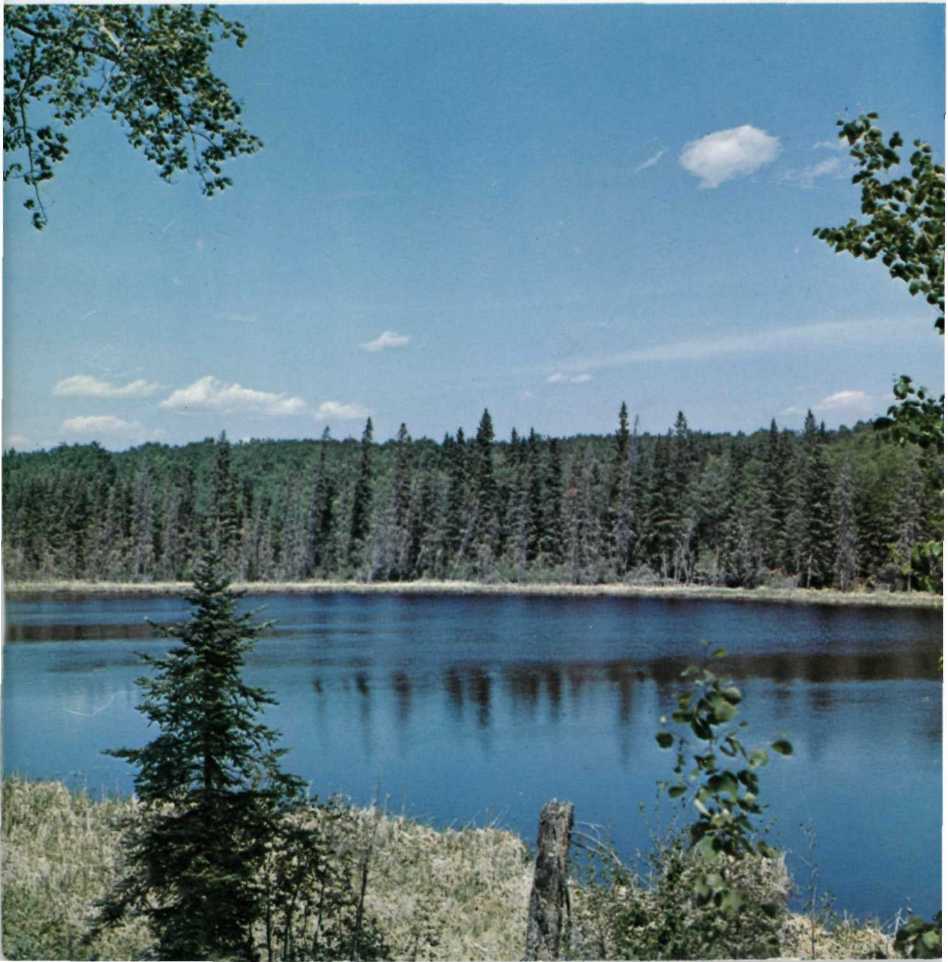
Guide to the Geology of
PRINCE ALBERT NATIONAL PARK
A Story of Hills, Lakes and Beaches

A. H. Lang



Cover —

Fairly round, small lakes such as this are probably 'kettle lakes' that fill depressions caused by the collapse of glacial drift after a buried, detached block of ice melted.

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ABOUT THIS BOOKLET

The main geological features of the park are described as non-technically as possible and the coverage is broadened to include interesting features that can be seen in the general region of the park.

Even if you have no knowledge of geology you can enjoy this booklet. The main geological processes involved are outlined and any additional technical terms are explained as needed.

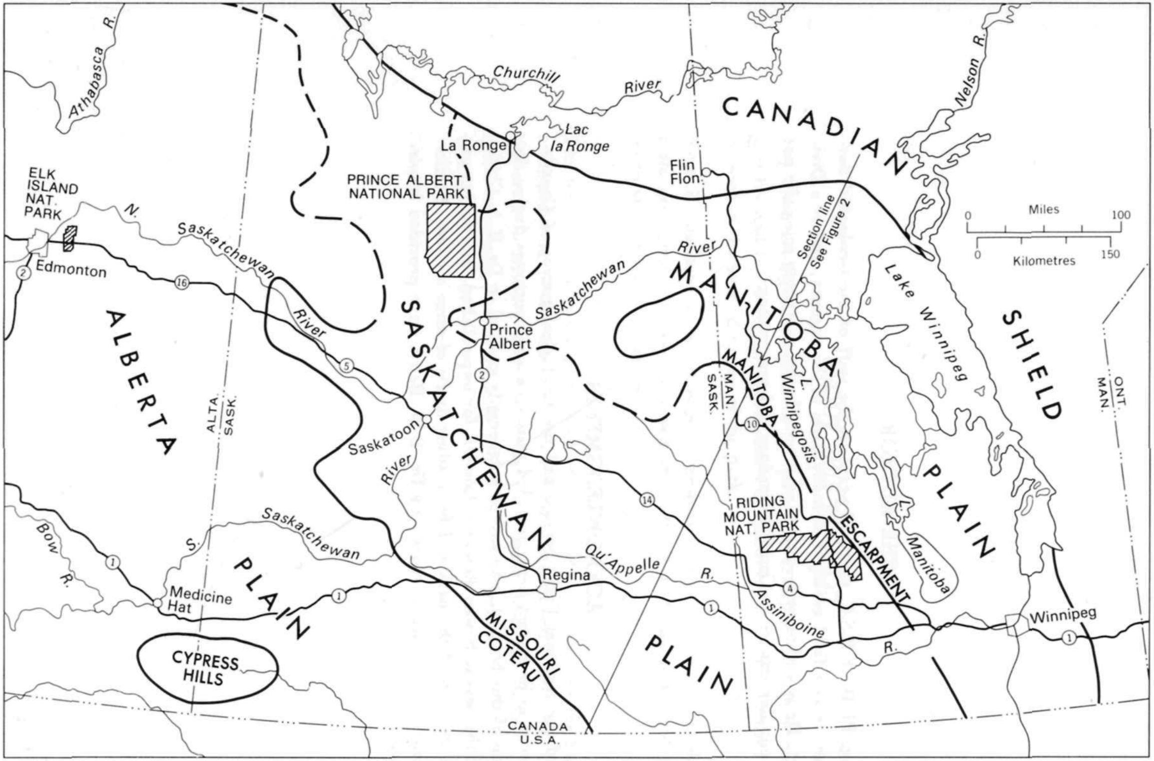
The best method of using the booklet is to study it before leaving home, and to obtain some of the maps or other literature mentioned at the end. Acquiring the book in advance would not only allow more thorough study at home or while travelling, but would help you to recognize interesting geological conditions along the way.

THE AUTHOR

A.H. Lang, Ph.D., F.R.S.C. spent 40 years on the staff of the Geological Survey of Canada as a field geologist in many parts of the country, and as a Division Chief. He is author or co-author of several books and many scientific papers and popular articles on Canadian geology and prospecting.

ACKNOWLEDGMENTS

Officers of the National Parks Service and the Geological Survey of Canada, too numerous to be named here, provided assistance and courtesies during the preparation of this booklet. The author is especially grateful to Dr. E.A. Christiansen of the Saskatchewan Research Council for unpublished information on the glacial deposits of the park and for reading drafts of some sections. Earlier publications in this series, prepared by Dr. D.M. Baird, have provided inspiring examples.

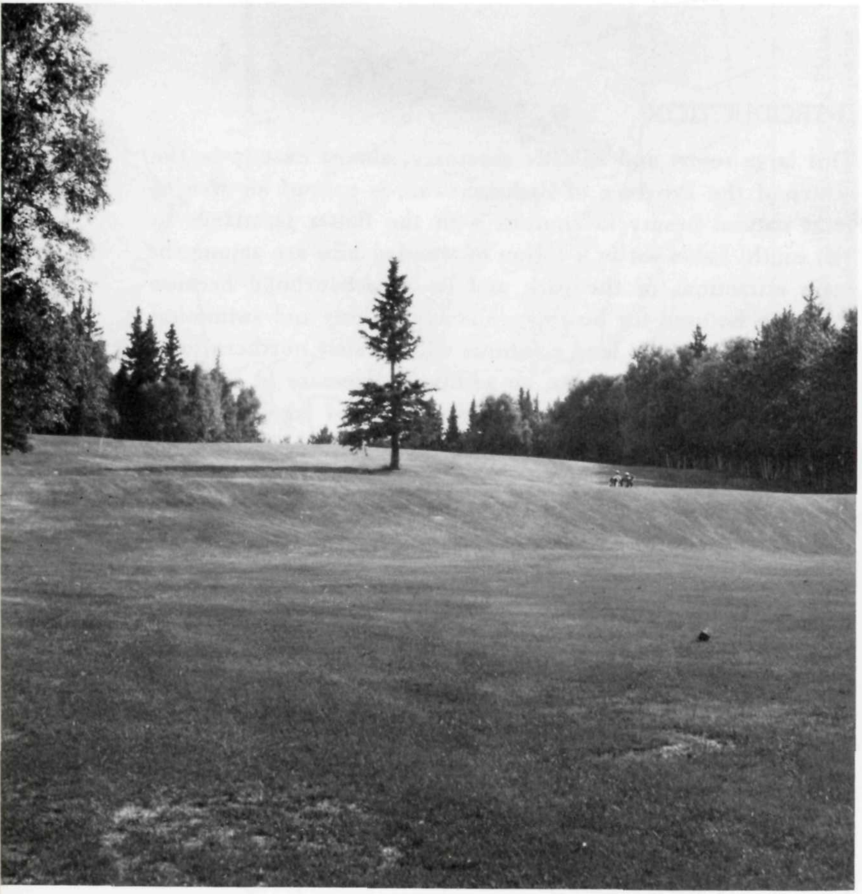


Prince Albert National Park and the two other National Parks in the southern part of the Interior Plains region, shown in relation to the Canadian Shield and the Alberta, Saskatchewan and Manitoba plains.

INTRODUCTION

This large resort and wildlife sanctuary, almost exactly in the centre of the Province of Saskatchewan, is part of an area of great natural beauty in contrast with the flatter farmlands to the south. Lakes set in a region of wooded hills are among the main attractions of the park and its neighbourhood because they can be used for boating, canoeing, fishing and swimming. The elevation of the land combines with a fairly northern location to provide cool nights, an additional pleasure in summer. Geological events caused the broad features of lakes and hills and also the scenic details, some of which are described later. Some understanding of them can add much to the enjoyment of a cruise along a lakeshore, a visit to a beach, a drive along one of the roads, or a walk on a trail.

Also, even a little knowledge of geology adds greatly to our understanding of the world, and man's place in it. This science is of special interest now because geology is fundamental to environment and ecology, which are now receiving more attention than ever before. For example, the geological history of a place determines its height above sea level, which has much influence on scenery and climate. The flatness or irregularity of land surfaces, which affects suitability for farming, road-building and such recreational activities as golf, is the result of geological processes. Geological conditions determine the kinds of soil, gravel and other overburden that blanket the bedrock of most regions. Climatic conditions, nature of the overburden, and to some extent, the type of bedrock, combine to determine suit-



The low hills and depressions of the golf course result from the moraine that covers the bedrock in this part of the park.

Waskesiu Lake and other fairly large lakes in the Interior Plains are generally in depressions caused by a combination of events in the local glacial history.

ability for farming and to influence the kinds of plants, forests and wildlife. The importance of geology in locating springs and wells, and in avoiding places that may be subject to landslides, is being increasingly recognized.

Like other National Parks, Prince Albert park was established for the benefit of Canadians and visitors from other countries, by setting aside areas of attractive territory in their natural state or under controlled development, and by preserving wildlife in their normal habitats. Examples of most of the visible geological features can be observed from roads open to the public or by walking short distances from them. Some features can be studied by driving slowly along a road but it is much better to park nearby and walk. Travel by water or long hikes will, in general, provide additional examples of the same features. The localities indicated on the accompanying map are, therefore, mainly the more accessible ones.

The collecting of specimens from the park is not permitted. The importance of leaving exposures intact so that they can be observed in their natural setting by those who come after cannot be emphasized too strongly.

BOUNDARIES AND ACCESS

The area of the park is 1,496 square miles. The southeast corner is, 'as the crow flies', 25 miles northwest of Prince Albert.

The main beach, at Waskesiu townsite, is almost straight. At its south end a prominent bluff, composed of compact, bouldery glacial till, helps to keep the beach from being eroded. The fairways of the golf course are to the right of the bluff. (NAPL photo) ▶

From this corner the east boundary follows the 106th meridian northward for 50 miles. The park is almost a rectangle, extending 30 miles west of the meridian, but the southwest border follows the winding north bank of Sturgeon River for about 20 miles.

Usually, the park is reached by driving about 50 miles from Prince Albert along Highway 2, which is paved as far as its junction with paved Highway 264. Within a few miles this passes through the East Gate of the park and leads to Waskesiu, a community administered by the National Parks Service, situated at the east side of the lake of the same name. An alternative route, Highway 263, branches from Highway 2 closer to Prince Albert, leads to an entrance at the southeast corner of the park, and then extends northward to Waskesiu. This is a more winding route, but as both routes pass through attractive scenery, going one way and returning the other has advantages. The south and west sides can also be reached by gravelled roads from the settled areas around Shellbrook and Big River.

A motor road extends from Waskesiu along the north shore of Waskesiu Lake. From this road, which is paved for about half its length, boats may be launched to provide access to two fairly large and very popular lakes, Kingsmere and Crean. A gravelled road open to the public extends westward from the south entrance, and then along the valley of Sturgeon River. Hiking trails and wardens' roads that may be used for hiking total some 150 miles.

THE REGION IN WHICH THE PARK LIES

Prince Albert National Park is in the southern part of what are classed officially as the Interior Plains of Canada, and although much of this vast area consists of true plains, many other parts,

including the park, are decidedly hilly. As shown in the sketch-map, the general region is divided into three main 'plains' or steppes; Prince Albert park is in the central one, known as the Saskatchewan Plain. Most of its surface varies from gently rolling to hilly, with elevations from 1,500 to 2,600 feet above sea level, but it contains some valleys as much as 400 feet deep and from 1 to 2 miles wide. Some are dry and others contain streams that are smaller than would be expected from the width of the valley. These valleys were formed completely or were enlarged from earlier valleys by floods of meltwater when the ice of the last Ice Age was wasting away.

The northern part of the Saskatchewan Plain is drained by tributaries of Churchill River, and the central part contains the North Saskatchewan and South Saskatchewan rivers. All drainage of this plain eventually enters Hudson Bay.

THE HILLS AND LAKES OF THE PARK

The park is located in one of the most hilly parts of the Saskatchewan Plain. The most prominent features are the Waskesiu Hills and Waskesiu Lake. The former is a large area of knobby summits and small lakes lying between Waskesiu Lake and the valley of Sturgeon River. The summits of several of these hills are more than 2,400 feet above sea level and more than 660 feet above Waskesiu Lake, and thus form a prominent feature that is a background for scenes along the east and north shores of the lake. The hills can also be seen to good advantage from the Height of Land Lookout near Highway 263, not far from the south end of Shady Lake, or by hiking along the Beartrap Creek trail. The areas north and west of Waskesiu Lake are more subdued, containing low hills lying between numerous lakes and streams.

The Waskesiu Hills form the main divide of the park. The crest extends from the vicinity of the Height of Land Lookout eastward along a ridge separating Beartrap Creek and Spruce River and then swings northward east of the headwaters of Sturgeon River. The waters south of this divide flow into Sturgeon River and then to Saskatchewan River. The streams and lakes immediately to the north flow into Waskesiu Lake. This empties by way of Waskesiu River into the south end of Montreal Lake, a long lake a few miles east of the park, which drains northward into the Churchill River system. Crean Lake empties into Montreal Lake farther to the north, by way of Crean River. A series of lakes along and near the north boundary of the park drain northward into the Churchill system.

THE UNDERLYING BEDROCK

The bedrock formations that form a platform beneath the gravel and other overburden of the park do not outcrop in or close to it. Much is known about these formations, however, from information on exposures farther to the north, from the results of drilling and geophysical surveys by oil companies in the general region, and from a single borehole put down in the park for the Saskatchewan Research Council.

The southern limit of the *Canadian Shield* * follows approximately the course of Churchill River about 100 miles north of the park. The Shield is formed of rocks whose ages range from about 3 billion to 570 million years. The Precambrian rocks that form the Shield and its southward continuation were cov-

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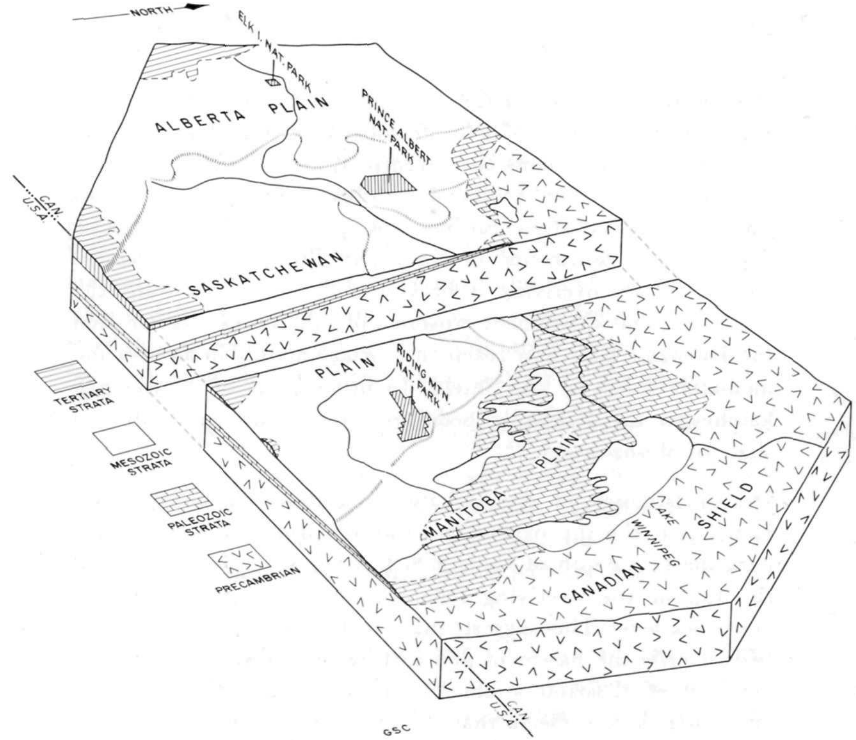
* Geological terms are printed in italics where first used and explained.



This 'block diagram' shows the structure of the rocks that underlie the southern Interior Plains. Because the height of the Alberta Plain above the Saskatchewan Plain, and the height of the Saskatchewan Plain above the Manitoba Plain, are small compared with the horizontal distances covered by the diagram, these heights have been exaggerated to make the relationship clearer. This causes an exaggeration of the thickness shown for the Mesozoic strata. The slope of the Precambrian 'basement' that extends east and south from the Canadian Shield has also been exaggerated, because this slope and that of the Paleozoic and Mesozoic strata above the basement are actually so slight that in any one locality the strata appear flat to the eye.

ered by seas at different times during the *Paleozoic* and *Mesozoic* eras (from about 570 to 65 million years ago) when thick successions of sediments that eventually turned into limestone, sandstone and other sedimentary rocks were laid down. At times the seas withdrew, causing erosion of earlier sediments, or deposition of sediments on land. The Precambrian basement and the strata overlying it became tilted slightly toward the southwest, and subsequent erosion wore the rocks away so that the Paleozoic beds now reach the surface mainly in an area immediately south of the Shield. In other parts of central Saskatchewan the Paleozoic beds are covered by sand, silt and shale of Mesozoic age.

Dr. Christiansen of the Saskatchewan Research Council estimated that the top of the Precambrian basement beneath the park lies at a depth of about 800 feet below sea level, and that the top of the overlying Paleozoic strata is about 600 feet above sea level. This suggests that about 1,400 feet of Paleozoic beds overlie the basement and in turn are overlain by roughly 600 feet of Mesozoic strata. The borehole already mentioned, and other data, indicate that the uppermost strata beneath the overburden of the park belong to the Ashville Group, which was deposited in a sea that existed late in the Mesozoic era.

THE PREGLACIAL LAND SURFACE

Erosion during Tertiary time (from about 65 to 1 million years ago) reduced the Mesozoic strata to a land surface which, by the time glaciation began, was more or less like the one seen today. Streams carved the main valleys and left the main hills and ridges between them. The preglacial North Saskatchewan River appears to have been approximately in its present location. Contours on the surface of bedrock, shown on a geological

map of Saskatchewan published recently by the Saskatchewan Research Council, show that in the Waskesiu Hills bedrock rises more than 1,400 feet above sea level. In the northern part of the park it rises to about the same height, and it rises to more than 1,600 feet above sea level a few miles north. The valley in which the present Montreal Lake lies may have been a main drainage feature in late Tertiary time, and the valley now occupied by Waskesiu Lake may then have been a southeastward-sloping feeder to the general 'Montreal' valley. These valleys may, instead, have been formed entirely by glaciation.

THE COMING OF THE ICE SHEETS

Ice that spread over most of Canada during the *Pleistocene epoch* had a greater effect on the present Canadian landscape than any other event in its long geological history. Important effects on the suitability of lands for agriculture and forestry resulted from glaciation.

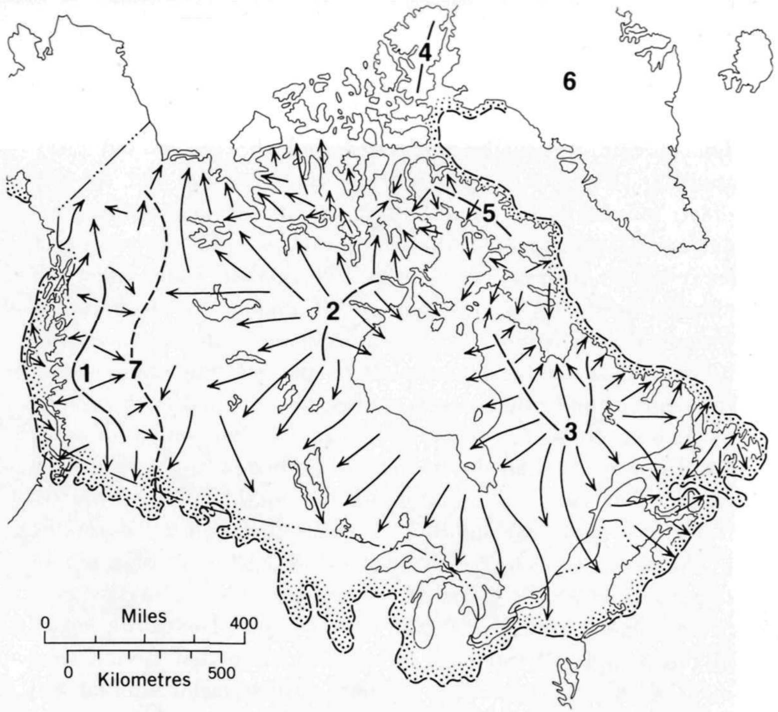
Pleistocene time began one to three million years ago — comparatively recently in a geological sense — when the climate gradually became colder, with the result that in summer, more snow remained in shady places than melted. Then snow began to remain in summer over larger and larger areas until the accumulation of snow eventually became so great that its weight caused the lower parts to crystallize into ice, thus forming *glaciers.* Finally the glaciers joined one another to form vast *ice sheets* thousands of feet thick, which flowed outward in a complex way resembling plastic flowage. Canada contains the largest area of glaciated terrain in the world, comprising 97 per cent of the country.

One of many exposures of glacial drift along roadsides in and near Prince Albert National Park.

The climate eventually moderated and the ice melted away gradually. Then the climatic cycle was reversed and the ice sheets formed again. Canada experienced four main glaciations during Pleistocene time, each lasting about 100,000 years and separated by interglacial intervals of longer duration, when the climate, as shown by the remains of plants, was as warm or warmer than it is now. Since each advance of the ice sheets obliterated most of the deposits left by the previous one, most of the deposits and other effects visible now resulted from the last glaciation, whose limits are shown in the illustration on page 14. In most of Canada the ice is estimated to have melted about 7,000 years ago, this date being considered by some authorities to mark the end of Pleistocene time and the beginning of the *Recent* epoch. Ice still remains, however, in high mountainous areas and in parts of the polar regions. This fact, and the relative shortness of 7,000 years compared with the length of the interglacial intervals, cause speculation that Recent time may be only the beginning of another interglacial interval and should be considered a continuation of the Pleistocene epoch.

Several theories have been suggested to account for the changes of climate that occurred during Pleistocene time, but none has been proved.

Glaciers and ice sheets are tremendously powerful agents of erosion and cause large deposits of rock debris. The ice erodes partly by forcing material in front and under it like a gigantic bulldozer, partly by freezing against rock and plucking it away, partly by freezing around boulders, gravel and soil and carrying them away, and partly by the abrasive effect of sand and larger fragments of rock frozen in the bottom or sides of a mass of ice like a bit or an abrasive set in a huge, slowly moving tool.



Generalized map showing farthest extent of ice in North America during the last Pleistocene glaciation, which greatly influenced present-day scenery by ice erosion of soils and rock, and by deposition of the resulting debris. The accumulation of snow and the resulting formation of ice caused flowage in different directions from ridge-like divides in the following localities: 1, Cordilleran; 2, Keewatin; 3, Labrador; 4, Queen Elizabeth Islands; 5, Baffin Island, and 6, Greenland. The largest ice sheet, formed by combining Keewatin and Labrador ice, is called the Laurentide Ice Sheet. The line marked 7 indicates the approximate eastern limit of the advance of Cordilleran ice, and the western limit of Keewatin ice. This map was modified from Map 1253A, *Glacial Map of Canada*, maps by V. K. Prest in the 4th and 5th editions of the *Geology and Economic Minerals of Canada*, and D. M. Baird in *A Guide to Geology for Visitors in Canada's National Parks*.

Material is also incorporated into ice by falling from the sides of valleys or being carried onto the ice by streams.

Erosion by glaciers and ice sheets results mainly in removal of most of the soil and rock fragments in their paths, and the wearing down, smoothing and scratching of the surfaces of bedrock or boulders. Generally, the depth of bedrock worn away was not great, but larger amounts were commonly eroded from the tops of hills and ridges and from the bottom and sides of valleys.

The debris from glacial erosion is left as a mantle of unconsolidated material overlying bedrock and filling or partly filling valleys and other depressions. As a result, no bedrock is exposed in some large expanses, and relatively little rock outcrops in most other parts of Canada, except in high mountains and some parts of the Canadian Shield. The general name for glacial debris is *drift*, which may be composed of rock 'flour', silt, sand, gravel, cobbles or boulders. Heterogeneous mixtures of such material are called *till*, and large deposits composed entirely or mainly of till are known as *moraines*. Another principal class of drift is *outwash*, which is composed of drift that has been sorted and transported by water from the melting of a glacier or ice sheet, thus forming stratified drift composed of layers of material of different sizes. Outwash may be deposited in a stream of meltwater, forming *fluvioglacial drift*, or the finer rock flour, mud or silt may settle as stratified *glacial lake deposits* on the bottom of a temporary meltwater lake.

Moraines are of several kinds, only three of which will be mentioned. As the ice flows forward debris is spread beneath it to form a mantle of *ground moraine*. When the ice melts and

Till containing many boulders, along the road between Waskesiu Lake and the golf course.

evaporates it is said to be receding; debris frozen in the ice or resting on top of it is released to form irregular patches of *recessional moraine* which commonly lie on top of ground moraine. A special type of recessional moraine called *stagnant ice* or *dead ice moraine* results from the eventual melting of a

Stratified sand and silt deposited in glacial meltwater at the end of the road along the north shore of Waskesiu Lake.

Hummocky stagnant ice moraine west of the south side of the valley of Spruce River.

large patch of ice that separated from a main ice sheet and remained stagnant after the surrounding ice had melted to a considerably distant location. Bodies of stagnant ice seem commonly to have been trapped on and around hilly areas in the Interior Plains region.

WHAT THE ICE DID TO THE AREA

The bedrock beneath the park and its vicinity is entirely covered by glacial drift of various kinds and thicknesses. These deposits, together with the lakes, which are also related to the glaciation, are responsible for most of the scenery. The visible drift appears to be related mainly or entirely to the last epoch of Pleistocene glaciation, as explained previously. Some of the deeper drift may, however, have resulted from earlier glaciation. It is estimated that the last ice left the area about 12,000 years ago.

The glacial deposits have not yet been studied or mapped in detail. Therefore, although the borehole mentioned earlier has provided useful data, most features are known only from reconnaissance and from a study of airphotos used to prepare the Glacial Map of Canada. Much has yet to be learned about the exact distribution of the different kinds of drift, their thickness, and the full origin of many of the lakes and other features. The accompanying map is believed to show fairly accurately the general distribution of the main kinds of glacial deposits, but the boundaries are approximate and, in places, speculative.

Moraines

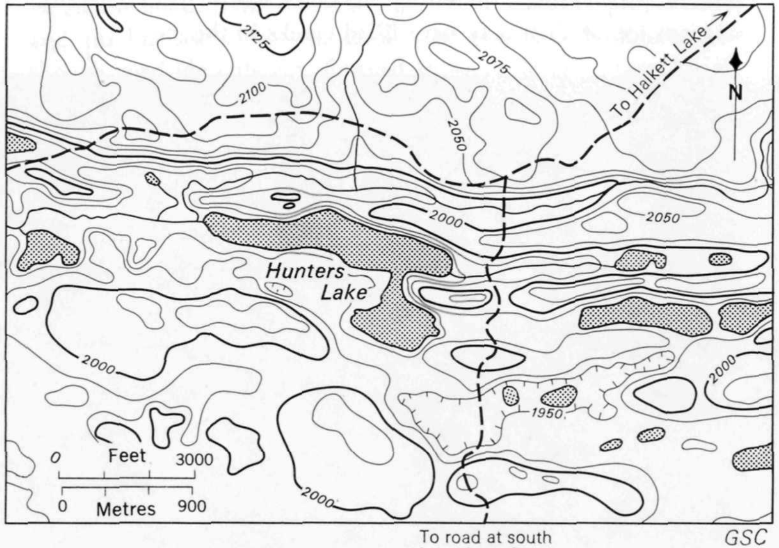
When the last ice sheet advanced over the land it left a blanket of ground moraine over most, if not all, of the park and its neighbourhood. This moraine consists of various proportions and thicknesses of gravel, sand, silt, clay and boulders. Although roadside cuts are slumped to some degree, examples of these deposits can be seen to good advantage along Highway 264 and the roads along the north and south shores of Waskesiu Lake. The golf course is in an area of fairly hummocky moraine, and the till that forms it can be seen in a large road embankment near the Waskesiu Lake Lookout. The course is in the general area of ground moraine, but is not typical of it.

A large area of probable stagnant ice moraine, much of which is very hummocky, extends from the south boundary through the Waskesiu Hills, then appears to extend east and north of Kingsmere Lake to the north boundary. A hike along some of the higher parts of the trail near the height of land would provide a good idea of the surface of this moraine. It appears to have been caused by the stagnation of a large block of ice trapped by the high ground indicated by the bedrock contours already mentioned, and probably rests at least partly on ground moraine. The difference between the estimated elevation of the bedrock 'high' in the Waskesiu Hills and the surface elevations suggests that the drift there is about 1,000 feet thick. The borehole mentioned earlier, which was drilled 2½ miles southwest of the First Narrows of Waskesiu Lake, encountered 894 feet of drift before reaching bedrock. It is not yet possible to estimate how much of these thicknesses is representative of different types of moraine.

Excellent examples of ridging parallel with the shape of the ice front can be seen on airphotos and by the contours of the Shellbrook and Halkett Lake sheets, in the southern part of the moraine between Lofthouse Brook and Halkett Lake. They are not as readily seen on the ground. These ridges may have been

pushed up by short, pulsating advances within the generally stagnant ice, or drift may have filled cracks in the ice.

Hunters Lake and other small lakes near it lie in depressions between more or less parallel ridges in the stagnant ice moraine in the southern part of the park. (NAPL photo)



Ridges parallel with shape of ice front occur in several places in the dead ice moraine in the southern part of the Wakesiu Hills. They are shown well by the 25-foot contours in this small area 4 miles north of the south boundary of the park and 8 miles west of Halkett Lake. This is locality 10 on the larger map. (From Map 73 G/9)

Glacial Flutings

In the southwest corner of the park, and west of it, are a series of parallel linear ridges and gouges, the latter containing lakes such as Snare and Amyot lakes. These glacial *flutings* were formed by the advancing ice sheet, which there moved southeasterly, probably being deflected by the high ground in the vicinity of the present Waskesiu Hills.

Snare Lake and other elongate lakes in the southwest part of the park lie in linear depressions gouged by the ice, which there moved southeasterly. (NAPL photo)

Effects of Meltwater

As the ice melted, huge amounts of water were carried in temporary streams and some was impounded for a time in lakes, either on top of the ice or on the moraines. The streams caused some sorting and redeposition of the drift, as can be seen now in banks of partly or completely stratified silt and other material. A large meltwater channel existed along or near the present course of Sturgeon River, and a smaller one appears to have formed the valley where Spruce River now flows.

Erratics

Large boulders, or *erratics* as they are called by geologists, were dropped by the ice in many parts of the park. These can be seen along the roadsides and also at many places in the townsite, where they have been used for retaining walls, fireplaces, etc. Most are granitic or gneissic rocks, such as form the harder and more resistant parts of the Canadian Shield. They were undoubtedly boulders or angular chunks that became rounded, were picked up by the ice somewhere in the Shield, and were probably carried several hundreds of miles before being dropped. An unusually large one, shown in the photo on page 28, was found at the landfill site at Waskesiu, and was moved to a position near the Administration Building in 1973. A study of these rocks would provide a good idea of the harder rocks of the Shield, and of the platform far below the park.

A smaller number of erratics in the park consist of white dolomite. A good example occurs at the east side of Highway 263, 1.7 miles north of the South Gate. A Park Warden stated that he had seen fossils in one such boulder. Although some limestone and dolomite occur in the Canadian Shield, these

The valley of Spruce River, shown here where it is crossed by Highway 263, was probably eroded by a stream of meltwater when the last ice was disappearing.

Erratics or 'field stones' form this wall around the pond at the golf course.

This large erratic boulder, along Highway 263 in the southeast corner of the park, consists of dolomite (magnesium carbonate), probably from the Paleozoic sedimentary rocks that border the Canadian Shield about a hundred miles north.

erratics probably came from the Paleozoic dolomite that outcrops or is now covered by overburden along the southwestern border of the Shield.

This huge boulder of hard Precambrian rock originated somewhere in the Canadian Shield at least 100 miles north of the park. Thousands of years ago, during the last Ice Age, ice froze around the boulder, slowly moved it southwest and dropped it amid gravel when melting took place near Waskesiu. The rock was found during excavations there and was placed on display near the Administration Building. (National Parks Service photo)

Lakes

With the possible exception of ponds dammed by beavers, all lakes and ponds resulted in one way or another from glaciation. Some, particularly in the area of hummocky moraine, may merely fill the depressions between hummocks and be the result of uneven distribution of drift. The medium-sized, round lakes, such as Namekus, Halkett and Crean, are probably, in part, *kettle lakes* formed by slumping after isolated blocks of ice covered by drift eventually melted; they may also partly result

The main beach at Waskesiu. The lake and the beach result from geological events.

from irregular deposition of drift or from being along meltwater channels. Kettle lakes are generally round because detached blocks of ice probably tend to melt to a more or less circular shape, and perhaps also because loose sand or gravel tend to take on round shapes.

A major meltwater channel may have extended southeastward along the present course of Waskesiu Lake, and continued southeastward to the 'Montreal' valley. If a large block of ice was insulated by drift in the area where the broader and deeper eastern part of Waskesiu Lake now exists, the depression caused by its melting would explain the location of the lake. The northern part of this channel, or a branch of it, may have extended through the present sites of Lavallée and Kingsmere lakes.

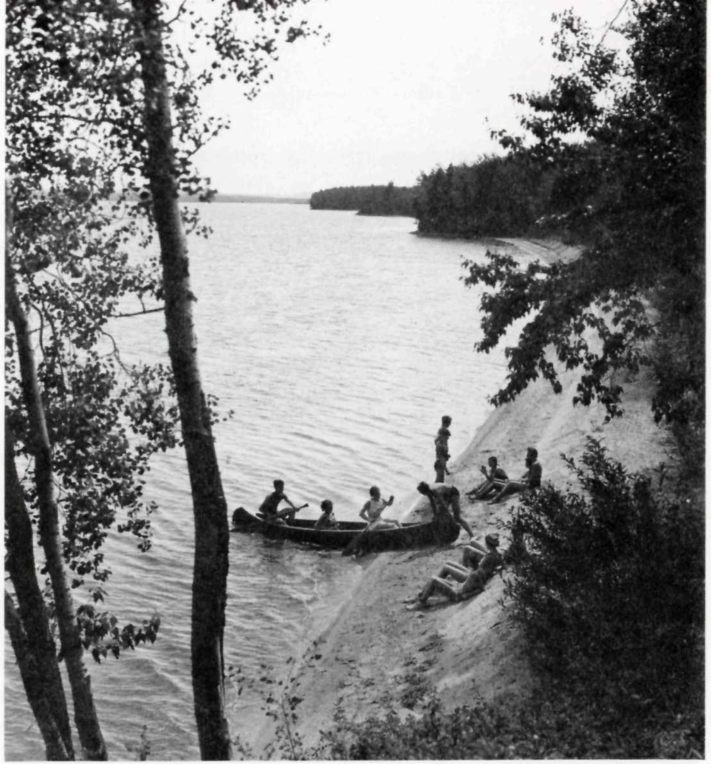
RECENT FEATURES

The most significant features that were formed comparatively recently are the beaches, which add so much to the scenery and enjoyment of the park. They have been caused by the action of waves eroding glacial drift, sorting out the sandier parts, and depositing it by backwash. Sand streaks of different sizes or colours that were created this way can be seen along the shores. The black streaks are mainly the black magnetic mineral *magnetite,* a common minor constituent of granites and rocks related to them and of sands resulting from their erosion. A feature of several beaches of Waskesiu Lake is the dark red to purplish sand, composed of grains of pink and orange garnet darkened by a little magnetite and amphibole.

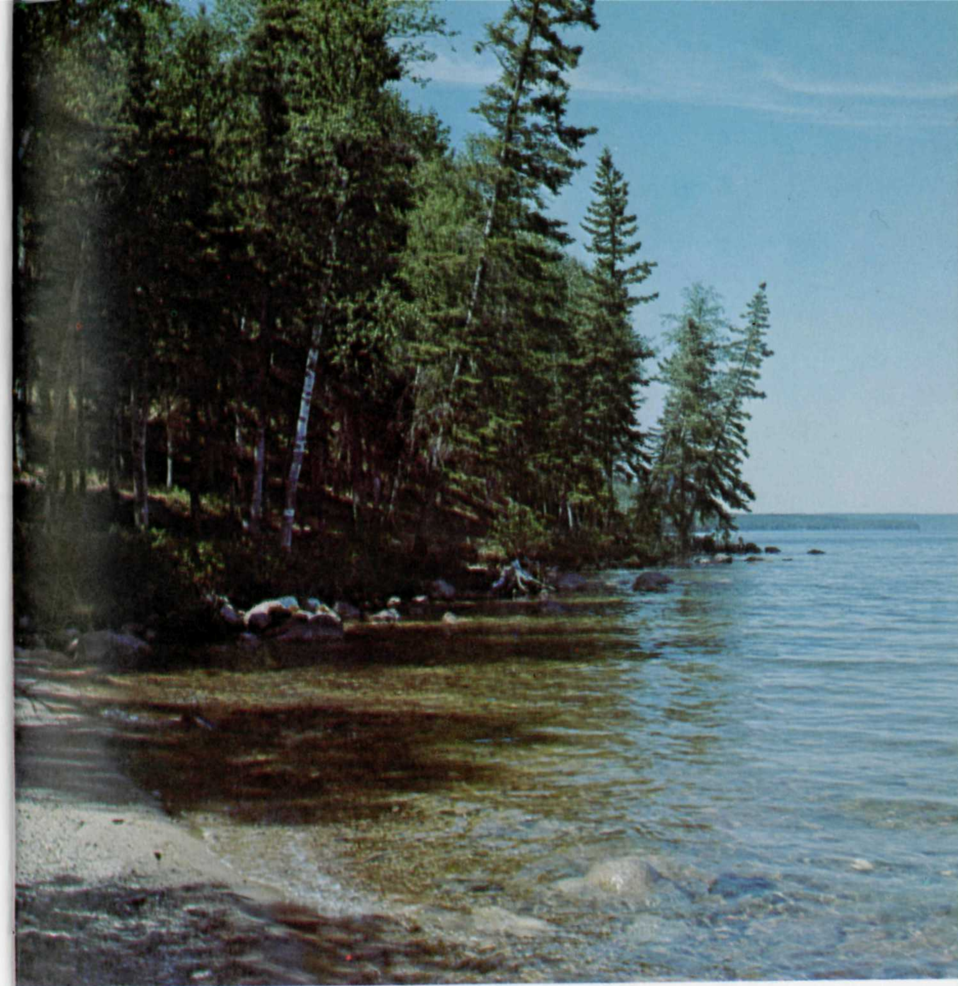
In general, the beaches appear to have been formed at places where the drift is especially sandy. At the east end of Waskesiu Lake it is evident that beaches are separated by bouldery points (small headlands) which probably represent more bouldery

The black sand streaks are composed largely of the heavy mineral *magnetite*, and are caused by the sorting action of the ebb and flow of waves.

parts of the drift. These headlands tend to protect the erosion of the beaches by along-shore waves or currents. The points at each side of the main bathing beach at Waskesiu have been stabilized by boulders hauled in and dropped on the ice in



This view of Waskesiu Lake illustrates one of the ways in which beaches occur. A series of beaches lie in coves separated by small 'points' (headlands). The points suffered less erosion than the intervening areas because the till there contains more boulders than the other parts, consisting mainly of sand and gravel. This is probably owing, in part, to the original, heterogeneous composition of the till, partly to later sorting by meltwater, and partly to recent washing by waves. The points act as breakwaters to prevent strong erosion and shifting of the beaches by along-shore winds and currents. (National Parks Service photo)



The south end of the main beach at Waskesiu townsite where the natural point has been augmented by boulders hauled and dropped as an additional protection. Beaches commonly occur between points of especially bouldery glacial drift, which protects the sand from along-shore winds and currents.

winter, as a further protection against erosion. The bluff at the south end of the townsite, where a lookout is situated, is made of particularly bouldery drifts. The base of this bluff has also been protected by boulders brought in for that purpose.

Small *deltas* and *spits*, or combinations of the two, occur along the shores of several lakes, notably at Waskesiu, Lavallée, Halkett and Montreal lakes. Spits are relatively long and narrow points made of sand commonly deposited by along-shore currents deflected – for one reason or another – by a curving shore, a rock or a patch of coarse gravel, or one or more logs or tree roots. Some spits have curved or hook-shaped ends, probably caused by refraction of waves from the sloping bottom of the lake. An interesting miniature spit can be seen in the process of formation at the south shore of Waskesiu Lake at the picnic ground, three miles east of the First Narrows.

In many places, expansion of the ice that covers the larger lakes in winter forces inland some of the sand and gravel lying along the shores. This causes ice-pressure ridges a few feet high, which may be located several feet inland from the water's edge. Examples can be seen at several places; an excellent one occurs at the explanatory marker near the north end of Wasagaming townsite.

The First Narrows of Waskesiu Lake is an interesting feature whose origin will require more study. A creek entering from the north side does not appear to be large enough to provide the material for the neck of land that projects from the north shore. Two creeks at the south side have no deltas. Although some of the material forming the neck may be sediment from the nearby creeks, the neck may represent a patch of high drift between two blocks of ice that melted to form depressions now filled by the parts of the lake above and below the narrows.

Typical glacial 'ground moraine' east and south of Crean Lake. Several small 'spits' formed of sediments deposited by currents can be seen along the shore. The moraine contains many ponds and bogs. (NAPL photo)

Waskesiu Lake, where a small, hook-shaped pile of sand called a spit is forming at the south shore.

Ice-pressure ridge near Waskesiu townsite, resulting from the expansion of winter ice on the larger lakes.

The First Narrows of Waskesiu Lake. The origin of the neck of land is not well understood because no detailed studies of the glacial deposits have been made. Two small 'spits' formed of sediments deposited by currents can be seen at the end of the 'neck' and two more are at the opposite shore.(NAPL photo)

Although small spits occurred at the end of the neck of land when the accompanying airphoto was taken, it does not seem probable that the entire neck could have been built by spits.

CONCLUSION

Reading this booklet and observing some of the examples described will have increased your appreciation of the scenery in and near the park, even if you have not grasped fully all the geological principles involved. It is not necessary to understand the details of geology in order to acquire a feeling for the processes that can be seen at work now, even if on a small scale, and to realize how these and other processes, operating over almost inconceivable lengths of time, resulted in development of the earth's surface and its inhabitants as we know them today.

Signs of erosion can be seen along most shorelines, stream banks and road-cuts. Little imagination is required to realize how this erosion is increased by storms or spring run-offs. Nature's balancing of erosion by deposition can also be observed in other places, although much of the finer sediment is carried farther away by the larger streams.

When you see a granite-like boulder, try to visualize the Precambrian basement, composed largely of rocks like this, that lies more than 2,000 feet below the surface of the park. Think of the seas that alternated again and again with swampy areas or lands well above sea level during the half billion years that have elapsed since the end of Precambrian time.

Some additional sources of information are listed below:

Map of Prince Albert National Park (uncontoured). Ottawa. Surveys and Mapping Branch, *Dept. of Energy, Mines and Resources.*

Shellbrook (73G) and Green Lake (73J) Sheets, contoured. Ottawa. Surveys and Mapping Branch, *Dept. of Energy, Mines and Resources.*

Halkett Lake (73G9) and Waskesiu Lake (73G16), contoured. Ottawa. Surveys and Mapping Branch, *Dept. of Energy, Mines and Resources.*

Geological Map of Saskatchewan. Regina and Saskatoon, 1972. *Dept. of Mineral Resources* and the *Saskatchewan Research Council.* (Shows bedrock geology and contours on bedrock surface.)

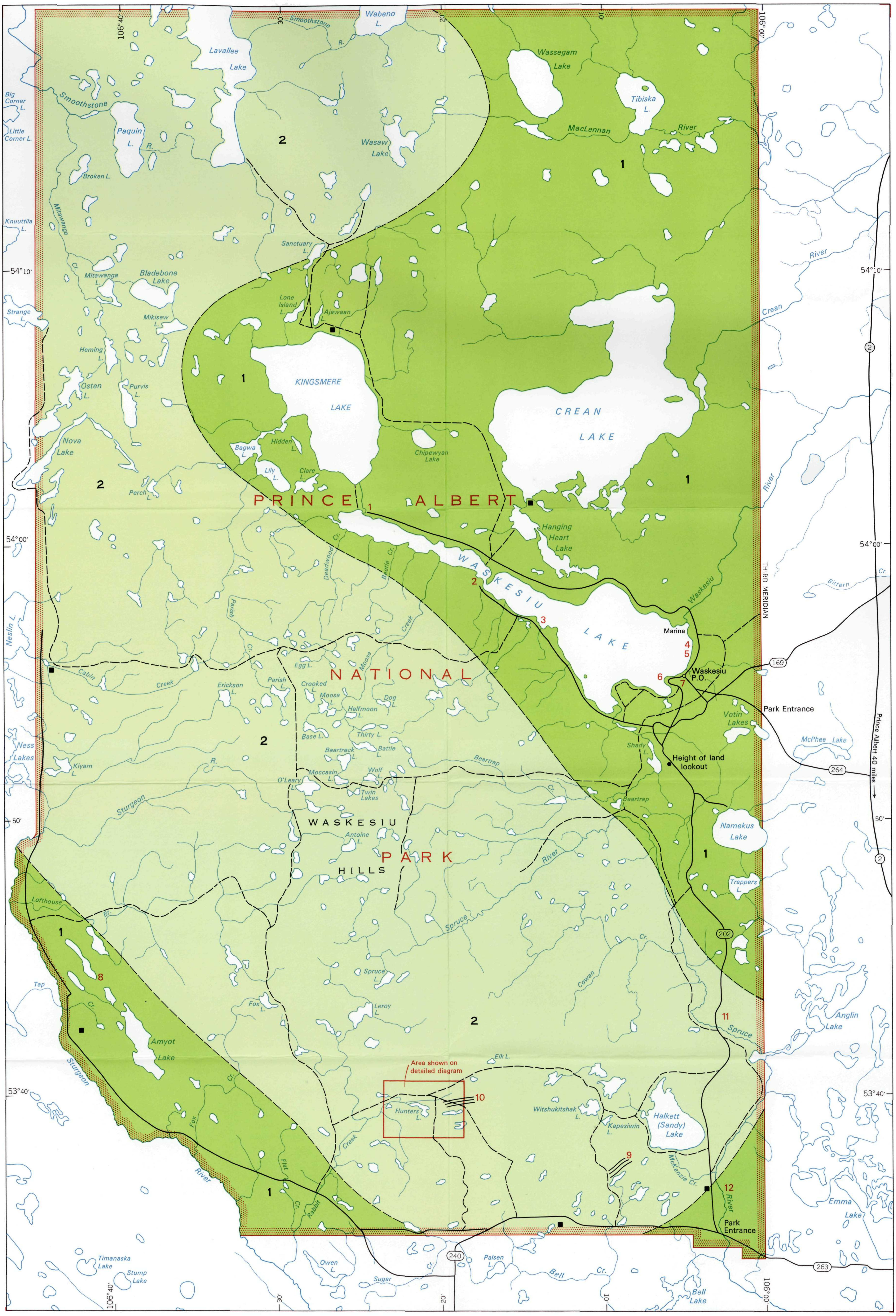
Any of the following publications would provide information on basic geology or Canadian geology in general :

Guide to Geology for Visitors in Canada's National Parks, by D.M. Baird. Ottawa, 1960. National Parks Service, National and Historic Parks Branch, *Dept. of Indian Affairs and Northern Development.* This is a pocket-size booklet containing 144 pages and 37 illustrations, which outlines in layman's language the general principles of geology with special reference to Canada's National Parks, and may be obtained from the National Parks Service (address given below) or from Information Canada.

Geology of Canada. A pamphlet obtainable free of charge from the *Geological Survey of Canada,* 601 Booth Street, Ottawa, Ontario, K1A 0E8.

Geology and Economic Minerals of Canada. An expensive, ($20.00) large, well-illustrated book containg much information on the geology of Canada. It was written with the expectation that the reader would have some knowledge of basic geology, but anyone who has studied the two publications listed above and who is particularly interested in obtaining further information on any part of Canada would find it helpful. It is accompanied by large geological, glacial and several other maps of Canada which can be obtained separately at $2.00 each from the *Geological Survey of Canada* at the address given above. The book can be obtained from that address or from Information Canada.

General information on the National Parks of Canada may be obtained from the Director, National and Historic Parks Branch, Dept. of Indian Affairs and Northern Development, 400 Laurier Ave. West, Ottawa, Ontario, K1A 0H4.



Map of Prince Albert National Park, showing principal kinds of glacial deposits, points of special geological interest, roads and main trails.

LEGEND

2	*Mainly hummocky dead-ice and disintegration moraine*
1	*Mainly ground moraine. Includes areas of hummocky moraine, water-deposited drift and, probably, other kinds of drift*

Ridges formed parallel with front of ice lobe or block . . . .

Geological boundary . . . .

Park boundary . . . .

Public road . . . .

Trail and wardens' road . . . .

Wardens' cabin . . . . ■

Scale 1:190,080

Miles 3 0 3 6 Miles

Kilometres 3 0 3 6 9 Kilometres

Geology in part from Glacial Map of Canada (1253A)

Geological cartography by the Geological Survey of Canada

Base-map cartography by the Geological Survey of Canada from maps published at 1:250,000 and 1:150,000 scale by the Surveys and Mapping Branch and a map published by the National Parks Service

POINTS OF INTEREST

1. Section of soil, top soil and unaltered stratified drift, at end of road
2. First Narrows, Waskesiu Lake
3. Small spit in process of formation
4. Garnetiferous sand
5. Ice-pressure ridges
6. Bluff of bouldery till
7. Hummocky moraine at golf course
8. Glacial flutings in drift, shown by long, narrow lakes

9, 10. Series of ridges in moraine, parallel with front of stagnant or disintegrating moraine

11. Meltwater channel, now occupied by Spruce River
12. Several glacial erratics along road in this vicinity including one large boulder of dolomite

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