higher in the section.

SUMMARY OF STRATIGRAPHY

It is beyond the scope of this report to enter into a critical review of the many published and unpublished reports dealing with the Devonian system in the Mackenzie River Valley. Varying and conflicting interpretations of the Devonian succession are found in this literature basically due to failure of some geologists to recognize major regional unconformities between Early and Middle Devonian and between Middle and Late Devonian and to ignore in correlations the occurrence of diagnostic index fossils at certain horizons in the Middle Devonian. Devonian biostratigraphy is well documented in publications by Bassett (1961), Braun (1966), Campbell (1950), Crickmay (1957, 1960a,b), Lenz (1961), McLaren (1962), McLaren and Norris (1964), Norris (1965), Warren (1949) and Warren and Stelck (1950, 1956, 1962). Formational nomenclature proposed by Bassett (1961) is used in this report. With the exception of the Canol formation Bassett's age designations are accepted. Braun's (1966) placing of the Canol formation in the Upper Devonian is preferred.

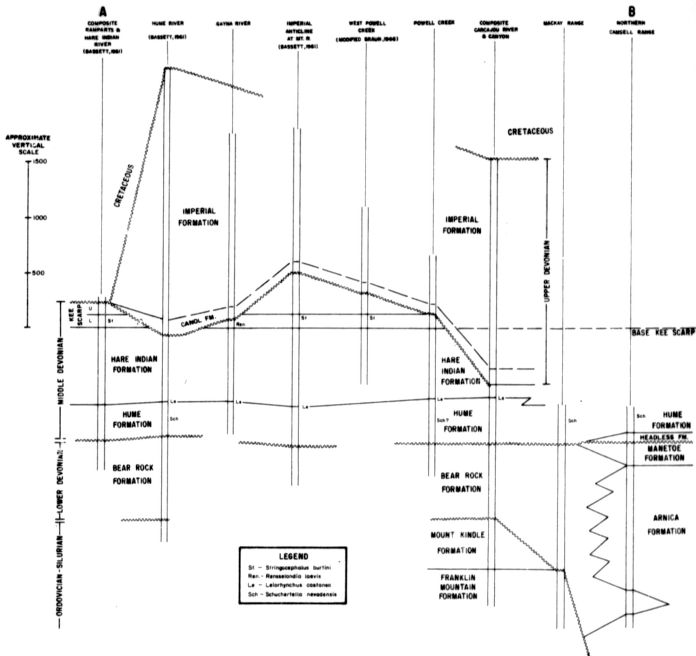


PLATE III

DEVONIAN CORRELATIONS FROM FORT GOOD HOPE SOUTH TO WRIGLEY, NORTHWEST TERRITORIES

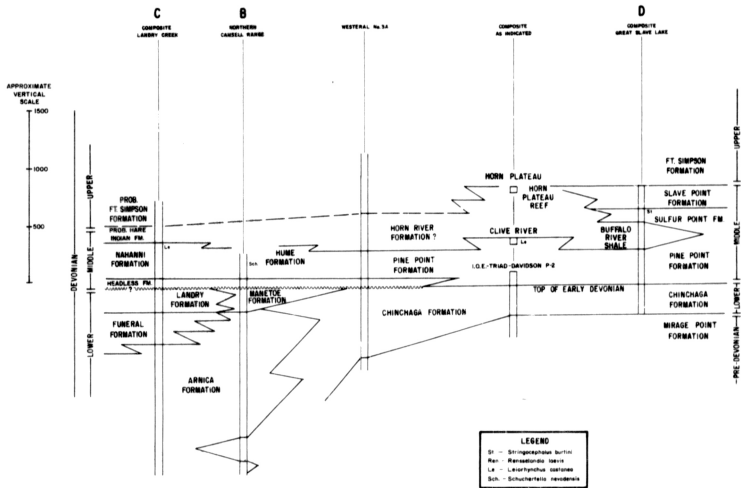


PLATE IV

DEVONIAN CORRELATIONS FROM LANDRY CREEK EAST TO GREAT SLAVE LAKE, NORTHWEST TERRITORIES

Early Devonian

The western limit of the Bear Rock formation is as yet undefined. East and southeast of Norman Wells it grades into the Chinchaga formation. To the south the Bear Rock merges with the Arnica formation along the Camsell Range (Localities 10, 11, 12). The Arnica extends south through the Beaver River area into northern British Columbia. The upper Arnica grades west into the Funeral formation of the Root River area (Locality 14). To the east, near Arrowhead River, the Arnica intertongues and grades into the Chinchaga formation.

Several hundred feet of coarsely-crystalline dolomite of the Manetoe formation overlies the upper Arnica along a narrow north-south trend extending from the north end of Camsell Range to the Arrowhead River area. West of Camsell Range the Manetoe grades into the Landry formation (Localities 10, 11, 12, 14). Further west the Landry may also grade into the upper Funeral formation as suggested by Douglas and Norris (1961, p. 19) although this facies relationship was not evident at the localities visited during the reconnaissance.

Bassett assigns a probable Early Devonian age to the Bear Rock formation based upon fauna collected from crystalline limestone and dolomite developed in the basal 2,000 feet of what is presumably the equivalent Arnica facies on upper Redstone River (1961, p. 485). He quotes Dr. G.O. Raasch as stating the fauna are either uppermost Silurian or lowermost Devonian (op. cit., p. 486). Bassett points out that Schuchertella adoceta (Crickmay), which is abundant in the middle of the overlying Hume formation, is a lowermost Middle Devonian species suggesting that the greater part, if not all, of the Bear Rock and equivalent facies are Early Devonian.

Evidence for an unconformity at the base of the Bear Rock and equivalent formations is well documented in the literature. The pinchout of the Ordovician-Silurian Mount Kindle formation between Carcajou Canyon (Locality 5) and MacKay Range (Locality 7) suggests the unconformity may be erosional.

Bassett (op. cit., p. 484), Douglas and Norris (1961, p. 19), and Hume and Link (1945, p. 17) suggest the

upper contact of the Bear Rock and equivalent facies may be disconformable. Irregularities along the Bear Rock-Hume contact in Carcajou Canyon (Locality 5) indicate a discordance. Likewise the limited distribution of the Manetoe facies in the Camsell Range-Arrowhead River area can be best explained by recrystallization and brecciation through solution and weathering along an exposed edge of the carbonate facies during an interruption in sedimentation.

Middle Devonian

The Headless formation is the lowermost subdivision of the Middle Devonian in the subject area. It has been mapped in the subsurface from Arrowhead River as far east as the southwest Tathlina Lake area. West of Arrowhead River the Headless grades into shale generally included as part of the Horn River formation. The Headless is carried as a separate unit north to the Camsell Range. North of Camsell Range the Headless apparently grades into the base of the Hume formation although it is also possible that the Headless represents an initial transgressive facies of only limited distribution deposited across the Early Devonian unconformity.

The Hume formation is lower Middle Devonian as evidenced by Schuchertella adoceta in the middle part of the formation. Schuchertella occurs in the middle Hume at MacKay Range (Locality 7), Hume River. (Bassett, 1961, p. 488), Norman Wells Discovery No. 3 well (Crickmay, 1960b), Imperial Range (Hume and Link, 1945, p. 20) and Camsell Range (Link, Downing, Cooke, 1961, p. 30), to mention only several of many reported occurrences. It is an excellent diagnostic species for regional correlations. Leiorhynchus castanea (Crickmay) is abundant in the upper limestones of the Hume formation. This species has been collected from the top of the Hume at Localities 2, 3, 4 and 6. It was collected from the top of the Nahanni formation at Locality 15. McLaren (1962, p. 84) has also identified Leiorhynchus in the top of the Nahanni on Root River as well as south of Iverson Lake indicating the Nahanni is equivalent to the Hume at these localities. Based upon McLaren's identification of Leiorhynchus at Clive River

north of Horn Plateau and at the south shore of Great Slave Lake (op. cit.) the Hume formation is correlated with the Lonely Bay formation including the lower part of the Pine Point formation as developed in the interval 358-709 feet at Consolidated Mining Sulfur Point core hole G-4.

The Hare Indian formation overlies the Hume and is correlated by Bassett (1961, p. 490) with Campbell's (1950) Buffalo River shale. Where this latter shale facies is not developed the Hare Indian is equivalent to the middle Pine Point.

The Kee Scarp formation is divided into two members by Bassett (1961, p. 492) and Braun (1966, p. 255). The platform Kee Scarp carries diagnostic Stringocephalus burtini (Defrance) and Rensselandia laevis (Meek) and is equivalent to the Sulfur Point formation or the uppermost pre-Watt Mountain Pine Point at Great Slave Lake if the Sulfur Point is not differentiated from the Pine Point. At Locality 2 slight bevelling across limestone beds near the Stringocephalus horizon is noted (Fig. 4). This break apparently occurs within Braun's ostracod assemblage or below the contact with his "Unnamed beds". The bevelling is near the same stratigraphic position as the pre-Watt Mountain unconformity in northern Alberta and suggests the upper part of the Kee Scarp platform member may be equivalent to the basal Slave Point formation.

Bassett (1961, p. 492) and Braun (1966, p. 251) suggest the Kee Scarp reef member is late middle Devonian and equivalent to the Slave Point formation. This correlation can be applied if it is kept in mind that the upper part of the platform Kee Scarp may also be time equivalent to the basal Slave Point. McLaren (1964) concluded that the Horn Plateau formation is of late Middle Devonian age. Due to the apparent position of the Horn Plateau reef in the stratigraphic section above the Clive River Leiorhynchus castanea horizon the reef must occur in either the Sulfur Point or Slave Point interval. Since neither Stringocephalus nor Rensselandia are known to occur at Horn Plateau this reef is provisionally correlated with the Slave Point formation and upper Kee Scarp.

Braun (1966) (p. 255-258) concludes the top of the Kee Scarp reef is marked by an erosional unconformity between Middle and Late Devonian. The upper Kee Scarp reef is

exposed in the hogback west of Locality 1. At West Powell (Locality 1) and Powell Creek (Locality 2) erosion has apparently removed the reef and the uppermost beds of the platform Kee Scarp. Braun's "Unnamed beds" may be an off-reef Kee Scarp facies and lie below the post-Kee Scarp unconformity or, as he suggests, they may be a reworked facies deposited on the erosional surface. Each implies an environmental and microfauna change. At Dodo Creek (Locality 4) and Carcajou River (Locality 6) erosion has removed all of the Kee Scarp and presumably much of the Hare Indian shale. A similar magnitude of post-Kee Scarp erosion is evident north in the Gayna River area (Locality 3).

Late Devonian

The Canol formation was deposited along the Middle Devonian unconformity in the Norman Wells area. The lithology of this formation is similar to that of the Hare Indian formation and where the two are in juxtaposition due to erosional removal of the Kee Scarp it is difficult to differentiate the two formations. At many of these localities the Hume formation is divisible into three members due to development of a shale facies near the middle of the formation. Failure to recognize the post-Middle Devonian unconformity has caused some geologists to erroneously correlate the medial Hume shale with the Hare Indian, the upper Hume limestone member with the Kee Scarp and the preserved Hare Indian with the Canol formation. This mistake can be avoided by identification of Leiorhynchus which occurs consistently in the upper Hume limestone.

The Canol formation is overlain probably conformably by the Imperial formation although Bassett (1961, p. 496) postulates the contact may be disconformable. The top of the Imperial is marked by a pre-Cretaceous erosional unconformity.

The lithology of the Fort Simpson formation of the Arrowhead River area is quite different from the Canol and Imperial formations and although the formations are probably time equivalent different depositional conditions existed. In the Great Slave Lake area the Fort Simpson is

overlain by a sequence of basin edge and shelf carbonates and shales called the Grumbler Group (Belyea and McLaren, 1962). The Jean Marie biostromes of the Arrowhead River area are developed in the base of this group. The biostromes of the Wrigley area (Locality 9) are considered by McLaren to be equivalent to part of the Grumbler group (Douglas and Norris, 1963, p. 22).

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Figure 1 - West Powell Creek

Hare Indian shale to left and center of photograph
dips northeast and is transitional into base of
Lower Kee Scarp. (Locality 1)



Figure 1. West face of the

base. In this photo, the left side shows the plateau and
dips northward and the right side shows the lower
Lower Kee Scarp. (See Fig. 2)

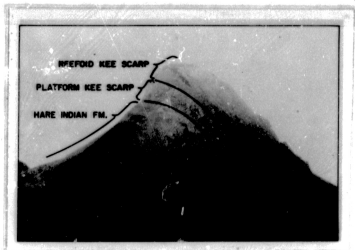


Figure 2 - View west toward hogback above West Powell Creek. Reefoid facies in Upper Kee Scarp overlies Lower Kee Scarp platform which is transitional into underlying less resistant Hare Indian shale. (Locality 1)

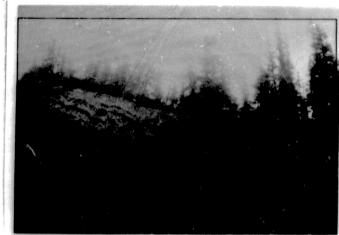


Figure 3 - Powell Creek

North Dipping Leiorhynchus castanea limestone at top of Hume formation. (Locality 2)

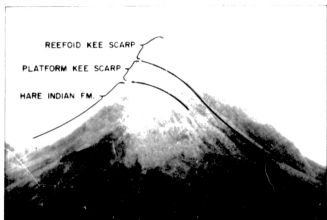


Figure 2 - View west looking south with West Fork Powell Creek. The scarp below the reefoid scarp is the platform scarp. The scarp below the platform scarp is the Hare Indian shale. (Locality 1)



Figure 3 - Powell Creek
North with the base of the Hare Indian shale. (Locality 1)

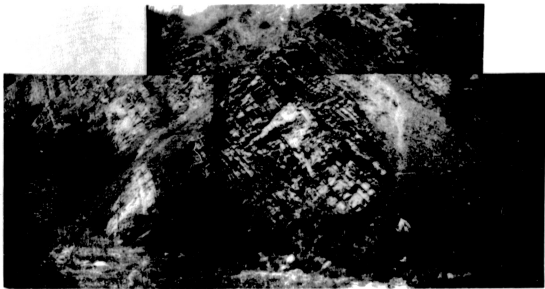
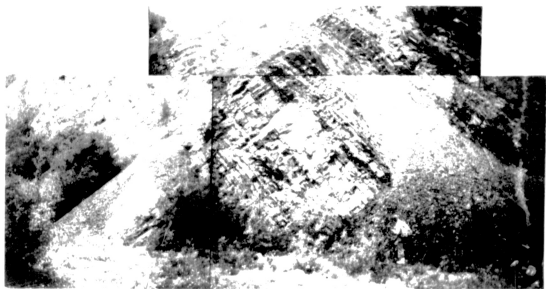


Figure 4 - Powell Creek

Evenly-bedded northeast-dipping platform limestones of Lower Kee Scarp. Unconformity suggested by bevelling of massive light-colored limestone above Dr. Scherp. (locality 2)



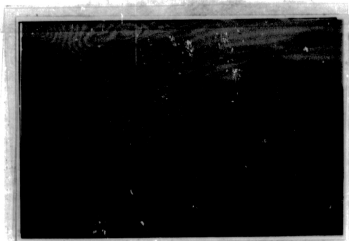


Figure 5 - View west across Powell Creek

Brown jagged rocks in left foreground are Upper Bear Rock overlain by brownish-grey talus covered slopes of Lower Hume. Three resistant lighter grey limestone beds are in Upper Hume, the one on the left of the gully being Leiorhynchus castanea horizon (Figure 3). Gully is eroded in grey recessive Hare Indian shale which grades upward into brown Lower Kee Scarp and location of Figure 4. Overlying apparently less steeply dipping brown limestone and grey shale are probably balance of Lower Kee Scarp and "Unnamed beds" of Braun (1966). West Powell Creek visible at right of photograph. Hogback in right background is Figure 2.

Photo courtesy of Scherp. (Localities 1 and 2)

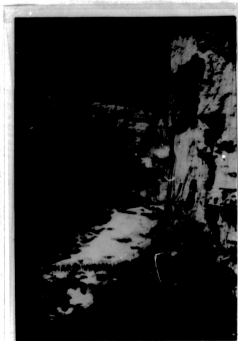


Figure 6 - View north down Gayna River.

Dark shales at lower right are Hare Indian transitional into overlying light Lower Kee Scarp and Rensselandia laevis (Meek) horizon. Overlying Canol shales are hidden behind Lower Kee Scarp dip-slope. Imperial formation in cliff at left background. (Locality 3)



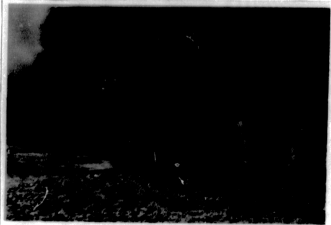


Figure 7 - Dodo Creek

Leiorhynchus castanea horizon at top of Hume formation
on west bank of creek.

Photo courtesy of Scherp. (Locality 4)

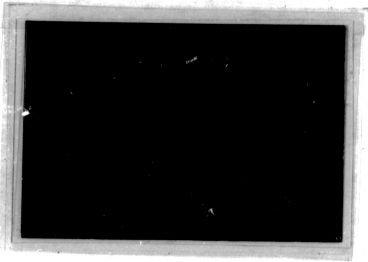


Figure 8 - Carcajou Canyon

Evenly-bedded grey Mount Kindie dolomite dips north and
is overlain by brown breccia of Bear Rock formation.

Photo courtesy of Scherp. (Locality 5)

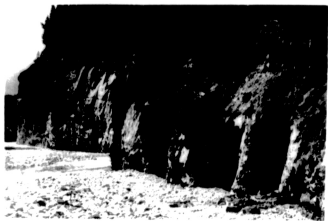


Figure 11. Beach, Island.

1900. Middle of island is covered by low, dense forest and on west bank of stream.

Photo courtesy of Senepe. (Locality 4)



Figure 12. Beach, Island.

2000. Beaches of Island. Beach is covered by low, dense forest and on west bank of stream.

Photo courtesy of Senepe. (Locality 4)



Figure 9 - Carcajou Canyon. Reefoid Lower Hume formation.
Photo courtesy of Scherp. (Locality 5)



Figure 10 - Kee Scarp Quarry
Massive reefoid limestones of Upper Kee Scarp on the right
separated by normal fault from bedded off-reef Kee Scarp and
overlying burnt shale on left. Beds dip southwest.
Photo courtesy of Scherp. (Locality 8)



Figure 9 - Caradigan Canyon - view into lower scarp formation.
Photo courtesy of Scherp. (2004, p. 12).



Figure 10 - Kee Scarp (2004).

Massive red-brown limestone of Upper Devonian age, which is separated by normal faulting from series of smaller, less steep and overlying burnt shale on left. (2004, p. 12).

Photo courtesy of Scherp. (2004, p. 12).

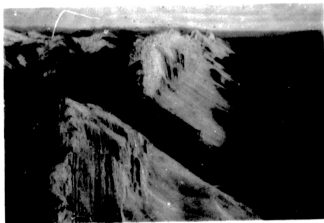


Figure 11 - View north along west limb of Trench Lake syncline. Ridge composed of white massive Landry limestone underlain by recessive-weathering Funeral shale and overlain by evenly-bedded brown argillaceous limestone of Headless and Nahanni formations. Photo courtesy of Scherp. (East of Locality 15)



Figure 12 - Landry Creek

brown Nahanni limestones containing Delonichthys castanea at top overlain by black fissile shales mapped as Upper Devonian Fort Simpson by Douglas and Norris (1961). Beds dip west into Delorme syncline. Photo courtesy of Scherp. (Locality 15)