Guide to the Geology of
ELK ISLAND NATIONAL PARK
The Origin of its Hills and other Scenery

A. H. Lang

Cover —

Astotin Lake, the largest in Elk Island National Park, is one of the chief attractions. (National Parks Service photo)

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ABOUT THIS BOOKLET

This booklet describes, as non-technically as possible, the main geological features of the park itself and also some of its surroundings. Even if you have no knowledge of geology you can enjoy this booklet. The main geological processes involved are outlined and additional technical words are explained as occasion arises.

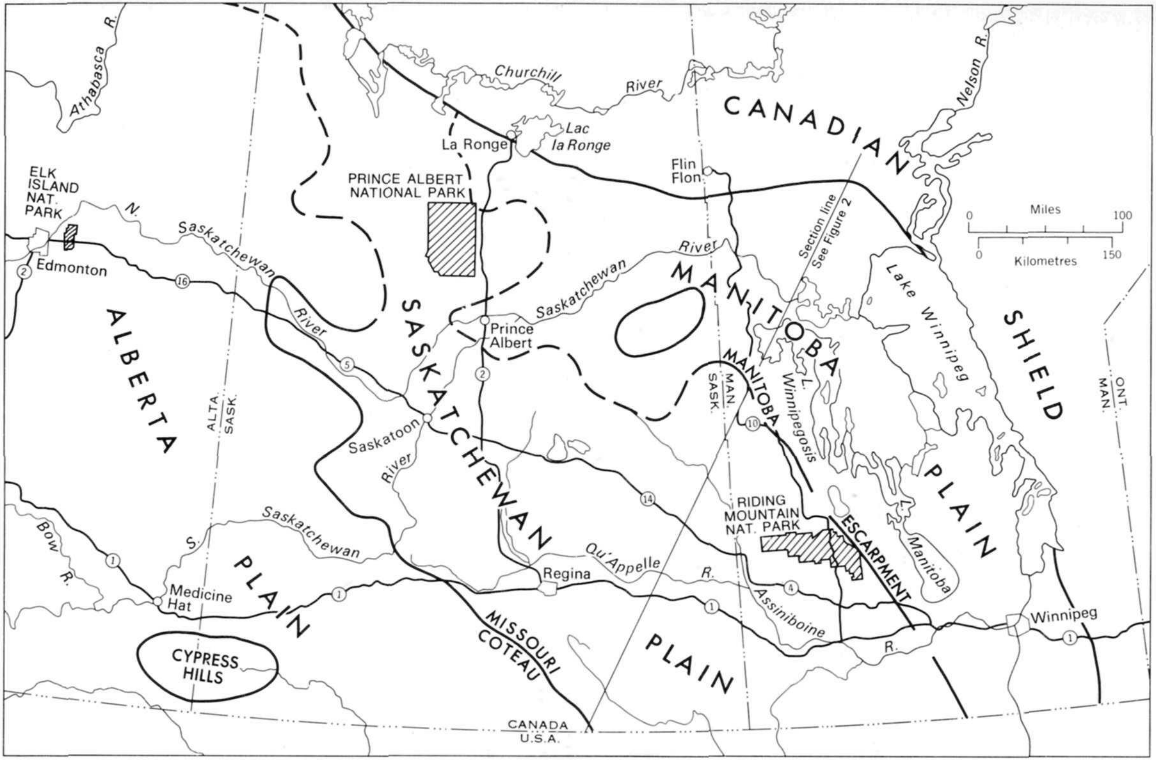
The best method of using the booklet is to study it before leaving home, and to obtain some of the maps or other literature mentioned at the end. Acquiring the book in advance would not only allow more thorough study at home or while travelling, but would also permit interesting geological observations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

The author is indebted to many persons in the National Parks Service and the Geological Survey of Canada for their co-operation. He is particularly grateful for discussion with L. A. Bayrock, formerly of the Alberta Research Council, who mapped the glacial deposits of an area which included the park. G. B. Mellon of the same organization kindly provided advance copies of part of the resulting map and its marginal notes, which were helpful in preparing part of this booklet and its main map.



Elk Island 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

The attractive scenery of this popular resort and game preserve is the result of a long and interesting geological history. Some awareness of it can add greatly to a visit to the park or a drive through any of the surrounding countryside.

Geology is also fundamental to features of ecology or "total environment.' 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 land use, road-building and such recreational activities as golf, are caused by geological processes. Geological conditions determine the kinds of soils, gravels and other overburden that blanket the bedrock of most regions. Climate, nature of the overburden, and to some extent, the type of bedrock, combine to determine suitability for farming and influence the kinds of plants, forests and wildlife. Geology explains the distribution of the streams and lakes that add so much to the beauty and enjoyment of the parks. Its importance in locating springs and wells, and in avoiding places that may be subject to landslides, is being increasingly recognized.

Like other National Parks, Elk Island 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 many of the visible geological features can be observed from roads open to the public or by walking short distances from them; some can be seen only by hiking. The taking 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 park is about 20 miles east of Edmonton, Alberta. It extends 14 miles from north to south and is 6 miles wide, except in the northern part where offsets reduce the width gradually to 3 miles. The park, which is completely fenced, has a total area of 76 acres.

Highway 16 crosses the park in an easterly direction, 3 to 4 miles north of the south boundary. The part south of the highway is not open to the public. The main park entrance is on this highway 5 miles east of the west boundary and 22 miles east of the city limits of Edmonton. From the main entrance, also called the South Gate, a paved road extends in a general northerly direction to the North Gate, 4 miles south of the town of Lamont on Highway 15. A short distance north of the South Gate the paved road passes a cleared area of buffalo paddocks and hayfields, which lies east. North of these the terrain becomes more hilly. Where this road reaches the south shore of Astotin Lake a branch leads left to the administration area and then westward a short distance to the West Gate, where a road connects with those joining Highways 15 and 16.

The main recreation area is close to the main park road, at the east side of Astotin Lake, and about 9 miles north of the South Gate. The main road is called the 'North Road' north of the

recreation area, and the 'South Road' between it and the South or Main Gate.

A gravelled road leading to Oster Lake extends northwestward from a point on the South Road 2.7 miles north of the Main Gate. A trail branching from this leads southward, west of Tawayik Lake and Little Tawayik Lake. The longest trail extends along most of the east boundary of the park. It is reached by several wardens' roads and trails from the North and South roads; one along the former south boundary of the park branches off not far south of Astotin Lake and others are between it and the buffalo paddocks. The wardens' roads are not open to private vehicles, but may be used for hiking. Shorter 'nature trails' extend from the main road at various places.

THE SURFACE OF THE LAND

The park is in the southern part of the Interior Plains of Canada. The term 'plains' is used in a general and relative sense, for although large areas are flat, others are hilly and some flat parts are cut by deep valleys. As shown on page 10, the whole region is divided into three main plains or steppes, called the Manitoba, Saskatchewan and Alberta plains, which are progressively higher toward the west. The park is in the central part of the Alberta Plain, most of which is fairly flat, with an elevation of about 2,500 feet above sea level, but several hilly areas rise to elevations of 3,500 feet or more, and the main rivers flow in valleys 200 to 400 feet below the general surface.

Elk Island National Park is part of a larger area of hills, called the Beaver Hills*, which rise 100 to 200 feet above the general

* Local name

level of the countryside. When viewed from the air, this hilly area looks somewhat like a forested island in the prevailing farmlands. When viewed from a distance along Highway 16, either eastward or westward, or southward from Highway 15, its height seems even greater than its actual relief.

The northern half of the park, northeast of Oster Lake, is a hummocky terrain of small knobs and depressions, best seen from road-cuts along the North Road, or to good advantage at the golf course because clearing of trees has exposed the land surface well. Several hills in the northern part of the park have elevations a little more than 2,400 feet above sea level. In the central part a hill ¾ mile east of Oster Lake is 2,410 feet above sea level, and another southeast of Moss Lake is of about the same height. A little south of a line between these two hills the surface is more gently rolling and includes some stretches that are relatively flat, such as those near the buffalo paddocks and along some parts of Highway 16. This generally lower section, however, contains both the highest and the lowest points of the entire park. The highest, more than 2,475 feet above the sea, is close to the west boundary and just north of Highway 16. The lowest, less than 2,325 feet in elevation, is at the east boundary about a mile north of Highway 16, where a small creek crosses the boundary.

Astotin Lake, the largest lake in the park, is irregularly shaped, 2½ miles wide, contains 21 islands, and has an average depth of 10 feet and a maximum depth of 18 feet. Its generally low, marshy shore includes the park's most popular beach. This is said to have been the only natural beach in the park, and it has been improved by the addition of hauled gravel. The next largest lakes are Tawayik Lake and its smaller

The beach at Astotin Lake is bounded to the north (centre of photo) by a bluff formed of hardened glacial till. Hardened patches of glacial till occur sporadically in till of the plains region; some are harder than some of the Mesozoic and Tertiary bedrock.

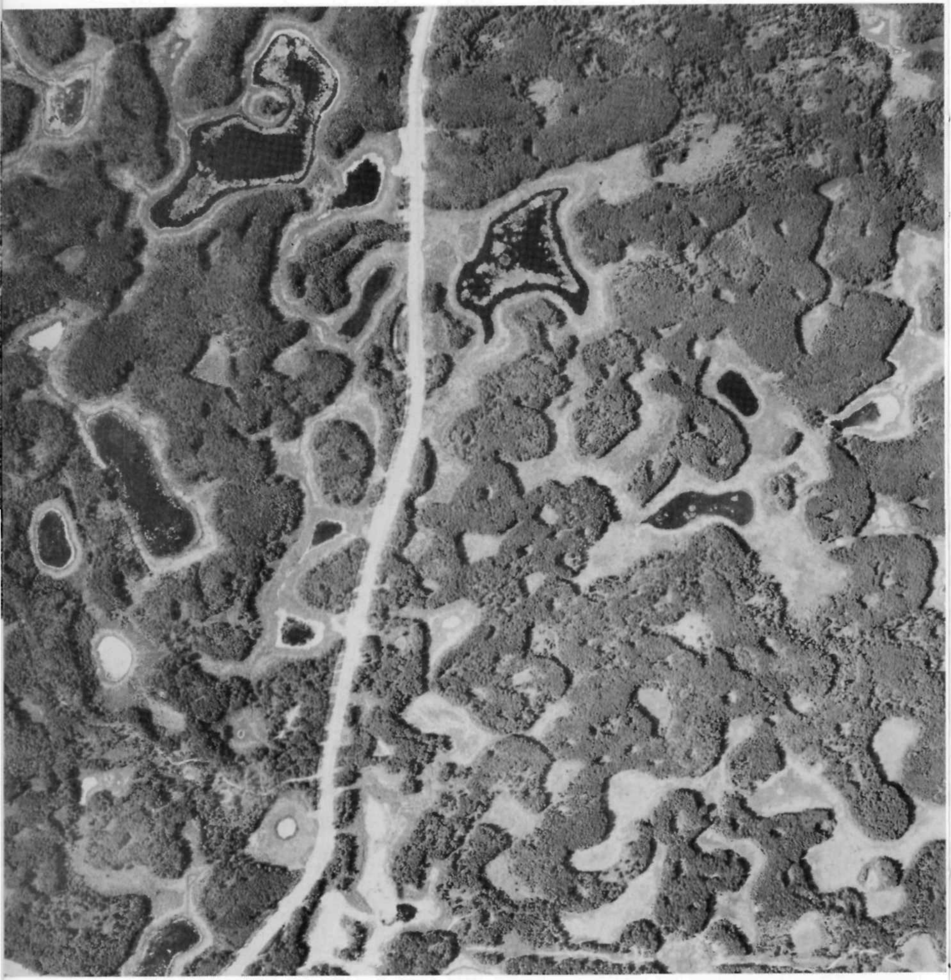
Part of Astotin Lake, showing the low, vegetation-covered shores that are typical of it. (National Parks Service photo)

neighbour, Little Tawayik; these are round lakes lying in the form of an hourglass. There are innumerable smaller lakes ranging from those small in size to tiny ponds. The latter are particularly common in the hummocky, northern part of the park. The many small scattered patches of meadow were probably ponds that have become partly or entirely dried, perhaps by a combination of silting and the encroachment of vegetation. At

Tawayik Lake is a good example of the fairly round lakes that commonly fill depressions called ''kettles''. These are caused by slumping after a block of ice buried in glacial drift finally melts. (National Parks Service photo)

times, some of these patches may contain water from melted snow or from prolonged rainy periods.

Many of the lakes and ponds are connected by small creeks; others drain through marshes or through the underlying soil. Astotin Creek, the largest stream in the park, flows northwestward into the North Saskatchewan River.



The terrain shown by this air photo is typical of the northern part of the park. The black patches are ponds in forested areas. The grey patches are marshes, bogs and meadows. Some of ◀ the bogs and meadows are probably flooded when snow is melting, or after long rainy periods. The ponds, marshes, bogs and meadows occupy low areas in the hummocky glacial moraine that covers most of the park.

THE BEDROCK BENEATH THE PARK

Bedrock in place is not exposed in the park and is only poorly exposed in the district. Information on these rocks has been obtained mainly from wells drilled for petroleum and natural gas, and from geophysical surveys. Although little can be seen of the rocks even by visiting places beyond the boundaries of the park, it is interesting to know a little about what is beneath the gravel, boulders and other glacial overburden, whose origin and characteristics form the main theme of this booklet.

The Interior Plains are underlain by thick successions of sedimentary rocks of different kinds and ages, which solidified from mud, sand and other sediments derived from the erosion of previously existing rocks. Some of these sediments were deposited in seas that occupied the region from time to time; others were laid down in lakes, swamps or streams, and still others, on dry land. The resulting sedimentary strata rest on a dark, stable *platform* * of rocks of *Precambrian* age. These rocks are subterranean extensions of the Canadian Shield, which contains rocks formed as long ago as 3 to 4 billion years. Near the park the top of this platform is about 5,500 feet beneath the surface. The average depth of overburden in the park is about 100 feet, thus indicating that a little more than a mile of sedimentary rock lies between the overburden and the platform.

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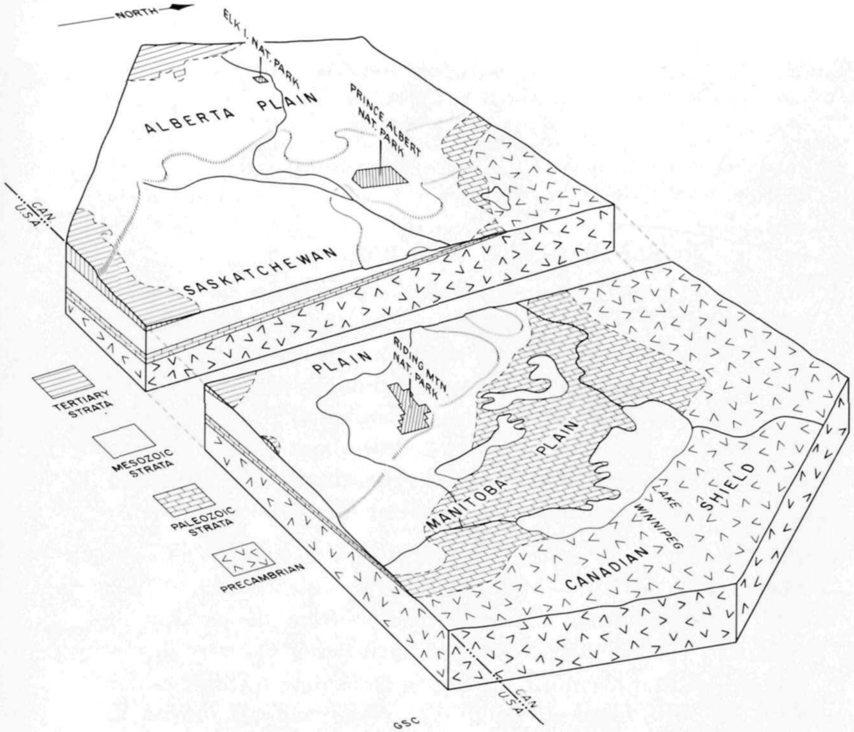
* Geological terms are printed in italics where first used and explained.



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.

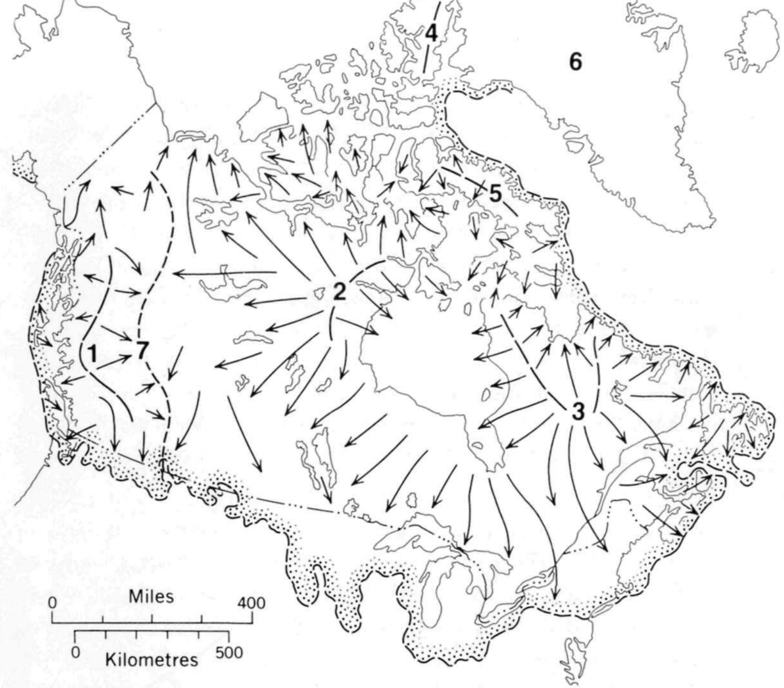
The strata above the platform were formed during the *Paleozoic* and *Mesozoic eras*, which lasted from about 570 to 65 million years ago. The youngest and uppermost bedrocks underlying the northeastern part of the park, and the area north and east of it, are *shales, sandstones* and other sedimentary rocks that originated both in seas and in fresh water. Most of the park is, however, underlain by the still younger Edmonton Formation, composed mainly of sandstone and shale; interbedded coal seams indicate that this formation was deposited in fresh water. Slabs of the Edmonton sandstone can be seen at the pit of a small, abandoned coal mine near the southwest corner of the park. The Edmonton Formation overlies the strata mentioned earlier as lying beneath the overburden in the northeastern part of the park where this formation has been eroded away. All these strata are of late *Cretaceous* age, representing the later part of the Mesozoic era, and are about 100 million years old. Further information on the distribution of these strata may be obtained from the map of the bedrock geology of the district, listed at the end of this booklet. Also, the booklet in this series that describes Riding Mountain National Park contains more detailed discussion of the bedrocks of the southern Interior Plains.

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 or more 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 and 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.

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 being 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. Each advance of the ice sheets obliterated most of the deposits left by the previous one, so most of the deposits and other effects visible now resulted from the last glaciation, whose limits are shown in the figure on page 13. In Canada the ice is estimated to have melted an average of 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.



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*.

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 the mass of ice like a bit or an abrasive set in a huge, slowly moving tool. Material is also incorporated in 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 is not great, but larger amounts are 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 in 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*; large deposits composed entirely or mainly of till are known as *moraines.* Another principal class

A typical exposure of glacial 'till' in Elk Island National Park. Note the lack of stratification.

of drift is *outwash*, 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, thus 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.

Kames are interesting special forms of glacial outwash which occur as isolated features at some places, and at others as complex clusters of kames and other forms of outwash. Kames consist of stratified drift deposited at the edge of a glacier or ice sheet, commonly where a stream of meltwater under pressure heaped up sand and gravel against the front of the ice. Isolated kames are generally steeply cone-shaped. They are difficult to distinguish from hills composed of till unless stratified drift can be seen in a road-cut, gravel pit or other excavation. Moraines are of several kinds, of which only three 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 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 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.

THE PREGLACIAL LAND SURFACE

For many years before the coming of the first Pleistocene ice sheet erosion wore the land, more or less, to its present appearance. The results of drilling indicated a pattern of streams flowing generally toward the northeast. The valley of the ancestral North Saskatchewan River was roughly in its present position near the park, but it is not known whether it continued toward the present position of Saskatchewan River or more northerly as a tributary of the preglacial Churchill River system.

The results of drilling also suggest that a hilly area corresponding more or less to the present Beaver Hills existed when the first ice advanced over the district.

THE DEBRIS LEFT BY THE LAST ICE SHEET

Moraines

The advance of the last ice sheet left a mantle of glacial till in the form of ground moraine over most of the region. In the neighbourhood of Elk Island park this moraine is exposed in the lower hilly area extending along Highway 16 about as far east as Ardrossan. From Ardrossan the belt of exposed ground moraine extends northeast to the Elk Island railway station and then easterly through Lamont. It then turns southerly, where it is crossed again by Highway 16 about 5 miles east of the east boundary of the park. Bayrock describes the moraine as only 10 to 40 feet thick in most places, with low hummocks as much as 15 feet high. It is composed of clay, silt, sand, pebbles and boulders.

Resting above the ground moraine, and forming the higher parts of the Beaver Hills, is a large area of hummocky stagnant ice moraine. This was formed during the retreat of the last ice sheet, when a large block of stagnant ice melted about 9,000 years ago allowing gravel, sand and silt that had been incorporated in the ice to be deposited in uneven piles, generally 40 to 150 feet thick. This material forms the higher part of the Beaver Hills and extends a few miles north of the park and a long distance south of it. Except for two kames mentioned in the next section, the entire park was mapped as part of the hummocky moraine area; patches of glacial lake deposits were not mapped separately. In general, its hummocks are noticeably higher than those of the ground moraine; its uneven nature can be seen well at the golf course and along the North Road.

Both types of moraine consist partly of material eroded from the Cretaceous bedrock and partly of igneous and metamorphic material from the Canadian Shield.

Kames and Outwash

A small hill about halfway between the southeast corner of Astotin Lake and the east boundary of the park is an isolated kame, and another may be seen at the east boundary a short distance south of the point where an offset occurs.

Old gravel pits outside the park, a short distance from the West Gate, provide two examples of sandy outwash. Another patch, accompanied by two kames, lies east of the park, north of Drygrass Lake. A belt of drift, which includes the golf course, extends diagonally from the gravel pits to the kames and outwash just mentioned, and is more sandy than most parts of the park.

Hummocky glacial moraine makes a challenging golf course. ▶

Sandy gravel in a belt of this kind of glacial drift that extends diagonally through the central part of the park.

Glacial Lake Deposits

The large flat area on which Edmonton and much of its neighbourhood is built is underlain by clay and silt deposited in a large temporary lake, called Lake Edmonton, which was filled for a time with water from the retreating ice sheet before it drained away. This lake had a long, complicated history. A fairly large area of sediments related to one phase of the lake lies west of the ground moraine near Fort Saskatchewan.

The southeastern part of the park contains a few road-cuts showing stratified clay and silt, apparently deposited in temporary meltwater lakes resting on the dead ice moraine. It seems likely that other flat areas there are also underlain by unexposed deposits of this kind.

Erratics

Among the most interesting and informative features of the park are the numerous large boulders of various kinds of rock along the roadsides and trails. These are known as *glacial erratics* because they are foreign to the local bedrock. They originated as boulders, and more angular chunks that were rounded by glaciation, and were transported hundreds of miles either within or on top of the ice before being dropped when and where melting took place. Some erratics were incorporated in till from which the smaller components were removed by recent erosion; others appear to have been dropped on top of other kinds of drift as a final effect of the melting ice.

Some of the best places to observe erratics in the park are along the Oster Lake road and the Parkland and Lakeview trails. Most of the erratics are granite or related types of rock, and banded gneiss, picked up when the ice flowed over the Ca-

This 'erratic' boulder originated in the Canadian Shield far north of the park and was incorporated in the ice sheet when it spread over the Shield. It was dropped when the ice melted.

nadian Shield. Close observation of some of these boulders will provide a good concept of the harder, very ancient rocks of that region and of the Precambrian platform far beneath the park. The largest erratic seen by the author was 40 inches long. An erratic on the short nature trail near Aspen Grove* parking lot contains a patch of pink *pegmatite* (coarse-grained granitic rock).

Effects of Glaciation on Drainage

The many lakes, large and small, that contribute so much to the scenic and recreational attractions and to the ecology of the Beaver Hills are legacies of the last glaciation. Most of the lakes, including Astotin, are in depressions that have resulted mainly from the uneven amount of glacial drift dropped over the area. The insulation of blocks of ice covered by drift, and the resulting slumping of the overlying drift when a block finally melted, may have been a contributing factor in the formation of Astotin Lake and some of the small lakes in areas of hummocky terrain. This effect also seems to have been mainly responsible for the more isolated, round kettle-like ponds and the larger Oster, Trappers and Tawayik lakes. Moss Lake, near the 'old south boundary trail', is probably a small *kettle* lake; its clear water suggests spring origin.

There are no large streams in the park. The few small creeks and the number of lakes for which no outlets can be seen on the map or on air photos indicate that many lakes either drain through stretches of marsh, or underground through the spaces between grains of silt, sand or gravel.

* Local name

Small lakes such as this, which fill depressions in glacial drift, are common in the park. The depressions may be caused merely by irregular deposition of drift, by slumping after a small block of ice buried in the drift melted, or by the upward pushing of ridges by ice pressure.

A 'spit' formed of sediment carried by currents, and probably bound in place by the roots of plants, forms a point of land extending from one of the picnic grounds at Astotin Lake.

RECENT FEATURES

Small-scale examples of recent erosion can be seen along road-cuts, stream banks and lake shores. Corresponding deposition can be seen in other places. An interesting example of recent deposition is a point of land extending southward from one of the main picnic grounds at Astotin Lake. This and some of the other ' points ' in the lake are, in part, probably *spits* formed by sediments carried and deposited by current action, and partly by sediments bound by the roots of plants.

Near the east boundary of the park, in the general area of the Hayburner Trail, the ground slopes gently toward the lowest point in the park. This slope causes the groundwater to reach the surface in wet weather in the form of four springs of water containing alkalis dissolved from the drift through which it percolates. Evaporation of alkali hardened the silty ground around the springs and left a white crust, which looks enough like dried soap suds to account for the springs being called locally ' soap holes. ' Analysis of a specimen of the crust showed it to consist of calcium carbonate and hydrous calcium sulphate.

The north end of the main beach is bounded by a bluff of hardened till. This hardening may result partly from alternate spraying by waves or rain, and from baking by the sun on hot days. Or, it may result entirely or partly from the cementing of sand grains and pebbles by one or more chemical compounds dissolved in and deposited by the groundwater percolating through the till.

Calcium carbonate (white) formed by evaporation around springs of water containing lime in solution. ▶

Detailed photo of hardened till at Astotin Lake. The hardening is considered to have resulted mainly from compaction by the weight of ice that once overlaid the till. It may also have resulted partly from cementing of grains by water containing alkali, or from 'baking' by the sun after the till was wetted.

CONCLUSION

When you look at any of the recent features mentioned above – features being formed by processes that are still going on – try to realize that it was partly by processes such as these that the crust of the earth was gradually transformed during many millions of years.

When you observe the boulders that dot the park, remember that they are fairly representative of the Precambrian basement that lies about a mile beneath the surface, and of the Canadian Shield far to the northeast. Think of the millions of years of slow accumulation of sediments that were required to form the mile of sedimentary strata that overlies the basement.

Finally, when you see the boulders, the banks of gravel and finer sediments along the roads, and the hummocks of this material, think of the great ice sheet that slowly advanced over the land, carrying boulders and other debris with it and, when it melted, dumped that material to form the surface seen today. Even a little awareness and understanding of these matters will increase your appreciation of the scenery and ecology of Elk Island National Park and of many other places in the plains region.

Some additional sources of information are listed below :

Topographic Map of Elk Island Park, Sheet 83 H/10. Ottawa, 1957. Surveys and Mapping Branch, *Dept. of Energy, Mines and Resources.*

Bedrock Geological Map, Tofield Area, by R.L. Rutherford, Ottawa, 1939. *Geological Survey of Canada.*

Surficial Geology, Edmonton Area, Sheet 83 H, by L.A. Bayrock, Edmonton, *Research Council of Alberta.*

Sequence of Glacial Lakes in North-Central Alberta, by D.A. St. Onge. Ottawa, 1972. *Geological Survey of Canada,* Bulletin 213.

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 can be obtained from 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, large, well-illustrated book containing 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 others 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 is obtainable 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.

Figure 3

Map of Elk Island National Park and vicinity, showing glacial deposits and points of special geological interest.

LEGEND

4	*Outwash sand and gravel*
3	*Kame*
2	*Mainly hummocky moraine with unseparated patches of stratified clay and silt*
1	*Ground moraine*

Public roads
Wardens' road
Trail
Park boundary
Intermittent stream, lake
Geological boundary (defined, approximate)

Scale 1:50,000

Miles 1 0 1 2 Miles

Metres 1000 0 1000 2000 3000 Metres

Surficial geology by L. A. Bayrock, Research Council of Alberta
Sheet 83 H, Edmonton, scale 1:250,000 (in press)

Geological cartography by the Geological Survey of Canada

Base-map cartography by the Geological Survey of Canada from map published at 1:50,000 scale by the Surveys and Mapping Branch in 1957 and map published by the National Parks Service

Copies of the topographical edition of this map may be obtained from the Canada Map Office, Department of Energy, Mines and Resources, Ottawa

POINTS OF INTEREST

1, 2. Sandy outwash
3. Example of the many ponds in depressions in hummocky moraine
4. Hardened till
5, 6. 'Point' in lake, probably caused partly by formation of a 'spit'
7. Hummocky moraine well displayed at golf course
8. Small lake probably filling a 'kettle' caused by collapse of moraine when a buried block of ice melted
9, 10, 11. Kames
12. Alkaline springs ('soap holes')
13. Sandy outwash
14. Several glacial erratics along road
15, 16. Lakes probably in fairly large 'kettles'
17. Abandoned, small coal mine

Note: Lines from numbers indicate specific points
Numbers without lines indicate general areas or a lake

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