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Geology and Geological Structure of the Alberta and Saskatchewan Plains

William E. Topley

GEOLOGY AND GEOLOGIC STRUCTURE

OF THE ALBERTA AND SASKATCHEWAN PLAINS

by
WILLIAM E. TOPLEY

A Thesis
Submitted to the Department of Geology
in partial fulfillment of the
Requirements for the degree of
Bachelor of Science in Geological Engineering

MONTANA SCHOOL OF MINES
BUTTE, MONTANA
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INTRODUCTION

The year 1947 was one of the most prominent, if not the most prominent, in the Canadian prairies' thirty-three year old oil history.

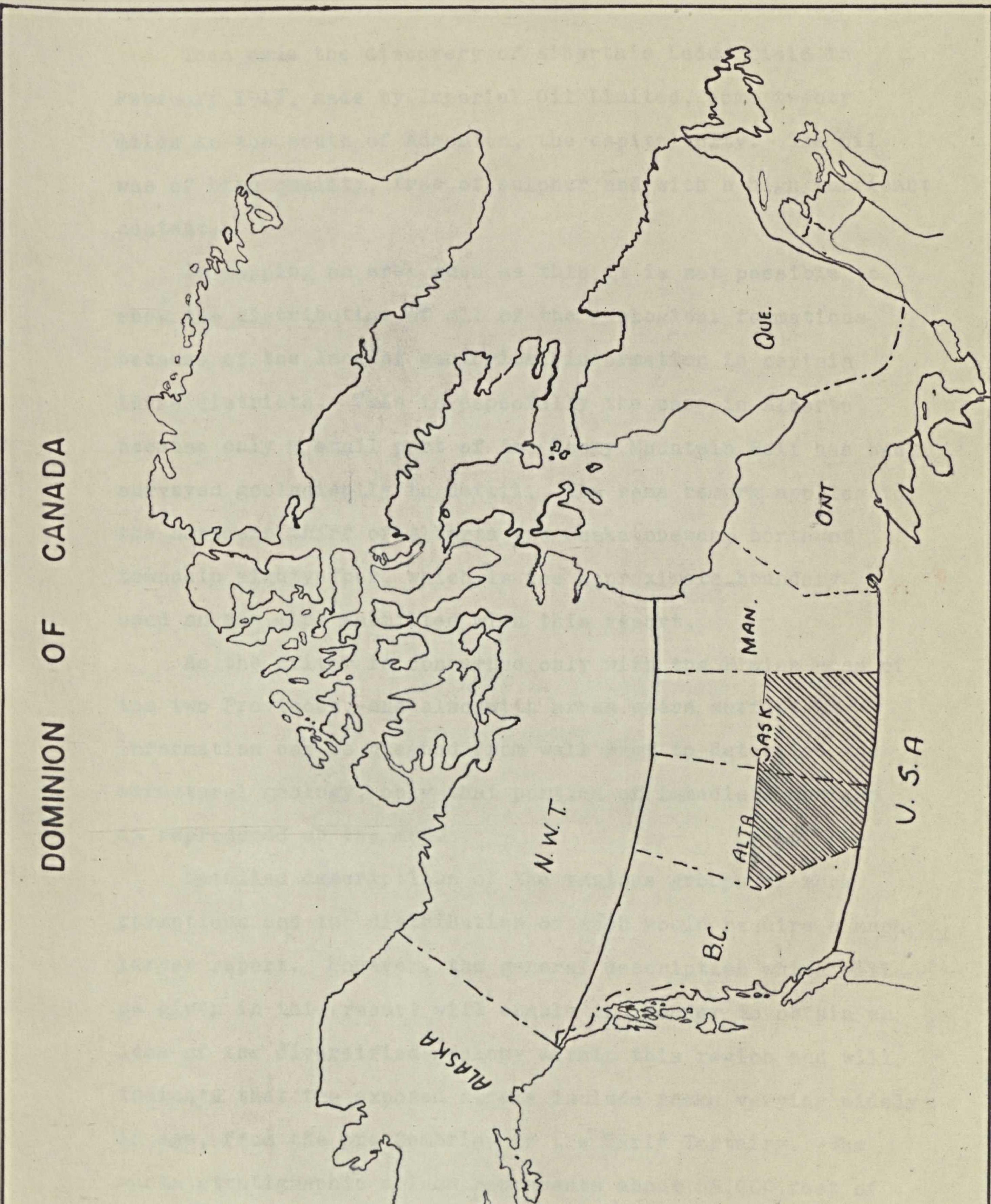
During this particular period the world was becoming acutely conscious of the oil shortage. The Western Hemisphere, both north and south, despite the enormous increased oil production of vast areas, was facing the general problem of keeping up with home demands. The immense oil areas of the Middle East, so vital to Britain and Western Europe, had become a prominent question mark in international politics. The Far East was relegated to the background for the time being by the ravages of war.

Alberta, responsible for ninety per cent of Canada's output, had, by 1947 entered into her fifth year of production decline. Only ten per cent of Canada's oil requirements were secured from home fields. Ninety per cent had to be imported, mainly from the United States. How long could imports be maintained on present levels? During the year, the United States had started rationing in one sector of its domain. Would this become general? If so, what was the answer for Canada?

PLATE 1.

Map Showing Area Under Discussion

PLATE 1.



Then came the discovery of Alberta's Leduc field in February 1947, made by Imperial Oil Limited, some twenty miles to the south of Edmonton, the capital city. The oil was of high quality, free of sulphur and with a high lubricant content.

In mapping an area such as this it is not possible to show the distribution of all of the geological formations because of the lack of geological information in certain large districts. This is especially the case in Alberta because only a small part of the Rocky Mountain Belt has been surveyed geologically in detail. The same remark applies to the northern third of Alberta and Saskatchewan, north of township eighty-four, which is the approximate boundary used on the maps submitted with this report.

As the writer is concerned only with the Plains area of the two Provinces, and also with areas where sufficient information can be gleaned from well logs to determine the structural geology, only that portion of immediate concern is reproduced on the map.

Detailed descriptions of the various groups of rock formations and the distribution of each would require a much larger report. However, the general description which will be given in this report will enable the reader to obtain an idea of the diversified geology within this region and will indicate that the exposed strata include rocks varying widely in age, from the pre-Cambrian to the Early Tertairy. The whole stratigraphic column represents about 65,000 feet of strata. The thickness of each formation differs widely in different localities, so it is not possible to give an average thickness for any formation throughout the area. In general, the separate formations thicken from east to west. In many localities several formations may be missing. The absence of a formation may be due to the fact that the sediments were not deposited or they have since been eroded.

The area included in this report extends from the Rocky Mountains on the west, eastward to the 105 degree of longitude which does not include all of Saskatchewan but the western two-thirds of the Province or an area with Regina as its eastern boundary. The area is bounded on the south by the 49 parallel, the International Boundary, and on the north by the known and mapped geological boundary which is approximately the 56 parallel.

ACKNOWLEDGEMENTS

The author is especially indebted to Dr. Eugene S. Perry, Head of the Department of Geology, Montana School of Mines, for his invaluable advise and assistance in the preparation of this report. Mrs. Loretta B. Peck, Librarian, who aided in the search for reports and obtained publications related to the subject, that were not part of the school's library, also made the task much easier. In addition, I wish to express my gratitude to Mr. Goodall and F.K. Beach, of the Petroleum and Natural Gas Board, Province of Alberta, and to the officers of the Department of Mines of Saskatchewan for their generosity in supplying information.

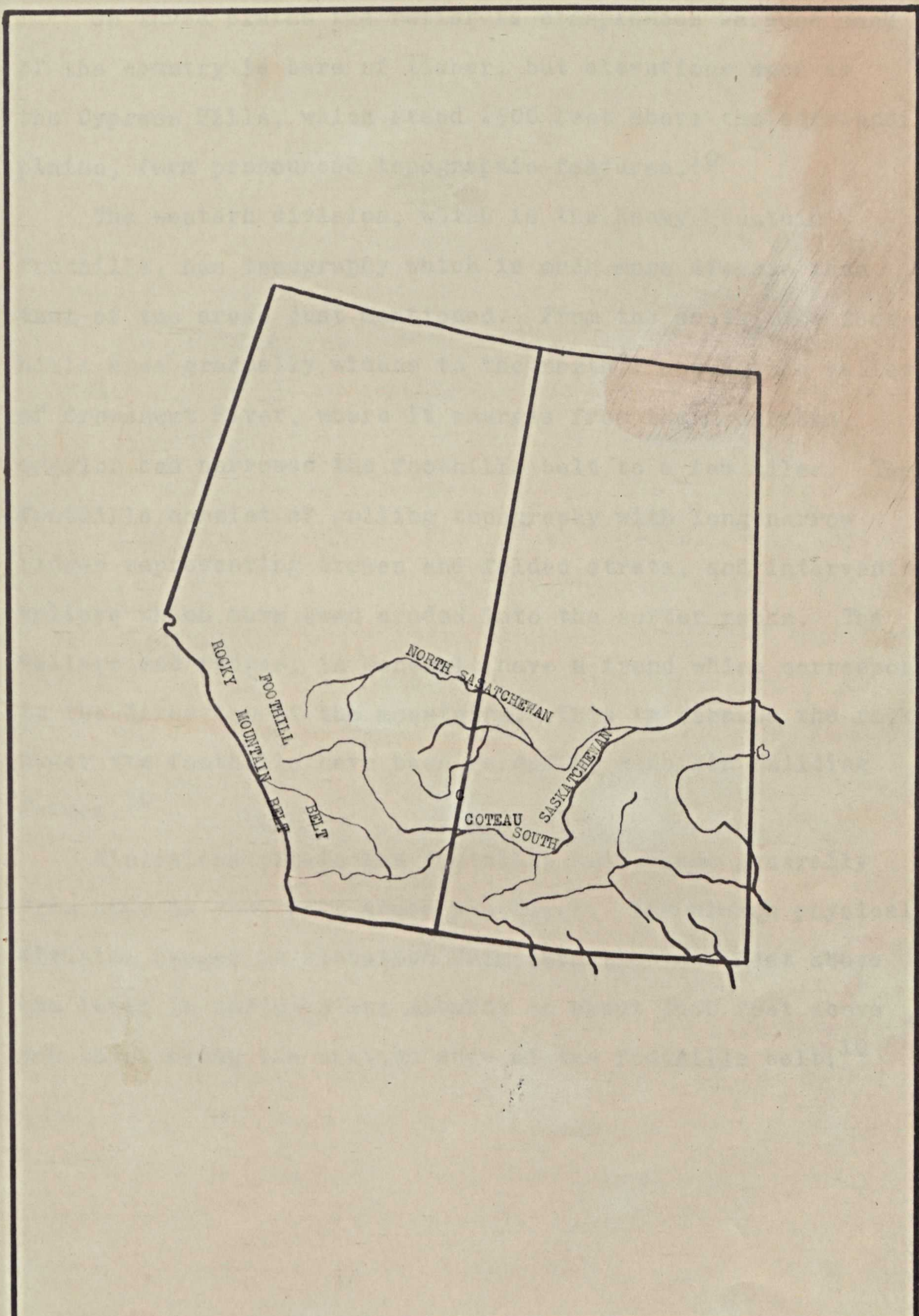
GEOMORPHOLOGY

The topography of the Northern Great Plains in Canada discussed in this report, consists of several diverse types, due both to structure and erosion. The most prominent feature, of course, is the western boundary - the Rocky Mountains. The area for approximately 1000 miles east of the mountains, although called plains, are, in reality, undulating table lands, which may be divided roughly into the following topographic divisions: the first is a plateau which has for its eastern edge the northeastern escarpment caused by the Cretaceous shaly deposits. This is not included in the area under discussion but lies farther east in the Province of Manitoba. The second division, mainly in Alberta and western Saskatchewan, may be considered as extending from the Coteau to the foothills, and consists of three sloping plains from which its present topography has been derived. The dividing lines between the three plains are; the water shed between the two branches of the Saskatchewan, and the valley of the Belly River. North of the Saskatchewan water shed, the country slopes generally northeasterly, and is drained radially by streams that run to Hudson Bay and the MacKenzie Valley. South from this water shed the slope is southeastward to the depression occupied by the Belly River. Still farther to the south the slope changes to nearly east, but following the valley of the South Saskatchewan, we find the slope extending northward from the Cypress Hills and Wood Mountain.[10]

PLATE 2.

Map Showing Physiographic Features

PLATE 2.



NORTH SASKATCHEWAN
ROCKY MOUNTAIN BELT
FOOTHILL BELT
COTEAU
SOUTH SASKATCHEWAN

On these plains the relief is conspicuous because much of the country is bare of timber, but elevations such as the Cypress Hills, which stand 2500 feet above the surrounding plains, form pronounced topographic features.[10]

The western division, which is the Rocky Mountain foothills, has topography which is much more diverse than that of the areas just mentioned. From the south, the foothills area gradually widens to the north; and in the valley of Crowsnest River, where it emerges from the mountains, erosion has narrowed the foothills belt to a few miles. The foothills consist of rolling topography with long narrow ridges representing broken and folded strata, and intervening valleys which have been eroded into the softer rocks. The valleys and ridges, in general, have a trend which correspondes to the direction of the mountains. This is because the rocks under the foothills have been folded by mountain building forces.[10]

Elevations within the foothills belt range generally from 3000 to 5000 feet above sea level. The plains physical division ranges in elevation from less than 800 feet above sea level in northwestern Alberta to about 3500 feet above sea level along the eastern edge of the foothills belt.[10]

GENERAL GEOLOGY

DESCRIPTION OF FORMATIONS

Pre-Cambrian

Rocks of pre-Cambrian age are exposed in the extreme northeast corner of Alberta and also in northern Saskatchewan. These pre-Cambrian rocks form part of the expansive pre-Cambrian shield, which occupies about 250,000,000 square miles of northern Canada, and in which valuable mineral deposits have been developed in Quebec, Manitoba, Saskatchewan at Gold Fields, and in the North West Territories at Yellow Knife and Great Bear Lake. To date no known mineral deposits have been found in these rocks in Alberta, but the indications are favorable for the occurrence of metallic minerals in this area. The rocks consist of highly metamorphosed volcanic and sedimentary types intruded by granite and other intrusive rocks. Large areas of pre-Cambrian rocks of sedimentary origin occur within the Rocky Mountains.[1]

Paleozoic

The Paleozoic formations overlap the pre-Cambrian of the Canadian Shield and crop out extensively among the folded and faulted strata of the eastern ranges of the cordillera. Paleozoic beds presumably everywhere underlie the younger strata of the plains, but may vary considerably in age , in character, and in thickness from place to place. There were intervals when parts of the region were above water and

PLATE 3.

A. Surface Distribution of Pre-Cambrian Rocks.

B. Surface Distribution of Paleozoic Rocks.

PLATE 3.

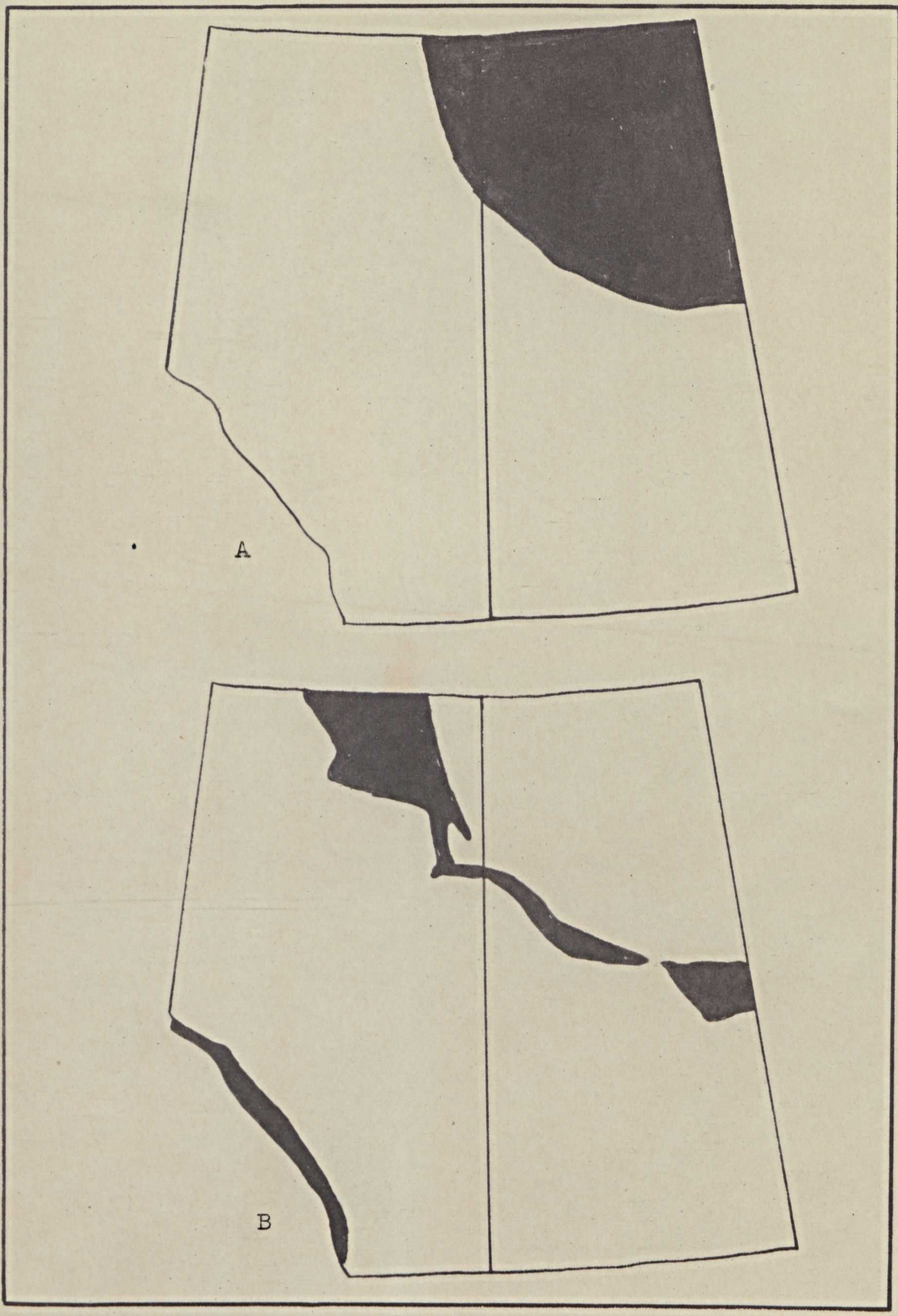


PLATE 4.

A. Surface Distribution of Mesozoic Rocks.

B. Surface Distribution of Cenozoic Rocks.

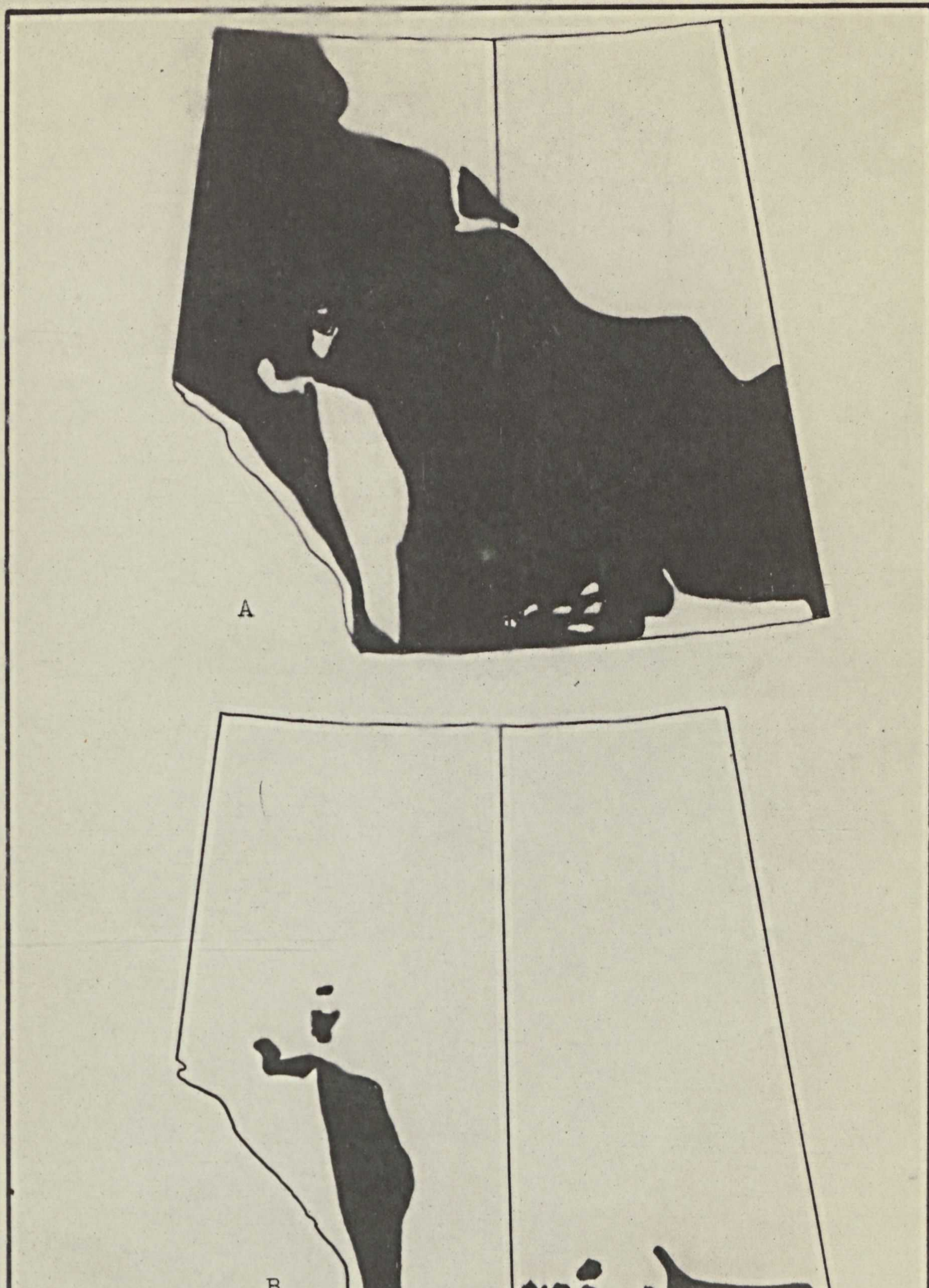
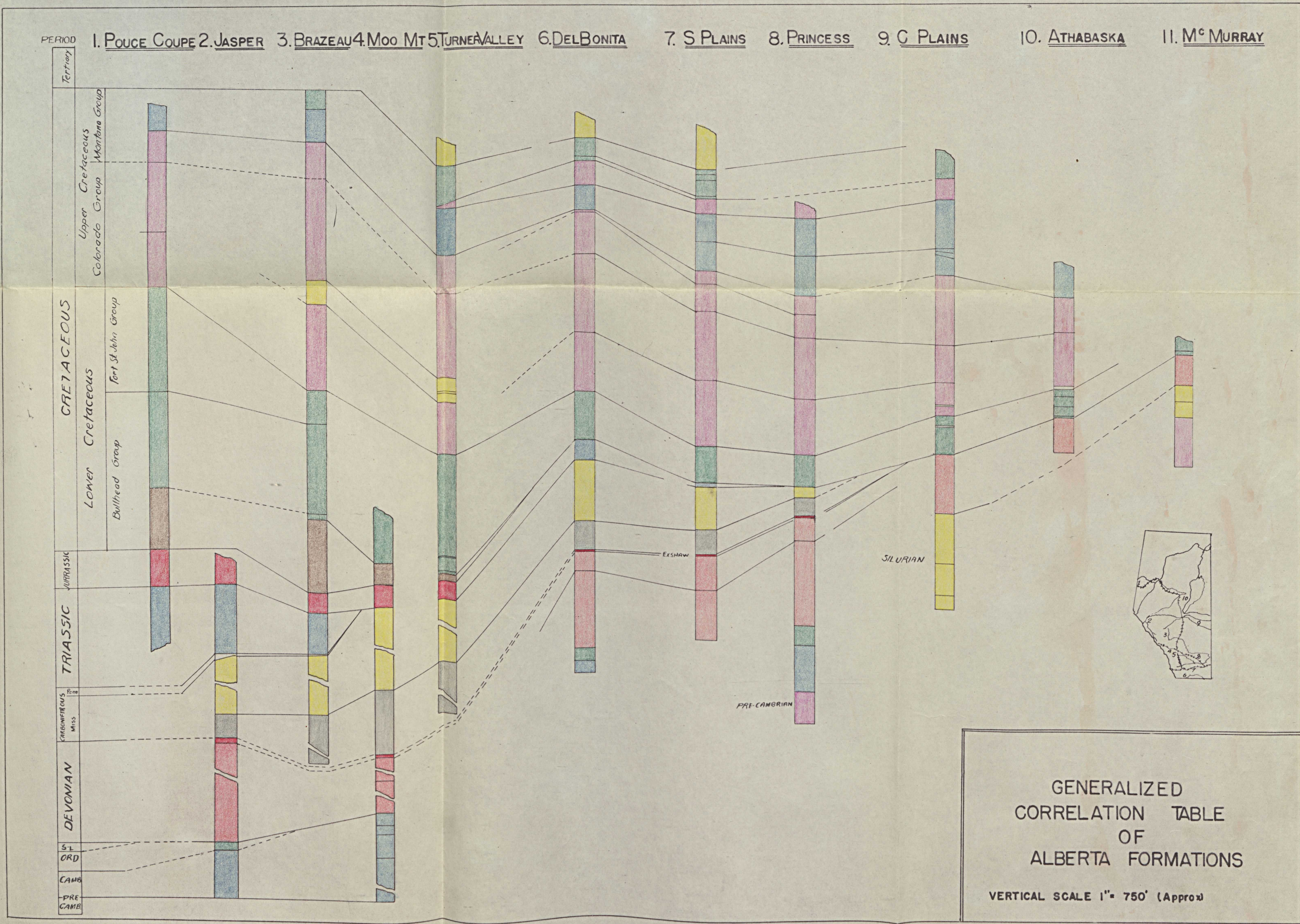

A
B

PLATE 5.

Correlation of Alberta Formations.[20]

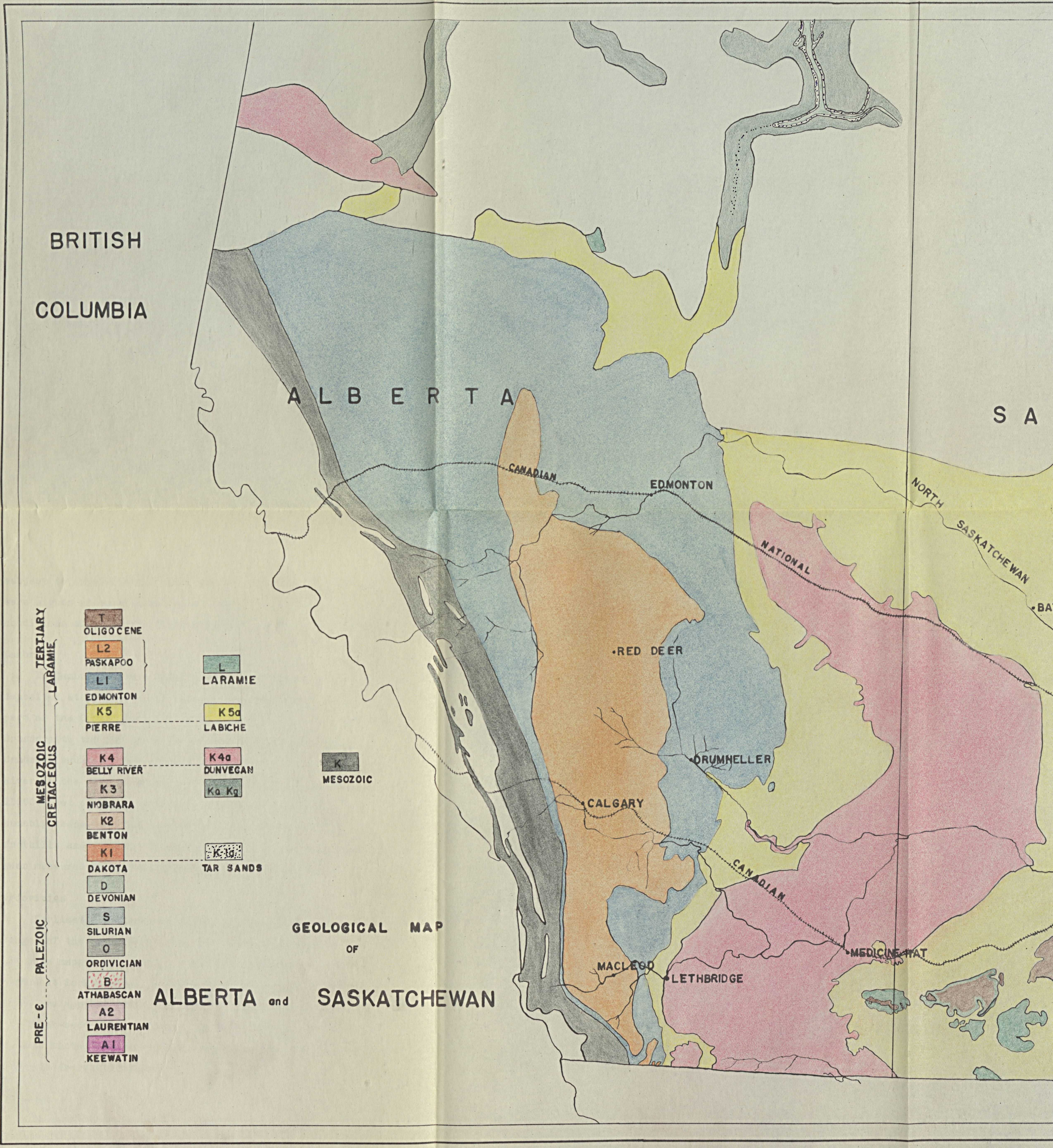


GENERALIZED CORRELATION TABLE OF ALBERTA FORMATIONS

VERTICAL SCALE 1" = 750' (Approx)

PLATE 6.

Geologic Map of Alberta and Saskatchewan Plains.[10]


BRITISH
COLUMBIA
ALBERTA
SA
CANADIAN
EDMONTON
NATIONAL
NORTH SASKATCHEWAN
RED DEER
DRUMHELLER
CALGARY
CANADIAN
MEDICINE HAT
MACLEOD
LETHBRIDGE
TERTIARY
LARAMIE
MESOZOIC
CRETACEOUS
PALEZOIC
PRE-Є
T
OLIGOCENE
L2
PASKAPOO
L1
EDMONTON
L
LARAMIE
K5
PIERRE
K5a
LABICHE
K4
BELLY RIVER
K4a
DUNVEGAN
K
MESOZOIC
K3
NIOBRARA
Ka Kg
K2
BENTON
K1
DAKOTA
K1a
TAR SANDS
D
DEVONIAN
S
SILURIAN
O
ORDIVICIAN
B
ATHABASCAN
A2
LAURENTIAN
A1
KEEWATIN
GEOLOGICAL MAP
OF
ALBERTA and SASKATCHEWAN

SASKATCHEWAN
MANITOBA
EDMONTON
NORTH SASKATCHEWAN
BATTLEFORD
NATIONAL
D DEER
SOUTH SASKATCHEWAN
SASKATOON
RAILWAY
DRUMHELLER
RY
CANADIAN
PACIFIC
REGINA
MOOSE JAW
RAILWAY
MOOSOMIN
MEDICINE HAT
LETHBRIDGE

subject to erosion while other parts remained submerged and were sights of continuous deposition. These varying conditions affected the distribution of individual formations.[13]

Cambrian

In Cambrian time a thick series of sediments was deposited at intervals, if not continuously along the eastern part of the Cordilleran region from south of the International Boundary to the far north in the MacKenzie Mountains. Cambrian sediments now exposed in the vicinity of the Bow River in the eastern Rocky Mountains comprise, more than 11,000 feet of sands, siliceous silts and limestones. Presumably these Cambrian beds extend some distance under the foothills and plains. Thicknesses up to 18,500 feet have been measured in the vicinity of Kicking Horse Pass.[1]

Ordovician

Earliest Ordovician sediments are exposed in the eastern ranges of the Rocky Mountains, but their distribution has not been mapped accurately. Ordovician strata crop out in northeast Saskatchewan, but the total thickness is not great. There are approximately 110 feet of strata made up of shales and thick-bedded limestones. The limestones are grays of various tints, are more or less argillaceous, and some of the beds are quite porous.[13]

Silurian

In northeastern Alberta upper Silurian rocks have been recognized where the beds crop out about eighty miles above the mouth of Peace River, and again in the vicinity of Fitzgerald and on Salt River, about twenty miles west of Fitzgerald. On Peace River the upper Silurian strata consists largely of gypsum which is exposed on both banks of the river almost continuously for a distance of sixteen miles. There are a number of salt springs at the base of the escarpment along Salt River and the brine in some of these is saturated with common salt. This indicates that the upper Silurian rocks in this part of Alberta contain rock salt. A narrow band of Silurian strata crop out in Saskatchewan and consists of hard, tough, light yellowish, dolomitic limestone with a thickness of approximately 200 feet.[13]

Devonian

Devonian rocks are very extensive in western Canada and presumably underlie younger strata under the whole of the Great Plains and foothills from the Manitoba lowland to the Rocky Mountains. Devonian rocks crop out along the western edge of the Canadian Shield in Saskatchewan, and are well exposed in Athabaska River north of McMurray in Alberta. Here the complete section, as determined by drilling, consists of 440 feet of alternating gray limestones and gray and greenish shales underlain by anhydrite and gypsum beds. Devonian strata crop out very extensively about the western end of Great Slave Lake and in the MacKenzie River Basin. In Alberta the formation is a fossiliferous grayish limestone interbedded with gypsum attaining a thickness of approximately 60 feet.[10]

Mississippian and Pennsylvanian (Carboniferous)

The Carboniferous is divided into Mississippian (lower) and Pennsylvanian (upper). Carboniferous marine strata of both upper and lower ages are widely distributed along the Rocky Mountains. They overlie the older Devonian strata. The Mississippian is represented by the Banff shale formation overlain by the Rundle limestone which, in turn, is overlain by the Rocky Mountain quartizite formation of Pennsylvanian or upper Carboniferous age. The massive limestone beds in the Rundle are commonly mountain forming limestones, and are found as cap rocks in many of the eastern ranges within the Rocky Mountains. The Carboniferous strata extend east from the front of the Rocky Mountains, under the foothills belt and plains, across the entire width of southern Alberta at least as far north as the latitude of Calgary. This eastward extension under the plains has been determined in wells drilled for petroleum and natural gas. It is not known how far north under the plains in Alberta the Carboniferous strata extend. The principal petroleum and natural gas horizon in Turner Valley oil field, and in other districts drilled in the foothills and plains, occurs in porous limestone beds within the upper 400 feet of the Mississippian strata. The total thickness of the Carboniferous strata is estimated to be 1100 feet in southern Alberta.[13]

Mesozoic

Triassic

Triassic strata crop out in narrow strips within the front ranges of the Rocky Mountains. The formation consists chiefly of shales, thin-bedded limestones, and dolomites with a thickness of about 3400 feet in the Banff area. Some of the lower beds consist of phosphatic shale. In the Big Horn Basin northwest from Nordegg, the Triassic is represented by cream colored dolomites and shaly limestones. Thick beds of good quality gypsum are known to occur in this formation on Peace River. No Triassic strata are exposed east of the foothills.[1]

Jurassic

Jurassic strata are present in the mountains and foothills and extend under a considerable part of the plains in southern Alberta and Saskatchewan. In the Blairmore area the Jurassic consists of 900 to 1000 feet of thin-bedded calcareous sandstones with light and gray shales. In the Turner Valley area the thickness is somewhat in doubt due to the difficulty of separating the Fernie from the overlying Kootenay, where it is probably not more than 220 feet thick.[13]

Lower Cretaceous

The Cretaceous is a thick series of non-marine and marine strata widely distributed over the plains and foothills. In western Canada in early Cretaceous time the area west of the present Rocky Mountains was uplifted and over the area of the present eastern mountains and foothills non-marine sediments with extensive coal seams were deposited. These beds constitute the Kootenay formation. It consists of coarser materials in the west than in the east, and the coal becomes less important and the formation becomes thinner to the east. Within the foothills the thickness of the Kootenay and the number of coal seams which it contains are quite variable.

The Blairmore overlies the Kootenay and is also non-marine. In the western foothills the basal Blairmore is a heavy conglomerate with intermingling beds of sandstone up to seventy feet thick. This basal phase thins rapidly eastward and disappears within the foothills. Where it is lacking, the division between the Kootenay and the Blairmore is difficult to determine and farther east in the region of the plains it is more convenient to refer to the equivalents as the Lower Cretaceous. If the interpretation of the Turner Valley section, which restricts the Kootenay to 100 feet or less, is correct, the Kootenay in the foothills shows a very rapid thinning eastward and, therefore, is unlikely to extend far under the plains. In the Crowsnest area, Southern Alberta, the Kootenay contains a great thickness of workable coal seams, whereas in other areas, formations of Blairmore age are important coal bearing members. Near the town of Blairmore in southwestern Alberta, the Kootenay has been determined to be 700 feet thick, and the Blairmore formation as 1850 feet thick.

Upper Cretaceous

The Upper Cretaceous in the foothills and plains consists of widespread marine and non-marine beds. In the southern foothills, marine shales of Colorado age overlie the Crowsnest volcanics, or, where these disappear to the north, the Blairmore formation. The base of the marine Colorado shales is marked by a fine-grained conglomerate, the "Grit" zone, varying from six inches to forty feet thick, and very persistent. The Colorado shales in the foothills pass without break upwards into marine shales of the Montana group and the whole series was formerly called the "Benton". The name "Benton" is not applicable, and in 1929 a new name, the Alberta shale, was proposed. The Alberta shale in the area south and immediately north of the Bow River is divided into a lower and upper part by bands of conglomerate and sandstone to which the name Cardium has been given. In mapping the western foothills areas it is not everywhere possible to determine a Cardium outcrop, and therefore in such places the boundary between the lower and upper Alberta shales may be incorrectly placed. All available evidence indicates that the Alberta shales, partly Colorado and partly Montana in age, extend from the foothills east beneath the plains region of Alberta and at least western Saskatchewan. The Alberta shale decreases in thickness from west to east from at least 2500 feet to approximately 500.

The Belly River formation overlies the Alberta shales in the foothills of southern Alberta. The Belly River as defined by Williams and Dyer, is equivalent to the Judith River of Montana. These strata, which range in thickness from 600 to 2000 feet, are represented by white sandstone strata cross-bedded; yellow, gray, blue, and greenish gray shales are common. On the Peace River the formation is probably represented by the Dunvegan beds, which are mainly of marine, brackish and continental origin with important coal seams.

On the plains of Alberta the Belly River non-marine beds are overlain by the marine Bearpaw formation. In the east, in Saskatchewan, where the Belly River thins and disappears, the Bearpaw marine shales directly overlie other marine Montana shales. The Bearpaw sea extended into the area of the southern foothills, and shales of this age are definitely recognizable on the east flank of Turner Valley. North of this area however, strata of Bearpaw age are not recognizable. In southwestern Alberta the Bearpaw is overlain by a relatively thin sandstone which L. S. Russell has called the Blood Reserve sandstone. This member thins northward and is replaced by the Fox Hills sandstone which may be younger than the Blood Reserve member.

In southwestern Alberta the Blood Reserve sandstone is overlain by the St. Mary River formation. It consists of non-marine sandstones and shales that are about 3000 feet thick in the foothills. In southeastern Alberta, particularly in the Cypress Hills area, the Bearpaw shales are overlain by the lower part of the Ravenscrag formation, consisting chiefly of interbedded brown sandstones and dark shales with some thin coal seams. In central Alberta the Bearpaw is overlain by the Edmonton formation, which in the Drumheller district is 1225 feet in thickness. The Edmonton formation contains several important coal seams.[13]

Tertiary

Eocene

The Eocene Paskapoo series overlies the central part of the area of the Edmonton formation, and extends from near the International Boundary northward beyond the 54 parallel. It is a fresh water formation, and consists of yellowish sandstone and blueish-gray and olive arenaceous shales with bands of ferruginous sandstone and concretionary blue limestone. In southern Saskatchewan the upper part of the Laramie is more arenaceous than the lower and is yellowish in color. It consists of relatively unconsolidated sands passing into soft sandstone, silts and clays. Maximum thickness is 750 feet.[1]

Oligocene

Beds of Oligocene age in Alberta occur as small areas capping three residual hills. House Mountain in the Swan Hills, south of Lesser Slave Lake, is capped by unconsolidated gravels of preglacial age but younger than the Paskapoo. Similar gravels, that have been unconsolidated to conglomerate, cap Hand Hills south of Drumheller. A third and larger area consisting of conglomerates, marls, and sands occurs on top of Cypress Hills in southeastern Alberta. These beds have been called the Cypress Hills formation.[1]

Pliocene

Beds, probably of this age, and known as the South Saskatchewan gravels, are found in preglacial depressions in southern Saskatchewan. There is generally a single bed of conglomerate 2 to 50 feet thick, composed of small quartzite pebbles either consolidated by a calcareous or ferruginous cement or lying loose in a sandy matrix.[13]

Quaternary

Pleistocene and Recent

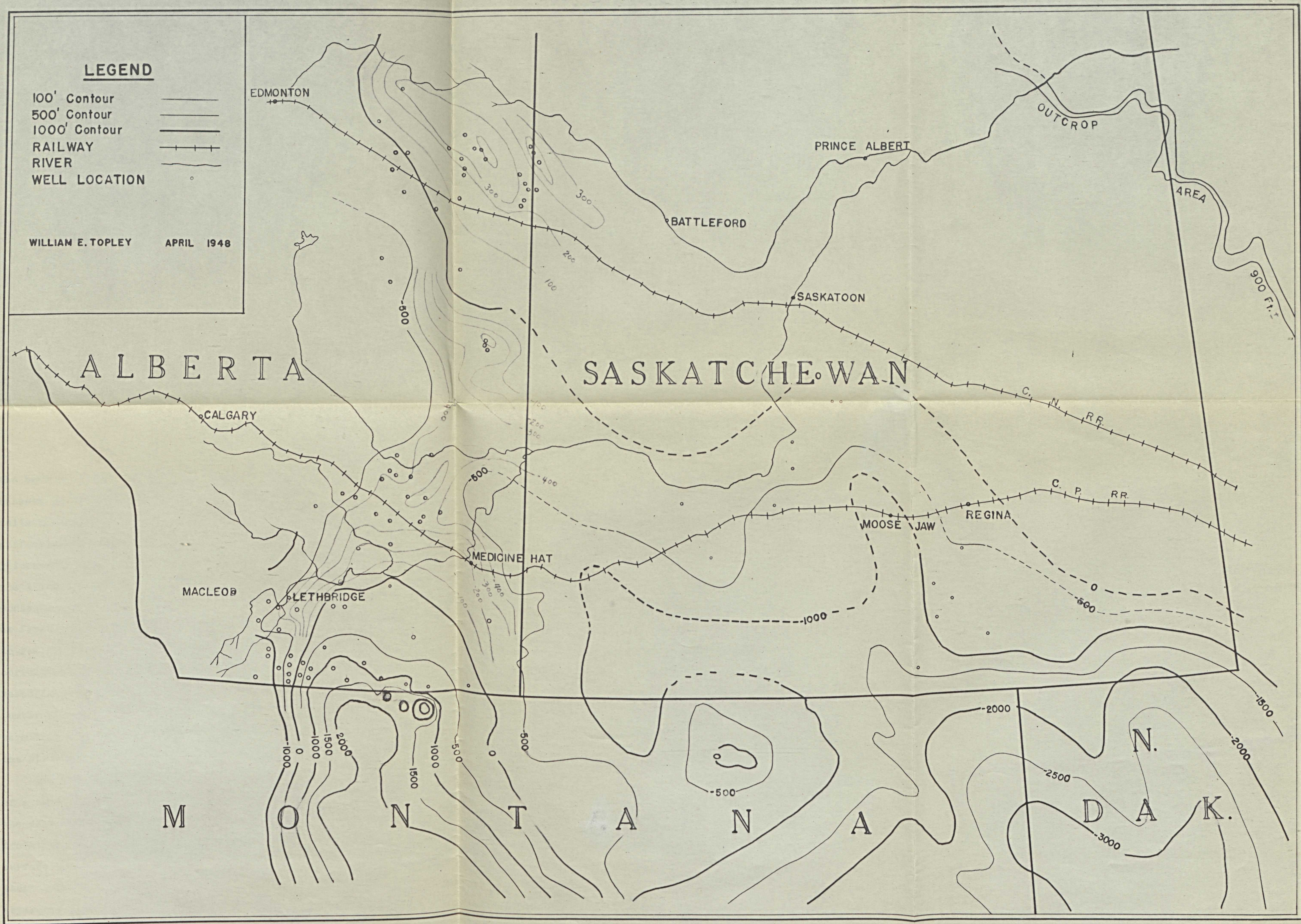
The younger and unconsolidated deposits of Pleistocene and Recent ages have not been mapped. These deposits consist of preglacial gravels, glacial till, boulder clay, alluvium, lacustrine and residual gravels, sands and clays, with local distribution of wind-blown deposits. The till of the Keewatin glacier does not always reach the eastern margin of the Rocky Mountain till, and possibly two distinct periods are represented. The eastern derived till forms a thin layer on the upland, and often appears to have been rearranged by deposition in water.[13]

STRUCTURAL GEOLOGY

In the general geologic study of this large area, dependance has had to be placed very largely on information gained from the beds outcropping at the surface; and existing geological maps have been prepared on that basis. It is true that from careful observation of the attitude of

PLATE 7.

Structure Contour Map of Southern Alberta and Saskatchewan, and Northern Montana.



STRUCTURE CONTOUR MAP OF SOUTHERN ALBERTA AND SASKATCHEWAN, AND NORTHERN MONTANA AS CALCULATED FROM WELL LOGS AND U.S.G.S.

CONTOURED ON BASE OF COLORADO SHALE

SCALE: 1 inch = 35 miles

the beds at the surface the general attitude of the beds beneath can be inferred, since a great thickness of apparently quite conformable strata underlies the plains; but, as perfectly uniformly deposited beds are rare, variations in thicknesses must be expected,,and the only absolute check on the thickness must be obtained from the drilling records. Consequently the aid of the drillers was sought, who, although at first reluctant to furnish the information, have now come to realize the benefit that follows the collection and correlation of these records, and they are now more readily respondant. Although the records contain details of a large number of wells, the deep wells are too few and scattered to permit of deductions being made with certainity in regard to the structure of the lower horizons over the region as a whole.[10]

The beds underlying the plains have, broadly, the form of a very large basin; that is, a bed which outcrops along the edge of the plateau to the east and is also found in the foothills, will be found at considerable depth beneath the surface between these two points. In this basin in Canada, there seem to be two very low points or depressions which are separated by a slight upraise. For the benefit of any non-technical student, the meaning of the term structure contours will be defined at this point. These contours are theoretical lines showing the form that the surface of the layer or bed under discussion would exhibit if the overlying material were removed. They are lines drawn through points of equal elevation of some particular geologic horizon.[10]

The necessity for a study of the structure contours of the various porous beds arises from the commonly accepted theory for accumulation of oil and gas that where these beds are porous, gas will seek the higher parts, and oil if present, will be found above the water saturation line. Borings have demonstrated that there is almost a certainity of finding salt water in certain beds in the lower parts of the basin. In the higher parts, where gas might be looked for, it is important to know whether or not the structure, or attitude, of the beds is favorable for the retention of the gas. An arch or dome structure is preferred, or, in cases where the beds crop out, the sealing of the upper part by surface water or asphalt residium must be assured. Although many beds of sand occur in the shallower deposits filling the basin it has been found that oil accumulations are to be looked for in the lower or older beds only, although occasionally asphalt lenses occur in beds high up in the section.[10]

An examination of the general distribution of the porous beds shows that in the foothills they contain an abundance of coarse, fragmentary material. Under the plains the amount of sandy material is much less than in the foothills. The great gas accumulation is to be found in sandy beds included in the lower part of the Colorado group. These beds are just above the horizon assigned to the Dakota formation which here is not well marked. Sands below the Dakota, which rests on shales of Jurassic age in southern Alberta and on Devonian limestones in the north, are impregnated with rather heavy oil; and in the foothills, in areas that have been subjected to much disturbance, with a much lighter oil.[10]

Difficulty was experienced in constructing a map to show the attitude of the beds holding the great gas flows, for it was found that the beds are not continuous. The irregular plain assumed is approximately that which separates the Colorado shale from the Dakota sandstones. In the eastern part of the area, the underlying bed is a sandstone; in Saskatchewan, it is made up of sandy shales or sands; and in Alberta, it is probably variegated green and red, sandy shales.

Records compiled from drillers logs of wells situated at various localities in Saskatchewan and Alberta were used in the preparation of the map which accompanies this report. The location of the wells is indicated by a small open circle on the map. A comparison of the details of the records of wells is useful where the wells are close together, but where wide areas separate them details are of small moment, and only the larger distinctions representing formations can be recognized. The observer is much aided in this study by a visual representation of the thicknesses in seeking the probable division lines. The plottings have , therefore, been prepared of a number of the sections and, an attempt has been made at a correlation. A careful study has shown that, although the observations recorded by the drillers are wanting in many respects, sufficient information can be gleaned from them for a very general comparison. There is

Royalite Oil Company to whose engineering staff we are indebted. The same company has also run levels to many wells in other areas if the operator doing the drilling did not also obtain that information. The larger companys have in most cases supplied the information respecting their wells, Geological data for wells drilled prior to 1927 have been gathered from numerous published and umpublished documents; Since that date examinations of drill cuttings has been made by the geological staffof the governmental agency currently responsible for supervision of operations. Interpretation of geological formation contacts has been the responsibility of the senior geologist currently employed and so far as possible we have quoted geological logs prepared by them. As time has passed, knowledge of the geological succession in various areas has progressed, and when later knowledge has shown that earlier correlations were in error or inconsistently reported, we have substituted revised names if recognizable markers permitted or if publications bearing evidence of better interpretations were available.

"Prior to the end of 1930, The Supervisory Mining Engineer of the Department of the Interior, Dominion of Canada, was responsible for supervision of the drilling operations. From 1931 to 1938 the Director of the Petroleum and Natural Gas Division, Department of Lands and Mines (Alberta Government) was responsible, and from 1938 to date The Petroleum and Natural Gas Conversation Board has been in charge. Examination of drill cutting samples and preparation of geological logs has been done by J. G. Spratt, W. P. Campbell, Vernon Taylor, R. M. S. Owen, W. C. Howells, J. R. Ower, D. B. Layer, Ian Cook, Mary Turner, D. G.Penner and others".[5]

The information on Saskatchewan drilling was supplied by the Provincial Department of Mines and Resources, this department supplied me with a large sheet with the compilation of fourteen deep-hole test wells drilled at various points in the Province. This program was carried on by Imperial Oil Limited and was known as the Norcanol Project.

The contours which were drawn from the above information were tied in to work done by Mr. Laird in North Dakota[16] and Messrs. Dobbin and Erdman, Structure Contour Map of the Montana Plains; U.S.G.S., 1946. By tying into this previous work done in the United States, a complete map of the general structure contour at the base of the Colorado is now available for the southern plains of Canada and the northern United States as far east as the 101 Meridian.

Due to the lack of sufficient information in certain large areas, no definite contours could be drawn but the probable or inferred contours were represented by a dotted line. Also in certain large areas sufficient information is lacking and the contour interval at most places is 500 feet. The author realizes that with such a large interval many structures ideal for occurrence of oil have been overlooked. But until the time that more information is available either from a concentrated drilling program or from results of geophysical work, the present map included in this report stands as complete.

In areas where sufficient information was available from wells drilled, the contour interval was reduced to 100 feet and upon looking closely at the map one will observe the complex structure plotted from the known data. There is no reason to believe that the structure in areas where the information is not so abundant would not also be complicated. The large scale upon which the map was drawn made it impossible to show the complete structure or all of the detail available even in a previously proven structure.

The map herewith presented differs somewhat from the previous maps prepared by L. S. Huntley[15] in 1915 and by D. B. Dowling[10] in 1919. The main reason for this is probably due to the fact that much more information was made available by the continued drilling program carried on by the various companys in their search for oil in the two priarie Provinces. Mr. Huntley[15] has a large syncline in the area south of Moose Jaw, more recent work has shown that this syncline lies farther to the south in North Dakota where it is known as the Williston Basin. The presence of this large syncline changes the trend of the contours from a north - south direction, inferred by Mr. Huntley, to more or less of an east - west trend.

The agreement with Mr. Dowling's[10] work is quite good in a general way, but, due to the small scale of his map and the large contour interval, it is impossible to say more than that, the general trend of the contours is about the same.

The folded and faulted regions of western Alberta, which includes the Turner Valley oil field was purposely ommited from the map because of the complex structure and numerous thrust faults which made it impossible to plot on a map to the scale of one inch equal to thirty-five miles. Structure contour maps have undoubtedly been prepared for this region by the various oil companys that have carried on a drilling program in the aforementioned area. This information has not been made public and therefore is not available to the writer.

Up to the time this report was written, no information had been published on the wells drilled in Alberta's new discovery field at Leduc. It has been learned by the author that this structure is an anticline with two producing zones in the Devonian limestone or dolomite. It has been said by Mr. J. B. Webb[28], Exploration Manager, Imperial Oil Limited, that the Leduc field may prove to be the turning point in Canada's oil production, as up to the present time, twenty-seven wells have been drilled and not one dry hole has been encountered. If this field meets expectations predicted by the geologists, Canada will soon become independant of any foreign sources of oil.[28]

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