GEOLOGY AND SCENERY

KILLARNEY PROVINCIAL PARK AREA ONTARIO

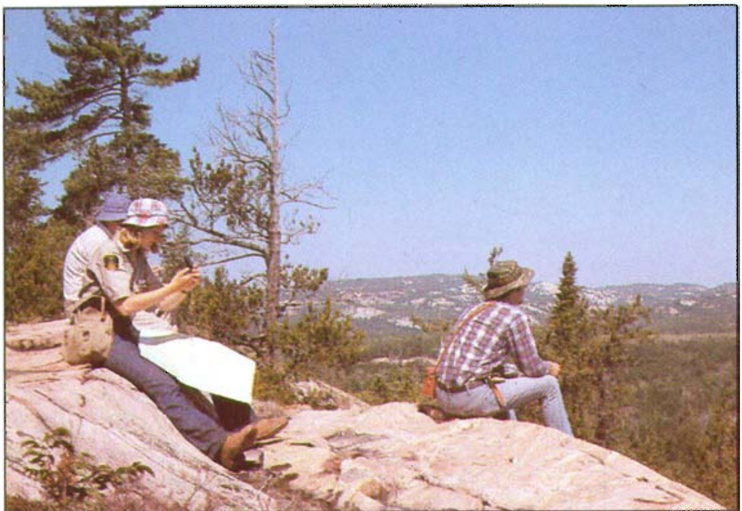
Electronic Capture, 2005

The PDF file from which this document was printed was generated by scanning an original copy of the publication. The file has been proofread to correct errors resulting from the scanning process. Obvious spelling and punctuation errors in the original publication have also been corrected.

Geology and Scenery Killarney Provincial Park Area

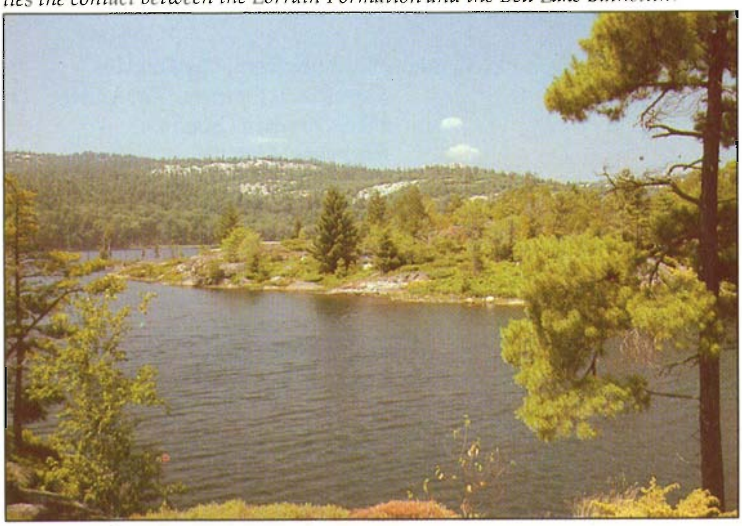
Caution: *When stopping on public roads, please park safely off the road and use proper care when walking nearby. When travelling by foot off the road, wear sturdy footwear, carry a compass and map and know how to use them. lnsect repellant and light-coloured clothing with long sleeves and pantlegs will help protect the hiker against insects. Canoeists should take similar precautions, particularly if the trip involves portages, and should wear approved life jackets.*

Cover: *"Summer Storm" by Franklin Carmichael. Courtesy: The McMichael Canadian Collection Kleinburg, Ontario.*



Frontispiece.*a. Hikers in Killarney Provincial Park. Photo courtesy N. Bellerby.*

b. View of Ruth-Roy Lake, just nothwest of Johnnie Lake. Ruth-Roy Lake overlies the contact between the Lorrain Formation and the Bell Lake Batholith.



GEOLOGY AND SCENERY

KILLARNEY PROVINCIAL PARK AREA ONTARIO

by R. L. Debicki

Ontario Geological Survey Guidebook No. 6

Ontario

Ministry of Natural Resources

Hon. Alan W. Pope
Minister

W.T. Foster
Deputy Minister

Printed in Canada
ISBN 0-7743-3907-1

This guidebook is published with the permission of E.G. Pye, Director, Ontario Geological Survey, Ministry of Natural Resources. Designed and produced by the staff of the Ontario Ministry of Natural Resources. Author: R.L. Debicki. Photographs not otherwise credited: R.L. Debicki. Editing: D.G. Beggs. Layout, general production: M.G. Sefton, Surveys and Mapping Branch. Maps and figures: M.G. Sefton, assisted by B.G. McQuaid, Surveys and Mapping Branch. Phototypesetting: Howarth and Smith Limited. Printing: J. Deyell Co.

Publications of the Ontario Ministry of Natural Resources and price list are available through the Map Unit, Public Service Centre, Queen's Park, Toronto, and the Ontario Government Bookstore, 880 Bay Street, Toronto. Orders for publications should be accompanied by cheque or money order, payable to the Treasurer of Ontario.

Debicki, R.L.
1982: Geology and Scenery, Killarney Provincial Park Area; Ontario Geological Survey Guidebook No. 6, 152 p.

CONTENTS

PART 4 Glossary, Bibliography

TABLES

FIGURES

MAPS

PHOTOGRAPHS

ACKNOWLEDGMENTS

The initial field work in the guidebook area was done by the geologists whose publications are listed in the bibliography. The compilation of material for this guidebook was done by R.L. Debicki. The author wishes to thank D.G. Innes, Dr. K.D. Card, and Dr. E.G. Pye for helpful discussions and editorial comments during the preparation of the guidebook. The staff of Killarney Provincial Park, and of Park Management Branch, Ministry of Natural Resources were helpful in providing unpublished background data on the guidebook area. Discussions with B. Burke, J.R. Warnica, and Dr. J.S. Speigal provided valuable information about the history of the area. Field assistance was provided by the Division of Mines and Division of Parks.

Photographs without credit were taken by the author. All those kindly supplied by others are credited in the photograph description. The staff of the Cartography Section of the Surveys and Mapping Branch prepared the figures and diagrams. The original manuscript was typed by Y.M. Paquette.

Introduction

A.Y. Jackson, one of the now famous Group of Seven painters, travelled through Baie Fine on September 2, 1931 on his way to Trout Lake for sketching purposes. While en route, he spoke to the area superintendent for the Spanish River Lumber Company who told "Hay Wire", as he called A.Y., of the company's plan to log the shores of the lake. Upon seeing the great beauty of the lake, A.Y. set out to remove the threat of logging. He contacted Fred Brigden, a fellow member of the Ontario Society of Artists (O.S.A.), who persuaded him to write a letter to Mr. Finlayson, the then Minister of Lands and Forests. Mr. Finlayson arranged for the Spanish River Lumber Company to accept a change of logging limits, and created a nominal park around Trout Lake, which was renamed O.S.A. Lake (see Photo 50) in 1933. In honour of A.Y. Jackson's efforts, and his 90th birthday, a lake in the present park was named after him in 1972. The present park was created on July 16, 1964, when some 344 km^2 *were set aside.*

The Killarney Provincial Park area is now serviced by Highway 637, as well as non-scheduled air and water routes. Since the opening of Highway 637 and Killarney Provincial Park, the volume of tourist traffic to the area has greatly increased. Its strategic position with respect to major subdivisions within the Canadian Shield has led to numerous geological studies of the area, and the recognition of the influence of geological processes upon the remarkable scenery of the area.

In recent years, the Ontario Ministry of Natural Resources and the former Department of Mines have published "Geology and Scenery" guidebooks describing Ontario's scenic attractions and the part geological processes have played in the development of its landscape. This guidebook is the sixth of the series. It was written primarily for use by the novice geologist in the Killarney Provincial Park area, although certain details will undoubtedly interest even those with an advanced knowledge. In case of difficulty, the guidebook reader is referred to the glossary for explanations of geological terms, or to the publications tabulated in the list of references. For further reading, many excellent books are available in most libraries and in larger bookstores.

The first part of the guidebook is a resumé of the geology of the region. It provides a summary of the relationships between the principal elements of the regional geology, and also gives the reader an account of the geological history of the area.

The second part of the guidebook gives a short history of the guidebook area and its development.

The third part of the guidebook lists various points of geologic, scenic, and historic interest along the various roadways, waterways, and trails and portages in the area. Descriptions and explanations of salient features are given, and the best means of access indicated. Although many of the described areas are easily reached from Highway 637, or well marked trails and waterways, many others are more difficult to reach. Anyone *leaving well marked routes is cautioned to carry a compass, to be familiar with its use, and to use every reasonable safety precaution.*

The fourth part of the guidebook consists of a glossary of the technical terms used in the guidebook, and a brief bibliography covering the most important geological papers, maps, and reports dealing with the area. The bibliographies in these papers and reports will provide information on further sources for the more specialized reader.

PART 1

Geology of the Killarney Provincial Park Area

The region described in this guidebook extends from McGregor Point on the North Channel of Lake Huron to Highway 69 near Estaire. and includes Killarney Provincial Park. It lies on the southern margin of the Canadian Shield, a complex assemblage of Precambrian igneous, metamorphic, and sedimentary rocks. The Canadian Shield, which has an exposed area of some 5 000 000 km^2, extends from Hudson Bay eastward to Greenland, southward to and beyond the Great Lakes, and westward to Alberta. Around much of its outer boundary, and in its centre around Hudson Bay, the gently sloping surface of the Shield is overlain by younger, Paleozoic and Mesozoic rocks. The Canadian Shield constitutes the nucleus and basement of the North American continent. ***Calcareous***[1] sediments deposited in tropical seas along the southern margin of the Shield during the Paleozoic ***Era*** cover the Precambrian rocks in the extreme southwestern part of the guidebook area. Localized deposits of sand, gravel and clay which were deposited during the Pleistocene ***Epoch*** of the Cenozoic Era, when continental glaciers covered much of North America, occur throughout the guidebook area.

---

[1] Many of the terms used in describing the geology of the area may not be familiar to guidebook readers. Such terms are explained in the text where possible, and are included in the glossary at the back of the guidebook. Terms included in the glossary are indicated by ***bold*** type where they are first mentioned in each section of the guidebook. Many of these terms are also explained in an ordinary dictionary.

Age of the Rocks

The Precambrian Eon is represented in Ontario by rocks of the Canadian Shield. The oldest of these ancient rocks were deposited more than 3 billion years ago, and the youngest were deposited about 1 billion years ago. The Precambrian Eon drew to a close approximately 570 million years ago when ***invertebrate*** organisms proliferated in the oceans of the world.

TABLE 1 THE GEOLOGICAL TIME SCALE.

Eon	Era	Period	Epoch	Age
	Cenozoic	Quaternary	Recent	10,000 years
			Pleistocene	1,800,000 years
		Tertiary		
				65,000,000 years
	Mesozoic	Cretaceous		
				135,000,000 years
		Jurassic		
				195,000,000 years
		Triassic		
				225,000,000 years
Phanerozoic	Paleozoic	Permian		
				280,000,000 years
		Carboniferous		
				345,000,000 years
		Devonian		
				400,000,000 years
		Silurian		
				435,000,000 years
		Ordovician		
				500,000,000 years
		Cambrian		
				570,000,000 years
Precambrian	Late Precambrian			
				1,500,000,000 years
	Middle Precambrian			
				2,500,000,000 years
	Early Precambrian			
				4,600,000,000? years

Phanerozoic rocks, those deposited since the end of the Precambrian, have been subdivided into three groups, based on their ages and on the types of animals present at that time. The Paleozoic, or *old life,* Era extended from approximately 570 million years ago to approximately 225 million years ago. During that era, invertebrate creatures abounded, primitive fish evolved, and amphibians emerged from the sea to become the first inhabitants of land. The Mesozoic, or *middle life,* Era extended from approximately 225 to 65 million years ago. Reptiles reached the peak of their development at that time, with some of the dinosaurs becoming the largest land animals which have ever lived. The Cenozoic, or *recent life,* Era began approximately 65 million years ago with the disappearance of dinosaurs and flying reptiles, and has continued to the present. It is characterized by the dominance of mammals. The major divisions and subdivisions of geologic time are listed in Table 1.

The Precambrian rocks in the Killarney area are Middle Precambrian and Late Precambrian in age. They comprise parts of two of the seven divisions, or structural provinces, of the Canadian Shield. The Southern Province is characterized by Middle Precambrian ***sedimentary*** and ***igneous rocks***. The Grenville Province is characterized by highly ***metamorphosed*** Middle and Late Precambrian sedimentary and intrusive igneous rocks. The Superior Province, largest of the divisions of the Canadian Shield, outcrops within 40 km of the Killarney area. It is characterized by Early Precambrian igneous and sedimentary rocks.

Early Precambrian Rocks

Early Precambrian rocks of the Superior Province do not outcrop within the area covered by this guidebook. They have, however, formed the surface, or "basement" upon which the rocks of the Southern Province and presumably the Grenville Province were deposited, and through erosion, provided the detritus which was deposited to form the Middle Precambrian sedimentary rocks of the Southern Province.

The oldest rocks in the Superior Province are the ***volcanic*** and associated sedimentary rocks of ancient volcanic environments. These assemblages, the "greenstone belts" of the Superior Province, were moderately to severely folded, faulted, metamorphosed, and intruded by granitic rocks prior to 2.5 billion years ago. All the rocks of the Superior Province underwent profound erosion before the sedimentary rocks of the Southern Province were deposited in Middle Precambrian time.

Eparchean Erosional Interval

The mountains formed during folding, faulting, and ***intrusion*** of the Superior Province rocks more than 2.5 billion years ago were weathered and eroded during the Eparchean interval. During this time, which may have lasted as long as 200 million years, a layer of rock several kilometres thick was stripped off, leaving a vast area of low relief similar to that found throughout the Superior Province at present.

The erosion which culminated in the formation of this extensive ***peneplain***, or area of low relief, undoubtedly proceeded at a faster rate than does erosion today. No vegetation was present on land at that time to break the force of wind, rain, and hail or to hold any soil from being carried away by air or water currents. The detritus which was eroded was carried mainly southward. Part of it, amounting to thousands of cubic kilometres was deposited around the margin of the Superior Province during Middle Precambrian time. The presence of undisturbed ***granite*** grading through blocky, disrupted granite into ***conglomerate*** and thence into clean ***sandstone*** indicates the profound erosion which occurred during the Eparchean interval. Such a break in the geologic record is called an ***unconformity***.

Middle and Late Precambrian Events

The huge volumes of ***detritus*** derived from the erosion of the Superior Province mountains were deposited in the Middle Precambrian era along the southern margin of the Superior Province to form the Huronian sedimentary sequence (Map 1). The Huronian sequence makes up most of the Southern Province of the Canadian Shield. The Southern Province is bounded on the north by the Superior Province, on the east by the Grenville Province, and on the south by rocks of Paleozoic age, which overlie it. The contact between the Southern and Grenville Provinces is known as the Grenville Front. It is well exposed in the guidebook area.

The highly deformed and metamorphosed rocks of the Grenville Province are, like the rocks of the Southern Province, of Middle Precambrian age. Those in the Killarney area may in part be metamorphosed Huronian sedimentary rocks.

Granitic, diabasic, and gabbroic intrusions ranging in age from approximately 2150 to 1000 million years occur in both the Southern and Grenville Provinces. Structural deformation and metamorphism, or ***orogeny***, affected the Huronian sedimentary rocks of the Southern Province at least once. The orogenic activity pre-dated some, and post-dated others of the intrusions in the Province. In the Grenville Province, intense orogenic activity, which ended about 1000 million years ago, masked the effects of any previous orogenic event.

Southern Province Rocks

Huronian Sequence

The Huronian sequence was named for its location along the north shore of Lake Huron by geologists who recognized over a century ago that the sequence was separated from the Early Precambrian rocks of the Superior Province by an unconformity. The Huronian rocks were deposited along the margin of the Superior Province between about 2150 and 2500 million years ago during the Middle Precambrian. At present, they occupy a belt over 300 km long and up to 50 km wide along the north shore of Lake Huron. The succession of Huronian rocks has a preserved thickness of approximately 4600 m at the east and west ends of the belt, while in the Sudbury-Killarney-Espanola area in the centre of the belt a thickness of approximately 11 000 m is preserved. Most of the Huronian rocks consist of medium- to coarse-grained detrital material derived from the Early Precambrian rocks to the north. The detritus was deposited in shallow water along a continental margin by offshore currents. A series of volcanic rocks is present at the base of the succession.

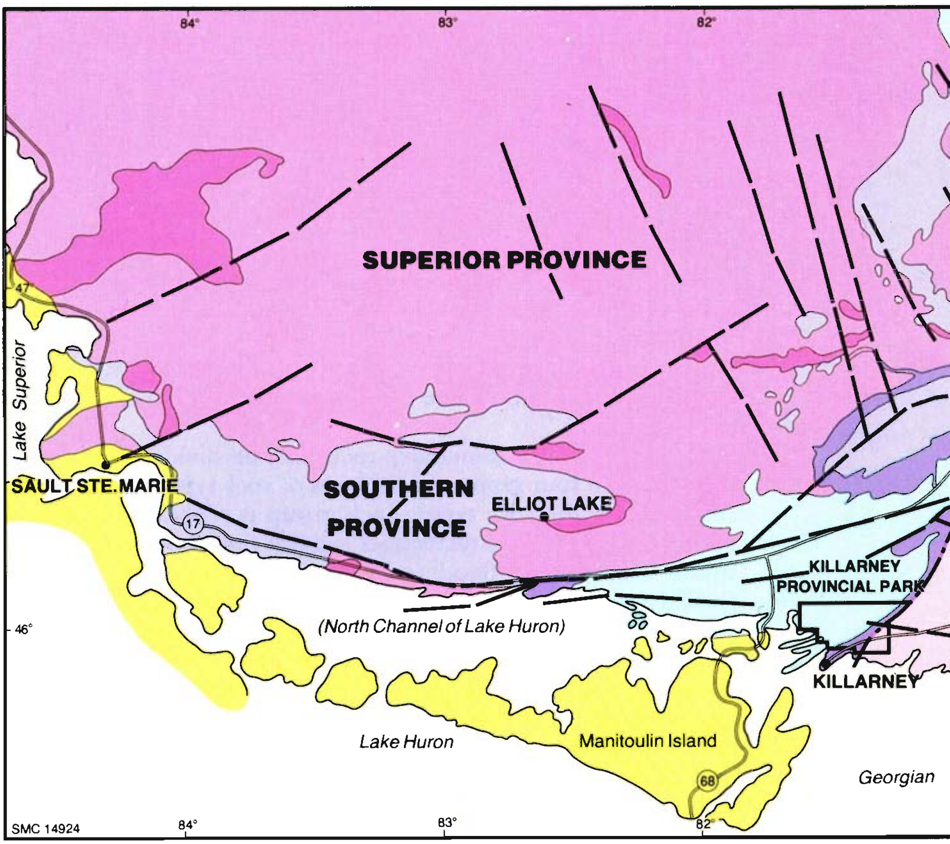
Several unusual features which may reflect environmental conditions during the Middle Precambrian have been recognized in Huronian sedimentary rocks. It is thought that some of these features may reflect a change in the Earth's atmosphere from one lacking free oxygen to one containing free oxygen as it does at present.

The Huronian sedimentary rocks can be divided into twelve ***formations*** in four ***groups*** on the basis of rock type, and the cyclic repetition of the rock types. Each group is separated by an unconformity. Their characteristic suggest that repeated cycles of uplift, erosion, and flooding by Middle Precambrian seas controlled the deposition of the sediments. Successive formations often lap farther onto the Early Precambrian basement rocks north of them. The presence of three formations dominated by conglomeratic rocks having certain diagnostic features suggests that glaciation was an important part of the depositional cycle.

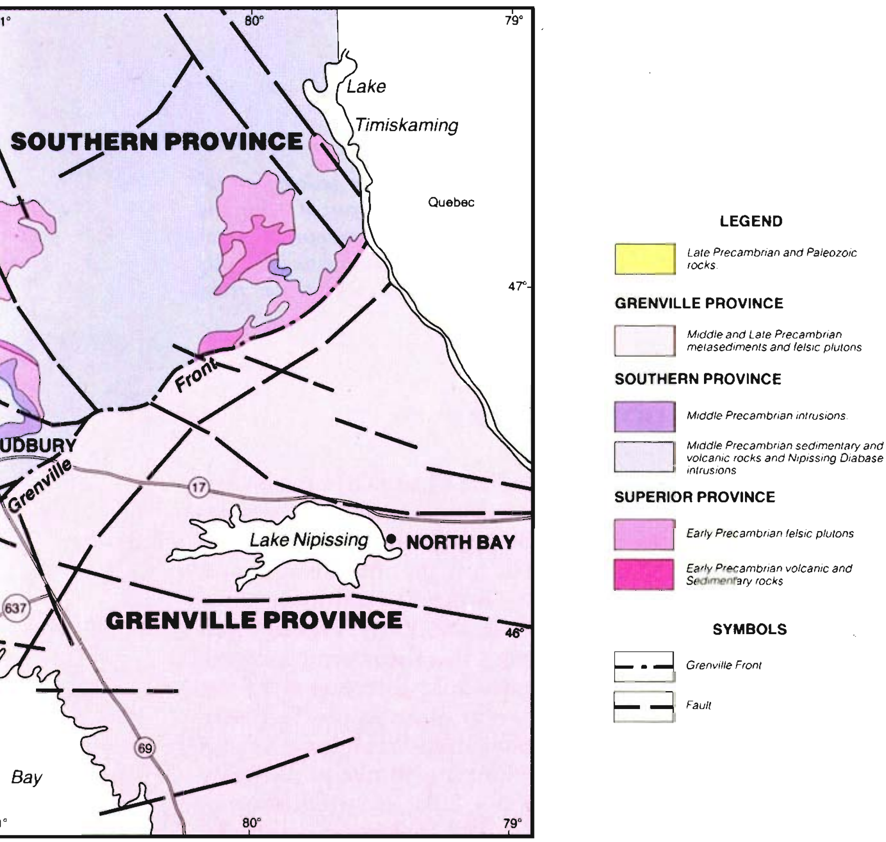
Although not all formations outcrop within the area, boulders of rock from all the Huronian formations may be found in Pleistocene gravel deposits in various parts of the Killarney Provincial Park area.

The descriptions of the various rock types in this section of the guidebook come mainly from these Ontario Ministry of Natural Resources publications: *Geology of the McGregor Bay–Bay of Islands Area,* by K.D. Card, Geoscience Report 138; *Stratigraphy, Sedimentology, and Petrology of the Huronian Supergroup in the Sudbury-Espanola Area,* by K.D. Card, D.G. Innes, and R.L. Debicki, Geoscience Study 16; and *Geology of the Burwash Area,* by S.B. Lumbers, Geological Report 116. Visitors wishing more detailed information are referred to these publications and others in the bibliography at the end of this guidebook.

Map 1. *Generalized geology of the North Channel region.*



ONTARIO SHOWING LOCATION OF MAP 1



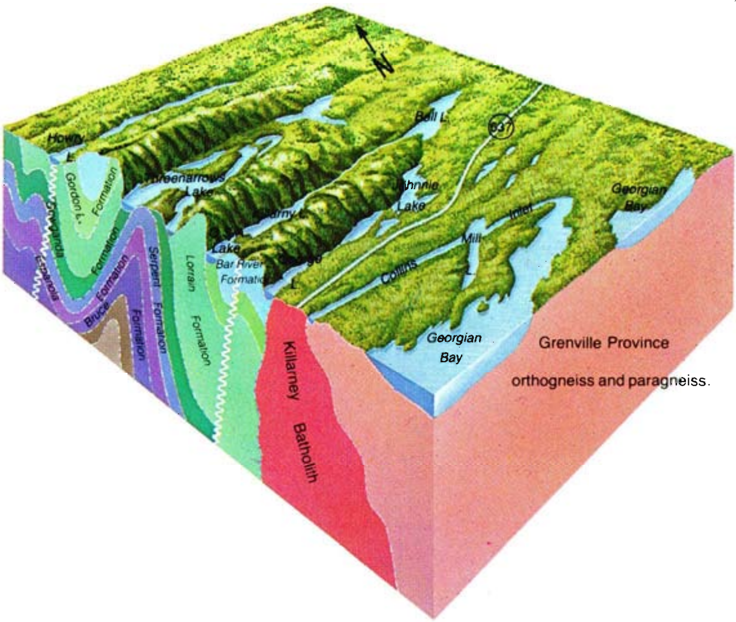


Figure 1. *Block diagram showing present relationship between geology and topography in the Killarney Provincial Park area. The northern part of the area is underlain by folded Huronian sedimentary rocks. The most erosion-resistant of these form the prominent ridges. The southern part of the area is underlain by contorted gneisses of the Grenville Province, separated from the Huronian rocks by intrusive plutons.*

ELLIOT LAKE GROUP

The lowermost Huronian group, the Elliot Lake Group, consists of the volcanic rocks of the Elsie Mountain, Salmay Lake, Stobie, and Copper Cliff Formations, and the sedimentary rocks, including uranium-bearing conglomerates, of the Matinenda and McKim Formations. The Elliot Lake Group lies unconformably on the erosion surface developed on the Early Precambrian rocks of the Superior Province during the Eparchean interval. The relative importance of the individual formations in the group varies considerably from place to place in the Southern Province. The various formations of volcanic rock have limited distribution. The Matinenda Formation, the dominant sedimentary formation in the group near Elliot Lake, is subordinate to the McKim Formation near Sudbury. The formations of the Elliot Lake Group roughly parallel Highway 17, about 25 km north of Killarney Provincial Park, but none actually underlies the guidebook area.

Volcanic Rocks

The Huronian volcanic rocks occur as a discontinuous layer at the base of the Huronian sequence. Not all the formations are present in any one area. The Elsie Mountain, Stobie, and Copper Cliff Formations are the only volcanic units which occur east of Espanola. They, in turn, are not found west of Espanola where the other volcanic units occur. Rocks of the Elsie Mountain Formation, and much of the Stobie Formation, are ***basaltic***, and often contain ***amygdules***. Sedimentary rocks including ***greywacke*** comprise the remainder of the Stobie Formation. The Copper Cliff Formation is characterized by ***felsic*** volcanic rocks including quartz-feldspar ***porphyry*** and ***rhyolite***. Rocks of all three formations show evidence of having been deposited in water.

Matinenda Formation

The Matinenda Formation is the lowest, or oldest, sedimentary unit in the Huronian sequence. Although the maximum thickness of the formation is as much as 600 m, its thickness varies considerably, and in some places the formation is absent entirely. The formation is worthy of special attention, however, because of the lenses of quartz-pebble conglomerate which occur in it. These lenses are from a few centimetres to approximately 5 m thick and occur at several levels within the sandstone of the formation. Some of the lenses contain the economic deposits of uranium being mined at Elliot Lake and at Agnew Lake. The sediments which formed the formation were derived from basement rocks to the north, and were deposited partly in stream channels and deltas near the shore of a Middle Precambrian ocean, and partly offshore in that ocean.

McKim Formation

The McKim Formation consists of dark grey detrital sedimentary rocks such as ***siltstone***, greywacke, argillaceous sandstone, and ***argillite***. It thins rapidly from a maximum thickness of approximately 2400 m near Sudbury, to less than 90 m near Elliot Lake. Further west it is even thinner, or absent altogether. The sedimentary rocks of the formation contain sedimentary features

Inset 1 — Some Sedimentary Rock Types Found in the Killarney Provincial Park Area

Photo 1. *Conglomerate from the Gowganda Formation. This conglomerate consists of boulders and pebbles of different rock-types in a matrix of finer grained material. Photo courtesy of D.G. Innes.*

Photo 2. *Feldspathic sandstone from the Lorrain Formation. Note gradation in grain size within each bed. Photo courtesy of D.G. Innes.*

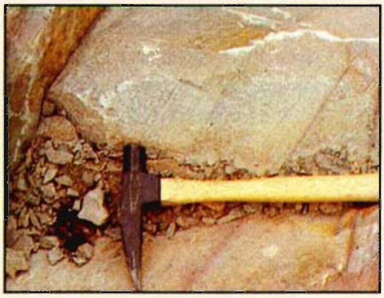


Photo 3. *Laminated siltstone from the Gowganda Formation. Photo courtesy of D.G. Innes.*

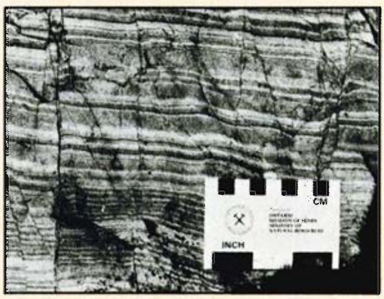
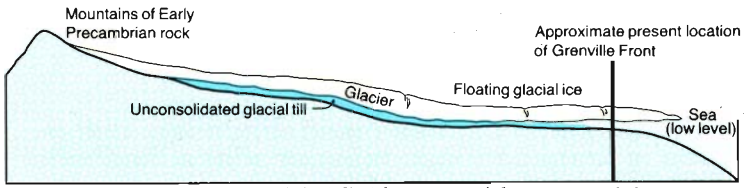


Photo 4. *Thinly bedded limestone and dolostone from the Espanola Formation. The dark laminae are silty layers. Photo courtesy of D.G. Innes.*

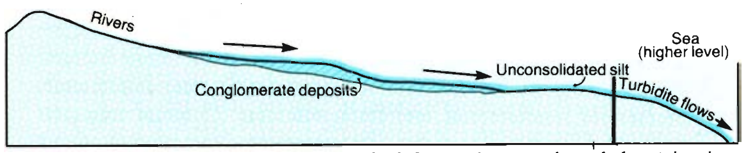
including ***graded bedding***, ***convolute bedding***, ***load casts***, ***cross laminations***, and ***climbing ripples*** which collectively suggest that the sediments were deposited by turbidity currents.

Although the McKim Formation does not form any part of the bedrock in the Killarney Provincial Park area, many boulders of this formation can be seen in the unconsolidated Pleistocene deposits in the park and many of the features characteristic of turbidity current deposits or turbidites may be seen in these boulders.

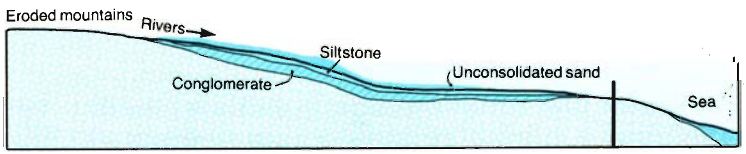
Figure 2. *Diagrammatic cross-sections showing the cycle of Huronian deposition, repeated three times over 300 million years.*



a. *Deposition of conglomerate (glacial). The source of the coarse rock fragments is the rugged moutains to the north.*



b. *Deposition of siltstone. Silt was washed down rivers and settled out in river deltas and the shallow sea margin. Some was carried by turbidity currents to deeper water.*



c. *Deposition of sandstone. The sediment was deposited in rivers and beaches. The sediments are more "mature" than earlier cycles, i.e. they underwent more prolonged erosion because of the subdued topography and slower flowing rivers. The sediment is composed of well rounded grains of stable minerals such as quartz.*

SMC 14910

HOUGH LAKE GROUP

The Hough Lake Group, which unconformably overlies the Elliot Lake Group, is composed of the Ramsay Lake, the Pecors, and the Mississagi Formations. Rocks of the Pecors and Mississagi Formations are exposed just north of Killarney Provincial Park in the Lake Panache area. The Mississagi Formation also underlies a portion of the west part of the park, and much of McGregor Island. The areas underlain by the Mississagi and Pecors Formations tend to be low and swampy showing that these rocks are easily eroded in comparison to the hard, erosion-resistant rocks forming the La Cloche Mountains. Lake Panache largely occupies depressions eroded in the Mississagi Formation.

The Hough Lake Group is the first of three groups having the succession conglomerate, siltstone, and sandstone. These repetitions of rock-types suggest cycles of sedimentary deposition during Huronian time (Figure 2).

Inset 2 — Turbidity Currents

Turbidity currents are dense flows of sediment-laden water capable of flowing down slight underwater slopes at considerable speeds because of their high density. The currents occur when large volumes of unconsolidated sediment lying on underwater slopes are suddenly thrown into suspension in the water by earthquakes, landslides, or other catastrophic events. The sediment is deposited as the current slows down, with the coarsest, or heaviest particles being deposited first, and progressively finer particles being deposited later. In one documented case, a turbidity current triggered by an earthquake on the Grand Banks near Newfoundland reached a velocity of 100 km/h and after 13 hours was still flowing at 15 km/h. The sediment deposited by the current covers 260 000 km^2 of ocean floor to a depth of up to 125 cm and to a distance of at least 650 km from the point where the current started.

Ramsay Lake Formation

The Ramsay Lake Formation ranges in thickness from 60 to 180 m and consists mainly of conglomerate and sandstone with pebbly sandstone and conglomerate lenses. The pebbles and boulders constitute as little as 10 percent or as much as 30 percent of the conglomeratic portions of the formation. The presence of smokey ***quartz*** grains and of ***pyrite*** and ***pyrrhotite*** in the conglomerate matrix is characteristic. In some places, the conglomeratic rocks of the formation contain '***dropstones***', pebbles and

Photo 5. *A relatively recent example of a dropstone in lake-bottom sediments. This cobble fell from glacial ice to the bottom of glacial lake Algonquin which covered the Killarney area about 12 000 years ago, during the retreat of large continental glaciers of the last ice age. Similar dropstones are found in some of the Huronian formations which in contrast are more than 2 200 000 000 years old. Photo courtesy P. Storck.*

cobbles which were apparently dropped into unconsolidated silt and clay. Today, stones can be dropped into lake or ocean bottom clay by a variety of agencies including man, animals, and uprooted vegetation. The most probable agency during Huronian time was floating glacial ice with embedded stones falling from the ice as it was pushed southward into the sea and melted. The "dropstones" therefore suggest that glacial processes had a part in the deposition of the Ramsay Lake Formation. Similar dropstones have been recognized in Pleistocene glacial deposits (Photo 5).

Pecors Formation

The Ramsay Lake Formation grades upwards into the Pecors Formation, a sequence of siltstone and greywacke with some sandstone and argillite. The thickness of the formation varies considerably, from an average of approximately 75 m in the northern part of its extent to an average of approximately 450 m in the southern part of its extent. Sedimentary structures present in the formation include graded bedding, ripples, cross laminations, parallel laminations, load casts, and ***sedimentary dikes***.

Mississagi Formation

The contact between the Pecors and Mississagi Formations is also ***conformable***. Rocks of the Mississagi Formation thicken from a sequence of approximately 300 m in the northern part of its extent up to 3000 m in the southern part of its extent. The sequence is composed of medium- to coarse-grained pink and grey sandstone with the average grain size increasing from the bottom to the top of the formation, and of subordinate amounts of siltstone, conglomerate, and argillite. A variety of types of crossbedding is present in the sandstone of the Mississagi Formation.

QUIRKE LAKE GROUP

The Quirke Lake Group comprises the Bruce Formation, the Espanola Formation, and the Serpent Formation. The succession conglomerate-siltstone-sandstone is well defined within the group. Carbonate-bearing sedimentary rocks, i.e. ***limestone*** and ***dolostone***, in the Bruce and Espanola Formations are of special interest as they are among the oldest of such rocks known in the world.

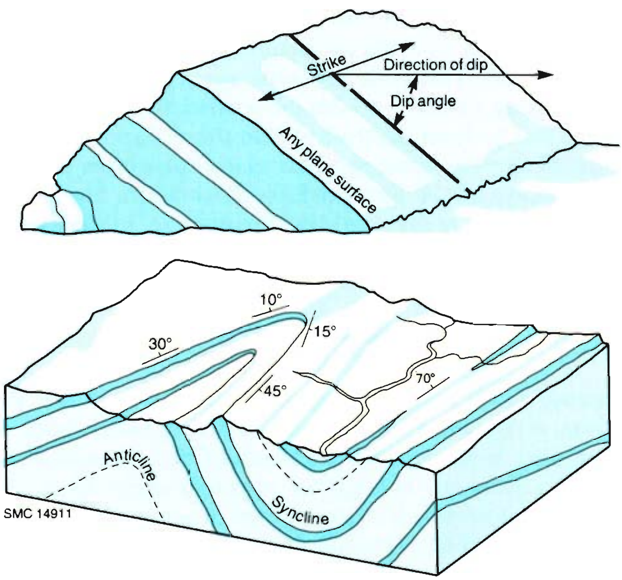


Figure 3. *Block diagrams illustrating strike and dip, and folded rock structures.*

Within Killarney Provincial Park, rocks of the Quirke Lake Group are exposed in the McGregor Bay—Threenarrows Lake area, where they form the core of a large fold, the McGregor Bay Anticline. An anticline (Figure 3) is a fold in which the strata of rock bend downwards from the central axis in the shape of an arch. Because of this geometry, when an ***anticline*** is eroded, older rocks are exposed in the core of the fold and younger rocks are exposed on the flanks. At the central axis of the McGregor Bay Anticline, the erosion-resistant sandstones (Serpent Formation) of the Quirke Lake Group form subdued hills (see Figure 5) between the north and south arms of Threenarrows Lake. The arms of the lake lie in depressions eroded in the younger, less resistant rocks of the Gowganda Formation of the Cobalt Group.

North of the park, in the East Howry Lake — Lake Panache area, rocks of the Quirke Lake Group trend east along the north flank of the La Cloche Syncline. In a ***syncline***, the rock strata bend upwards from the central axis in the form of a trough, so that when the fold is eroded, younger rocks (here the Cobalt Group) lie at the centre of the fold and older rocks (the Quirke Lake Group) lie on the flanks.

Bruce Formation

The contact between the Bruce Formation and the underlying Mississagi Formation is generally abrupt, regular, and apparently conformable. There are, however, exceptions to this generalization. In some areas the contact is gradational, while elsewhere, evidence suggests that it is an ancient erosional surface. Even where the contact is abrupt and regular, but apparently conformable, the lower part of the Bruce Formation contains features which suggest material was incorporated from the Mississagi Formation into the base of the Bruce Formation.

In contrast to the Mississagi Formation, the thickness of the Bruce Formation decreases from north to south. In the northern part, it is up to 400 m thick and averages about 150 m in thickness. It is less than 60 m thick in the south, and in some places is absent entirely.

The rocks of the Bruce Formation are generally ***massive*** and unbedded conglomerates with pebbles and boulders of granite, ***greenstone***, quartz and sandstone in a greywacke matrix with minor amounts of pyrite and pyrrhotite. Thin beds of siltstone and silty limestone occur in the upper part of the formation. The characteristics of the conglomerates of the Bruce Formation suggest that it was deposited at least partly in water by a glacier moving from the north. The moderation of the climate at the end of the glacial period may be indicated by the silty rocks near the top of the formation.

Inset 3 — Interpreting Sedimentary Rocks

The usual aim of mapping the geology of an area is to unravel its geological history and to reconstruct the ancient environment. The geologist gathers evidence by noting all the physical characteristics of the rock (e.g. grain size and shape, mineral composition, colour etc.), the structures within the rock (e.g. crossbedding, mud cracks etc.), and the sequence or combination of rock types. He then tries to fit these features to one of the models of sedimentary environment postulated by geologists on the basis of both ancient rocks and modern environments.

OBSERVATIONS	INTERPRETED ENVIRONMENT	
Geometry	*Continental*	*- river deposits*
Lithology (rock type)		*- lake deposits*
Sedimentary structures		*- wind deposits*
Fossils*		*- glacial deposits*
	Shorelines	*- linear deposits (e.g. beach)*
		- deltaic deposits
	Marine	*- reef deposits*
		- continental shelf deposits
		- turbidite deposits
		- deep ocean floor deposits

*not applicable to Precambrian rocks.

Adapted from "Ancient Sedimentary Environments" by R.C. Selley, Science Paperbacks, Chapman & Hall, 1976.

Some of the kinds of evidence used by a geologist are described in Inset 5 and an example of a sedimentary environment is given in Inset 4.

Espanola Formation

The Espanola Formation consists of limestone, dolostone, siltstone, and sandstone, and is characterized by the prevalence of the carbonate minerals ***calcite*** and ***dolomite*** throughout. It thickens southward from approximately 150 m in the north to as much as 600 m in the south. The contact between the Espanola Formation and the underlying Bruce Formation is generally conformable, but abrupt. In many localities, however, the upper few metres of the Bruce Formation contain carbonate minerals in the conglomerate matrix.

The various rock types in the Espanola Formation have their own characteristics. The limestone, which occurs near the base of the formation, is cream coloured, and is often interbedded with siltstone. The siltstone which makes up the main part of the formation is commonly thinly bedded and contains a wide variety of sedimentary structures including graded beds, parallel laminations, ripples, climbing ripples, load casts, ***mud cracks***, and ***slump folds***. White- to pink-weathering sandstone with minor interbeds of siltstone and greywacke occurs near the top of the formation. Crossbedding is common in the sandstone, as are ripples and parallel laminations in the interbedded siltstone. The carbonate minerals present in the Espanola Formation indicate that it was deposited in warm water, The multitude of ripples and mud cracks present indicate that it was deposited in shallow water, and occasionally exposed to the air.

Serpent Formation

The Serpent Formation comprises a sequence of feldspathic sandstone and siltstone, with minor amounts of calcareous rocks and conglomeratic rocks. The contact of the Serpent Formation with the underlying Espanola Formation is conformable and gradational. The Serpent Formation increases in thickness from approximately 150 m at its northern limit to more than 1500 m in the south.

Within the formation, a thin lower unit of grey sandstone with siltstone and argillite interbeds, and an upper unit of pink to green sandstone with minor siltstone, conglomerate, and carbonate-bearing beds can be recognized. The grain size and bed thickness of the sandstones generally increase upward through the formation, while the amount of siltstone decreases. Crossbedding is present in the sandstone units of the formation, while parallel laminations, cross laminations, ripples, and mud cracks occur in the siltstone units. These sedimentary structures suggest that the Serpent Formation was deposited in shallow water, and was occasionally exposed to the air.

COBALT CROUP

The Quirke Lake Group is overlain by the Cobalt Group which contains the upward sequence conglomerate, siltstone, sandstone, siltstone, and sandstone within the Gowganda, Lorrain, Gordon Lake and Bar River Formations.

Rocks of the Cobalt Group underlie much of Killarney Provincial Park. The very hard, erosion-resistant quartzite, and sandstones of the Lorrain and Bar River Formations form the dominant topographic feature of the area — the spectacular white ridges of the La Cloche Mountains and South La Cloche Range. These ridges form a large west-facing ***U*** where the Lorrain Formation bends around the nose of the McGregor Bay Anticline (see Figure 1). The intervening Gowganda and Gordon Lake Formations are much softer and more easily eroded. They form the valleys between the ridges (Figure 5), and many lakes have formed in the depressions.

Inset 4 — An Example of a Sedimentary Environment — The River Delta

A model of a sedimentary environment must necessarily be a much simplified version of real conditions. Each real sedimentary environment is unique, but models which attempt to show too much detail would be unwieldly. The important thing is to recognize features which are common to all river deltas, for example, and to be aware of those features which will change under slightly different conditions.

Evidence of river deltas is found in the Serpent Formation and other Huronian Formation.

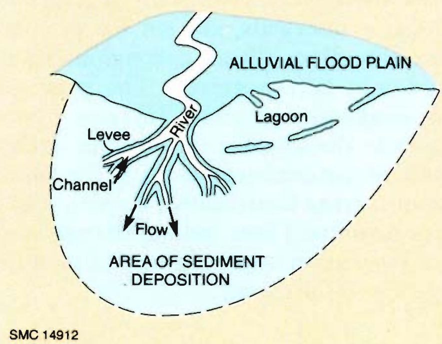


Figure 4a. *Plan or map view of a delta.*

The fundamental reason a river delta forms is that when a sediment-laden river meets a lake or ocean, the current rapidly splays out and decreases, and the sediment settles out. First, near the river mouth, the coarse material which has been tumbled along the river bottom by the current stops moving. Next, the sand swept along near the river bottom settles, a bit further out from the river mouth. Finally the fine-grained mud and silt carried in suspen-

sion settle further out to sea where the current dies. The result is a thick lens or pile of sediment fanning out from the river mouth, thinning towards the edges, and consisting of successively finer material away from the river. As the river channel changes course, the lenses of sediment shift sideways and may grade into or overlap older deposits.

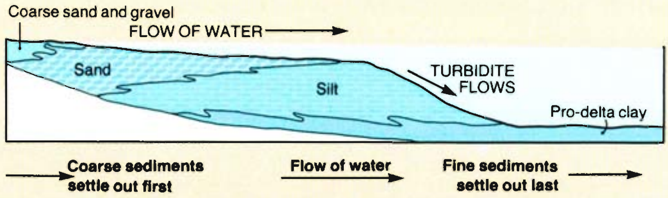


Figure 4b. *Longitudinal section (parallel to river) of a delta. Note upward coarsening sequence of sediment. When these sediments are indurated, they will form rocks such as shale, argillite, siltstone, sandstone and conglomerate.*

Gowganda Formation

The contact between the Gowganda Formation and the underlying Serpent Formation varies from conformable and gradational to ***disconformable.*** In some areas, the base of the Gowganda Formation cuts down across the bedding of the underlying sandstone for as much as 9 m.

In the park area, the Gowganda Formation can be divided into two approximately equal parts. They are a lower member of conglomerate and argillite, and an upper member of siltstone and sandstone. The thickness of the formation decreases from approximately 1500 m in the north to approximately 1400 m in the south, mainly due to the rapid decrease in thickness of the conglomerate from north to south.

The conglomerate is characterized by angular to round pebbles, cobbles and boulders of granitic, volcanic, gabbroic, and sedimentary rock set in a matrix of sandy siltstone or silty sandstone (see Photo 1). The conglomerate varies from massive and unstratified to well bedded. The siltstone in the lower part of the formation contains a variety of sedimentary structures including parallel laminations, graded beds, climbing ripples, contorted laminations, and load casts. Some apparent dropstones are present. These characteristics of the lower member of the Gowganda Formation suggest that it was deposited by glaciers moving over a continental land mass in the north, and a gradually deepening sea in the south.

The argillite and sandstone of the upper member of the Gowganda Formation comprise a series of upward coarsening cycles of siltstone, siltstone and sandstone, and feldspathic sandstone. The siltstones are characterized by parallel and cross laminations, mud chips, and load casts. Crossbedding and load casts characterize the sandstone. The amount of sandstone present in each cycle increases upward in the sequence as the contact with the overlying Lorrain Formation is approached.

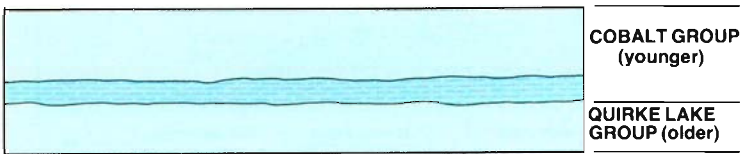
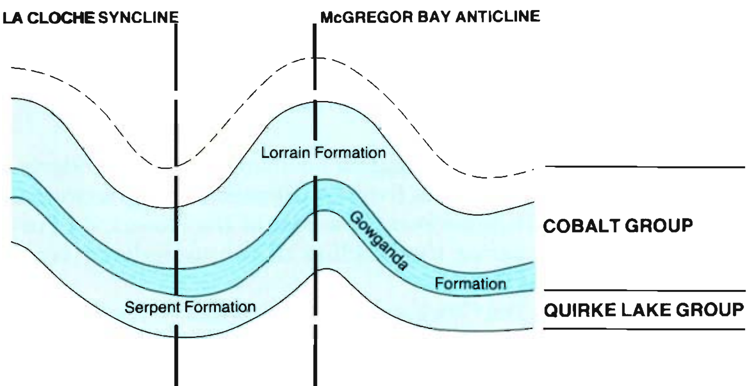
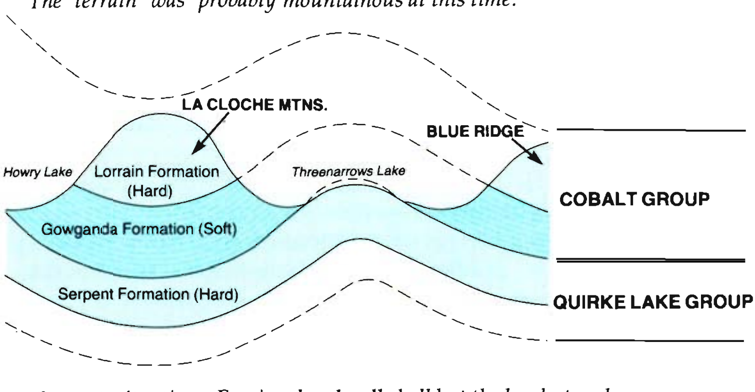


Figure 5. *Diagramatic cross-sections showing how folding of Huronian sedimentary rocks and the relative hardness of the individual formations has determined the present day topography.*
a. *Original horizontal configuration of formations.*



b. *Large scale buckling forces fold the strata into synclines and anticlines. The terrain was probably mountainous at this time.*



c. *Present situation. Erosion has levelled all but the hardest rocks.*
SMC 14913

Evidence of the transition of the atmosphere from one without free oxygen to one with free oxygen may be present within the Gowganda Formation. ***Hematite*** is stable in an oxygen-bearing environment; the presence in the upper part of the Gowganda Formation of hematitic sandstones deposited by aerated waters suggests that free oxygen was present in the atmosphere during deposition of this part of the formation. The absence of hematite in similar rocks lower in the Huronian succession suggests that the earlier atmosphere of the Earth was not oxygenated. The large quantities of oxygen necessary for this significant change in the atmosphere could have been produced by the photosynthetic processes of algae which were proliferating in oceans in other parts of the world at that time.

Lorrain Formation

The Lorrain Formation is a remarkably thick sequence of quartz-rich, erosion resistant sandstone. The contact of the formation with the underlying Gowganda Formation is conformable, and gradational over an interval of up to 30 m. The Lorrain Formation increases in thickness from north to south. In the north where the uppermost part of the formation has been removed by erosion, the remaining thickness is less than 360 m. In the south, the thickness of the formation reaches as much as 2400 m.

A number of conformable intergradational ***members*** can be recognized within the formation. They are the silty sandstone, feldspathic sandstone, green micaceous sandstone, hematitic sandstone, aluminous (containing clay minerals) sandstone, and ***orthoquartzite*** members. The sand grains in the formation increase rapidly in size in the lower part of the formation from fine to medium grained, and then decrease in size until at the top of the formation they are very fine grained. The feldspar content of the sandstones of the formation decreases upward from the bottom of the formation until feldspar disappears in the hematitic sandstone member. The disappearance of feldspar and the appearance of hematite and clay minerals at approximately the same stratigraphic level have led geologists to speculate on the climatic conditions at the time the sandstone was deposited. It is suggested that the mineralogical changes may record a change in conditions from a frigid climate to a tropical one in the area from which the sediment was derived. ***Ripple marks*** and various types of crossbedding are present in all members of the formation. Specular (black) hematite grains accentuate some bedding and crossbedding surfaces in the feldspathic sandstone and hematitic sandstone members. Conglomeratic lenses containing rounded pebbles of ***jasper*** and ***chert*** also form a distinctive part of the hematitic sandstone members. The orthoquartzite, or uppermost member of the Lorrain Formation is of special economic interest as it is sufficiently pure in ***silica*** for use as a smelter flux, and for use in the steel and glass industries.

Gordon Lake Formation

The Gordon Lake Formation conformably overlies the Lorrain Formation. It consists of 550 to 760 m of grey, pink, brown, black, buff, and green fine-grained sandstone and siltstone. There are three conformable and intergradational members within the formation. The lowermost member is a thin unit of interbedded sandstone and siltstone in which the bed thickness and grain size decrease upward. The middle member is the main part of the formation, and consists of thin-bedded siltstone and fine-grained silt and sandstone. It contains abundant sedimentary structures including parallel- and cross-lamination, graded beds, ripples, load casts, mud cracks, and ***slump*** and ***flame structures*** (Photo 6). The thin upper member of the formation represents the gradational contact zone with the overlying Bar River Formation. The zone consists of an upward coarsening sequence of sandstone and siltstone.

Photo 6. *Mud cracks (centre of photo), slump structures (below hammer head), and crossbedding (top of photo) in interbedded siltstone and sandstone of the Gordon Lake Formation, north shore of Cave Lake.*

Bar River Formation

The Bar River Formation consists of a sequence of at least 900 m of erosion-resistant orthoquartzite and hematite-bearing siltstone and sandstone. The true thickness of the formation is unknown as it is the uppermost formation of Huronian rocks which has been preserved, and at least part of it has been removed by erosion.

The Bar River Formation can be subdivided into five conformable intergradational members. They consist of white and reddish orthoquartzite, white orthoquartzite, blue and reddish hematitic sandstone with white orthoquartzite, hematitic sandstone and siltstone, and cream and buff coloured ***quartzite***. Parallel- and cross-laminations (Photo 7), load casts, and ripple marks (Photo 8) can be recognized in most members. Hematite concentrations mark the cross-laminations in some beds. The siltstone of the hematitic sandstone and siltstone member contains as much as 15 to 20 percent hematite, making it low grade ***iron formation***.

Photo 7. *Cross-laminations in orthoquartzite of the Bar River Formation, George Lake area.*

Photo 8. *Ripple marks in hematitic sandstone of the Bar River Formation. Photo courtesy D.G. Innes.*

Insert 5 — Structures in Sedimentary Rocks

Structural features which formed during the deposition of a sediment or during the compaction of the sediment are often diagnostic of the type of environment in which the sediments were deposited. Everyone is familiar with the ripples found in shallow water on a sandy beach or on a sand bar in a fast flowing stream. If these ripples are cut into with a shovel so that their internal structure is revealed, the ripples formed by waves will be seen to be formed of wavy layers parallel to the surface of the ripple; the ripples formed by the current in the stream will be seen to be formed of layers tilted on edge and crosscut by other layers (Figure 6). If similar features were seen in a sandstone, one might deduce whether the sand was originally deposited on a beach or in a river. Of course interpreting structures is not always simple because there are many types and combinations of structures, and similar structures can be formed in very different environments.

The following illustrations show some of the structures formed in sedimentary rocks in the Killarney Provincial Park area, and the type of conditions under which they could have been formed.

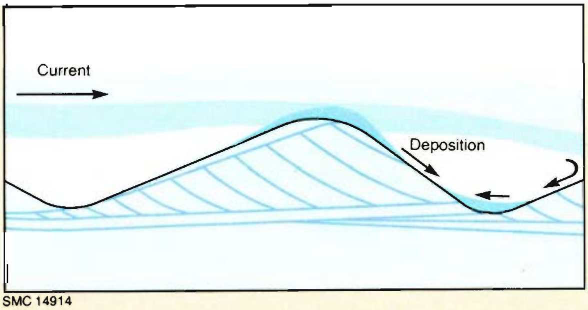


Figure 6. *Internal structure of a current ripple. Deposition of sand on the downstream side of the ripple and erosion on the upstream side cause the ripple to migrate in the direction of the current. After Reineck and Singh (1973, p.15).*

Small-scale current ripples are very common in river deposits, tidal flats and channels, and are also found in beach deposits (long shore currents) as well as in turbidite and deep-sea deposits. Small-scale ripples are formed by slower currents than large-scale ripples which are formed by fast currents in river, tidal, and shore line deposits. They are not found in turbidite or deep-sea deposits.

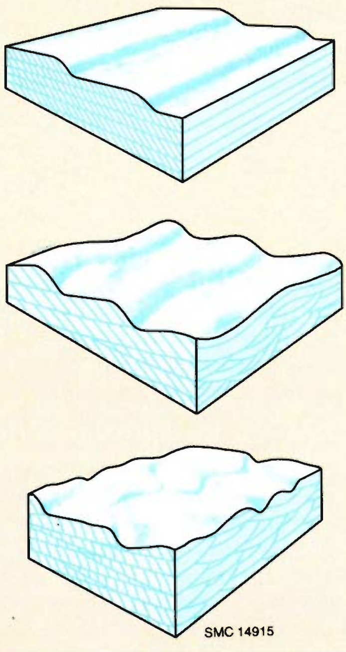


Figure 7. *Block diagrams showing the effect of increasing current speed on small-scale current ripples and the type of crossbedding produced by their migration. After Reineck and Singh (1973).*

a. *Straight-crested ripples; planar cross bedding. Formed by slow currents.*

b. *Undulatory ripples; weakly festoon-shaped cross bedding. Formed by faster water.*

c. *Lingoid ripples; strongly festoon-shaped crossbedding. Formed by strong currents.*

Inset 5, continued

Figure 8. *Internal structure of a wave ripple. The oscillation of the water (waves) without a net forward or backward movement builds a symetrical ripple with laminations parallel to the surface. After Selley (1976, p.220).*

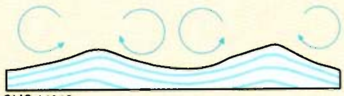


Figure 9. *Flaser bedding. Ripple bedding with lenses and laminae of mud deposited during slack periods in the current. After Reineck and Singh (1973, p.100).*

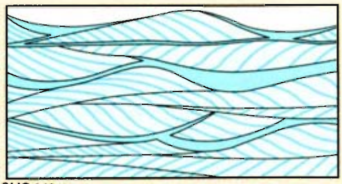


Figure 10. *Lenticular bedding. Isolated sand ripples in layers of mud. After Selley (1976, p.220).*

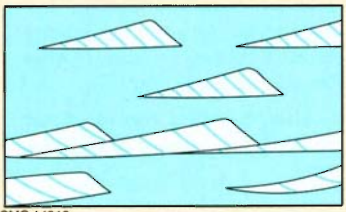


Figure 11. *Graded bedding, a characteristic structure of turbidity currents (see Inset 2), which generally occur in the deep ocean but also in some lakes. In this type of current, a complete range of sediments from boulders and pebbles to sand and mud are carried in suspension. As the flow of sediments and water slows down, the coarse material settles out first, followed by successively finer grained sediment, to form beds in which the grain size grades from coarse at the bottom to fine at the top.*

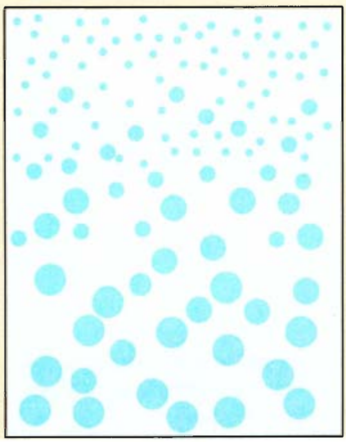


Figure 12. *Mud cracks or dessication cracks, caused by contraction of drying mud exposed to air. The mud cracks are preserved by infilled sand. After Selley (1976, p.230).*

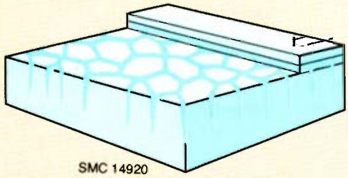
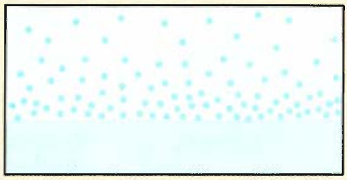


Figure 13. *Load casts developed where a layer of sand rests on a layer of mud. After Reineck and Singh (1973, p.76).*

a. *Prior to slumping.*



b. *After slumping.*

Figure 14. *Ball-and-pillow structures develop where an overlying layer of sand sinks into mud and break up into saucer-like "pillows". After Reineck and Singh (1973, p.78).*

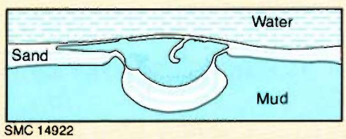


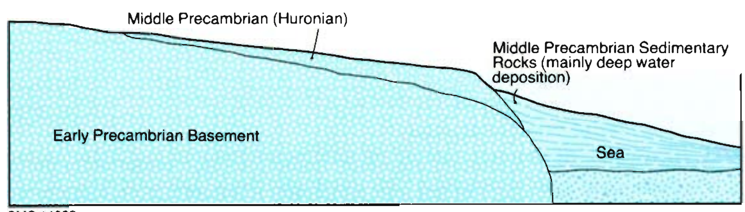
TABLE 2 SUMMARY OF HURONIAN STRATIGRAPHY IN AND NEAR KILLARNEY PROVINCIAL PARK AREA.

Group	Formation	Lithology	Thickness (metres)	Depositional Mode Environment
Cobalt	Bar River	Sandstone, siltstone.	900	Shallow marine
	Gordon Lake	Siltstone, sandstone.	550-760	Shallow marine
	Lorrain	Sandstone	360-2400	Shallow marine
	Gowganda	Conglomerate, sandstone, siltstone, argillite.	500-1400	Glacial in north; marine glacial in south
Quirke Lake	Serpent	Sandstone.	150-1500	Fluvial, fluvial-deltaic, shallow marine
	Espanola	Dolomite, limestone, sandstone, siltstone.	150-600	Tidal mudflat, shallow marine
	Bruce	Conglomerate.	0-400	Glacial marine
Hough Lake	Mississagi	Sandstone.	300-3000	Fluvial, fluvial-deltaic
	Pecors	Argillite, sandstone.	75-450	Fluvial-deltaic
	Ramsay Lake	Conglomerate.	60-180	Glacial marine
Elliot Lake	McKim	Argillite, siltstone, greywacke	90-2400	Shallow water turbidite
	Matinenda	Sandstone, conglomerate.	0-600	Fluvial, fluvial-deltaic
	Volcanic rocks	Basalt, andesite, rhyolite.	local	Marine?

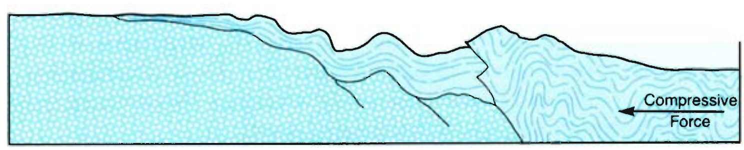
INFERRED HISTORY OF HURONIAN DEPOSITION

A summary of Huronian stratigraphy is shown in Table 2. In examining Huronian stratigraphy, the repetition of certain characteristics within the succession of sedimentary rocks becomes apparent. The sequence conglomerate, siltstone, sandstone appears three times, beginning with the Ramsay Lake Formation. The contact relationships of the conglomeratic units range from conformable to disconformable in each case. Each of the conglomeratic units in the repetitive sequences appears to have been deposited in a glacial-marine or glacial-terrestrial environment. Each of the conglomeratic units thins southward. The siltstones, which conformably overlie the conglomeratic units, thicken southward. They contain an abundance of sedimentary structures including parallel- and cross-laminations, graded beds, load casts, and possible mud cracks, which suggest that the siltstones were deposited in shallow water. The siltstone units are conformably overlain by the sandstone units. The sandstones, which also thicken southward, contain features such as cross laminations indicating that they were deposited in river delta, and

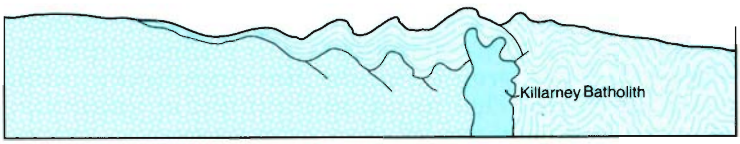
Figure 15. *Schematic cross sections showing the supposed sequence of events following the end of Huronian deposition. First, large scale forces in the Earth's crust crumpled (b.) the layered sedimentary rocks up against the more rigid block of crystalline Early Precambrian rocks. Next, a series of plutons were intruded (c.) along the zone of weakness between the block of Early Precambrian rocks and the more ductile, crumpled sedimentary rocks. The last event (d.) was the further deformation of the layered sedimentary rocks southeast of the zone of plutons, again by large-scale forces in the Earth's crust. This event had little effect on the Huronian rocks north of the plutons, perhaps because these rocks were now essentially part of the crystalline basement.*



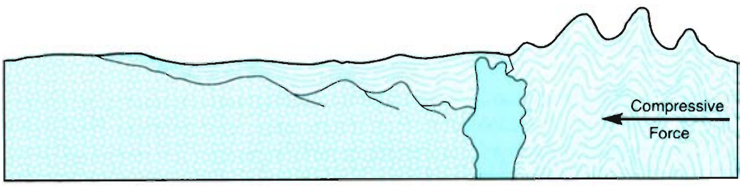
a. *Undeformed sedimentay rocks at the end of Huronian time.*



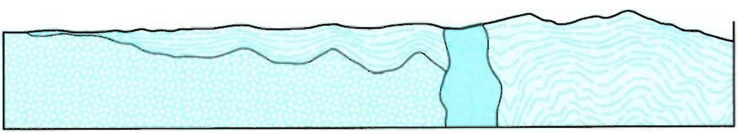
b. *Folding of sedimentary rocks during the Penokean orogeny.*



c. *Intrusion of Killarney Batholith and other plutons along the present Grenville Front Zone.*



d. *Additional deformation of rocks southeast of the Killarney Batholith during the Grenville Orogeny.*



e. *Erosion to the present level.*

shallow marine environments.

A summary of the history of deposition of the Huronian rocks must take into consideration the geologic features and interpretations listed above. The sediment which makes up the rock was derived from the Early Precambrian basement to the north, was transported southward by streams and glaciers, and was deposited along the margin of a shallow sea which periodically flooded, or transgressed across the basement. Each successive ***transgression*** reached farther north across the land mass so that successive formations overlapped onto the Early Precambrian basement. Glaciers covered the area as may as three times, and moved quantities of rock and soil southward.

During the ***deposition*** of the lower formations of the Huronian succession, the source area of the ***detritus*** must have had a very rugged topography, for the character of the sediment indicates that it was eroded, transported, and deposited relatively quickly. As deposition of the succession continued, the topography of the source area became more subdued, because the character of the sediment indicates that it underwent weathering before being deposited. Sediments at the top of the Huronian succession apparently underwent even more prolonged weathering before being deposited. The source area of the sediment may have been reduced to a ***peneplain*** similar to the present topography of the Early Precambrian rocks of the Superior Province. The erosion of some 950 000 km^3 of rock would have been necessary to provide the volume of sediment now present in Huronian sedimentary rocks. This is equivalent to eroding an area extending over 300 km north from the Huronian rocks along the north shore of Lake Huron to a depth of 6.5 km. It is not surprising, then, that as much as 300 million years may have been needed for the erosion of the sediment and the deposition of the Huronian sedimentary rocks, or that repeated glaciation, repeated inundation of the continent by the sea, a major change of climate, or even a change from an atmosphere lacking free oxygen to one with it should have had time to occur.

Nipissing Diabase

Approximately 2160 million years ago, Nipissing Diabase intruded the rocks of the area. The emplacement of the ***diabase*** sheets, which range in thickness from a few metres to several thousand metres, was partly controlled by major regional faults and other structures such as ***bedding*** interfaces and joints. The major regional faults probably acted as channelways allowing upward movement of the ***magma***. The diabase formed both ***dikes***, which crosscut any internal stratification such as bedding or ***gneissosity*** which may be present in the host rock, and ***sills***, which are parallel to any such stratification. Where no internal stratification is present, as in large bodies of granite or gabbro, the sheet-like intrusions are called dikes. The dikes and sills of Nipissing Diabase are gabbroic to dioritic in composition.

Folding, Fracturing, and Metamorphism of Southern Province Rocks

Huronian deposition was terminated by a long period of intense deformation and mountain building. In the eastern part of the Southern Province, the Huronian sedimentary and volcanic

Photo 9. *Folded hematitic siltstone and sandstone of the Bar River Formation, north shore of George Lake. Note the orientation of the cleavage in the sandstone bed across the crest of the fold.*

rocks were structurally deformed into large ***synclines***, or trough-shaped folds, and ***anticlines***, or arch-shaped folds (see Figure 2). These folds are approximately paralleled by major ***faults*** — fractures in the rock along which movement of the rock walls has occurred. The major structures in the Killarney Provincial Park area trend easterly to northeasterly.

The intensity of ***deformation*** of the rock varies markedly from place to place, but it generally increases towards the south and east. The folds, for instance, are open structures with gently ***dipping*** limbs in the Elliot Lake area, while in the Killarney Provincial Park area, they are tight, complex structures with steeply dipping limbs.

Several periods of deformation and mountain building activity which occurred intermittently over a period of 1000 million years affected the rocks of the Southern Province. Evidence for more than one period of deformation includes the presence of several generations of major and minor structures such as folds and faults.

Although the detailed sequence of deformational and metamorphic activity has not yet been worked out, it is apparent that orogenic events affected different parts of the Southern Province at different times. Deformation of the Huronian rocks commenced prior to intrusion of the Nipissing Diabase 2160 million years ago (an age determined by ***radiometric dating*** methods) and continued after intrusion of the diabase. The two strongest phases of deformation occurred between the commencement of orogenesis more than 2160 million years ago, and its end about 1600 million years ago. These phases of deformation have variously been equated with the Penokean Orogeny of Michigan and Minnesota and the Hudsonian Orogeny of the Churchill Province of the Canadian Shield. During the ***orogeny,*** the rocks were folded (Photo 9) and faulted, mainly along east-west axes, and mildly ***metamorphosed***. The later folds modified the earlier folds to varying degrees from place to place. The effects of metamorphism, which occurred approximately concurrently with deformation, also vary in intensity from place to place. Minerals which have developed in the ***argillaceous*** rocks of the Huronian sequence as a result of metamorphism include ***mica***, ***chloritoid***, ***garnet***, ***staurolite***, and ***andalusite***. ***Kyanite*** and andalusite have developed in parts of the Lorrain Formation. ***Scapolite***, ***diopside***, ***tremolite***, ***actinolite***, and ***hornblende*** occur in metamorphosed ***calcareous*** rocks of the Espanola Formation. Some of the earlier formed metamorphic minerals were retrograded (altered to other metamorphic minerals of lower temperature and pressure of formation) in the less intense waning stages of the orogenic period. Igneous rocks were intruded in several localities. Radiometric studies indicate that these intrusions occurred between approximately 1600 and 1750 million years ago. In the Killarney Provincial Park area, the suite of granitic plutons which occupies the Grenville Front Zone was intruded at that time.

Grenville Front

The Grenville Front is the boundary between the Grenville Province to the southeast and older geological provinces to the northwest. It can be traced over 2000 km northeastward from Lake Huron to the coast of Labrador. In some areas, the boundary is marked by a very rapid increase in the degree of deformation and metamorphic grade from the older geologic provinces to the Grenville Province. In other areas, it is marked by one or more faults across which the degree of deformation and metamorphic grade change abruptly. In the area between Killarney and Sudbury, the boundary between the Southern and Grenville Provinces is marked by a number of contiguous granitic ***plutons***, or bodies of igneous rock which solidified below the surface of the Earth. These plutons occupy what is called the “Grenville Front Zone”. The composition of the Grenville Front Zone plutons ranges from ***granite*** to ***gabbro***, but is mainly ***quartz monzonite***. The contact relationships between the plutons and the rocks of the Southern Province are often complex. Dikes of granitic rock extend into the country rock in some places. Elsewhere, ***agmatite*** or angular inclusions of country rock in a granitic matrix, occurs at the contact. The inclusions or xenoliths have moved little from their original position in some cases, indicating relatively quiet intrusion of the granitic matrix. In other cases, however, the blocks are disoriented, indicating more forceful intrusion of the magma which formed the pluton. The term batholith means the same as pluton, but generally implies a larger body of rock.

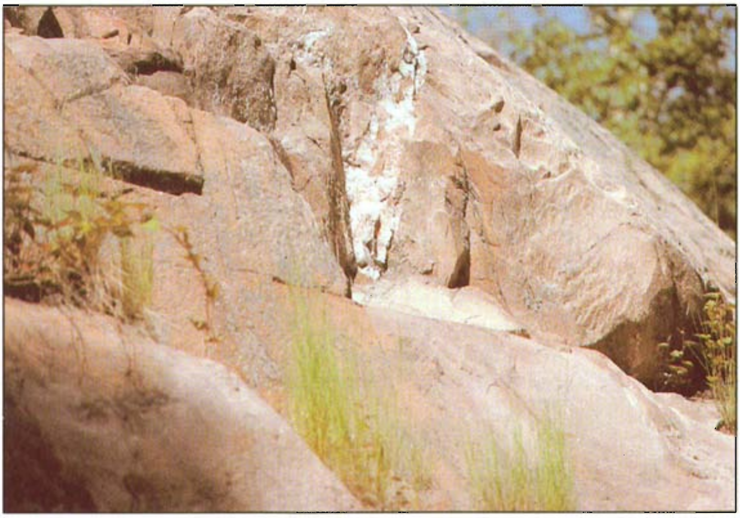


Photo 10. *Quartz veins in foliated granite of the Killarney Batholith, south shore of George Lake near boat launching area.*

Photo 11. *Porphyritic granodiorite of the Bell Lake Batholith, south shore of Johnnie Lake.*

KILLARNEY, BELL LAKE AND CHIEF LAKE BATHOLITHS

The Killarney Batholith is the most southwesterly of the Grenville Front Zone plutons. It consists mainly of bright pink, massive to ***foliated*** quartz monzonite and granite (Photo 10). Rocks of the Bell Lake Batholith lie northeast of the Killarney Batholith in the Grenville Front Zone. They are massive to foliated, pale pink to grey, ***porphyritic*** quartz monzonite and granodiorite (Photo 11). A porphyritic rock is one which contains crystals of one or more minerals which are considerably larger than the other minerals which make up the rock. In this case, the large grains or ***phenocrysts*** are of feldspar. The Chief Lake Batholith occupies the Grenville Front Zone northeast of the Bell Lake Batholith. It is a composite intrusion of massive and foliated porphyritic and ***equigranular*** quartz monzonite, ***quartz diorite***, and ***granodiorite***. Geologic mapping of the contacts between the batholiths described above is difficult because the contact zones between them are intruded in part by small, younger plutons. The northern part of the contact zone between the Killarney and Bell Lake Batholiths is intruded by a light pink to grey granodiorite. The contact between the Bell Lake and Chief Lake Batholiths is also intruded by light coloured granite.

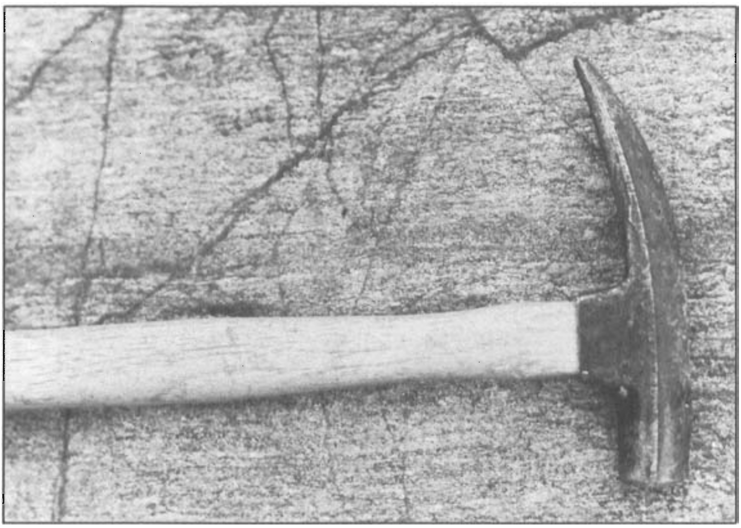


Photo 12. *Well developed foliation in gneissic granite is defined by dark minerals oriented in a plane parallel to the hammer handle.*

In the Southern Province, unmetamorphosed diabase dikes form a prominent northwest-trending swarm. Some of the dikes intrude the Grenville Front Zone batholiths, and hence are younger than them. Within the Grenville Province, possible equivalents of these dikes are highly deformed and metamorphosed, indicating that they are older than at least part of the orogenic activity which took place within the Grenville Province. Radiometric dating reveals them to be approximately 1 250 million years old. The diabase is a dark grey, magnetic rock, with a characteristic rust brown weathering colour.

The dikes form long, narrow bodies from 0.3 to 180 m wide, and average about 30 m in width. Some of them extend for distances in excess of 80 km. The locations of the dikes, which usually weather more readily than their host rocks, are often marked by long, narrow northwest-trending valleys.

Grenville Province Rocks

The rocks of the Grenville Province in the Killarney Provincial Park area include metamorphosed and deformed Middle and Late Precambrian sedimentary and igneous rocks. They display well developed foliation (Photo 12) and ***lineation*** (Photo 13) and high grade metamorphic minerals. Their texture is ***gneissic***. The degree of metamorphism and deformation sometimes makes it difficult to distinguish between altered sedimentary rocks (or paragneiss), and altered igneous rocks (or orthogneiss) in the Grenville Province.

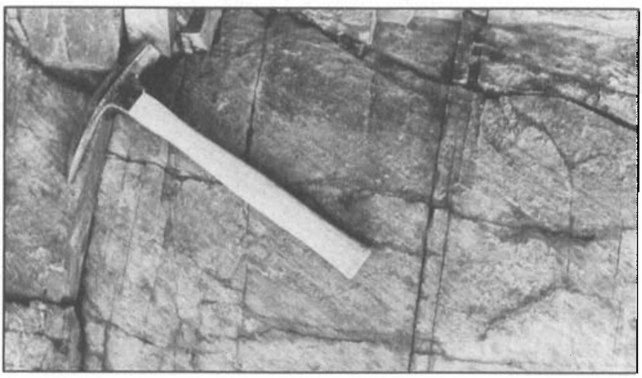


Photo 13. *Well developed lineation parallel to the hammer handle resulted from the orientation of quartz grains in one direction. This lineation occurs in gneiss exposed in a road cut at 59.1 km [36.7 miles] along Highway 637.*

Photo 14. *Pink and grey banded paragneiss exposed in roadcut east of the Bell Lake access road, 37.5 km [23.3 miles] along Highway 637.*

The ***paragneisses*** of the Grenville Province are characterized by prominent compositional layering which reflects in part their original bedding. Pink and grey quartz-rich, ***feldspar***, ***biotite***, and ***muscovite*** paragneisses occur as interstratified and intergradational units (Photo 14). Highly metamorphosed conglomerate and orthoquartzite are also present. Relict primary sedimentary structures such as bedding and crossbedding can be recognized at some localities. Observation of features such as composition, variations in composition, and sedimentary structures in the Grenville paragneiss has led to the conclusion that in the Killarney area, the paragneiss is equivalent at least in part to the Huronian succession found nearby in the Southern Province.

Igneous rocks ranging from unaltered to intensely altered occur within the Grenville Province. Some tabular bodies of deformed and metamorphosed gabbroic rock which are apparently older than the Grenville Front Zone plutons, may be correlative with the Nipissing Diabase intrusions of the Southern Province. Other metamorphosed ***mafic*** igneous rocks in the Grenville Province may be equivalent to the olivine diabase dikes discussed earlier. Still other bodies of metagabbro or mafic ***orthogneiss*** may represent mafic igneous rocks which were intruded only in the Grenville Province, and have no equivalents within the Southern Province. A number of undeformed, post-orogenic mafic igneous dikes and ***stocks*** also occur in the Grenville Province.

The deformed and metamorphosed felsic intrusive rocks of the Grenville Province are mainly pink to grey, medium- to coarse-grained granitic rocks. Radiometric studies indicate that many of the intrusive bodies are of approximately the same age as the Grenville Front Zone plutons (1600 to 1800 million years).

Very coarse grained, or ***pegmatitic*** dikes (Photo 15) of granitic composition intrude all the rocks of the Grenville Province except the youngest mafic intrusive bodies. Some are gneissic, and hence older than the main period of deformation and metamorphism of the Grenville Province, while others are undeformed, and hence are younger than the orogenic activity.

Photo 15. *Pegmatite dike crosscutting rocks of the Bell Lake Batholith, north shore of Carlyle Lake.*

Grenville Orogeny

The gneisses of the Grenville Province have undergone a complicated history of deformation and metamorphism. Evidence of early metamorphic and deformational events has, however, been largely obscured by the effects of the most recent period of orogenesis, the Grenville orogeny.

Mineral associations in the metamorphic rocks of the Killarney area of the Grenville Province indicate that the pressure and temperature conditions of metamorphism during the Grenville orogeny were uniform throughout the area. Pressures of approximately 6000 to 9000 times the pressure at the Earth's surface, and temperatures of approximately 650° to 750°C were attained. Pre-existing mineral assemblages were recrystallized and

Photo 16. *Tightly folded paragneiss exposed in road cut east of the Bell Lake access road, 37.5 km [23.3 miles] along Highway 637.*

new minerals such as biotite, garnet, kyanite, and ***sillimanite*** were formed. The mineral banding of the gneisses was developed, and the rock subsequently deformed (Photo 16) in response to the intense pressure to which it was subjected.

The orogeny in the Grenville Province reached its culmination between 1200 and 1400 million years ago after which structural and metamorphic activity subsided. Grenville Province rocks which give a radiometric age of approximately 950 million years are thought to reflect a lesser, more recent event than the main Grenville orogeny. Although no topographic evidence remains, the result of orogenic activity in the Grenville Province must have been an imposing range of mountains.

Lipalian Erosional Interval

The Lipalian interval was a long period of erosion which began after orogenic activity in the Grenville Province. It was brought to a close approximately 600 million years ago during the Paleozoic Era when seas advanced across the continent and deposited sandstone, limestone, and shale on the Precambrian rocks of the Southern and Grenville Provinces (Photo 17). During the Lipalian interval, the mountainous terrain of those structural provinces was reduced to a surface very similar to that which exists today.

The amount of erosion which could have occurred during a period of time as long as the Lipalian interval can be brought into perspective by a comparison with the amount of erosion the Appalachian Mountains have undergone. The Appalachian Mountains were probably originally comparable to the Rocky Mountains of western North America where orogenesis continued until the Quaternary Period. In the 225 million years which have passed since the Appalachian Mountains were formed, they have been reduced from rugged peaks thousands of metres high to the subdued range present today.

Photo 17. *The great unconformity between Precambrian and Paleozoic rocks. Parallel beds of calcareous sandstone and limestone of Paleozoic age overlie Precambrian orthoquartzite. The head of the hammer rests on the unconformity, which represents the Lipalian interval. This outcrop lies west of the guidebook area, on Great La Cloche Island.*

Phanerozoic Events

The Paleozoic, Mesozoic, and Cenozoic Eras are known collectively as the Phanerozoic Eon, a major period of Earth history, which is also referred to as the eon of evident life. Unlike the Precambrian Eon which preceded it, the Phanerozoic Eon can be subdivided by age with relative ease. Its formations are readily identifiable because of the abundant traces of life which they contain, and in Ontario, because of their undisturbed condition.

Consolidated sediments of the Phanerozoic Eon occur in the southwest part of the Killarney area, along the north shore of Lake Huron, on Manitoulin Island, and on many of the smaller islands in the area. All the Phanerozoic rocks in the area are from the Paleozoic Era. Mesozoic deposits are not found in the southern part of Ontario, although Cenozoic deposits are widespread throughout the province as an unconsolidated layer of sand, gravel, silt, clay, and till overlying the bedrock.

Paleozoic Rocks

Paleozoic sedimentary rocks, which underlie much of North America, lap onto the margin of the Canadian Shield along the north shore of Lake Huron. The Paleozoic strata generally dip southwest, and as some formations are particularly resistant to erosion, several northeast-facing escarpments are present. The most important of these is the Niagara Escarpment which continues south from Manitoulin Island through southern Ontario, and is responsible for Niagara Falls.

During the Paleozoic Era, the dominant forms of animal life were ***invertebrate***, or lacking backbones. Many of these invertebrate animals living in the shallow Paleozoic seas which had flooded the continents had the ability to extract calcium carbonate from seawater to build protective shells. Such resistant body parts tend to be preserved as fossils, providing an excellent record of early Paleozoic marine life.

The rocks of the Paleozoic Era in the Killarney area were deposited in a shallow sea between approximately 500 and 400 million years ago during the Ordovician and Silurian Periods. As the topographic relief of the underlying Precambrian rocks was comparable to the present-day relief of the area, islands of Precambrian quartzite protruded at least for a while through the water of the shallow sea.

The Ordovician and Silurian rocks of the area are grey, finely crystalline limestone, argillaceous limestone, dolostone, and shale. The abundant fossils of early Paleozoic marine life include remains of various types of ***trilobites***, ***bryozoa***, ***brachiopods***, corals, ***pelecypods***, ***gastropods***, and ***graptolites.***

Post-Silurian Erosional Interval

Since the deposition of the Ordovician and Silurian rocks and the withdrawal of the Paleozoic seas, the area has probably remained much as it is today. The Paleozoic rocks were subjected to erosion after the withdrawal of the sea, and the land surface formed during the Lipalian interval eroded further where it was not covered by Paleozoic strata.

Cenozoic Deposits

The Cenozoic Era began approximately 65 million years ago and continues at present. It is subdivided into the Tertiary and Quaternary Periods. No deposits of the Tertiary Period are found in the Killarney area. The Quaternary Period, which began approximately 1.8 million years ago, is further subdivided into the Pleistocene and Recent ***Epochs***. The time of commencement of the Recent Epoch varies from place to place, as it is generally considered to be the time when glacial activity in the area ceased. In Ontario, the Recent Epoch began approximately 10 000 years ago.

The Pleistocene deposits of the Killarney area are unconsolidated sediments deposited by glacial agents. About 1.8 million years ago, continental glaciers thousands of metres thick spread across the northern half of North America and advanced southward over the continent, removing soil and scouring, scratching, and grooving the bedrock. Several retreats and re-advances of the great ice sheet occurred during the Pleistocene Epoch. Toward the end of the epoch, the ice sheet advanced a final time, and then was wasted away by melting, and gradually reduced northward.

As the glaciers melted, great volumes of water flowed southward or were ponded in front of the glaciers in the Great Lakes basin, forming the succession of lakes known as Algonquin, Stanley, Nipissing, Algoma and Huron. During most of the stages of the succession of glacial lakes, the waters were deeper and more extensive than in the present Great Lakes. The Stanley stage did, however, drain to an extremely low level. With the changing lake levels, and spontaneous uplift or ***isostatic rebound*** of the Earth's surface in response to the removal of the tremendous weight of glacial ice, the glacial lakes formed a series of shorelines. This succession of shorelines is recorded by abandoned beaches and wavecut terraces which now stand at various elevations above the present Great Lakes. Gradual uplift of the Killarney area due to isostatic rebound is still continuing at a rate of approximately 13 cm a century.

Inland from the Great Lakes basin, a thin discontinuous layer of unconsolidated soil, sand, and boulders, or glacial till, was deposited when the glacial ice melted away and left behind the sediment which it carried. In some areas, the retreat of the glacier was stalled for some time when the rate of glacial advance equalled the rate at which it was melting back. The locations of such stalling points are marked by mounds of sand and gravel, or ***moraines***, which consist of detritus brought forward by the glacier and deposited when it melted, like material being stockpiled at the end of a conveyor belt. Deposits of ***varved*** clay and silt which are now found inland from the Great Lakes mark areas which were once covered by the waters of forerunners of the Great Lakes, or by other lakes or ponds of glacial meltwater. Glacial meltwater also flowed southward, depositing sediments as ***eskers*** and valley train deposits, and carving broad valleys which are often partly occupied by smaller, modern streams and rivers.

In Ontario, Recent deposits are generally restricted to swamp and bog deposits, and minor lake and river sediment deposits. These deposits are significant, however, for it is in them that evidence of the presence of early man in Ontario is found.

Early Man

Early man probably came to North America during the Pleistocene Epoch. Evidence from Sheguiandah on Manitoulin Island, where artifacts were found incorporated into glacial till suggests that man was present in the area as much as 30 000 years ago. If this startling discovery has been interpreted correctly, it represents one of the earliest indications of man in North America.

Photo 18. *Bifacially-worked artifacts from the O.S.A. Lake Site 1, produced by people of the Shield Archaic culture. Photo copyright Royal Ontario Museum, Toronto.*

During the Recent Epoch, early man was attracted to the Killarney area by its white quartzite deposits. The fine-grained quartzite was found to be excellent for making arrowheads, scrapers, and other tools (Photos 18,19). At least two ancient quarries, and several tool-making sites have been found in the region. A quarry and a tool-making site near George Lake were used approximately 9000-10 000 years ago when the retreating glacier was less than 150 km away. The crests of the quartzite hills were islands in post-Algonquin glacial lakes at that time. Campsites occupied 6500, 4000, and 2000 years ago have also been identified in the area. Although the early occupants of the area have not been positively identified, it is probable that they were the forerunners of the modern Algonkian speaking people.

Photo 19. *Archaeological excavation in Killarney Provincial Park by staff of Royal Ontario Museum. Photo courtesy B. Sigmon.*

History of the Area

The town of Killarney is located on the north shore of Georgian Bay, approximately 75 km southwest of Sudbury. It occupies the end of a peninsula underlain by red Killarney granite that juts out into Georgian Bay. Killarney is protected from direct exposure to Georgian Bay by George Island, directly opposite the town. The narrow east-west channel between the island and the peninsula has been a major factor in the development of Killarney.

Original Settlement

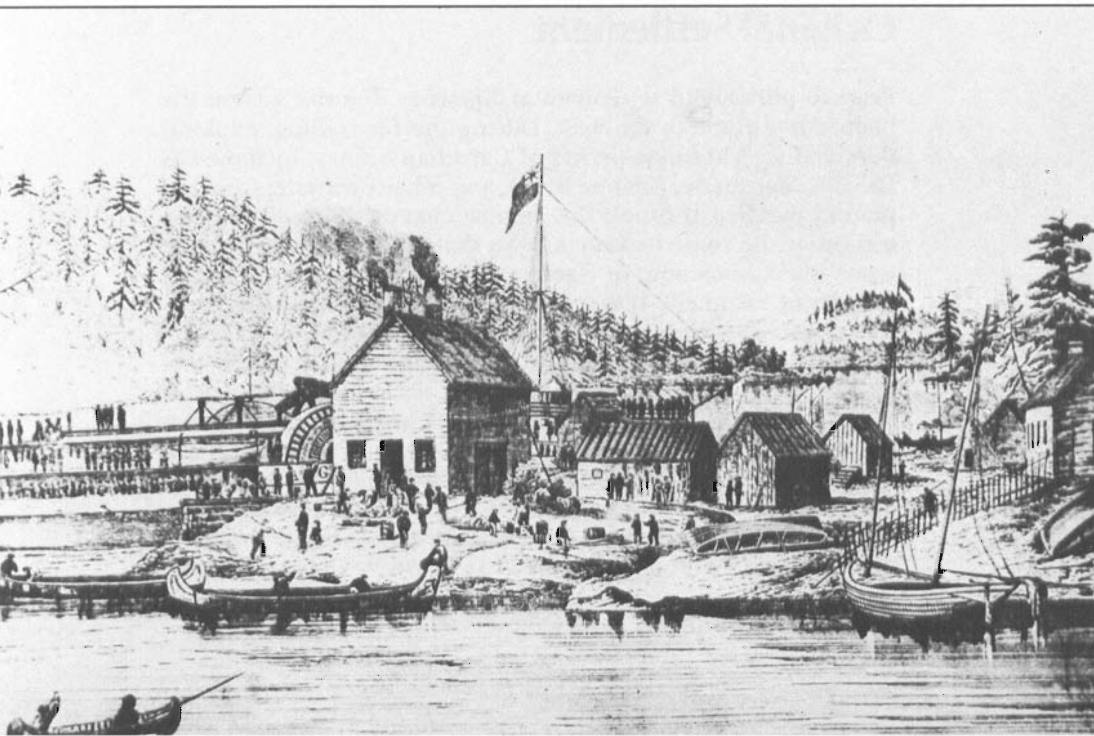
Prior to permanent settlement at Killarney, the site was on the main canoe route to the west. During the fur trading, exploration, and freight canoe period of Canadian history, such men as LaSalle, Marquette, Etienne Brulé, and other fur traders and explorers paddled through the narrow channel. So well did this section of the route become known that it received the Ojibway name Shebahonaning, or Shebawenahning, meaning "here is a safe canoe channel". It is said that Flat Point at the eastern entrance to the channel was frequently used as a campsite. The desirability of having a trading post at Killarney was eventually recognized by Etienne Augustin Rochbert de la Morandière, who became the first white settler of the area when he established a post there on June 28, 1820. Until the 1860s, the post was the major establishment in the area, and a few Indians, trappers, and traders took up permanent residence in the surrounding area. The acceptance of the settlement as a permanent community by the Canadian government came in 1854 when a post office was opened. Although some reports state that the name Shebahonaning was not changed to Killarney until 1882, the first postal stamp bore both names in 1854.

Lumbering

By the early 1850s, lumbermen had moved into the upper Great Lakes in search of timber to meet the demands created by the industrial revolution. In 1868 a mill was established at Collins Inlet, some 15 km east of Killarney. Although it was far removed from road or rail terminals, the site was accessible by boat during the shipping season, and was well protected from the main part of Georgian Bay.

During the lumbering era, the entire area prospered. By 1900, however, the prime timber had been cut. Minor logging operations continued in the area until the late 1940s. The trees removed from the area were red and white pine, spruce, hemlock, cedar, ash, birch, maple and oak. Remnants of the logging era include log chutes, work camps, corduroy roads, boom rings anchored in rock faces, wharf pilings, and of course, thousands of tree stumps.

Photo 20. *Immigrants travelling via Shebahonaning (Killarney) to Dawson Road and on to the prairies, ca. 1875(?). Photo from engraving, Public Archives of Ontario.*



Shipping

The development of Killarney as a port was a legacy of the lumber era. Many ships docked there (Photo 20) both to pick up lumber and to deliver supplies. After 1875, a regular scheduled run between Killarney to Owen Sound was set up. The presence of the scheduled run to Killarney, and from Killarney to market, did much to encourage both the tourist and fishing industries of the area. It must be remembered that no railway has ever served Killarney, and that the road which now connects the town with Highway 69 was opened only in 1961.

Fishing

During the 1880s, a commercial fishing industry developed in the Killarney area. The decline in abundance of fish, and the seasonal nature of the fishing industry have combined to seriously restrict it at present. Reminders of the importance of fishing in Killarney in bygone years can, however, be seen along the waterfront of town where fishing boats rest at dry dock beside empty ice houses and warehouses.

Mining

Geological investigations of the Killarney area began in 1854 when Alexander Murray began his mapping work for the Geologic Survey of Canada. Prospecting activity is recorded as early as 1880 when a Captain Tranche of Goderich investigated an iron deposit on the northwest shore of George Lake. The deposit was probably part of the hematitic sandstone and siltstone member of the Bar River Formation. Continuing prospecting led to the discovery in 1911 of several small deposits of gold along Howry Creek north of Killarney Provincial Park. Gold was produced from one of the deposits at the Bousquet Mine during the 1930s.

Development of the greatest mineral resource of the Killarney area began in 1911 when a silica quarrying operation began approximately 6 km west of the town on Badgeley Point. It operated seasonally almost every year until 1970 when the machinery was moved to Badgeley Island and a new quarry was started. The quarries have been excavated in ***orthoquartzite*** of the Huronian succession. The old quarry extracted orthoquartzite from the Lorrain Formation, while rock quarried at the new location is from the Bar River Formation. Orthoquartzite has also been quarried from both formations in the Little Current area.

The crushed rock is shipped from the Badgeley Island quarry to Midland and to the United States for use as an abrasive, in the production of bottle glass, and in the production of ferrosilicon for the steel industry.

Tourism

The tourist industry in the Killarney area dates back to the lumbering era. Many of the ships which called in to pick up lumber carried paying passengers to help defray their costs. For many of the passengers, their recollection of stories of good fishing and hunting, and their impression of the scenery of the surrounding area were enough to bring them back to Killarney with their friends. During the 1920s, yachting in the area increased. A cottage register from Baie Fine records yachting visits of the president of Zenith Radio Corporation, the inventor of the outboard motor, and the founder of Toronto radio station CFRB during the summer of 1929. The sculptor of Mount Rushmore, and William Hale Thompson, the ex-mayor of Chicago, were aboard yachts in Baie Fine in 1932. The flamboyant Mr. Thompson was no stranger to the area for he owned a cottage on Threenarrows Lake during the 1920s, while he was in office. Speculation has it that Al Capone, the gangster, used to holiday there. A further increase in yachting activity has been noted in the area since 1960. The more recent craft have been of the cabin cruiser type, however, rather than the hundred-foot-long luxury vessels owned by the earlier visitors to the area.

Highway 637, the secondary highway connecting the town of Killarney to Highway 69, was begun in 1956, and completed in 1961. With its completion, and the opening of Killarney Provincial Park in 1964, visitors travelling by car became an important part of tourism in the Killarney area.

Painting

Artists from many fields have long recognized the wild beauty of the country in the Killarney area. Perhaps no other group is as well known for its activities in the region as the Group of Seven painters. Lauren Harris, who was the first member of the group to visit the area, made his initial visit in 1918, two years before the group was officially formed. Arthur Lismer and A.Y. Jackson frequented the area after 1920. Franklin Carmichael was so impressed by the region that he built a cottage at Cranberry Bay in 1934. J.E.H. MacDonald and F.H. Varley also painted in the region. Visits by A.J. Casson and other members of the Group of Seven to the area continued through the 1940s and into the 1950s.

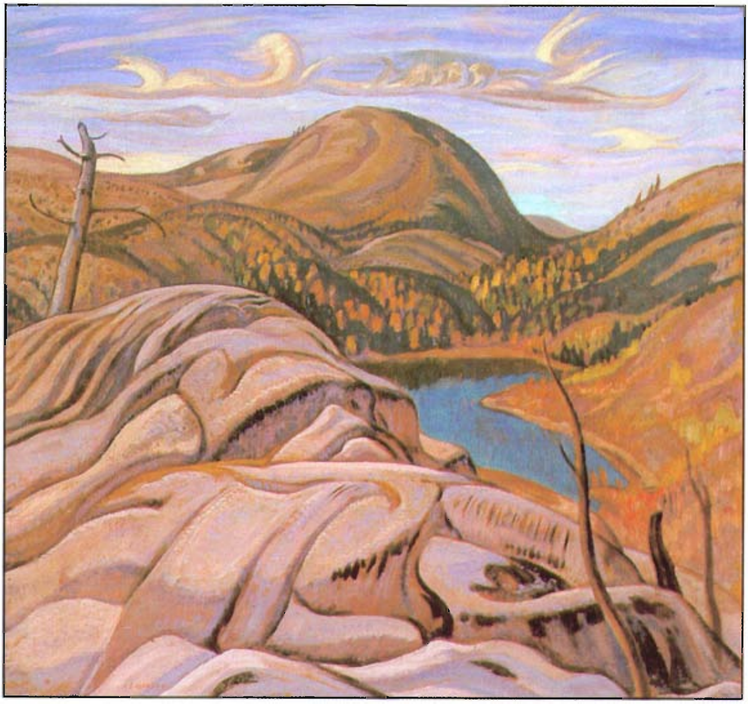


Photo 21. *"Nellie Lake" by A.Y. Jackson. Courtesy The McMichael Canadian Collection.*

The most readily identifiable works of the region are Arthur Lismer's "Happy Isle" painted at McGregor Bay, A.J. Casson's "White Pine", Franklin Carmichael's "October Haze", and A.Y. Jackson's "Nellie Lake" (Photo 21). According to Jackson's long-time sketching companion Joachim Gauthier, however, A.Y. Jackson's "Nellie Lake" is not of that lake at all, but rather of Grace Lake. Regardless of the locality of the lake depicted by Jackson, it is unlikely that the ultimate result of his visits to the Killarney area, the creation of Killarney Provincial Park, is widely recognized.

PART 3

Points of Interest

This guidebook deals with the entire length of Highway 637. In addition, side trips away from the highway including hikes, and canoe and motor-boat tours (Photos 22, 23, 24) are described. It is recommended that visitors take as many of these side trips as possible because the best scenery, and much of the most interesting geology lies along them.

The geology and scenery of the Manitoulin Island, Bay of Islands to Espanola, and Sudbury areas which lie immediately to the west and north of the area described in this guidebook are described in Guidebook No. 4 of this series.

Photo 22. *Preparing for canoe trip, Killarney Provincial Park. Photo courtesy P. Storck.*

Photo 23. *Portaging canoe, Killarney Provincial Park. Photo courtesy B. Sigmon.*

Photo 24. *Canoeing, Killarney Provincial Park.*

Highway 637

Highway 637 traverses rocks of the Grenville Province and Grenville Front Zone. The low-lying relief of the area it crosses is typical of regions underlain by rocks of the Grenville Province, as is the long, straight configuration of the branches of the lakes and rivers of the area. Pockets of Pleistocene glacial ***till*** occupy depressions in the bedrock in inland areas, while closer to Georgian Bay the deposits of glacial lakes can be recognized. Recent swamp accumulations are not uncommon because of the poor drainage of the area. Although the spectacular white ***orthoquartzite*** hills of the Southern Province may be seen from several points on Highway 637, the highway does not traverse any part of the Southern Province. Owing to the lack of easily identifiable landmarks along Highway 637, the geology along the highway is presented in road-log form, beginning at the intersection of Highway 637 and Highway 69. The distances of such land marks as are present are noted.

Road Log

0 km *[0 miles]* Turn onto Highway 637.

1.3 km *[0.8 miles]* The effects of weathering upon gneissic ***quartz diorite*** may be examined at this locality. The outcrop on one side of the bend in the road has weathered light pink in colour, and ***lineation*** and ***foliation*** defined by ***biotite*** aggregates are visible in the outcrop. On the other side of the road, the fresh surface of the same rock is dark grey in colour. White feldspar, blue-grey quartz, black biotite, and small red garnet grains are visible.

6.8 km *[4.2 miles]* Railway crossing.

6.9 km *[4.3 miles]* Occasional low outcrops of ***paragneiss*** occur over the next 3 km.

10.3 km *[6.4 miles]* ***Fault*** in fine-grained paragneiss is exposed at this locality. The transition from unbroken rock through fractured rock to ***breccia*** is accentuated by the presence of purple-red ***hematite*** in the fractures and breccia ***matrix***. The fault is parallel to the highway.

15.5 km *[9.6 miles]* Wanapitei River bridges. Good examples of layered pink and grey paragneiss can be seen on the island between the bridges.

29.0 km *[18.0 miles]* Tyson Lake picnic area. Outcrops of well banded pink and grey paragneiss occur along the road and lakeshore at this locality.

34.0 km *[21.1 miles]* Mahzenazing River bridge. Outcrops of well banded pink and grey paragneiss with small purple-red **almandine garnet** grains may be seen on both sides of the river. Square timbers set across the river channel south of the bridge are evidence that this river was used to transport logs to the sawmill at Collins Inlet during the logging era.

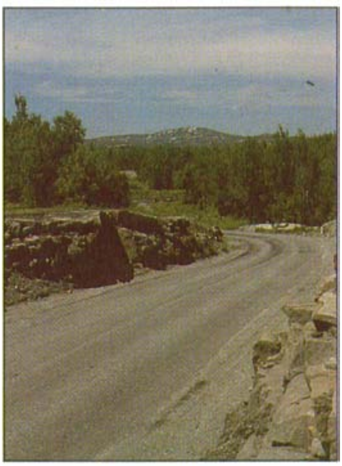
35.4 km *[22.0 miles]* Highly metamorphosed but recognizable orthoquartzite is exposed at this locality. The well developed, nearly vertical foliation follows the **bedding** surfaces of the quartzite. Original sedimentary structures are faintly visible in the small outcrop south of the road at 35.6 km [22.1 miles] (Photo *25).*

Photo 25. *Highly metamorphosed orthoquartzite exposed along Highway 637. Bedding was parallel to the present foliation, and crossbedding is still visible on close inspection.*

37.8 km *[23.5 miles]* Bell Lake road turn-off. Low outcrops of pink and grey paragneiss occur at this locality (Photo 26). At this point, the La Cloche Mountains may be seen from Highway 637 for the first time (Photo 27). The broad summit of Silver Peak reaches 543 m above sea level, or approximately 365 m above Georgian Bay. It is the highest point in any direction for at least 80 km, and probably for a much greater distance.

Photo 26. *Compositional layering in paragneiss exposed in roadcut east of the Bell Lake access road, 37.5 km [23.3 miles] along Highway 637.*

Photo 27. *Roadcut in tightly folded paragneiss just east of the Bell Lake access road, 37.5 km [23.3 miles], Highway 637. Silver Peak is visible in the distance. This is the first point on Highway 637 from which any of the orthoquartzite hills may be seen.*



44.1 km *[27.4 miles]* West Mahzenazing River.

52.1 km *[32.4 miles]* Evidence of structural deformation can be seen in the roadcut at distance 52.1 km. The fine- to medium-grained gneissic ***granite*** at this locality is badly fractured, and two fault zones characterized by highly fractured rock and gouge, or rock powder, may be seen. A similar fault zone may be seen at 68.4 km along the highway (Photo 28).

58.4 km *[36.3 miles]* George Lake campsite entrance.

58.7 km *[36.5 miles]* The road descends rather steeply here, dropping approximately 6 m. The same slope can be seen extending several hundred metres to the south of the road. This slope marks the shoreline of glacial Lake Nipissing, which existed approximately 6000 years ago. Beach sands deposited by the lake may be seen along the side of the road where it crosses the slope.

Photo 28. *Fault zone in gneissic granite, 68.4 km [42.5 miles], Highway 637. Reddish hematite staining accentuates the pulverized rock.*

58.9 km *[36.6 miles]* From 58.9 km to Killarney, much of the area is extremely flat, and is underlain by till, sand, and clay. The sand and clay deposits are the lake bottom sediments of glacial Lake Nipissing. The lake deposits are interrupted in places by outcrops, which might have been islands or shoals in the glacial lake, and by sand and gravel deposits left by ancient and existing streams and rivers.

70.3 km *[43.7 miles]* The town of Killarney is situated at the terminus of Highway 637. Outcrops of smoothly rounded and water sculpted granite of the Killarney Batholith may be seen throughout the town.

Tyson Lake

At 29.0 km [18.0 miles] along Highway 637, a public picnic area is situated on the shore of Tyson Lake. The lake is a large one, with numerous bays, inlets, and islands. The body of water beside which the picnic area is located is but one arm of the lake.

The geologic controls of the shape and character of Tyson Lake are easily recognizable. The well developed ***gneissosity*** of the rocks of the Grenville Province which underlie Tyson Lake is reflected by the northeasterly orientation of the inlets and peninsulas of the lake. The relatively low-lying topography of the area surrounding the lake is typical of areas underlain by rocks of the Grenville Province. Exposures of a variety of paragneisses including metamorphosed limestone and conglomerate, and a variety of orthogneisses including metamorphosed diabase and granite may be seen at a number of localities along the shores of Tyson Lake.

Several smaller lakes including Lone, Spoon, and Attlee Lakes, may be reached by channel and portage from Tyson Lake. Because these lakes lie outside of Killarney Provincial Park, motorboats may be used on them as well as canoes and sailboats. Paragneiss and orthogneiss similar to those underlying Tyson Lake also underlie the smaller lakes of the area.

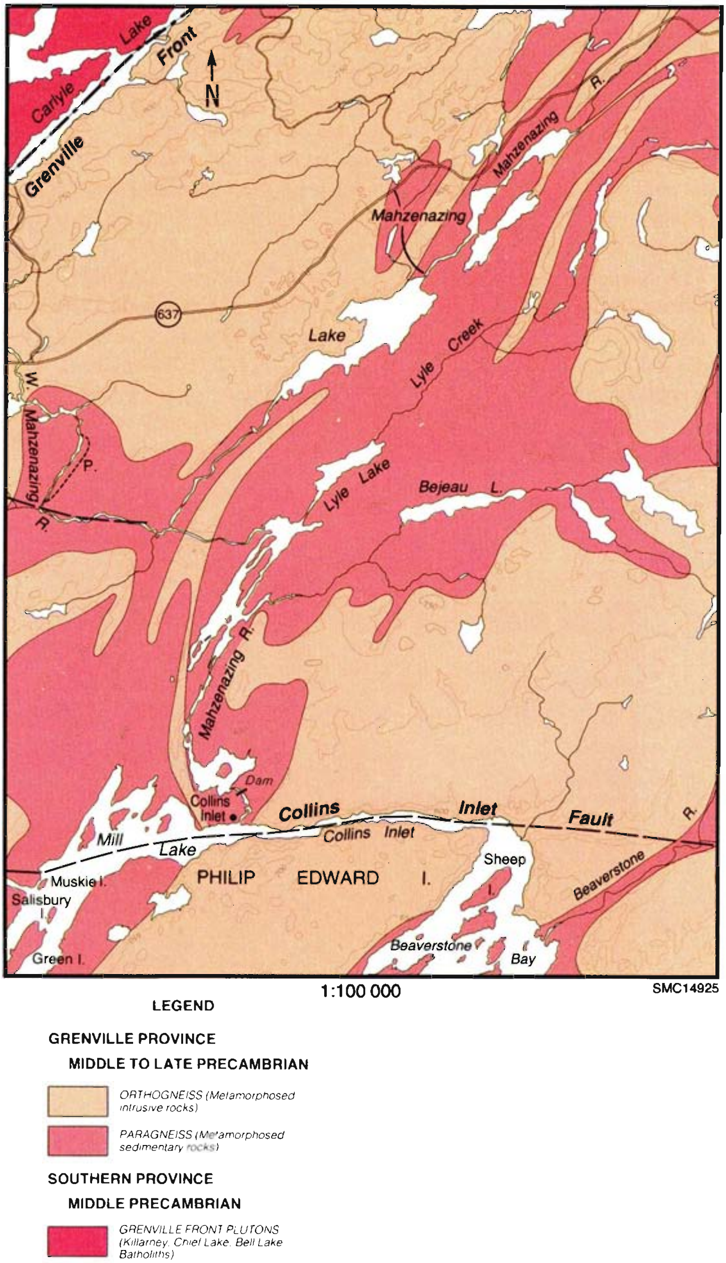
Mahzenazing Lake to Collins Inlet

At 38.0 km [23.6 miles] along Highway 637, a 1.5 km road leads south to Mahzenazing Lake. Boating trips may be made from Mahzenazing Lake to Collins Inlet and Georgian Bay by way of the Mahzenazing River (Map 2). Motorboats may be used as well as canoes because these waterways do not lie within Killarney Provincial Park. A dam blocks the waterway at Collins Inlet.

Mahzenazing Lake

Mahzenazing Lake is an elongate lake about 5 km in length, consisting of two sections joined by a long, narrow channel. Its elongation is parallel to the gneissosity of the underlying rock, a complex mixture of paragneiss and orthogneiss. The paragneiss here represents the metamorphic equivalent of ***quartzite***, ***greywacke*** and ***argillite*** of the Huronian succession, and may best be seen along the shore of the channel joining the two portions of the lake. Orthogneiss is well exposed on the west shore of the southern part of the lake.

Map 2. *Mahzenazing Lake to Collins Inlet.*



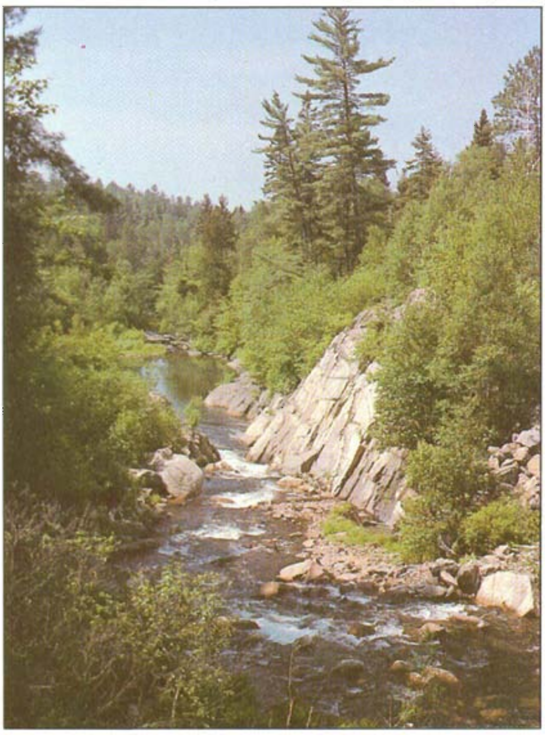
Geology after K.D. Card, 1978, Map 2360.

Mahzenazing River

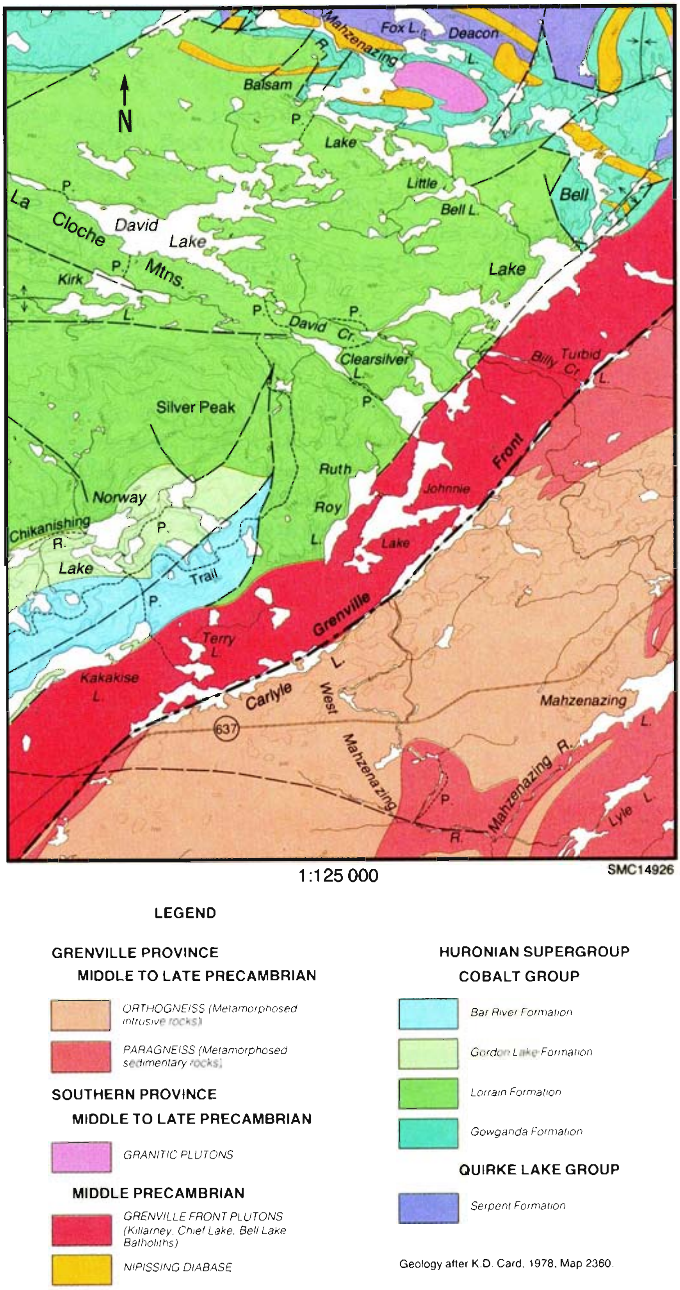
The Mahzenazing River (Photo 29) follows the gneissosity of the underlying rock and the trace of a lineament which crosscuts the gneissosity. Near its confluence with Collins Inlet, the river broadens, and is much like a lake. The numerous bays and islands in it also reflect the gneissosity of the underlying rocks. Outcrops of orthogneiss and paragneiss may be examined in exposures along the shores of the bays, and islands, and at numerous other localities along the river.

The Mahzenazing River flows into Collins Inlet at Collins Inlet settlement. The settlement was established in 1868 when the first of several lumber mills opened on the site. Features such as iron rings anchored in rock outcrops, and stranded boom logs with hewn ends carrying heavy chains are evidence of logging activity in the area. More complete descriptions of the lumbering activity which went on in the area, and of features of geological interest near Collins Inlet are given in later sections of this guidebook.

Photo *29. The Mahzenazing River, looking south from Highway 637.*



Map 3. *Johnnie Lake Circle route.*



Johnnie Lake Circle Route

Johnnie Lake may be reached by a 2.4 km long road which leaves Highway 637 at 43.9 km [27.3 miles], just east of the West Mahzenazing River bridge. From Johnnie Lake, a circle tour of approximately 30 km may be made through Bell, Balsam, David, and Clearsilver Lakes (Map 3). Side trips to the numerous small lakes of the area, and a hike to Silver Peak may also be taken. Access to the Threenarrows Lake, Howry Creek, and Lake Panache watersheds may be had at several points along the route.

Johnnie Lake

Johnnie Lake is a large lake of irregular shape. Its configuration is controlled more by the relative resistances to weathering of the various rocks underlying it and the contact locations of those various rock types than by any foliation in the rock. In fact, very little of the underlying rock is foliated at all. The lake straddles the Grenville Front Zone, and is hence underlain by orthogneiss and paragneiss of the Grenville Province, felsic plutonic rocks of the Grenville Front Zone, and Huronian sedimentary rocks of the Southern Province. A wide variety of rock types and geologic features may be seen along the shores of the lake.

The arm of the lake to which the road provides access is situated over the contact between the gneisses of the Grenville Province and the granitic rocks of the Bell Lake Batholith. Outcrops on the south shore of the lake near the landing are of pink and grey paragneiss crosscut in places by dikes of pegmatite and granite. Farther to the northeast, gneissic granite is exposed on the same shore of the lake. Between the areas underlain by orthogneiss and paragneiss, a zone of gneissic agmatite cut by granite and pegmatite dikes is exposed.

From observations of geologic relationships along the south shore of the arm, the viewer can establish a chronology of geologic events in the area. The sedimentary rocks must have been present before the granite incorporating them was intruded. Both the sedimentary rocks and the intruding granite were metamorphosed and deformed during orogenic events in the Grenville Province, and were later intruded by granite and pegmatite dikes.

Approximately 2.5 km from the landing, Johnnie Lake turns sharply to the west-southwest, and transects the Bell Lake Batholith. A representative sample of Bell Lake quartz monzonite may be examined in the outcrop on the north shore at the bend in the lake. There, pink phenocrysts of feldspar constituting up to

25 percent of the rock are surrounded by a pink to grey, medium- to coarse-grained matrix of ***quartz***, feldspar, and ***mica***. Blocks of paragneiss of the Grenville Province surrounded by a matrix of Bell Lake quartz monzonite are common near the contact of the ***batholith***, forming the second type of agmatite to be found along the shores of Johnnie Lake.

Photo 30. *Granite dike crosscutting porphyritic granodiorite, just north of the narrows in Johnnie Lake. The dike is terminated by a fault and cut by veinlets of epidote.*

As the distance from the Grenville Province increases, the number of inclusions of gneiss decreases rapidly. Instead, inclusions of sedimentary rock from the Southern Province, and likely part of the Lorrain Formation, become common, forming a third type of agmatite. The extremely variable alteration and deformation of the inclusions can be seen in the numerous outcrops in the area.

The multitude of inclusions of material from both the Grenville and Southern Provinces which are found within the Bell Lake Batholith, and the texture of the quartz monzonite itself allow some inferences to be made about the intrusive history of the body. The magma must have cooled slowly at depth for a considerable period of time to allow the formation of the large feldspar crystals. Then, the crystal-bearing mush intruded the country rock at a higher level, incorporating blocks of the country rock and partially or completely digesting them. The abundant inclusions show that the intrusion fractured the host rocks, suggesting that the magma was fairly cool (i.e. solidifying) and had reached a fairly high level near surface. A magma which solidified at depth, surrounded by relatively hot host rocks, would have "cooked" and plastically deformed the host rocks rather than fracturing them.

Photo 31. *Breccia exposed along the shore of Johnnie Lake in which blocks of orthoquartzite stained by hematite are set in a matrix of white quartz.*

Just north of the shallow narrows, Johnnie Lake turns to the northeast. Here it overlies the contact between the Bell Lake Batholith and quartzite of the Lorrain Formation of the Southern Province. At the campsite on the east shore of the lake just north of the narrows, Bell Lake quartz monzonite crosscut by dikes of younger, ***equigranular*** pink granite can be seen (Photo 30). The effects of faulting upon the rock at this locality are readily recognizable, for the granite dikes are offset across a fault zone. Green ***epidote***, an alteration product of feldspar, occurs in the fractured rock. Further evidence of faulting at and near the contact between rocks of the Grenville Front Zone and rocks of the Southern Province can be seen in the high outcrop to the north of the campsite. There, quartzite of the Lorrain Formation is brecciated, and in part impregnated with a hematitic stain. At the east end of the outcrop, where the ***breccia*** is most spectacular, blocks of stained quartzite are randomly oriented in a white quartzose matrix (Photo 31). At the west end of the outcrop, the breccia is not so spectacular because the breccia fragments have no hematitic stain to provide contrast with the matrix. Unbrecciated ***feldspathic*** quartzite of the Lorrain Formation occurs on the point of land directly across the lake from the brecciated rock.

The strategic position of Johnnie Lake with respect to the Southern and Grenville Provinces makes it an excellent location to study geology and its influence on the landscape.

The topography of the area around the lake is strongly influenced by the bedrock geology. Southeast of the lake, in the area underlain by gneisses of the Grenville Province, the topography is characterized by broad, flat-topped hills which slope steeply to the lake's shore. The topography surrounding the central part of the lake, which is underlain by the Bell Lake Batholith, has no more relief than the area southeast of the lake, but is more rugged in appearance because the hills are less broad. The area underlain by Lorrain quartzite north of Johnnie Lake has an even more rugged topography, with high steep hills and deep valleys.

Bell Lake

Bell Lake may be reached by road, or by portage from Johnnie Lake. The Bell Lake road leads from Highway 637 at 37.8 km [23.5 miles]. The wise driver will inquire about its condition before using it, however, for much of its length of approximately 8 km may not be suitable for use by all vehicles in all weather. Similarly, the canoeist planning to portage from Johnnie Lake to Bell Lake via Log Boom Lake would be wise to check the condition of the portage before using it. Fluctuations of the water levels in the area have been known to create problems for canoeists using that route. An alternative route, known locally as High Portage, also leads to Bell Lake. The 400 m long portage leads from the north-western corner of the most northeasterly bay of Johnnie Lake. Occasional outcrops of feldspathic quartzite of the Lorrain Formation occur along the portage.

Bell Lake is, like part of Johnnie Lake, situated over the contact between the Bell Lake Batholith of the Grenville Front Zone and the sedimentary rocks of the Huronian sequence of the Southern Province. Outcrops of porphyritic quartz monzonite occur along the southeast shore of the southern part of the lake, while high outcrops of feldspathic quartzite are exposed on the northwestern shore. Silver Peak and other impressive hills of ***orthoquartzite*** may be seen to the southwest of Bell Lake.

Approximately 3 km northeast of the terminus of High Portage, Bell Lake swings to the northwest, away from the Grenville Front Zone, to approximately parallel the contact between the Gowganda and Lorrain Formations. The relief of the area underlain by the rocks of the Gowganda Formation is low, and the number of outcrops relatively few. A denser forest than any encountered previously covers the area.

A variety of rocks of the Southern Province may be seen on the shores of Bell Lake. An ***olivine diabase dike*** crosscuts argillite of the Gowganda Formation just east of the point where Bell Lake swings to the northwest. On the west shore of the lake, approximately 600 m north of the island, interbedded ***siltstone***, argillite, and ***conglomerate*** of the upper member of the Gowganda Formation are exposed. Bedding in the outcrop is nearly vertical, and strikes perpendicular to the shore. Deformation of the rock has resulted in the dissected appearance of the arkose beds of the outcrop. Laminated argillite of the upper member of the Gowganda Formation is exposed on the north side of the channel leading to the portage at the northwest end of Bell Lake. The parallel laminations can be easily seen on the broken surfaces of the outcrop. Glacial ***striae*** are clearly etched into the smooth face of the outcrop which drops steeply into the water. Olivine diabase is exposed in the outcrop across the channel from the outcrop of laminated argillite.

Balsam Lake

Balsam Lake may be reached via a short lift-over situated near the end of the channel at the northwest end of Bell Lake. A small marine railway (Photo 32) has been in use at the lift-over for many years. Its continued serviceability depends upon the care and maintenance of those who use it.

Outcrops at the site of the lift-over and along the shore nearby are of dark grey diabase. Exposures of the Lorrain and Gowganda Formations, and of granite also occur along the shores of Balsam Lake. Pink weathering sandstone of the lowermost, or silty sandstone, member of the Lorrain Formation can be seen on both sides of the first narrows passed after leaving the lift-over. Minor interbeds of grey weathering siltstone are also present in the outcrops. Approximately 410 m southwest of the narrows, feldspathic sandstone is exposed on the south shore of the lake. The noticeable differences in colour and feldspar and siltstone contents between the rocks at this locality and those at the narrows illustrate the difference between the lowermost and second lowest members of the Lorrain Formation. Outcrops of typical Nipissing Diabase can be examined on the largest island in the most northerly part of Balsam Lake. Near the entrance of the

Photo 32. *Marine railway at Bell Lake.*

bay leading to Deacon Lake, yet another rock type is exposed. The pink rock which outcrops there is part of a small pluton of muscovite-bearing granite. A number of such intrusions occur in the area. The contrast in colour between the granite and the Nipissing Diabase and sedimentary rocks of the Gowganda Formation which outcrop nearby is quite noticeable.

The topography of the area surrounding Balsam Lake is significantly different from that of lakes described previously. Balsam Lake is situated in an area of very low relief. The dense forest surrounding the lake reflects the layer of nutrient-rich soil which covers most of the area. The water of the lake also has indications that it is rich in nutrients. The abundance of organic material in it gives it a murky green colour, quite different from the clear blue water of Johnnie Lake.

David Lake

David Lake may be reached by way of a 620 m long portage leading from the south shore of Balsam Lake. David Lake is underlain completely by rocks of the Lorrain Formation. A good cross section of the lower part of the formation may be seen along the shores of the lake. The lowermost, or silty sandstone, member is exposed on the shores of Balsam Lake. The portage crosses over this member and the transition zone into the next. so that at David Lake, the outcrops are of the second lowest, or feldspathic sandstone, member of the formation. Outcrops along the southeast shore of David Lake near the portage are of the feldspathic sandstone member. The steeply dipping bedding is accentuated in some outcrops, where pink and grey feldspathic sandstone units are interbedded. Approximately 1.5 km southwest of the terminus of the portage, feldspar disappears from the sandstones of the Lorrain Formation and light green mica appears. This change marks the transition from the feldspathic sandstone member of the formation to the green micaceous member. Outcrops from this transition zone to the southern end of David Lake are all of the green micaceous sandstone member of the Lorrain Formation.

The succession exposed on the northwest shore of the lake is somewhat different than that exposed on the southeast shore, because of faulting in the area. Peach coloured quartzite of the hematitic sandstone member, containing a small amount of hematite which gives it its colour, may be seen near the west end of the northwest shore of the lake. No member of the Lorrain Formation higher than the hematitic sandstone member is exposed along the shores of David Lake. Kirk Lake, the lake which lies approximately 475 m south of David Lake, is underlain entirely by rocks of the green micaceous member of the Lorrain Formation.

The characteristics of the topography of the area surrounding David Lake vary considerably from the north end of the lake to the south. The area around the northern part of the lake, which is underlain by the feldspathic member of the Lorrain Formation, is characterized by a subdued topography with relief of less than 25 m and a dense forest cover. The area underlain by the green micaceous and hematitic sandstone members of the Lorrain Formation is characterized by fairly rugged topography with over 75 m of relief. This difference reflects the relative resistance to erosion of the feldspathic, green micaceous, and hematitic sandstone members. Hills of the even more resistant aluminous sandstone and orthoquartzite can be seen south of David Lake. The thin forest cover on the high ridges reflects the lack of soil and nutrients in areas underlain by the upper members of the Lorrain Formation.

Silver Peak, the highest point of land for many kilometres in any direction, is one of the orthoquartzite hills which lie south of David Lake. It is described in more detail in a later section of the guidebook.

Clearsilver Lake

Clearsilver Lake is underlain by rocks of the green micaceous sandstone member of the Lorrain Formation, although few outcrops are exposed along the shores of the lake. It may be reached by way of a short portage which leads from the east end of David Lake to a shallow pond, and from there by way of a portage of approximately 1000 m which leads from the south side of the pond to Clearsilver Lake.

Return to Starting Point

A portage of approximately 890 m leads from the southeast end of Clearsilver Lake to Johnnie Lake. The portage reaches the northwest shore of Johnnie Lake in the area underlain by rocks of the green micaceous and hematitic sandstone members of the Lorrain Formation. The Johnnie Lake landing may be reached by travelling to the south end of Johnnie Lake.

Bell Lake may be reached from Clearsilver Lake by way of a portage leading from the end of the bay on the northeast side of Clearsilver Lake. The portage is approximately 550 m long. An alternate route from David Lake to Bell Lake by way of David

Creek is shown on some maps. Much of the David Creek waterway cannot be navigated, even by canoe, however, except in times of exceptionally high water levels. A portage of 2 km may therefore be necessary in order to reach Bell Lake directly from David Lake.

Carlyle Lake

Carlyle Lake may be reached by way of the channel which leads to the southwest from the landing on Johnnie Lake. Access to Carlyle Lake is also possible by way of a short road which leads to the southwest end of the lake from 49.1 km [30.7 miles] on Highway 637.

Photo 33. *Lit-par-lit injection of pink granitic rock of the Killarney Batholith into grey quartz monzonite of the Bell Lake Batholith, south shore of large peninsula, south side of Carlyle Lake.*

Carlyle Lake has the same geologic setting as the southwest arm of Johnnie Lake. Both lakes overlie the contact between the gneisses of the Grenville Province and the granitic rocks of the Grenville Front Zone plutons. The geology of the Carlyle Lake area is, however, more complex as parts of three different granitic plutons and their contacts are exposed in the area.

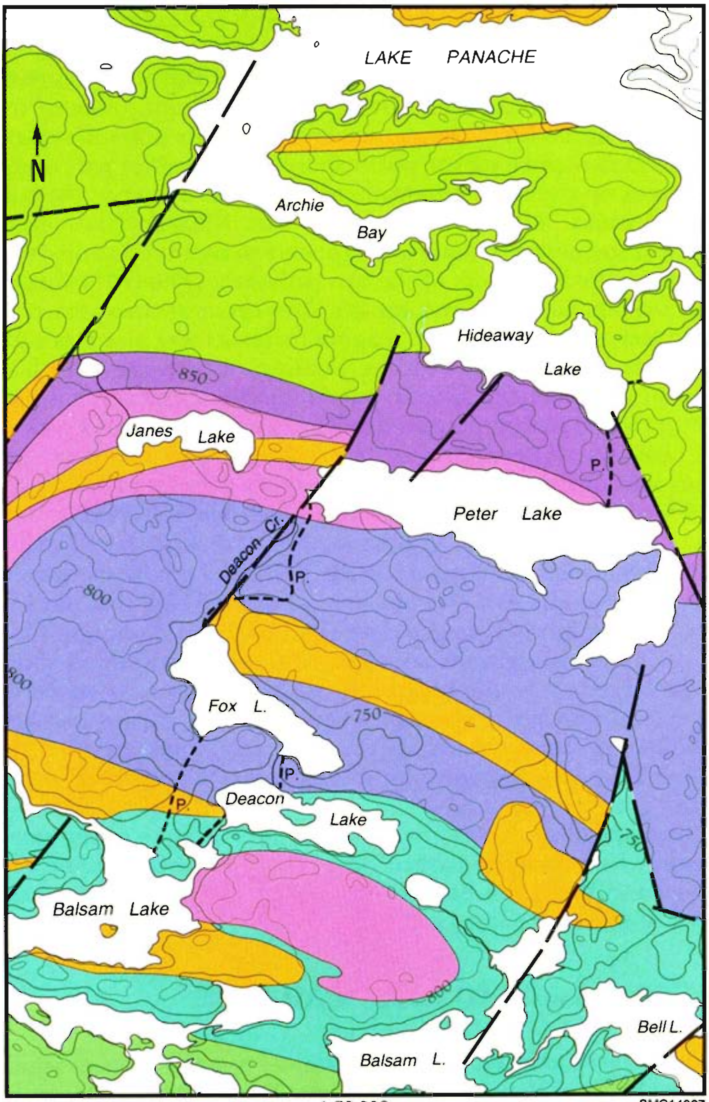
The south shore of Carlyle Lake is, with the exception of the large peninsula in the western part of the lake, underlain entirely by orthogneiss of the Grenville Province. On the north shore of the lake, near its east end, porphyritic quartz monzonite of the Bell Lake Batholith cut by granite and ***pegmatite*** dikes is well exposed. Outcrops along the north shore of the central part of the lake, and on the large peninsula in the western part of the lake contain rocks of both the Bell Lake and Killarney Batholiths. Many of the outcrops have what appears to be a succession of interlayered beds of rocks of the two batholiths (Photo 33). Such a relationship, although uncommon, does occur at the contacts of some intrusive bodies when magma forces its way along pre-existing structures such as bedding, jointing, or cleavage in the host rock, in a mechanism called ***lit-par-lit*** injection. The result is a series of closely spaced parallel dikes or ***sills*** of the igneous rock in the host rock. Where the host rock is igneous also, and both rock types are equally abundant, it is sometimes difficult to determine which of the rocks is the host, and which has intruded it. The dikes of pegmatite, and granite similar to that of the Killarney Batholith, which clearly intrude the Bell Lake quartz monzonite exposed near the east end of Carlyle Lake indicate that the Killarney Batholith is younger than the Bell Lake Batholith. Outcrops of Killarney granite are exposed along the southwest shore of the large bay on the north side of Carlyle Lake. As would be expected if the age relationships between the Killarney and Bell Lake Batholiths suggested above are correct, there are no dikes of Bell Lake quartz monzonite cutting across the outcrops of Killarney granite.

Outcrops of coarse-grained, pinkish grey granite of the small pluton which occupies part of the contact zone between the Killarney and Bell Lake Batholiths may be observed on the north shore of the large bay mentioned above.

Balsam Lake to Lake Panache

Lake Panache may be reached by way of a series of lakes which lie northeast of Balsam Lake (Map 4). The route leads from the shallow eastern bay at the north end of the lake along Deacon Creek to Deacon Lake. From Deacon Lake, a 215 m portage leads to Fox Lake. During periods of low water, a portage which leads approximately 825 m from the north shore of Balsam Lake west of the shallow bay directly to Fox Lake may be the preferable route to take. From the north end of Fox Lake, a portage of approximately 1490 m leads to Peter Lake. A portage from the east end of the north shore of Peter Lake leads 410 m to Hideaway Lake, a bay of Lake Panache.

Map 4. *Balsam Lake to Lake Panache.*



1:50 000

SMC14927

LEGEND

SOUTHERN PROVINCE

MIDDLE TO LATE PRECAMBRIAN

GRANITIC PLUTONS

MIDDLE PRECAMBRIAN

NIPISSING DIABASE

HURONIAN SUPERGROUP

COBALT GROUP

Lorrain Formation

Gowganda Formation

QUIRKE LAKE GROUP

Serpent Formation

Espanola Formation

Bruce Formation

HOUGH LAKE GROUP

Mississagi Formation

Geology after K.D. Card, 1978, Map 2360.

Several formations of the Huronian succession may be examined along this route. Rocks of the Gowganda Formation underlie Deacon Lake, while rocks of the Serpent Formation may be examined along the shores of Fox Lake. The succession from the Serpent Formation down through the Espanola Formation to the Bruce Formation is exposed along the shores of Peter Lake. The Bruce and Mississagi Formations are exposed along the shores of Hideaway Lake. Outcrops of Nipissing Diabase and olivine diabase are also exposed at a few localities along the route.

David Lake to Murray Lake

Murray Lake may be reached from David Lake by way of Great Mountain Lake, and a series of long narrow lakes along Howry Creek (Map 5). Access is available from Murray Lake to a number of other lakes and waterways.

Great Mountain Lake may be reached from the west arm of David Lake. A 475 m long portage leads from the end of the arm of David Lake to the east end of a shallow, unnamed lake. A 1370 m portage leads from the west end of that lake to Great Mountain Lake.

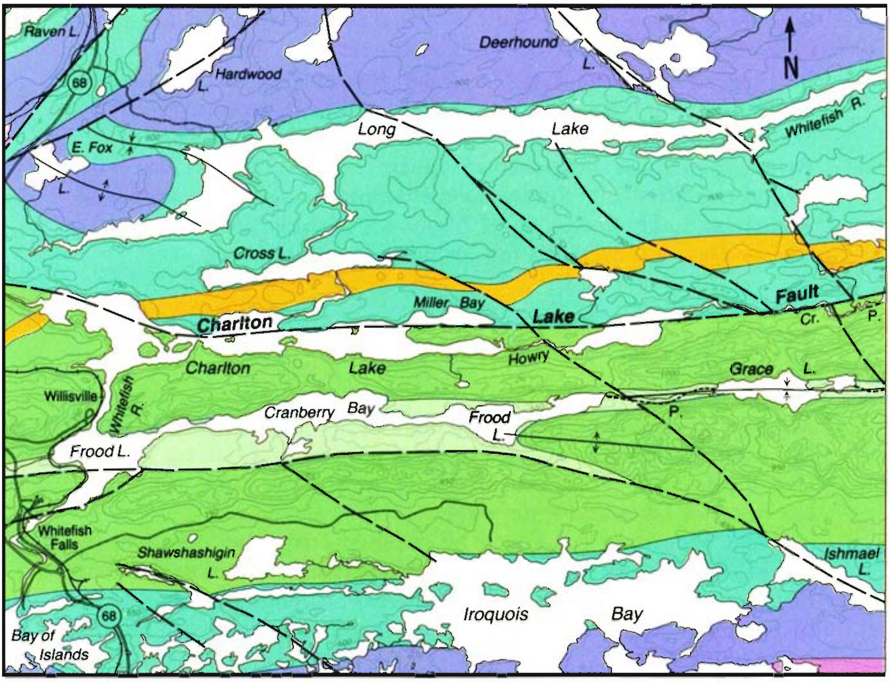
Great Mountain Lake, like David Lake, is underlain entirely by rocks of the Lorrain Formation. Exposures of rocks of the green micaceous, hematitic ***sandstone,*** and aluminous ***quartzite*** members may be seen along the shores of the lake. The topography of the region surrounding Great Mountain Lake (Photo 34) is also similar to that of the area surrounding David Lake.

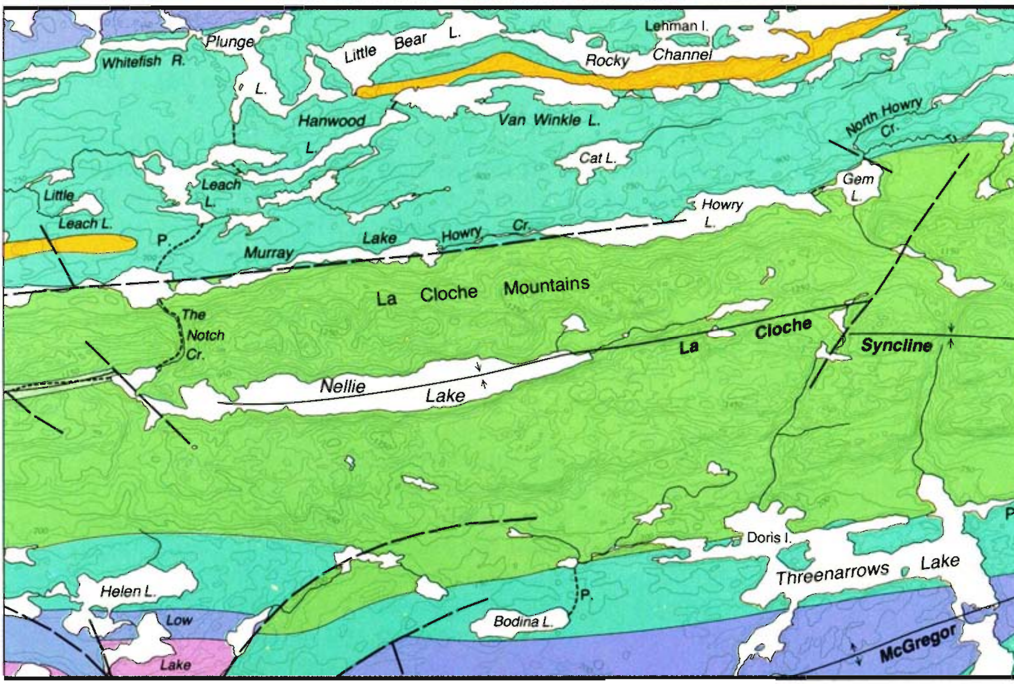
The route to Murray Lake leads to Fish Lake by way of a 475 m portage from the most northwesterly bay of Great Mountain Lake. Outcrops of conglomerate and laminated argillite of the Gowganda Formation are exposed on the north and south shores, respectively, of Fish Lake, which overlies the contact between the two units.

From the west end of Fish Lake, a portage leads approximately 90 m to Howry Creek. Howry Creek flows into Gem Lake approximately 3 km from the end of the portage. One or more liftovers may be necessary on Howry Creek. Outcrops of conglomerate of the Gowganda Formation are well exposed north of Howry Creek. Although laminated argillite of the same formation occurs very close to the north shore of Gem Lake, the lake is underlain entirely by silty sandstone and ***feldspathic*** sandstone of the lowermost members of the Lorrain Formation. Gem Lake is the subject of a well known 1941 painting by A.Y. Jackson.

The route leads from Gem Lake to Howry Lake by way of a 160 m portage. Howry Lake overlies the contact between the

Map 5. *David Lake to Murray Lake.*





1:100 000

LEGEND

SOUTHERN PROVINCE

MIDDLE PRECAMBRIAN

NIPISSING DIABASE

HURONIAN SUPERGROUP

COBALT GROUP

Gordon Lake Formation

Lorrain Formation

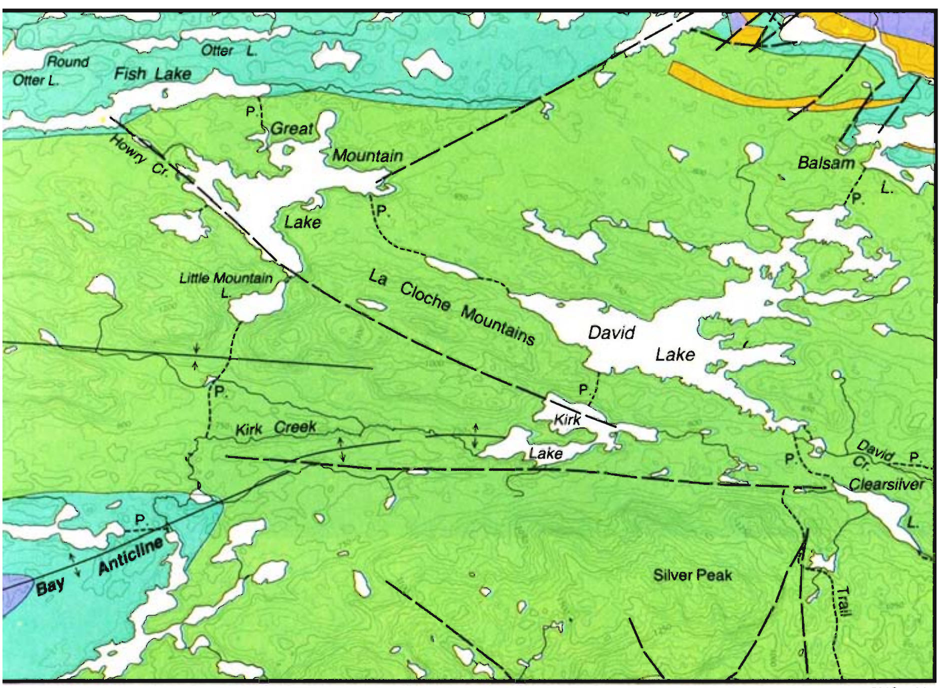
Gowganda Formation

QUIRKE LAKE GROUP

Serpent Formation

Espanola Formation

Geology after K.D. Card, 1978, Map 2360.



SMC14928

Gowganda and Lorrain Formations. Exposures on the north shore of the lake are of conglomerate of the Gowganda Formation. An olivine diabase dike 135 m wide is well exposed midway along the north shore. A few outcrops of rock of the lower members of the Lorrain Formation occur along the south shore.

Murray Lake can be reached from Howry Lake by way of Howry Creek. A number of liftovers and one 220 m portage are encountered on the 1235 m long route. Murray Lake, like Howry Lake, overlies the contact between the Gowganda and Lorrain Formations. Outcrops of conglomerate are again well exposed on the north shore of the lake, while a few outcrops of feldspathic sandstone occur on the south shore.

Bay of Islands (Photo 35) may be reached from Murray Lake by way of Howry Creek, Charlton Lake, Frood Lake, and Whitefish River. A longer route leads to Bay of Islands from Murray Lake by way of Leech Lake, Plunge Lake, Lang Lake, and the Whitefish River through Cross Lake, Charlton Lake and Frood Lake. Lake Panache may be reached from Murray Lake by way of Plunge Lake, Little Bear and Bear Lakes, and Walker Lake. Rocks of various formations of the Huronian succession, and Nipissing Diabase and olivine diabase, are exposed along all these routes. Nellie Lake may also be reached from Murray Lake.

Photo 34. *Looking south across Great Mountain Lake and Little Mountain Lake. Threenarrows Lake lies beyond the ridge of orthoquartzite.*

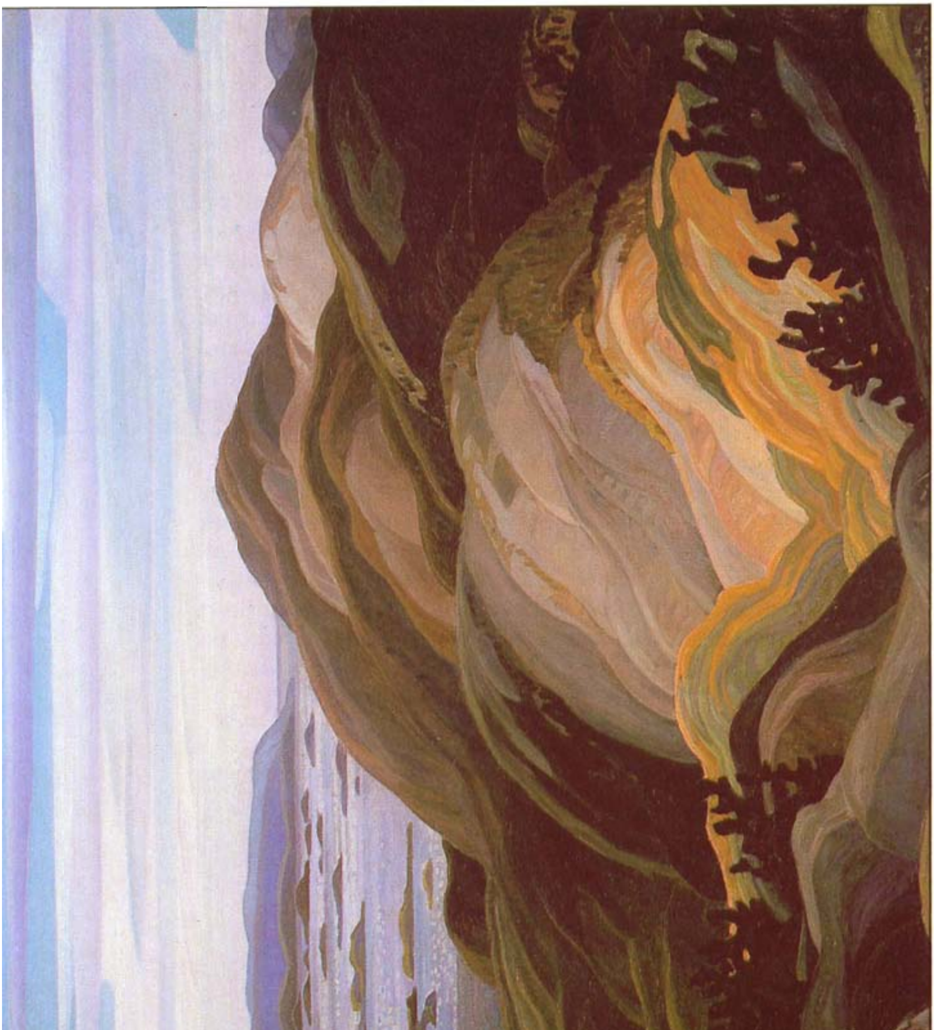


Photo 35. *"Bay of Islands" by F. Carmichael. Courtesy Art Gallery of Ontario.*

Nellie Lake

Nellie Lake may be reached by way of a 1550 m long portage which leads from the south shore of the widest part of Murray Lake. The portage follows a deep gully called The Notch through the quartzite hills to an embayment of Nellie Lake which has been named Carmichael Lake in honour of Group of Seven member Franklin Carmichael. Nellie Lake, a long, narrow lake, is completely surrounded by high white ridges of aluminous sandstone and orthoquartzite of the upper members of the Lorrain Formation. An excellent view of Nellie and Carmichael Lakes may be had from the summit of the 55 m high hill on the peninsula separating them. An interesting rock feature may also be observed at the summit of the hill. The orthoquartzite there has been fractured, forming a ***breccia***. Where the matrix and fragments are both featureless white sandstone, it is difficult to distinguish them. In some places, however, the matrix has been stained red by hematite. The contrasting white breccia fragments and red matrix make a spectacular rock.

The clear azure water of Nellie and Carmichael Lakes is very different from the organic-rich, green water of Howry Creek and the lakes along it. This difference highlights the nearly complete lack of nutrients provided by the weathering of the orthoquartzite which surrounds Nellie Lake to the water which flows over the rock. Further, the weathering of the orthoquartzite results in the formation of silicic acid, a weak acid which nonetheless prohibits the growth of some types of aquatic life.

Photo 36. *Canoeing on George Lake. Photo courtesy D. Burnett.*

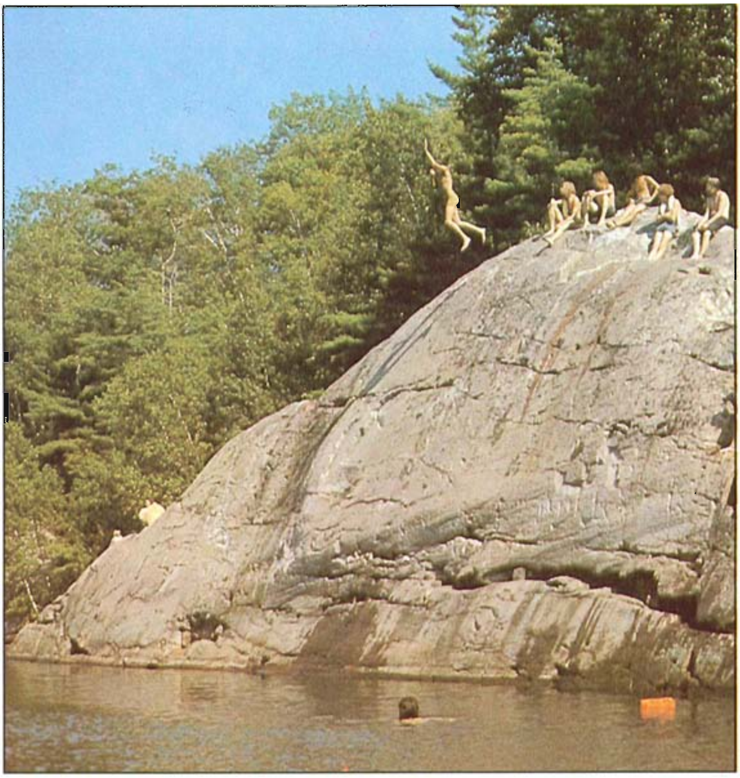
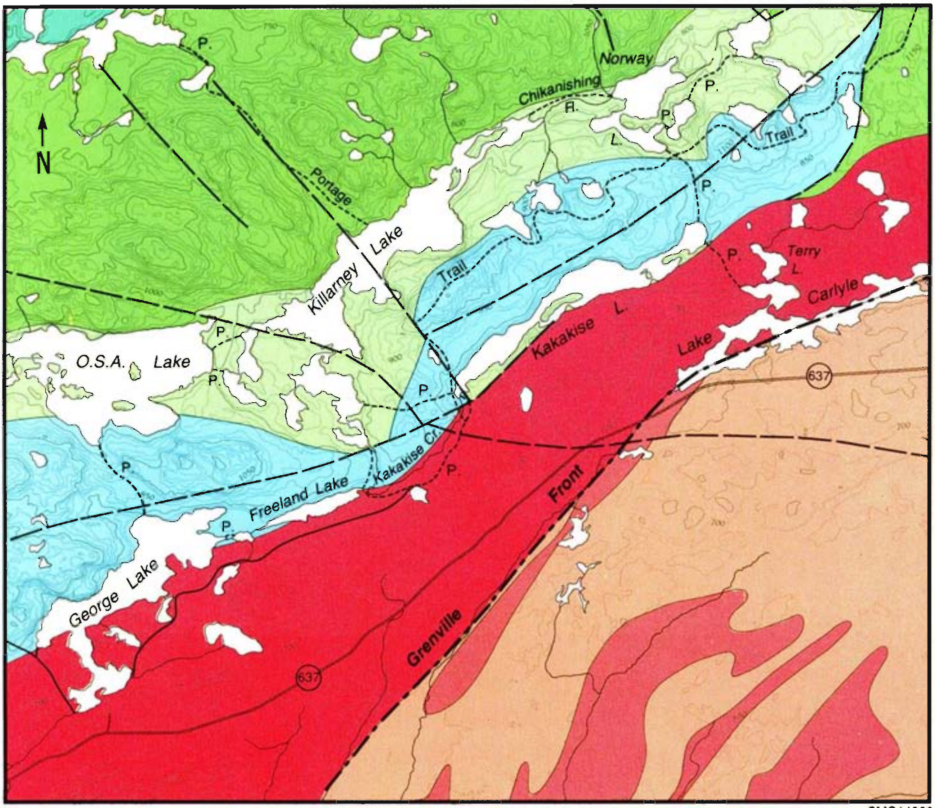


Photo 37. *Junior Rangers at the "Diving Rock", George Lake. Photo courtesy D. Burnett.*

George Lake Circle Route

George Lake may be reached by way of the access road at 58.4 km [36.3 miles] on Highway 637. Two beaches and canoe launching sites are present on the south shore of the lake. From George Lake (Photos 36, 37), a circle tour of approximately 27 km can be taken to Freeland, Kakakise, Norway, and Killarney Lakes (Map 6). Side trips to several small lakes in the area and a hike to Silver Peak can also be taken. Access to Baie Fine, O.S.A. Lake, and Threenarrows Lake is available from points on the circle route.

Map 6. *George Lake circle route.*



1:100 000

SMC14929

LEGEND

GRENVILLE PROVINCE

MIDDLE TO LATE PRECAMBRIAN

ORTHOGNEISS (Metamorphosed intrusive rocks).

PARAGNEISS (Metamorphosed sedimentary rocks)

SOUTHERN PROVINCE

MIDDLE PRECAMBRIAN

GRENVILLE FRONT PLUTONS (Killarney, Chief Lake, Bell Lake Batholiths)

HURONIAN SUPERGROUP

COBALT GROUP

Bar River Formation.

Gordon Lake Formation.

Lorrain Formation.

Gowganda Formation

Geology after K.D. Card, 1978, Map 2360.

George Lake

George Lake, like Johnnie Lake, overlies the contact between the Grenville Front Zone and the Southern Province. Outcrops of rock from both environments are well exposed (Photo 38). Rocks which outcrop along the south shore of the south bay of George Lake are granite of the Killarney Batholith with large inclusions of sedimentary rock. Outcrops of granite are exposed near both boat launching sites. Small, irregular veins of white quartz and buff ***dolomite*** are present in the granite. The main part of the south bay of George Lake is underlain by the large inclusion of sedimentary rock exposed along the shores of the penisula between the boat launching sites (Photo 39). The original sedimentary character of the rock has been almost completely obscured by ***contact metamorphism***. Small outcrops on the north shore of the bay, near the channel to the main body of George Lake, also

Photo 38. *Aerial view of George Lake looking west. The area south of the lake is underlain by pink granite of the Killarney Batholith, while the area north of the lake is underlain by white orthoquartzite of the Bar River Formation.*

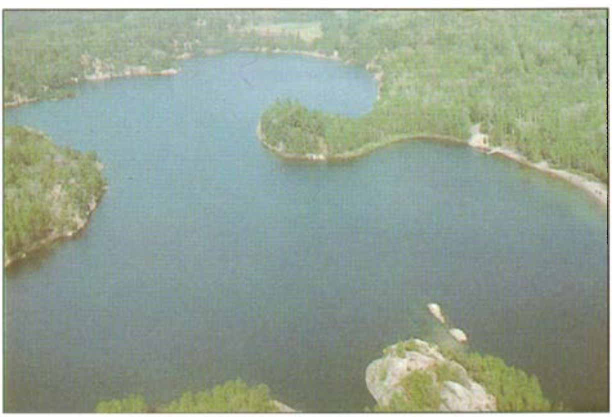


Photo 39. *Aerial view of the south bay of George Lake showing the boat launching sites and the peninsula between them.*

exhibit the effects of contact metamorphism (Photo 40). Contact metamorphism occurs in the host rock along the margins of igneous intrusions, and in blocks included in the intrusive body, and is a result of the high temperature to which the host rock was heated by the intruding magma. The small, stubby, white grains of ***scapolite*** which occur throughout the outcrop in question are a result of contact metamorphism caused by the magma which formed the adjacent Killarney Batholith.

From the south bay of George Lake, a broad channel leads across the Killarney Batholith of the Grenville Front Zone to the main part of George Lake. A high ridge of white orthoquartzite of the Southern Province which lies north of George Lake can be seen through the channel (Photo 41).

Photo 40. *Inclusion of sedimentary rock within the Killarney Batholith. This outcrop, which is exposed on the north shore of the south bay of George Lake, shows remnants of sedimentary structures. Scapolite that formed during contact metamorphism of the rock can be seen in an examination of the outcrop.*

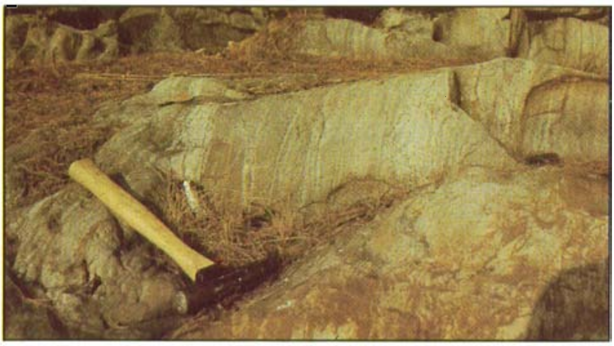


Photo 41. *View across George Lake from the south bay of the lake. The rows of trees across the white orthoquartzite hills north of the lake mark the locations of diabase dikes. Pink granite of the Killarney Batholith, which underlies much of the south part of the lake, can be seen in the foreground of the photograph.*

Outcrops of Killarney ***granite*** occur all along the south shore of the main body of George Lake. In some places, well developed foliation related to a ***fault*** lying near the shore may be observed. In other places, irregular dark inclusions occur in the granite. They are most probably the remnants of inclusions in the Killarney granite which were not completely digested before the ***magma*** solidified.

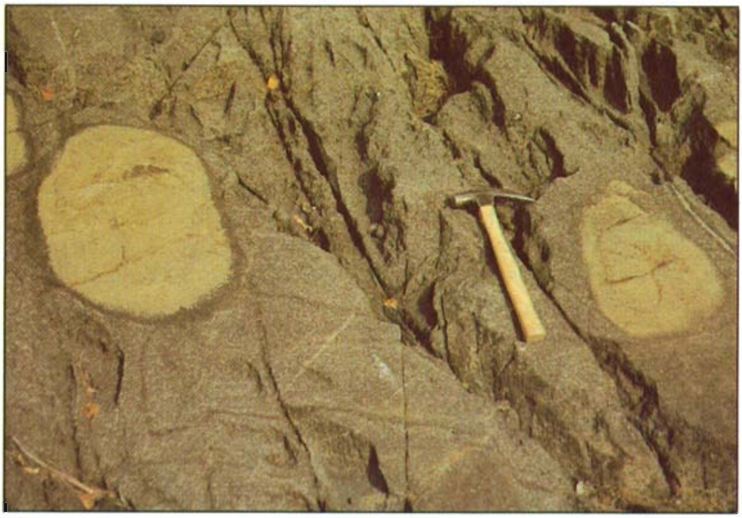


Photo *42. Unusual aggregates of epidote and chlorite in highly altered diabase at the east end of George Lake.*

Heat from the magma which formed the Killarney Batholith undoubtedly affected the body of rock exposed on the small island just opposite the landing of the George Lake to Freeland Lake portage. Although the whole body of rock, which was originally diabase, has been highly altered, small patches within the body show evidence of even more alteration than the rest of the body. Within these patches, which are approximately the size and shape of footballs, and appear light green against the dark green rock surrounding them, ***chlorite*** has replaced the pre-existing minerals almost completely (Photo 42).

The contact between the Killarney Batholith of the Grenville Front Zone and rocks of the Southern Province underlies the main part of George Lake. The contact is obscured by overburden at the east and west ends of the lake.

Outcrops of siltstone and sandstone of the Bar River Formation are well exposed along the north shore of the lake. Much of the exposed rock is orthoquartzite. In some places, pink spots of hematite staining are present within the rock. Sandstones of this type which underlie the northeastern part of George Lake and are exposed along the north shore are of the uppermost of the five members of the Bar River Formation. The central part of the north shore of the lake is underlain by siltstone and sandstone of the second highest member of the formation. A large outcrop on the west shore of the broad bay opposite the channel leading from the south part to the main part of George Lake contains interbedded sandstone and siltstone of that member in which a variety of sedimentary structures are well exposed. Ripples, ***starved ripples***, and ***ball-and-pillow*** structures are present (Photo 43). The beds themselves are highly contorted as a result of deformation which the rock has undergone. West of the exposure of contorted siltstone and sandstone, a Nipissing Diabase ***dike*** can be seen crosscutting quartzite of the middle member of the formation. The colour contrast between the black ***diabase*** and white quartzite is striking. Elsewhere, the location of diabase dikes can be identified by observing the distribution of trees.

Photo 43. *Ball-and-pillow structures and detached slump balls in interbedded siltstone and sandstone of the Bar River Formation, north shore of George Lake.*

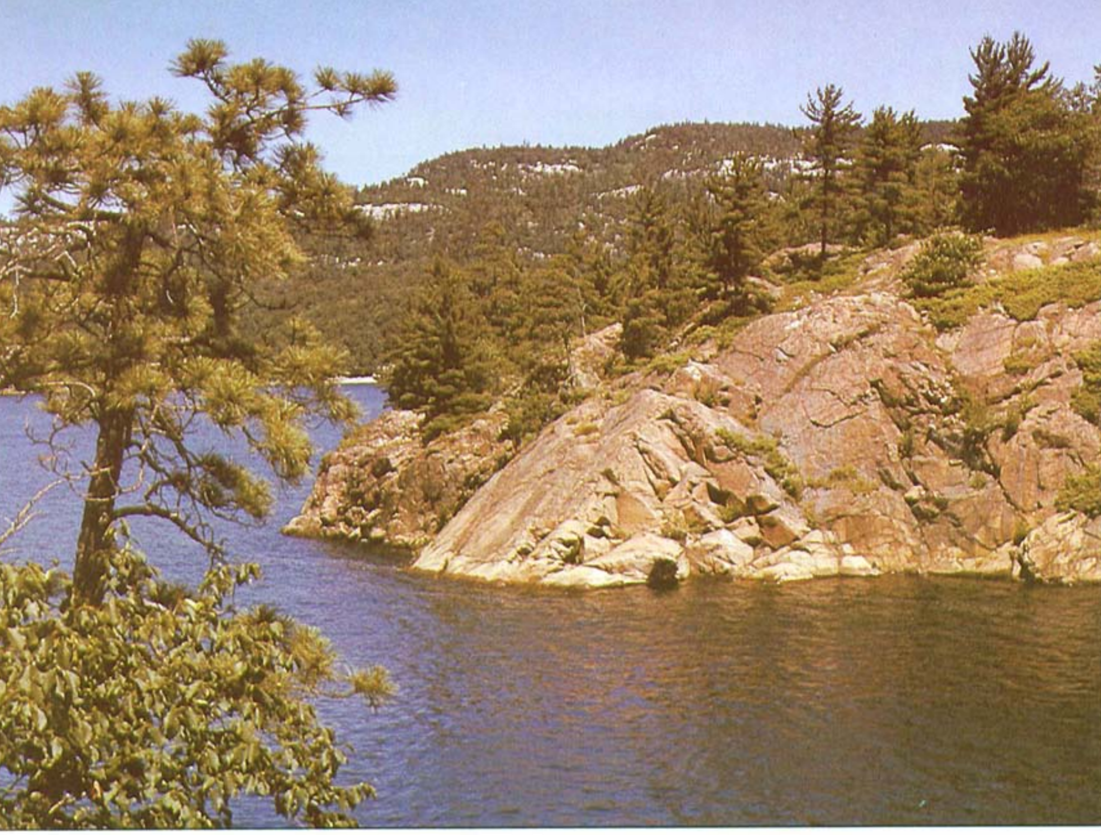


Photo 44. *Little Sheguiandah Lake. Photo courtesy D. Howes-Jones.*

Since the diabase is less resistant to erosion than the quartzite, and upon erosion supplies more nutrients to the soil which is formed, vegetation tends to grow over the areas underlain by the diabase. dikes. The long, narrow rows of trees which cut across the rocky slopes of the north shore of George Lake mark the locations of diabase dikes (see Photos 41 and 64).

The accumulations of angular fallen blocks which lie at the base of cliffs along the north shore of the lake are called talus, or ***scree***.

Two small lakes may be reached from the south shore of George Lake. A.Y. Jackson Lake lies approximately 135 m south of the main body of George Lake, and just east of the channel joining the south bay to the main part of the lake. Little Sheguiandah Lake (Photo 44) lies immediately south of the central part of the main body of George Lake (Photo 45). Both lakes are underlain by rocks of the Killarney Batholith.

O.S.A. Lake may also be reached directly from George Lake. That route is described in a later section of the guidebook.

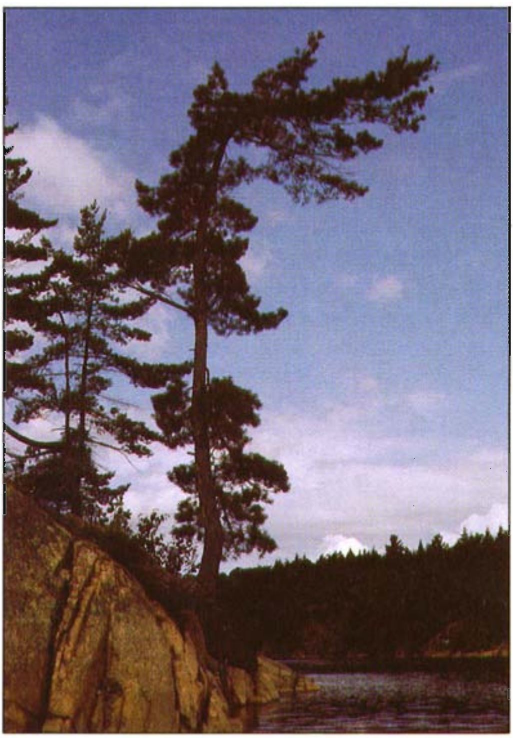
Photo 45. *Aerial view of George Lake, A.Y. Jackson Lake (centre of photo), and part of Little Sheguiandah Lake (extreme right of photo). The area north of George Lake is underlain by orthoquartzite and has high relief, while the area south of George Lake is underlain by granite, and gneissic granite and has a much smoother topography. The colour difference between the pink granite in the foreground and the white orthoquartzite in the distance is quite striking.*

Freeland Lake

Freeland Lake is a long, narrow, shallow lake which may be reached by way of a portage of approximately 135 m from the east end of George Lake (Photo 46). The creek which flows from Freeland to George Lake lies directly over the contact between the Killarney Batholith of the Grenville Front Zone and the rocks of the Southern Province. South of the creek, Killarney granite is well exposed. North of the creek, highly altered diabase similar to that which underlies the small island approximately 275 m to the west is found. It contains numerous very thin intrusive veinlets of what appears to be granite from the nearby batholith. Dark red iron oxide, or ochre such as that used as a dye by the Indians of the area, oozes from cracks in the rock. It forms as the rock is weathered by groundwater percolating through fractures and fissures in it.

Photo 46. *Portage at east end of George Lake leading to Freeland Lake. Photo courtesy P. Storck.*

Photo 47. *Kakakise Lake. Photo courtesy D. Howes-Jones.*



Outcrops of Killarney granite are exposed on the south shore of Freeland Lake near its west end. There are few other outcrops exposed along the shore. The only other large outcrop occurs approximately midway along the south shore of the lake. It is of highly altered silty sandstone of the Bar River Formation.

The characteristics of Freeland Lake are very different from those of George Lake. The water of Freeland Lake is clouded by abundant algae, and much of the lake is crowded with aquatic plants. The high content of organic material in the lake is due in part to its shallow depth. Light can penetrate to the lake bottom, and allows photosynthesis to occur throughout all the water of the lake. The shallow depth is emphasized in a few places where boulders lying on the bottom are exposed at the surface of the lake. The area surrounding Freeland Lake is also characterized by lower relief than the area surrounding George Lake.

Kakakise Lake

Kakakise Lake may be reached by way of a portage of approximately 1800 m from Freeland Lake. The portage begins on the south side of Kakakise Creek, approximately 90 m east of the end of Freeland Lake. It may be reached by way of a shallow channel through the brush at the east end of Freeland Lake. Markers tied to the brush indicate the routes to the Freeland to Killarney and Freeland to Kakakise Lakes portage landings. During times of high water levels, Kakakise Creek may be navigable all the way from Freeland Lake to Kakakise Lake.

Like Freeland Lake, Kakakise Lake overlies the contact between the Southern Province and the Killarney Batholith of the Grenville Front Zone. Outcrops of ***orthoquartzite*** are well exposed along most of the north shore of the lake. Near the northeast end of the lake (Photo 47), exposures on the north shore are of the second highest member of the Bar River Formation. In these outcrops, reddish and bluish ***siltstone*** interbeds contrast sharply with the predominant white orthoquartzite. Despite the relatively high relief along the south shore of Kakakise Lake, there are few well exposed outcrops. The area south of Kakakise Lake lies within the Grenville Front Zone and is underlain by the Killarney Batholith. The large island in the central part of Kakakise Lake and the southern shore of the lake are underlain by highly metamorphosed rocks of the Gordon Lake Formation. Alteration of the sedimentary rocks resulted from contact ***metamorphism*** which occurred when the Killarney Batholith was emplaced. Exposures of Killarney granite occur on the south shore of the lake near the terminus of the portage from Freeland Lake.

Carlyle and Killarney Lakes may be reached by way of portages from Kakakise Lake.

Norway Lake

Norway Lake may be reached by way of a portage of approximately 1580 m which leads from the north shore of the northeast end of Kakakise Lake. The terminus of the portage is at the southeast end of the southern part of Norway Lake.

Although Norway Lake lies between Blue Ridge and Killarney Ridge of the South La Cloche Range, it is not underlain by orthoquartzite. The valley between the two ridges is underlain by the Gordon Lake Formation, which is less resistant to erosion than either the Lorrain or Bar River Formations. A complete section across the Gordon Lake Formation may be examined in the Norway Lake area. Approximately 1100 m along the portage from Kakakise Lake to Norway Lake, numerous outcrops of reddish quartzite of the lowermost member of the Bar River Formation and silty sandstone of the uppermost member of the Gordon Lake Formation are exposed. Near the terminus of the portage, the upper member of the Gordon Lake Formation grades into the siltstone and silty sandstone of the middle member of the formation.

Most of the outcrops along the shore of Norway Lake are of the middle member of the formation. Near the north shore, however, the middle member grades into the lower sandstone and siltstone member. Outcrops on the small island near the terminus of the portage to Killarney Lake are of this member. High, white outcrops exposed along the north shore are of the upper member of the Lorrain Formation.

From Norway Lake, a series of small lakes along the headwaters of the Chikanishing River may be reached by portage. Partridge, Sandy, Amikogaming, Hemlock, and Whiskeyjack Lakes are underlain by rocks of the Lorrain, Gordon Lake, and Bar River Formations. Silver Peak, which is described in more detail in a later section of the guidebook, may be reached by hiking from the north shore of either Norway Lake or Sandy Lake.

Killarney Lake

Killarney Lake, an irregular elongate lake over 5 km in length, may be reached by way of a portage of approximately 1440 m from Norway Lake. The portage begins opposite the small island in the northwestern part of Norway Lake. The remains of a set-

Photo 48. *Killarney Lake. Photo courtesy D. Howes-Jones.*

tlement on Killarney Lake at the terminus of the portage are relics from the logging era in the region.

Like Norway Lake, Killarney Lake is mainly underlain by the Gordon Lake Formation. They are but two of a number of lakes lying in the valley which resulted when the silty sandstone and siltstone of the Gordon Lake Formation were more deeply eroded than the resistant orthoquartzites of the Lorrain and Bar River Formations. Outcrops of the middle member of the Gordon Lake Formation are nevertheless well exposed along the shores of Killarney Lake (Photo 48). The transition from Lorrain Formation to Gordon Lake Formation may be seen on the shore, and the small islands lying near the shore on the north side of the lake, just southwest of the large islands in the centre of the lake. The easily identifiable ***bedding*** at this location has been rotated from its original horizontal position to one which dips at approximately 60 degrees into the lake. The differences in weathering characteristics between the Lorrain and Gordon Lake Formations are well shown north of the southwestern part of the lake. There, high, nearly treeless ridges of orthoquartzite give way to smooth, low, tree-covered areas underlain by silty sandstone (Photo 49).

View points on the crest of the ridge of orthoquartzite of the Lorrain Formation north of Killarney Lake are from 230 to 275 m above the lake level. On a clear day, landmarks over 55 km from the ridge may be seen. Although the crest of the ridge lies less than 1.5 km from the shore of Killarney Lake, visitors are advised to allow plenty of time for the climb. Access to the crest of the ridge from the portage between Killarney and Threenarrows Lakes is described in the Threenarrows Lake section of the guidebook.

The high white orthoquartzite hills lying south of Killarney Lake are of the Bar River Formation. A faulted contact between the Gordon Lake and Bar River Formations may be seen south of the deep narrow bay of the central part of the lake. Siltstone and sandstone of the Gordon Lake Formation lie to the west of a zone of deformation and disruption of the rock. To the east of

Photo 49. *Aerial view of the east end of Killarney Lake. Note the difference in the topography and the amount of vegetation on areas underlain by the Gordon Lake Formation north and south of the lake, and areas underlain by the Lorrain Formation north of the lake.*

that zone, orthoquartzite of the Bar River Formation is exposed. The bedding of the Gordon Lake Formation appears to be met across the zone of disruption by the bedding of the Bar River Formation. For this contact to be the original one is a geologic impossibility. Hence, the zone of disruption is recognized as a ***fault***, and an upward movement of the Gordon Lake Formation with respect to the Bar River Formation is inferred. Exposures of interbedded siltstone and sandstone of the Gordon Lake Formation also occur along the shores of the deep bay at the southern end of Killarney Lake.

Return to Starting Point

From Killarney Lake, visitors may return to their starting point by way of Freeland Lake. A portage of approximately 435 m leads from the south shore of the deep bay at the southern end of Killarney Lake to the east end of Freeland Lake. George Lake may be reached by way of the short portage at the west end of Freeland Lake.

Killarney Lake to Baie Fine

From Killarney Lake, a trip of less than 8 km can be taken through the series of lakes along the Artist Creek waterway (Map 7). The route leads from Killarney Lake through O.S.A., Muriel, and Artist Lakes to Baie Fine, an appendage of Lake Huron. All the bodies of water along this route occur in the valley underlain by rocks of the Gordon Lake Formation which lies between the ridges of orthoquartzite of the Lorrain and Bar River Formations. As described earlier, Killarney Lake also occupies part of this valley.

O.S.A. Lake

O.S.A. Lake may be reached by a portage leading approximately 500 m from the west shore of the entrance of a deep, marshy bay at the southwest end of Killarney Lake to the east end of O.S.A. Lake. It may also be reached by way of a trail approximately 1100 m long which leads from the northeast shore of the deep bay on the north side of George Lake to the south shore of O.S.A. Lake. Although this trail receives some use as a portage, visitors are advised that it is better used as a hiking trail as it has some steep slopes en route. The trail leads through a mature maple forest. Residents of the Killarney area relate that these trees were tapped for their sap by the Ojibways of the area as recently as the first part of this century.

O.S.A. Lake (Photo 50) is an important one in the history of the area, for it was the centre of the first park established in the area. That park was created after A.Y. Jackson wrote to the Minister of Lands and Forests in 1931 regarding the possibility of prohibiting logging around the shores of the lake.

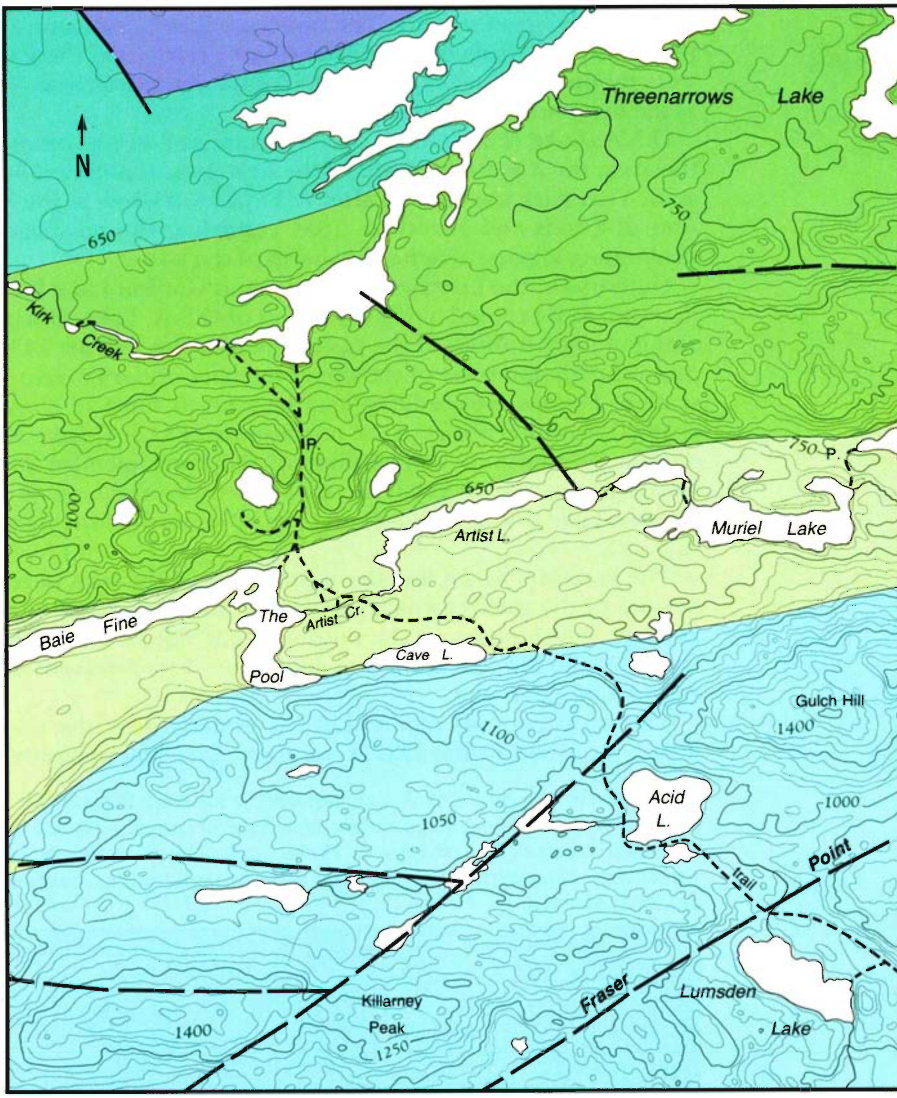
Outcrops of the Lorrain, Bar River, and Gordon Lake Formations are well exposed along the shores of O.S.A. Lake. Outcrops along the north shore of the eastern part of the lake are of fine-grained orthoquartzite of the upper member of the Lorrain Formation. ***Festoon crossbedding*** may be seen in some of the outcrops. The western part of the north shore of O.S.A. Lake is underlain by sandstone and siltstone of the lower member of the Gordon Lake Formation. The contact between the Lorrain and Gordon Lake Formations lies less than 90 m north of the shore in this area.

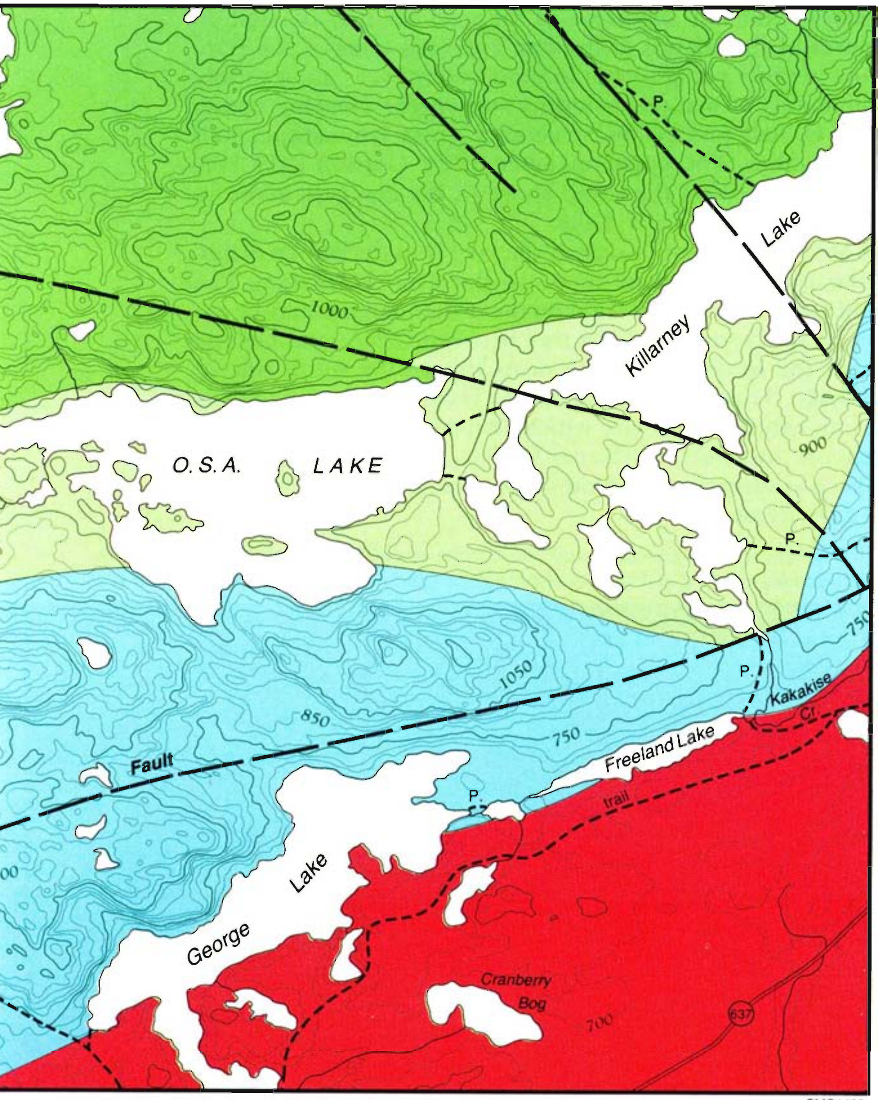
The boulders which line the north shore of the lake were deposited by the glaciers which passed over the area. Deposits such as these, which occur on the down-current side of hills with respect to the direction of ice movement, are referred to as ***crag-and-tail*** deposits.

The main body of O.S.A. Lake is underlain by the middle member of the Gordon Lake Formation. Excellent exposures of

Photo 50. *Aerial view of O.S.A. Lake between the Killarney Ridge of Bar River orthoquartzite in the foreground and the Blue Ridge of Lorrain orthoquartzite in the middle distance of the photograph. The La Cloche Mountains may be seen in the distance. Threenarrows Lake lies in the valley between the Blue Ridge and the La Cloche Mountains.*

Map 7. *Killarney Lake to Baie Fine.*





1:50 000

LEGEND

SOUTHERN PROVINCE

MIDDLE PRECAMBRIAN

GRENVILLE FRONT PLUTONS (Killarney, Chief Lake, Bell Lake Batholiths).

HURONIAN SUPERGROUP

COBALT GROUP

Bar River Formation

Gordon Lake Formation

Lorrain Formation.

Gowgand Formation

QUIRKE LAKE GROUP

Serpent Formation

Geology after K.D. Card, 1978, Map 2360.

the ***siltstone*** and silty ***sandstone*** of the member may be seen on the shores of the islands at the east and west ends of the lake. Bedding is easily recognizable in most outcrops, as are a variety of sedimentary structures including ***mud cracks***, ***climbing ripples*** (Photo 51), ball and pillow structures, cross laminations, and sandstone dikes. The upper member of the Gordon Lake Formation is exposed on the south shore of the elongate island in the southern part of O.S.A. Lake.

The shore on the south side of the lake is underlain by orthoquartzite of the lower members of the Bar River Formation. The effect of structural deformation on the orthoquartzite may be examined at the terminus of the trail between O.S.A. and George Lakes, at the south end of the deep bay on the south side of O.S.A. Lake. There, the orthoquartzite is cut by a myriad of fractures, only centimetres apart, which formed when the rock broke in response to structural forces (Photo 52). Other less brittle rocks such as siltstone often flow rather than fracture in response to the same stress.

Photo 51. *Cross-section exposure of mud cracks (top), and climbing ripples (centre) in interbedded siltstone and silty sandstone of the Gordon Lake Formation.*

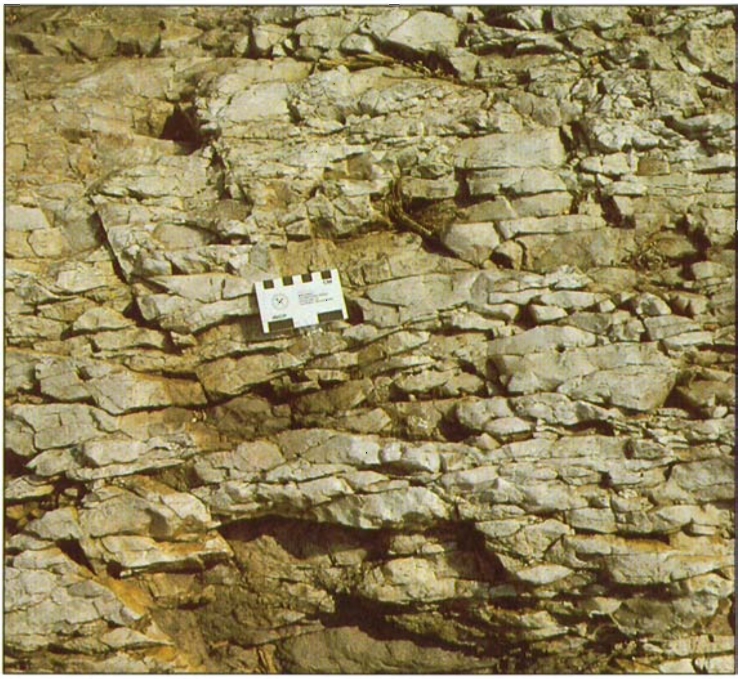


Photo 52. *Highly fractured orthoquartzite of the Bar River Formation at the O.S.A. Lake landing of the trail from George Lake to O.S.A. Lake. The scale on the card is in centimetres and inches.*

Muriel Lake

Muriel Lake is an elongate lake lying west of O.S.A. Lake. It may be reached by way of a portage of approximately 320 m which leads from the most westerly part of O.S.A. Lake.

Outcrops along the shores of Muriel Lake are of the middle member of the Gordon Lake Formation. The bedding strikes approximately parallel to the length of the lake, and dips nearly vertically. Examples of various sedimentary structures may be examined in outcrops along the north shore of the lake, where exposures are more accessible than along the south shore.

Artist Lake

Artist Lake is a long, narrow, weed-filled lake. It may be reached by way of a series of portages and small lakes leading from the north shore of Muriel Lake near its west end. Artist Lake and the route leading to it are underlain by the Gordon Lake Formation.

Baie Fine (Eastern Part)

Baie Fine (Photo 53) may be reached by way of Artist Creek which flows from the southwest end of Artist Lake. A portage of approximately 105 m bypasses a shallow, rocky section of the creek. Individual siltstone beds of the Gordon Lake Formation from 2 to 5 cm thick are exposed in outcrops at that point. Although sedimentary structures other than bedding are not present, well preserved glacial ***striae*** may be seen. Artist Creek flows into Baie Fine near the middle of the section known as "The Pool" (Photo 54).

The eastern part of Baie Fine is a narrow bay nearly 3 km in length, which, with the western part of Baie Fine (formerly Narrow Bay), the larger body of water into which it leads, is reputed to resemble a Norwegian fjord. This is an apt comparison, for the bay is long, and narrow, and lies between Blue Ridge and Killarney Ridge of the South La Cloche Range. The ridges rise steeply to over 185 m above the water level both north and south of the bay. The highest summit, Leadingmark Hill, rises south of Baie Fine to 267 m above the level of the bay.

Like all the other bodies of water along the Killarney Lake to Baie Fine route, Baie Fine is underlain by the Gordon Lake Formation. Outcrops of the formation in the eastern Baie Fine section are few, however, except around The Pool.

The north shore of eastern Baie Fine is mainly covered by overburden, including crag-and-tail deposits. Most of the boulders in the deposit are orthoquartzite of the Lorrain Formation, which forms the Blue Ridge north of Baie Fine, although some boulders are from other, more distant sources. The south shore of eastern Baie Fine is underlain by the middle member of the Gordon Lake Formation. The best exposures of this member in the Baie Fine area are those mentioned earlier which occur around The Pool.

Although Baie Fine is now an idyllic spot to spend vacation hours, such was not always the case. Lumbering operations were carried out from a base on eastern Baie Fine for many years during the first half of this century. Little is known regarding the size and extent of logging activity in the area, although it is known that at least four companies worked there. The Spanish River Lumber Company was the second company to work in the area. Their operations lasted longer than those of the other companies, spanning the years 1908 to 1927. They operated an average of two camps each season, and removed more than 18 000 000 m of red and white pine, hemlock, and spruce logs. The logs were boomed out of the bay to sawmills in other areas. Remnants of log chutes, work camps, a large wharf, and corduroy roads in

Photo 53. *Baie Fine. Photo courtesy D. Burnett.*

Photo 54. *The Pool at the east end of Baie Fine. Blue Ridge of the South La Cloche Range can be seen in the distance to the west.*

the area bear witness to the logging activity. Part of the headquarters of the Spanish River Lumber Company still stands on the shore of Baie Fine at the northeast end of The Pool. The unobtrusive appearance of the building, and its present use as a private summer cottage belie its earlier stature with regard to the commerce of the area. Other lumber company buildings which stood nearby housed horses, cattle, pigs, and chickens.

The numerous boat trips to Baie Fine and The Pool made by business men and tourists during the logging era led to the recognition of the area as a yachtsman's haven. Kenneth Welles, author of several books on yachting, acknowledges in his book "Cruising the North Channel" that The Pool is one of the finest anchorages (see Photo 44) to be found anywhere. Members of the Group of Seven sketched and painted the bay, and the lakes nearby. The small lakes lying near the crest of the Blue Ridge were favourite subjects (Photo 55).

Access into the Baie Fine area is also possible by way of the hiking trail, and by way of Frazer Bay of Lake Huron. Both routes are described in a later section of the guidebook.

Silver Peak

Silver Peak, the highest point of land for many kilometres in any direction, is situated at the juncture of the La Cloche Mountains and South La Cloche Range. It may be reached by a number of routes (Map 8).

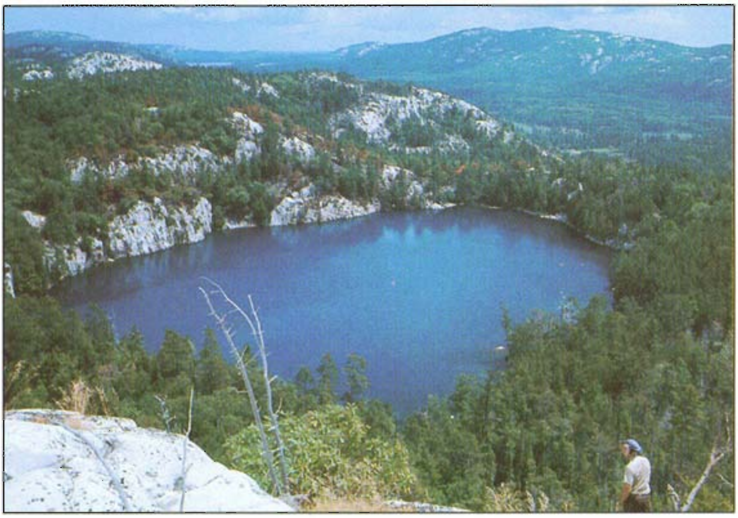
Silver Peak may be reached from two lakes along the Johnnie Lake circle route. Visitors may hike due south across country for 1900 m from the east end of Kirk Lake (Photo 56), or in a direction 30 degrees south of west for approximately 2600 m from the north end of Clearsilver Lake. The route from Clearsilver Lake is a little longer, but it is less steep.

Silver Peak may also be reached from the George Lake circle route. Visitors may portage to Sandy Lake, and then hike due north from the north shore of the lake to the summit 1.4 km away. Alternatively, they may hike to Sandy Lake from the northeast corner of Norway Lake by hiking approximately 805 m in a direction 60 degrees east of north before turning north towards the summit. Visitors may return to their starting points by retracing their steps. Anyone travelling across country should carry a map and compass and be familiar with their use.

The view from the summit of Silver Peak, which has an elevation of 543.5 m above sea level, or 365 m above Lake Huron, encompasses landmarks more than 55 km away.

Silver Peak is underlain by resistant orthoquartzite and aluminous sandstone of the upper members of the Lorrain Formation, and is situated at the nose of a giant ***anticline*** which plunges to the east. The La Cloche Mountains and South La Cloche Range are part of the north and south arms of the anticline respectively. The combination of a major geologic structure and rocks resistant to erosion have resulted in the formation of the predominant topographic and scenic feature of the Killarney area.

Photo 55. *Topaz Lake at the crest of Blue Ridge, north of The Pool. This lake and others at the crest of the ridge were favourite subjects of members of the Group of Seven.*



Map 8. *Silver Peak.*

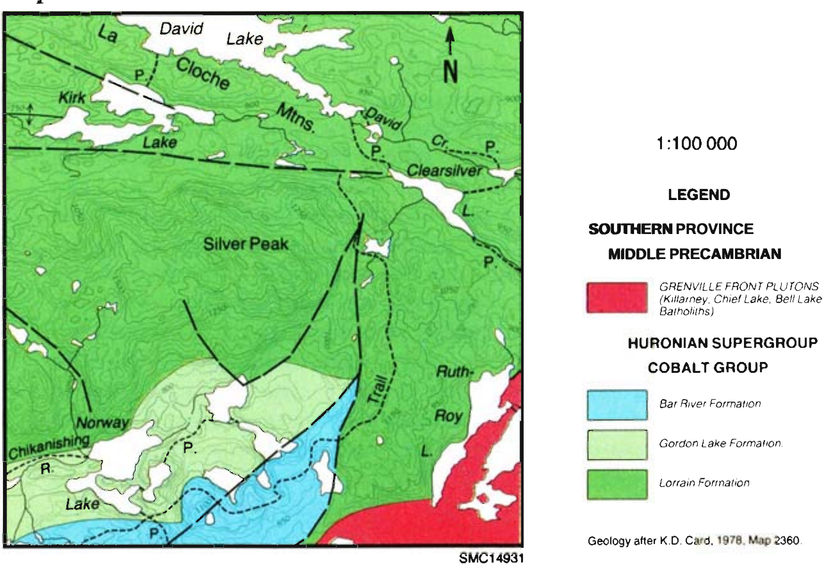


Photo 56. *View of Silver Peak from the north shore of Kirk Lake.*

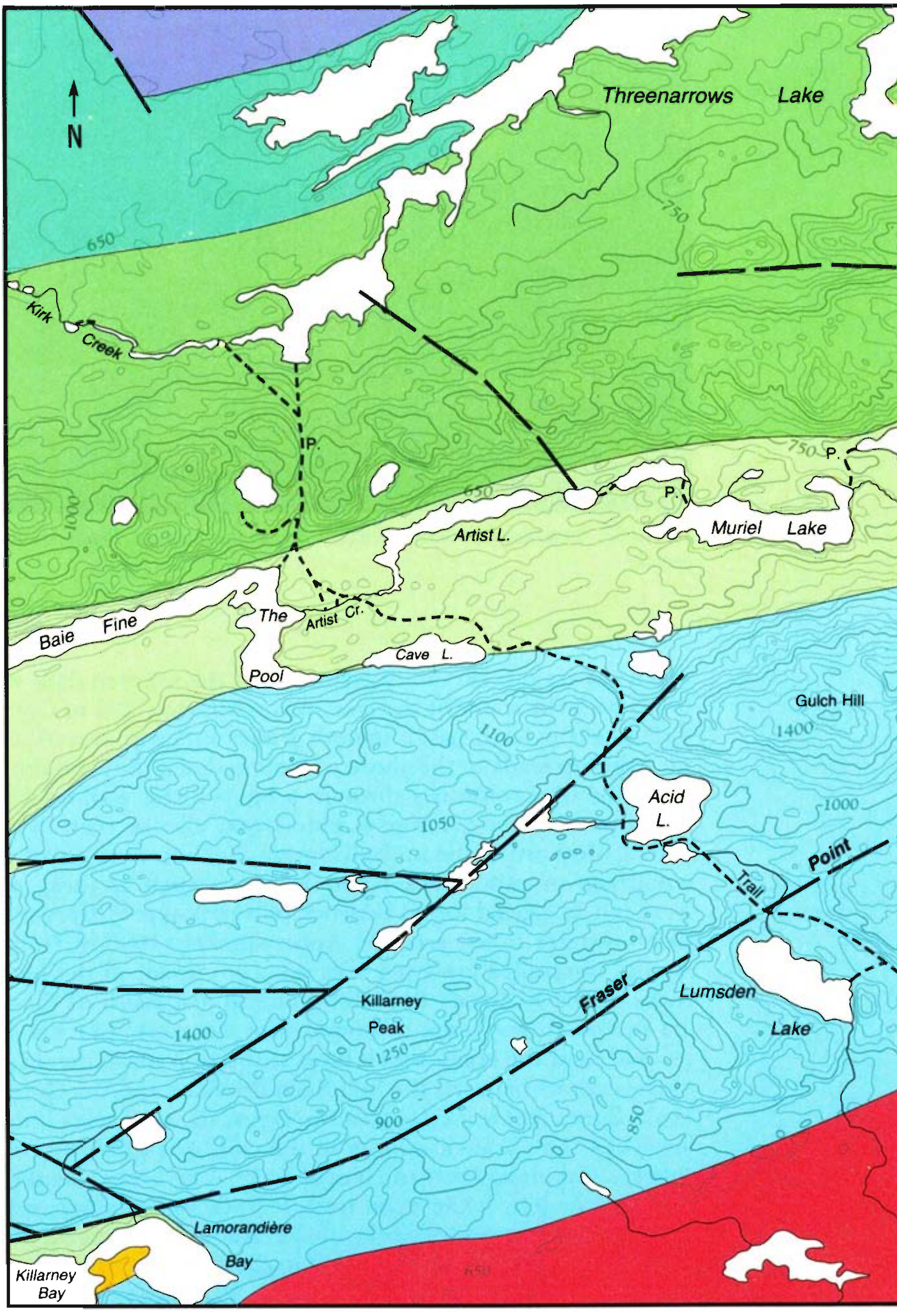
Hiking Trail

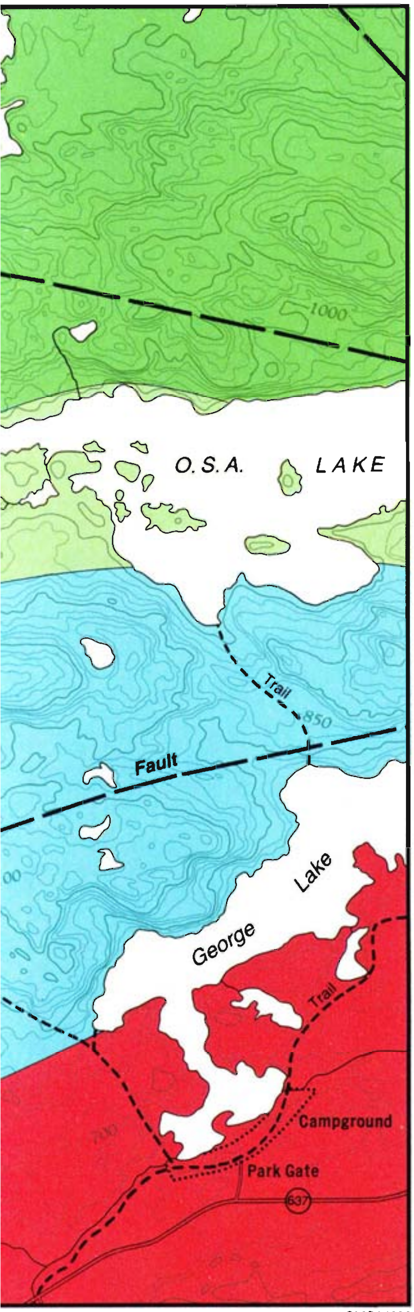
The hiking trail described below is part of a proposed larger network of trails which is to extend around the perimeter and across the interior of Killarney Provincial Park. Until such time as the network is complete, however, hikes may be taken on the section of the trail leading from George Lake to Threenarrows Lake (Map 9). Short side trips may be taken to Lumsden Lake, Cave Lake, and The Pool, and to viewpoints at the crests of the Killarney and Blue Ridges. Although the trail is faint in a few places, hikers should be able to find their way without great difficulty. Anyone using the hiking trail is reminded that it does not loop back to George Lake; hikers must retrace their steps to return to their starting point. The total distance from George Lake to Threenarrows Lake, one way, is approximately 9.5 km. Children should be accompanied by adults when hiking on the trail. The hiking trail begins where the Chikanishing River flows from George Lake, at the west end of the south bay of the lake. To

Photo 57. *Lumsden Lake with Georgian Bay in the distance. Photo courtesy P. Storck.*

reach the trail, hikers must wade across the wooden dam which holds back the water of the lake. Approximately 200 m from the dam, the trail leads past a smooth ***granite*** outcrop. A walk across the outcrop leads to the shore of George Lake. Beyond the outcrop, the trail continues through a birch forest with occasional outcrops of granite. Large boulders may also be seen in a few places. Most are of the underlying granite, but some are of orthoquartzite or other rock types. Boulders such as these which were left by glacial ice on bedrock of a rock-type different than their own are called ***erratics***. Approximately 1000 m from the start of the trail, a low-lying area is encountered. At this locality, rocks of the Killarney Batholith outcrop just south of the trail. To the north are white orthoquartzite outcrops. The low-lying ground, and the creek which flows through it mark the location of the contact between the Southern Province and the Grenville Front Zone. A few metres past the creek, the trail splits into two branches. The branch leading to the east, or right, leads to the shore of the main body of George Lake. The branch leading to the west, or left, is the main trail. It leads to the northwest between high outcrops of rocks of the Bar River Formation. Approximately 805 m from the fork in the trail described above, a second branch is reached. This branch leads approximately 180 m to the left, or west of the main trail to the shore of Lumsden Lake.

Map 9. *Hiking trail.*





SMC14932

1:50 000

LEGEND

SOUTHERN PROVINCE

MIDDLE PRECAMBRIAN

GRENVILLE FRONT PLUTONS (Killarney, Chief Lake, Bell Lake Batholiths)

NIPISSING DIABASE

HURONIAN SUPERGROUP

COBALT GROUP

Bar River Formation.

Gordon Lake Formation.

Lorrain Formation.

Gowganda Formation.

QUIRKE LAKE GROUP

Serpent Formation.

Geology after K.D. Card, 1978, Map 2360.

Photo 58. *Folded interbedded quartzite and dark ferruginous siltstone of the Bar River Formation, east of Lumsden Lake.*

Between the starting point of the main trail, and the branch leading to Lumsden Lake, the trail follows very closely the bed of a road built and used by the lumbermen who worked in the area. These roads were not the well built thoroughfares of today. In upland areas, they were simply tracks cleared through the bush. In swampy and low lying areas, the roadbeds were of corduroy construction. Several examples of this type of construction whereby logs were placed side by side across the road to form a stable base for it, may be seen along the trail between George Lake and the Lumsden Lake branch trail. Further examples may be seen farther along the trail.

The trail to Lumsden Lake leads to the southeastern part of it. Just south of the end of the trail is a hill approximately 45 m high. The view (Photo 57) from the top of this hill encompasses Lumsden Lake, Georgian Bay, and, on a clear day, Manitoulin Island.

Lumsden Lake is underlain by rocks of the second highest member of the Bar River Formation. The hematitic siltstone and sandstone of this member are well exposed on the flanks and crest of the hill south of the trail. Part way up the hill, deformed red and blue hematitic siltstone is exposed (Photo 58). It is this part of the formation which contains sufficient iron for it to be classified as ***iron formation***. Its response to structural deformation in this area was to flow, and to form the contorted folds exposed on the side of the hill. Ferruginous (iron-bearing) sandstone and orthoquartzite are exposed at the crest of the hill. The pink colour of the rock is caused by its iron content. Well developed cross laminations may be seen in many of the sandstone and orthoquartzite beds.

The effects of a weathering process called ***exfoliation*** or spalling may be also seen at this locality. Large angular slabs of rock ranging in thickness from a few centimetres to approximately 0.5 m lie atop the outcrop in a few places.

From the hill east of Lumsden Lake, hikers may return to the main trail by way of the branch trail.

Between the branches to George Lake and to Lumsden Lake, the trail is situated just west of the foot of a high quartzite ridge. The summit of the ridge, which is part of the Killarney Ridge of the South La Cloche Range, lies approximately 400 m north of the junction of the main trail with the branch trail to Lumsden Lake. A climb to view points at the summit of the ridge is best started from a point on the trail approximately 90 m beyond the junction with the branch leading to Lumsden Lake. The crest is approximately 105 m above the trail. From the summit, the George Lake beach area 3 km away, and the town of Killarney approximately 10 km away, may be viewed. If the day is clear, Manitoulin Island, the largest freshwater-surrounded island in the world, may be seen 30 km away. The low, flat profile of the island reflects the fact that it is underlain by flat-lying ***Paleozoic*** sedimentary rocks. On an exceptionally clear day, another low profile may be faintly visible on the horizon just south of Manitoulin Island. This profile is of the Bruce Peninsula in the Tobermory area, more than 90 km from the viewpoint.

Approximately 730 m beyond the junction of the branch trail leading to Lumsden Lake with the main trail, the trail may appear to be lost. A well defined trail leads to the edge of a drained beaver pond, and disappears. The trail does, however, continue. A detour trail leads west from the main trail some 45 m before the drained pond is reached. The detour trail is not as good as the main trail, but can be followed through the bush and across an outcrop of orthoquartzite to a small beaver dam at the west end of the drained pond. Hikers may either cross by way of the beaver dam, or by stepping across the creek just downstream from the dam. The detour continues some 27 m to the east along the north shore of the drained pond to the main trail.

A large outcrop of ***orthoquartzite*** which lies near the trail approximately 100 m beyond the drained pond is of special historical significance[1], for the rock was quarried by prehistoric inhabitants of the area. Dr. Emerson Greenman, a noted archeologist, examined the site over 20 years ago. His work suggests that the quarry was used approximately 9000 years ago, at a time when the retreating glacier was less than 150 km away. Gravel deposits just west of the trail at this locality indicate that the lakeshore was close to the quarry at that time.

From the quarry, the trail leads approximately 660 m to the shore of Acid Lake. A small lake lying left of the trail is passed just before Acid Lake is reached. A short distance beyond the first locality at which the trail reaches Acid Lake is an excellent viewpoint and comfortable resting place on the shore. Outcrops of orthoquartzite, and hematitic siltstone and sandstone of the middle member of the Bar River Formation are well exposed at the viewpoint, or close to it.

Just west of the viewpoint, the trail detours south around a small bog on the shore of Acid Lake. The detour skirts a dried beaver pond, and passes by one which is almost dry. On the shore of the partially dried pond, the trail passes over a smooth, high outcrop of dark rock. At first glance, the rock appears similar to the ferruginous siltstone exposed at the viewpoint. Closer examination reveals, however, that it is massive, not bedded, and

[1]Note that it is prohibited by law to disturb archaeological sites or to remove artifacts from their original location anywhere in the Province, except by permission of the Ontario Government.

has a crystalline rather than sedimentary texture. The dark rock is ***olivine diabase***, or the same rock which underlies many of the rows of trees that extend across the barren orthoquartzite hills.

For approximately 550 m beyond the end of the detour at the southwest end of Acid Lake, the trail lies to the west of Acid Lake. Outcrops are exposed at several localities on or near the trail in this area. All are of the interbedded ferruginous siltstone, sandstone, and orthoquartzite of the middle member of the Bar River Formation which occur at the viewpoint on Acid Lake. Past the north end of Acid Lake, some 550 m north of the end of the detour, orthoquartzite of the second lowest member of the Bar River Formation is the only rock type underlying the trail. Approximately 550 m north of Acid Lake, the trail begins to make a wide swing to the west, or left, and to descend to the level of Baie Fine. On this descent, it passes through a majestic forest of mature hemlock trees, and leads to the east end of Cave Lake. Just before the lake is reached, the trail splits into two branches. The branch leading north, or right, is the main trail to Baie Fine. The other branch, which leads straight ahead, terminates at the east end of Cave Lake. The vantage point at that locality is described here, for it is a popular locality for hikers to rest and picnic.

Photo 59. *Feldspathic sandstone and siltstone of the upper member of the Gordon Lake Formation near its contact with the Bar River Formation, east end of Cave Lake.*

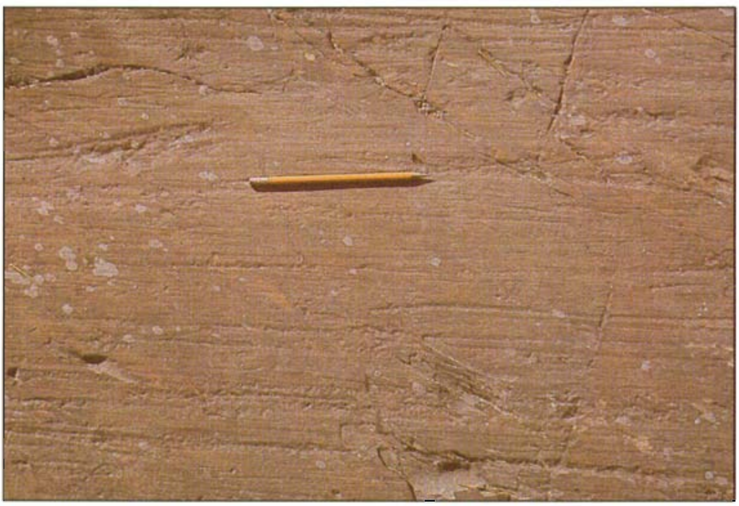
The contact between the Gordon Lake and Bar River Formations lies under the southern part of Cave Lake. Thus, the outcrops at the east end of the lake are of the upper member of the Gordon Lake Formation. Interbedded sandstone and siltstone are exposed there (Photo 59). The proportion of sandstone increases towards the south end of the outcrop area, while the amount of silt in the sandstone beds decreases, and individual beds thicken. The rock at the south end of the outcrop grades from ***feldspathic*** sandstone to quartzite, with a few ***argillaceous*** interbeds. Outcrops of orthoquartzite of the Bar River Formation are exposed less than 45 m from the exposure of feldspathic sandstone and quartzite. ***Cross laminations*** are well developed in the upper member of the Gordon Lake Formation.

Photo 60. *Cross-sectional exposure shows mud cracks (light-coloured features in dark siltstone near top and bottom of photo), and ball-and-pillow slump structures (centre of photo) in interbedded siltstone and sandstone of the Gordon Lake Formation, north shore of Cave Lake.*

Hikers wishing to continue from the viewpoint at the east end of Cave Lake to The Pool must back track approximately 90 m to reach the main trail. It leads north over a small outcrop, at right angles to the trail to the viewpoint. After approximately 60 m, the trail reaches a broad, dry marsh. Some hikers may wish to skirt the edge of the marsh, but during most weather it is dry enough to cross without trouble where the trail reaches it. The trail begins again at the outcrop on the opposite side of the marsh. It may prove difficult to find, but hikers should not worry, for a variety of routes may be taken north of Cave Lake without mishap. Perhaps the most scenic route is along the outcrops

Photo 61. *Nearly vertical bedding in rocks of the Gordon Lake Formation, north shore of Cave Lake, near west end.*

Photo 62. *Well developed glacial striae on siltstone of the Gordon Lake Formation northwest of Cave Lake. The striae are parallel to the pencil. Bedding in the siltstone is faintly visible at an angle of about 40° (from upper left to lower right of photo) to the glacial striae.*



which overlook the lake. These outcrops are of the uppermost part of the middle member of the Gordon Lake Formation. Examination of the interbedded siltstone and feldspathic sandstone of any of the outcrops reveals a variety of sedimentary structures including ***starved ripples***, cross and parallel laminations, mud flakes, sandstone ***(sedimentary) dikes***, ***flame structures***, ***mud cracks***, ***load casts***, and ***ball-and-pillow*** structures (Photo 60).

Hikers travelling along the outcrops will find one small swamp to hike around, part way along the shore. The detour is approximately 75 m in length. Hikers following the trail will find it marked by bright tape tied to trees and bushes. After the trail passes the swamp mentioned above, it leads across an outcrop near the shore for approximately 140 m and then leads north of a ridge of outcrop, and alongside a swamp. In this region, the trail is less hilly than the route along the outcrops, but the lake is lost to view. Hikers wishing to continue along the outcrops beyond the detour will find the effort worthwhile, for the scenery is different from every viewpoint, and outcrops along the lakeshore (Photo 61) contain further examples of the sedimentary structures listed earlier. Very near the west end of the lake, a wide trail leads away from the shore. This trail narrows, and then leads back to the main trail.

The main trail leads north from the west end of Cave Lake, and passes close to several outcrops of rocks of the Gordon Lake Formation. These outcrops are of interbedded siltstone and silty sandstone of the middle member of the formation, and are typified by beds approximately 5 cm thick. One notable feature of these outcrops is the well developed glacial striae (Photo 62). As mentioned before, the ***striae*** are formed when the pebbles and boulders embedded in the bottom of the glacial ice sheet are scratched over the outcrop like a giant sheet of sandpaper. Hikers are asked to recall if they have seen such well developed striae anywhere on outcrops of orthoquartzite. Most probably, none will come to mind. The reason for this is not that the ice was less forceful in scraping over the outcrops of orthoquartzite. Rather, while the pebbles and boulders embedded in the ice were generally of harder rock than the Gordon Lake siltstone and silty sandstone, and hence scratched them, the orthoquartzite was harder than the majority of pebbles and boulders, and hence wore them down rather than being scratched itself.

Approximately 410 m beyond the west end of Cave Lake, the trail reaches Artist Creek. A short detour upstream is necessary in order to cross the creek. Once across the creek, hikers may return to the main trail by following a detour trail downstream for approximately 45 m. From Artist Creek to the northeast end of The Pool and Baie Fine, the distance is approximately 410 m.

More than one trail leads from the main trail to the northeast shore of The Pool. Hikers are advised, however, that the first wide trail, which was formerly a road, leads to a private summer cottage. The view from the end of the next branch, which is a point of historical significance, is equally as impressive.

From the viewpoint at the northeast end of The Pool, hikers may look down the length of Baie Fine, and also see most of The Pool. The viewpoint, which is now the terminus of the Baie Fine to Threenarrows Lake portage, was once the site of the wharf of the Spanish River Lumber Company. Large pilings in the water are all that remain of the wharf. A more complete description of Baie Fine and early activities in the area was given in the Killarney Lake to Baie Fine canoe route guide.

The trail leading from Baie Fine to Threenarrows Lake is also used as a portage by canoeists. Near Threenarrows Lake, the trail branches. The branch on the right provides the shortest route to the lake, and is the one most often used by canoeists. The left branch leads to a point at the west end of the lake where the creek flowing from the lake may be crossed. The total length of the trail from Baie Fine to the west end of Threenarrows Lake is approximately 1.5 km. It is along this trail that William Hale Thompson, the flamboyant mayor of Chicago, was carried in a sedan chair by his bodyguards while en route to his cottage on Threenarrows Lake during the 1920s.

Before hiking along the trail to Threenarrows Lake, hikers may wish to leave the trail near Baie Fine to climb to vantage points either east or west of the trail. The panoramas which may be seen from the crest, and the small lakes which lie near the crest of the Blue Ridge on both sides of the trail, were favourite subjects of the Group of Seven painters who worked in the area. From the highest summit, which lies west of the trail, the Blue and Killarney Ridges of the South La Cloche Range can be seen bordering the valley in which Baie Fine and Cave, Artist, Muriel, O.S.A., Killarney, and Norway Lakes lie. Although the orthoquartzites of the two ridges are both dazzling white in the sun, it is worth noting that the Blue Ridge is underlain by rocks of the Lorrain Formation, while the Killarney Ridge farther south is underlain by rocks of the Bar River Formation. The valley between the ridges is of course underlain by the pink- and brown-weathering rocks of the Gordon Lake Formation. Beyond the orthoquartzite hills, Manitoulin Island may be seen. Northwest of the Blue Ridge, McGregor Bay with its myriad of islands may be seen (Photo 63).

It is noted that one published map of the Killarney Provincial Park area indicates a route along the crest of the Blue Ridge, to the west of the trail to Threenarrows Lake. The route shown continues around the entire perimeter of the park. Hikers are cautioned, however, that at the time of writing of this guidebook, no trail was in existence there, and the route indicated was exactly as described in the legend on the map as a "future hiking trail".

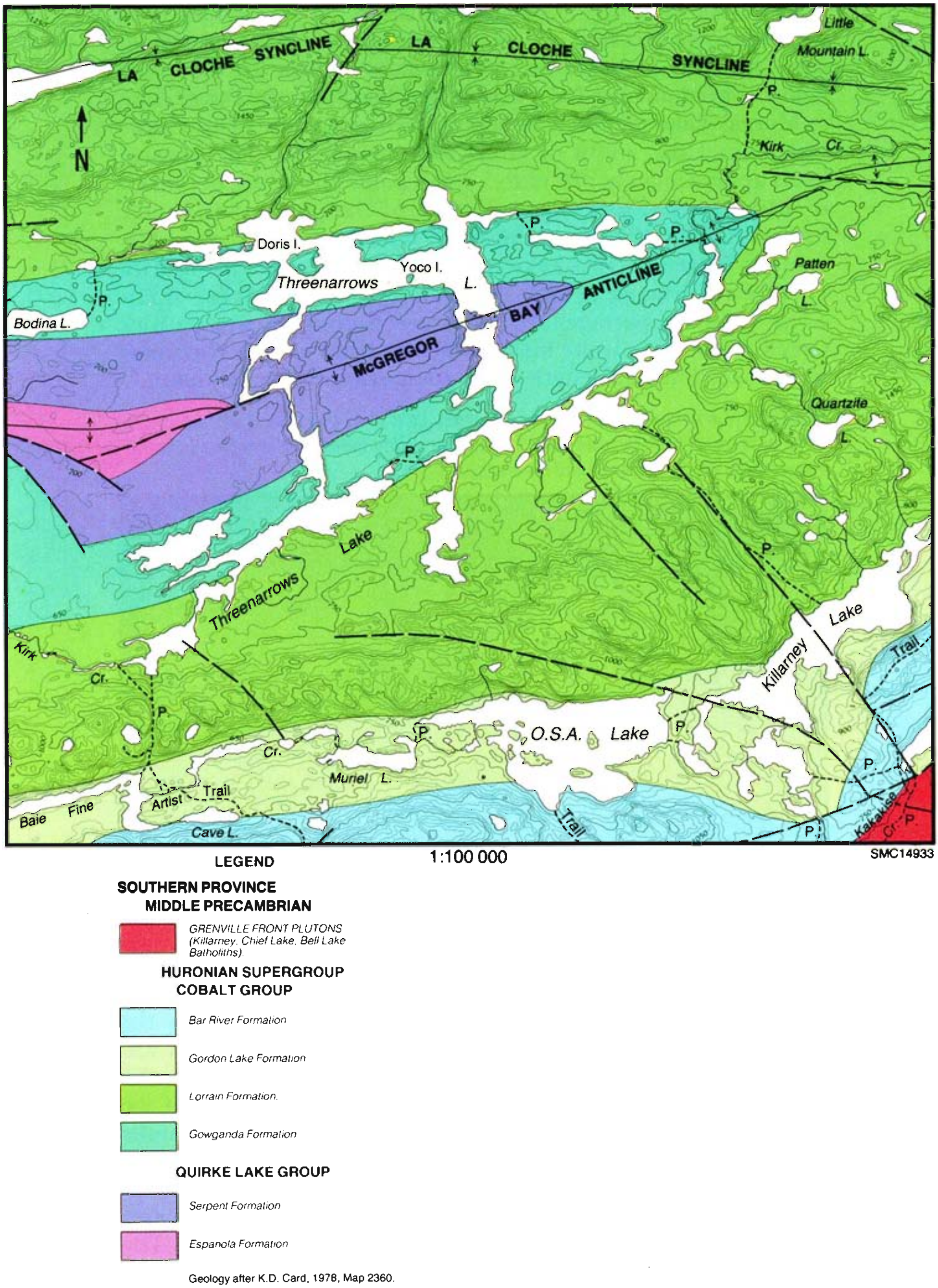
Photo 63. *View of McGregor Bay from the crest of the Blue Ridge, north of The Pool. The numerous channels and islands of the McGregor Bay area may be seen in the distance.*

The hike from The Pool to Threenarrows Lake crosses most of the Lorrain Formation, from the uppermost member on down. Exposures of orthoquartzite, and aluminous, hematitic, and micaceous sandstone may be examined along the trail. The feldspathic sandstone and silty sandstone members are not exposed along the trail, but do underlie the area north of Threenarrows Lake opposite the ends of the portage and the trail. A summer camp is located opposite the end of the trail.

Threenarrows Lake

Because of the large size of Threenarrows Lake (Map 10), it may be reached by several routes from different waterways. Its location between the La Cloche Mountains and South La Cloche

Map 10. *Threenarrows Lake.*



Range does, however, mean that the access routes are long ones which involve crossing one of the orthoquartzite ridges (Photo 64). The main access routes to Threenarrows Lake are described below. Threenarrows Lake may be reached from the David Lake to Murray Lake waterway by way of a portage leading from Little Mountain Lake, south of Great Mountain Lake. The portage leads approximately 915 m to a small pond on the north branch of Kirk Creek. From the south side of the pond, the portage leads a further 1215 m to the south branch of Kirk Creek. The route to Threenarrows Lake then leads downstream along Kirk Creek for a distance of approximately 1850 m. A number of lift-overs and short portages are encountered along the way on Kirk Creek. This access route leads to the northeast end of Threenarrows Lake. The total length of the route is approximately 4 km.

Photo 64. *Orthoquartzite north of Killarney Lake cut by diabase dikes marked by rows of trees. Threenarrows Lake lies in the valley between the ridges of orthoquartzite in the foreground and distance.*

Threenarrows Lake (Photo 65) may be reached from the George Lake circle route by way of a portage leading from Killarney Lake. The portage begins in a bay near the centre of the north shore of the lake. It leads approximately 3200 m to the south shore of a small unnamed lake. A portage beginning at the northeast end of that lake leads approximately 390 m to Threenarrows Lake. This route provides access to the central part of the south arm of Threenarrows Lake. The route is approximately 3700 m long. It follows a linear valley across Blue Ridge. The crest of the ridge both east and west of the portage is over 220 m above the level of Killarney Lake and over 140 m above the highest point on the portage. The ascent of the ridge adjacent to the portage requires less cross country travel than does ascent directly from the lakeshore, making it the easier, and less time consuming, route to the spectacular vantage points at the crest.

A third access route is by way of the trail which leads from The Pool to Threenarrows Lake. This route, which was described in some detail as part of the hiking trail, leads to the southwest end of Threenarrows Lake.

Photo 65. *Threenarrows Lake at sunset. Photo courtesy D. Burnett.*

Threenarrows Lake may also be reached from McGregor Bay by way of Kirk Creek. This route is described in more detail in a later section as a side trip from Threenarrows Lake to McGregor Bay.

As noted earlier, Threenarrows Lake is a large lake. Its total length is nearly 13 km. That distance is not, however, stretched along the length of a long, straight lake. Threenarrows Lake is one whose shape is controlled directly by the topography of the surrounding area, and thus indirectly by the geologic features of the area. The major geologic structure of the area, the McGregor Bay Anticline (Photo 66), is expressed topographically by the La Cloche Mountains and South La Cloche Range. Silver Peak is located at the nose of the anticline where the two ranges meet. Consequently, the shape of Threenarrows Lake with nearby York Lake is much like a broad "V" pointing to the east. Two wide channels join the arms of the "V". Besides controlling the shape of the lake, geologic factors also control its position. The arms of the "V" overlie the contact between the Lorrain and Gowganda Formations and eroded rocks of the Gowganda Formation, while the channels joining the arms are underlain by faults. Much of the area between the arms of the "V" is underlain by the rocks of the Serpent Formation.

Because of the shape of the lake, a circle tour of much of it may be made. One portage along the route leads from one part of the lake to another. Alternatively, a longer tour with three portages en route may be taken on Threenarrows and York Lakes. Visitors arriving from either Killarney or Little Mountain Lake may make a short circle tour of York Lake and the eastern part of Threenarrows Lake.

Photo 66. *Threenarrows Lake viewed from Blue Ridge on the portage from Killarney Lake. The La Cloche Mountains in the distance to the north and Blue Ridge of the South La Cloche Range form limbs of the McGregor Bay Anticline.*

The size of the lake prohibits specific reference to individual points of geologic interest, but the general geology of the area may be easily recognized by visitors to Threenarrows Lake. The areas north and south of the lake are underlain by rocks of the Lorrain Formation. Exposures along the shores are of silty ***sandstone*** and feldspathic sandstone of the lower members of the formation. Individual beds and sedimentary structures such as ***crossbedding*** are easily identifiable in many of the outcrops of the Lorrain Formation which occur around the lake. Rocks of the Gowganda Formation underlie most of the northern and southern arms of the Threenarrows Lake "V" structure. ***Conglomerate***, silty sandstone, and laminated ***argillite*** are exposed along the shores there. The central part of the Threenarrows Lake area is underlain by feldspathic sandstone of the Serpent Formation. Sedimentary structures such as crossbedding, parallel laminations, and ripple marks may be seen in many of the outcrops. ***Bedding*** may also be recognized. An examination of the dips of the beds in outcrops exposed along the channels which join the north and south arms of the lake leads to a recognition of the major structure of the area.

Although Threenarrows Lake is large, few lakes of significant size occur near it. Numerous shallow swamps rather than lakes have been formed on the rather flat topography of the region between the La Cloche Ranges.

Threenarrows Lake to McGregor Bay

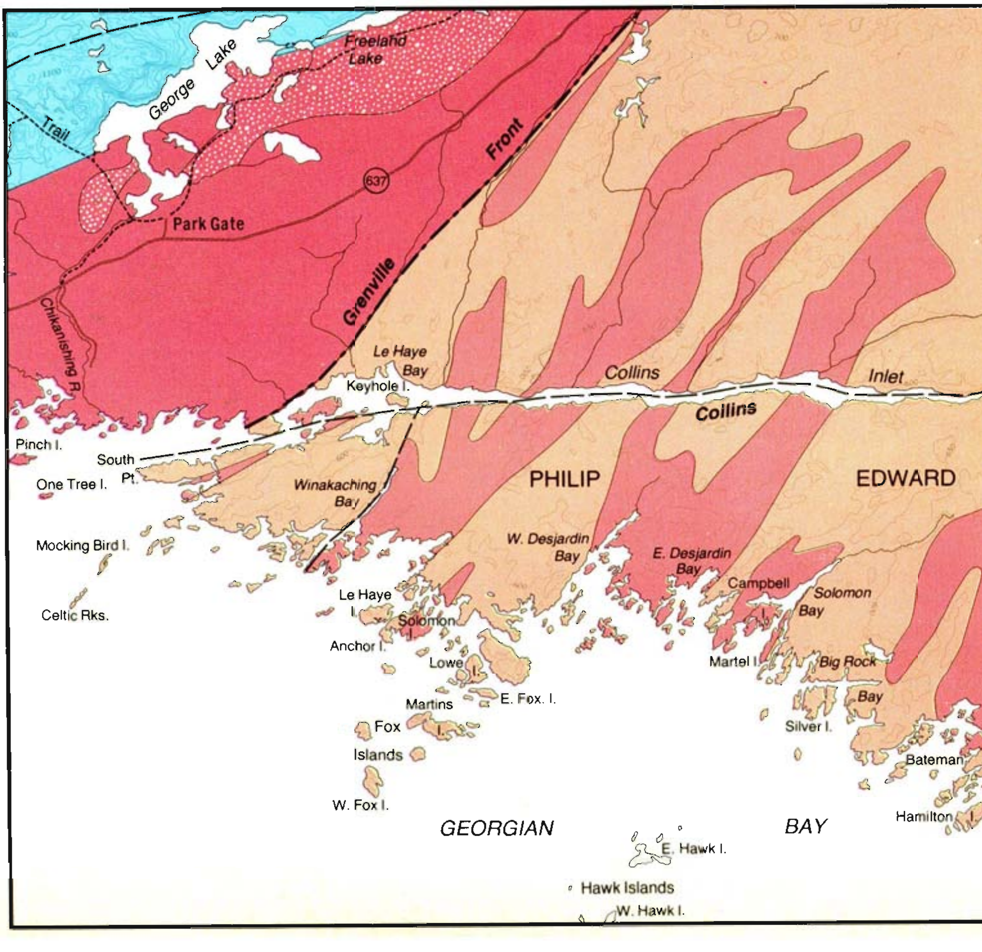
McGregor Bay of Lake Huron may be reached from Threenarrows Lake by way of Kirk Creek. The route begins at the southwest end of Threenarrows Lake at the terminus of the hiking trail. Two liftovers, closely spaced, mark the beginning of the route. A number of liftovers and short portages are necessary at several points along the route, which is approximately 4800 m long.

Kirk Creek lies close to the contact between the Lorrain Formation and Gowganda Formation for the length of this route. Outcrops exposed along the creek are of hematitic, feldspathic, and silty sandstone of the lower members of the Lorrain Formation and of laminated argillite and conglomerate of the upper member of the Gowganda Formation. Sedimentary structures including bedding and crossbedding may be seen in outcrops along the route. The McGregor Bay area is described in more detail in a later section of this guidebook.

Georgian Bay and Lake Huron

Georgian Bay (Photo 67) and the North Channel of Lake Huron are part of the Great Lakes waterway. In the Killarney area, this fact has been of great importance, for both prehistoric and historic development of any area have depended on the natural resources there and the trade routes to them. Geologic features have been important both topographically and economically in the development of the Killarney area. They control the location of channels, and the shapes of bays and harbours, while certain types of rocks have been quarried intermittently during a period extending back approximately 9000 years. Because of the number and size of the bodies of water connecting to Georgian Bay and Lake Huron in the Killarney area, each will be described individually.

Map 11. *Collins Inlet.*



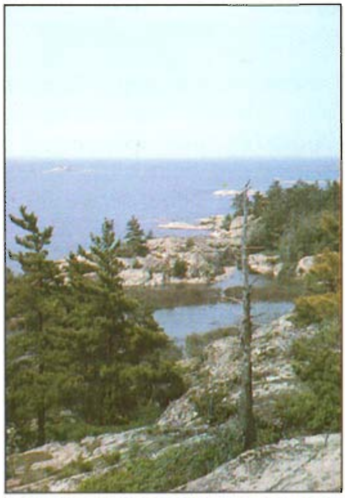
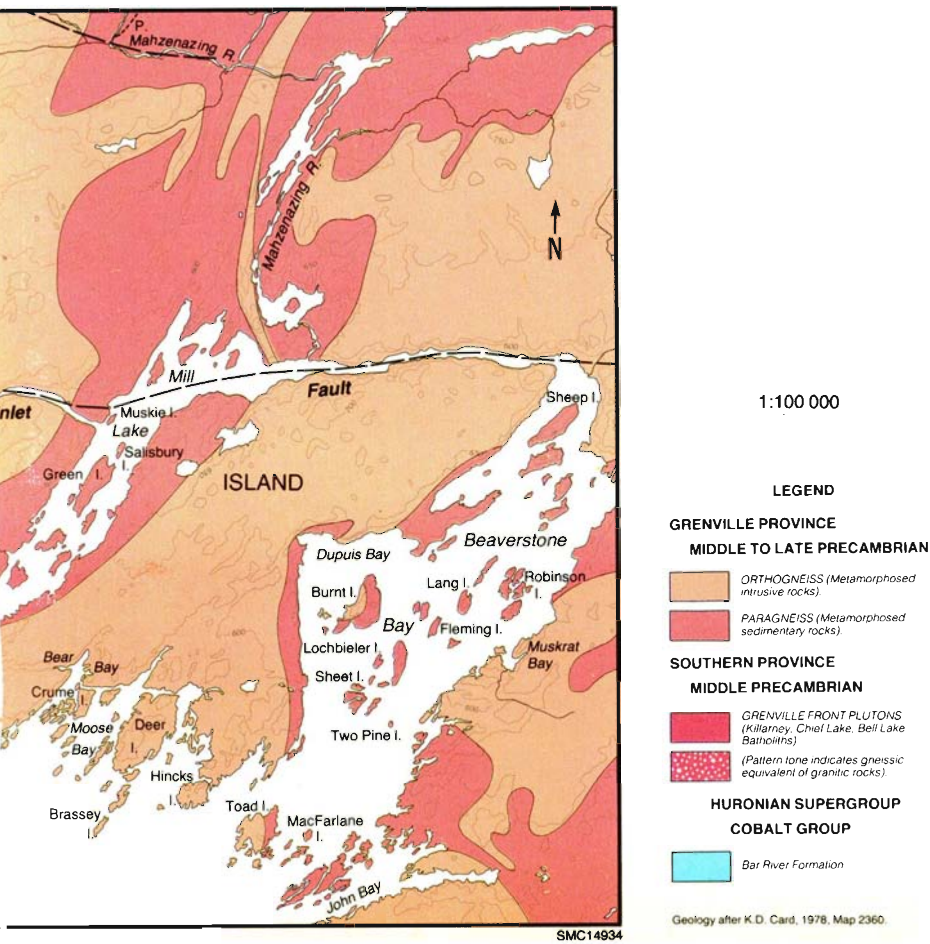


Photo 67. *Georgian Bay, with Manitoulin Island in the distance. Photo courtesy P. Storck.*



Collins Inlet

Collins lnlet is a straight channel approximately 20 km in length which separates Philip Edward Island from the mainland north of Georgian Bay (Photo 68). The west end of the channel opens onto Georgian Bay near the mouth of the Chikanishing River, while its east end leads into Beaverstone Bay. A large lake lies across the channel near its east end (Map 11).

The history of Collins Inlet as a waterway is a long and impressive one. The route was undoubtedly used in prehistoric times by the native people of the area for it is a well protected waterway. With the coming of the French Canadian voyageurs and the fur trade, use of the route increased. The earliest voyageur was probably Etienne Brulé, a contemporary of Samuel de Champlain. Another notable voyageur and explorer who visited the area was Alexander Henry. On his trip in 1761, the canoes he used were 10 m long, 1.4 m wide at their widest point, and made of birchbark 6 mm thick. Each canoe had eight Indian paddlers

Photo 68. *Collins Inlet, looking west. Phillip Edward Island is on the left of the photograph, while the mainland is on the right.*

who, with the freight, made a total weight of 3.5 tonnes in each canoe. The route of the voyageurs led to Georgian Bay by way of the French River. From the mouth of the French River, they travelled west to the North Channel, north of Manitoulin Island. Between the mouth of the French River and Manitoulin Island, however, they had to cross more than 50 km of water open to the winds and waves of Georgian Bay. If the weather was good, and looked as if it would remain so, the voyageurs most often continued their journey to Manitoulin Island and depended upon the numerous small islands between them and Georgian Bay to protect them from the wind and waves. When the weather was bad, however, they turned north into Beaverstone Bay to follow the longer, but well protected route through Collins Inlet.

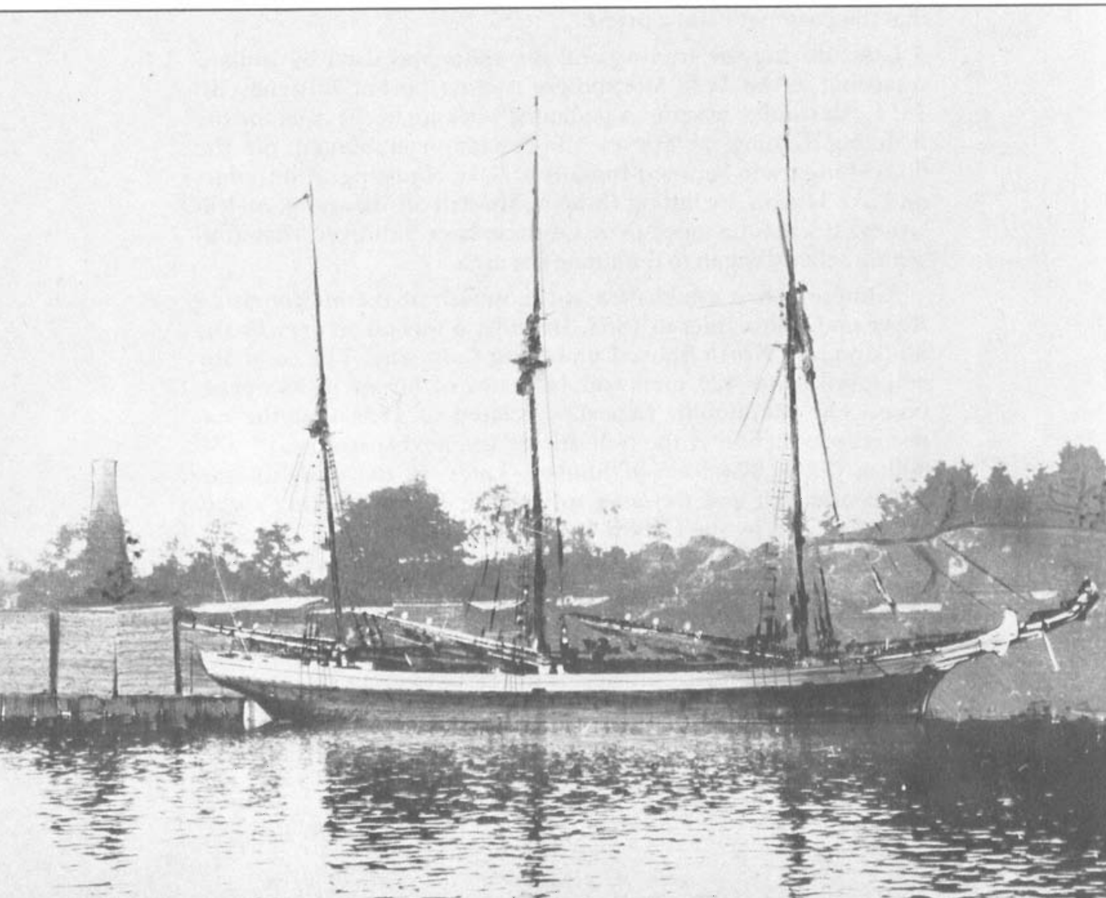
During the years Collins Inlet was used as a trading route, Indian rock paintings were found on the north shore of the channel about midway down its length. They were painted with ochre, or iron oxide, and have become badly faded over the years. It has been suggested that the paintings were made after Europeans made contact with the Indians in the area, for one of the figures in a painting of a canoe with passengers has a cross positioned over his head. It is believed that the cross is to indicate that the passenger was a priest.

Later during the trading era, the route was used by Indians travelling to the de la Morandière trading post at Killarney. In 1854, Alexander Murray, a geologist working in the area for the fledgling Geological Survey of Canada, commented on the flourishing trade between Indians of Lake Nipissing, and traders on Lake Huron, including those at Shi-bah-ah-nah-ning, or Killarney. It was little more than a decade later, however, that lumbering activity began to dominate the area.

A mill was first established at the mouth of the Mahzenazing River on Collins Inlet in 1868. In 1882, it was taken over by the Midland and North Shore Lumbering Company. The company employed some 125 men and 16 teams of horses in its operations. The Manitoulin Expositor related in 1884 that the expected production at the mill during the next season was 2 130 000 m (7,000,000 feet) of lumber. Later, in the mid- to late-1880s, the mill and the area to which it had lumbering rights were acquired by the Collins Inlet Lumber Company. The company cut its timber in an area centering around lakes draining into the Mahzenazing River. The majority of the timber cut was white pine, although some red pine and hemlock were also cut.

The cutting was done during the fall and winter, and the logs were sledded to the ice surface of the lakes to await spring breakup. When breakup arrived, the logs floated downstream to the mill where they were stored in the mill pond until needed. A number of flood control dams along the waterway ensured adequate volumes of water for the log drive. The logs which were supplied to the mill were cut into lumber at the rate of 6100 m (20,000 feet) of boards a day. The lumber was shipped south to points in Canada and the United States, or processed into pickets, lath, and wooden boxes for the same markets. Special boxes were produced for the commercial fishermen at Killarney. The shipment of these products kept Collins Inlet as busy with large vessels (Photo 69) as it had been earlier with trading canoes. Activity continued at the Collins Inlet mill until 1917, when it was destroyed by fire. Although the mill was not rebuilt, logging activity did not cease in the Collins lnlet area. A different company began lumbering operations on the Mahzenazing River watershed. It rafted the logs through Collins Inlet in great booms to its mill at Midland. At many places along the shore of the inlet, iron rings anchored in the rock (see Photo 77) bear witness to this pe-

Photo 69. *The three-masted schooner "Sophie", built at Collins lnlet ca. 1910. Photo courtesy Public Archives of Ontario.*



riod of the lumbering era. The booms were chained to the rings to either store the booms for a period of time, or hold them stationary against rough water in unprotected areas near the mouth of the inlet. Lumbering activity continued on a very restricted scale in the area until 1942.

Visitors travelling to Collins Inlet may reach it by way of the Mahzenazing River from Tyson or Johnny Lakes, from the Chikanishing River, or from Georgian Bay. Access from Georgian Bay is direct at the west end of the inlet, and by way of Beaverstone Bay at the east end of the inlet. Since the most common means of access into the inlet is from the west, via Georgian Bay or the Chikanishing River, the inlet will be described begining at its west end.

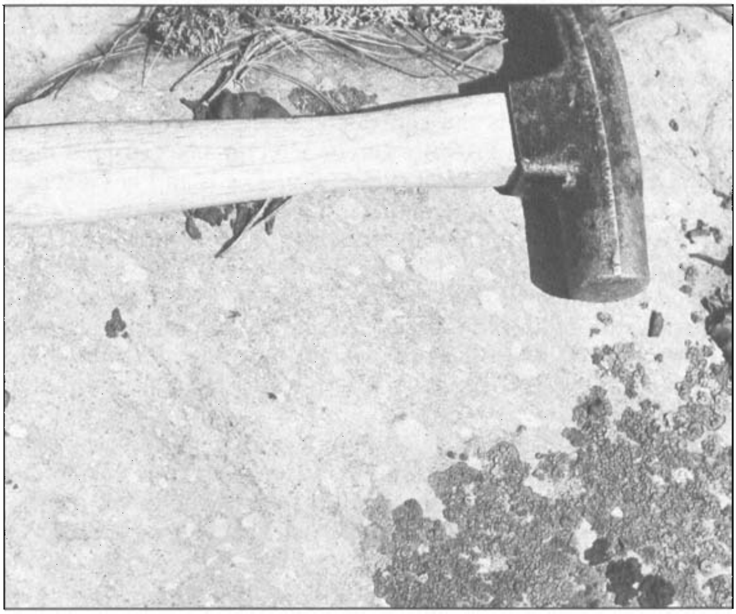


Photo 70. *Well preserved equivalents of the Gowganda Formation exposed within the Grenville Province on the large island near the west end of Collins Inlet. Individual pebbles are easily recognizable in the paragneiss.*

Collins Inlet is situated within rocks of the Grenville Province. The remarkable length and straightness of Collins Inlet results from the fact that it overlies a fault zone. Because the fault zone cuts across the trend of the geology in the area, outcrops along the channel afford a good cross section of the rocks which underlie the area.

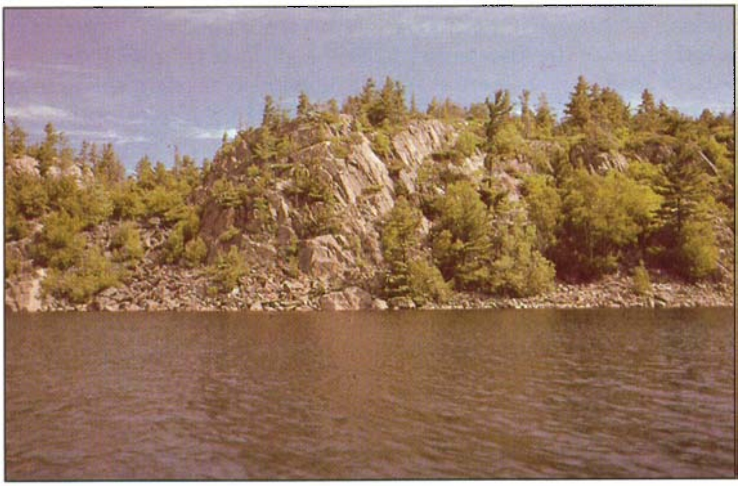


Photo 71. *Talus, or scree, at the base of a high outcrop of jointed gneissic rock, north shore of Collins Inlet.*

Paragneiss which is the equivalent of the Gowganda Formation of the Southern Province can be seen on a large island near the west end of Collins Inlet (Photo 70). The island lies just east of a broad peninsula which juts out from the north shore of the inlet, and protects the rest of the channel from the wind and waves of Georgian Bay. On the north side of the island, deformed laminated ***siltstone*** and conglomerate can be seen. Other outcrops exposed on the island and on its south shore are of deformed pink feldspathic sandstone. The original sedimentary characteristics of the rock exposed on this island are remarkably well preserved.

To the east of the island underlain by the well preserved sedimentary rocks, Collins Inlet widens into bays on both sides of the channel. Outcrops of gneissic granitic rock (orthogneiss) are exposed in a number of places in that area. Farther east, exposures of both orthogneiss and paragneiss can be examined. The ***orthogneiss*** is characterized by its pink to red colour, while the paragneiss is characterized by alternating pink and grey bands up to more than 1 m in thickness. Structural features including ***gneissosity***, ***jointing***, ***cleavage***, and ***lineation*** may be identified in many of the outcrops along the shores of Collins Inlet (Photo 71). Small folds can be seen in some outcrops, especially where the alternating pink and grey layers of the paragneiss delineate the structure. Approximately 8.8 km east of the island with the well preserved sedimentary rocks, another feature of geological interest may be seen. In some outcrops in that area, thin ***dikes*** of metamorphosed diabase cut across the gneissic granite. Farther east, deformed diabase dikes can be seen. In a vertical outcrop of

Photo 72. *Folded diabase dike in gneissic granite, south shore of Collins Inlet.*

gneissic granite on the south side of the channel, a number of diabase dikes are exposed. Several of the dikes are close together and parallel to each other. One dike, near the water's edge, has been folded sharply to the form of an inverted "V", or anticline (Photo 72). It is possible that some of the other dikes in the same outcrop are really only one dike which has also been folded, but fold crests which would verify the presence of such folds are not exposed. East of the outcrops intruded by diabase dikes, gneissic granite is again exposed. Overburden covers the area east of the outcrops of gneissic granite almost as far east as Mill Lake, the lake which lies across the channel. Outcrops lying at the entrance to Mill Lake are well banded paragneiss.

Mill Lake is a large lake, almost 5 km long, and 0.8 km wide. It overlies the same broad band of paragneiss as underlies the Mahzenazing River, Mahzenazing Lake, and much of Tyson Lake. Because the foliation of the rock and the band of paragneiss both trend northeast (Photo 73), the lake is oriented in that direction. Paragneiss is exposed on many of the islands in the lake, and in outcrops along much of its shore. On the north end of Green Island, the large island near the middle of the lake, are outcrops containing recognizable sedimentary features (Photo 74). The rock, metamorphosed orthoquartzite, contains recognizable bedding surfaces from 5 to 20 cm apart, which ***strike*** parallel to the length of the lake, and ***dip*** to the northeast. The quartz grains making up the rock are now quite coarse, for recrystallization of the grains of the sandstone occurred during ***metamorphism***. A few small dikes of pegmatitic granite intrude the paragneiss here.

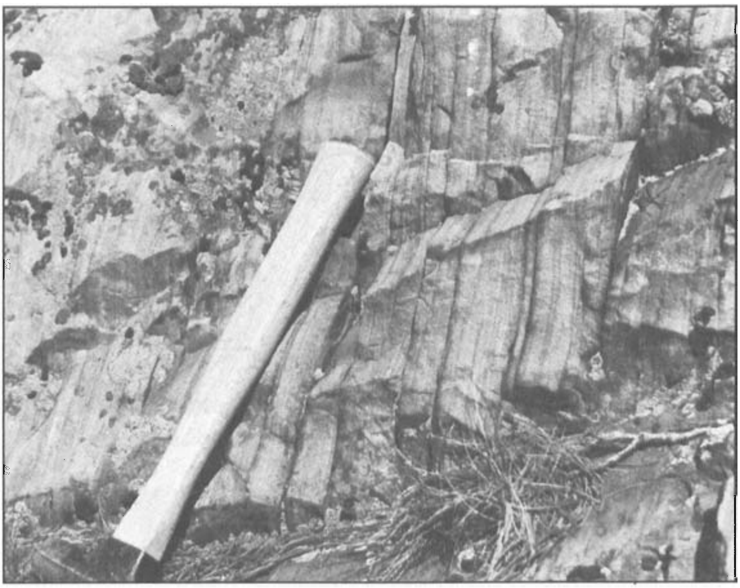
Photo 73. *Paragneiss north of Collins Inlet. It is apparent that the well developed gneissosity in these rocks has a considerable effect on the configuration of streams, rivers, lakes, and bogs, and on their location.*

Just east of the mouth of the Mahzenazing River, Collins Inlet narrows again to a channel. It is here, on the north side of the channel, that the loading docks of the lumber company were situated. Although the docks are no longer standing, the pilings which supported them may be seen. Judging from the size and number of the pilings, the docks must have been impressive structures.

East of the former lumber company docks, the area is underlain by gneissic granite. The gneissic granite in the outcrop on the south shore at the entrance to Beaverstone Bay is highly fractured. In this outcrop, which is apparently cut by the fault which underlies Collins Inlet, the rock is broken into pieces 20 cm across and smaller, and cemented by rock flour stained red by ***hematite***. Paragneiss and orthogneiss may also be examined along the shores and on the islands of Beaverstone Bay.

Boaters travelling through Collins Inlet may wish to return to their starting point by way of the same route, or in the case of large boats, by way of Beaverstone Bay and Georgian Bay.

Photo 74. *Paragneiss exposed on Green Island, Mill Lake. The gneissosity is parallel to the bedding in the sandstone from which the paragneiss was formed. The original bedding is still visible.*



Chikanishing River

The Chikanishing River arises in the small lakes near Silver Peak, and flows from them through Norway, Killarney, and Freeland Lakes to George Lake. It flows out of George Lake at the west end of the south bay of the lake. From George Lake, the Chikanishing River flows across a lowland with only minor topographic irregularities of relatively low relief. One large bluff east of the Chikanishing River which rises 45 m above the surrounding area is the only discontinuity in the flat topography of the region. Although the ***gneisses*** of the Grenville Province characteristically weather to a topography having little relief, other factors have contributed to making the area a flat one. The deposits of post-glacial lakes which flooded the area were laid down in any depressions which may have existed in the lake's bottom, and smoothed out whatever irregularities in the surface did exist. Examples of those deposits of laminated clay with a few small dropstones may be seen in the high banks of the river in a few places. The size of the ***dropstones*** which can be ice-rafted into a lake is, however, limited only by the size of rocks available, and by the amount of ice present to carry it. In a trench dug close to George Lake, an ice-rafted dropstone in grey laminated clay had a maximum diameter of over 2 m.

Photo 75. *Aerial photograph of the mouth of the Chikanishing River (right of photo) and the west end of Collins Inlet.*

Photo 76. *Perpendicular joint surfaces in gneissic granite have resulted in these "steps" at the mouth of the Chikanishing River.*

Photo 77. *Iron boom ring anchored in gneissic granite at the mouth of the Chikanishing River is a relic of the logging era in the Killarney area.*

Because of the deposits of the glacial lakes which occur in the area, few outcrops are exposed along the Chikanishing River between George Lake and its mouth. Those outcrops which do occur lie near the shore of Georgian Bay, where wind and wave action have washed away the overburden. A hike from the landing near the mouth of the Chikanishing River a few hundred metres to the south (Photo 75) leads past a number of interesting geologic features. The bedrock exposed in the area is gneissic granite of the Grenville Front Zone. Although the gneissosity in the granite is rather poorly developed, jointing is well developed. The individual joints are 1 m to several metres apart and occur in two major sets which are nearly perpendicular to each other. Since one set is nearly horizontal, and the other is close to vertical, what looks like a giant set of stone steps has been produced in several places near the mouth of the river (Photo 76). Iron boom rings from the logging era can be seen anchored in rock along the shore in that area (Photo 77). Spalling, or ***exfoliation***, may be observed in some places on the flat outcrops (Photo 78). Glacial striae preserved on some of the joint surfaces indicate that the present topography existed, at least in part, before the final glacial advance in the area. Glacial ***erratics*** lie on the rock steps in some places. At one locality, boulders of pink granite, white quartzite, and black diabase lie together atop the gneissic granite (Photo 79). The quartzite and diabase have been transported to their present locality from somewhere north of George Lake; the granite was transported to its present locality from somewhere between George Lake and where it now lies.

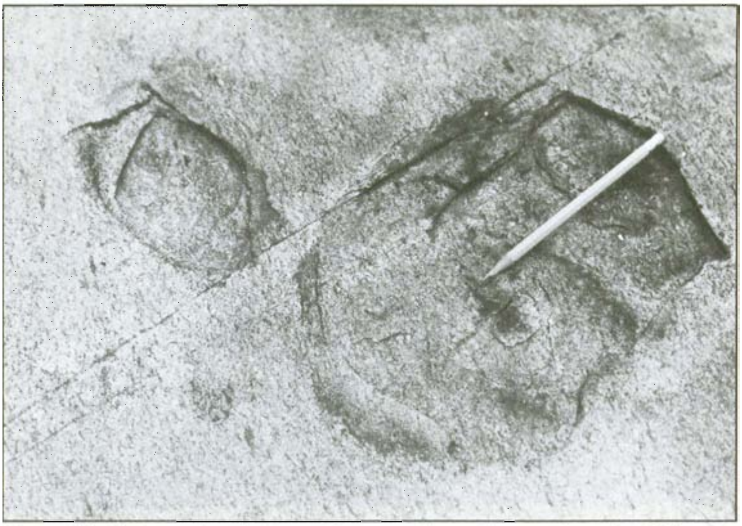
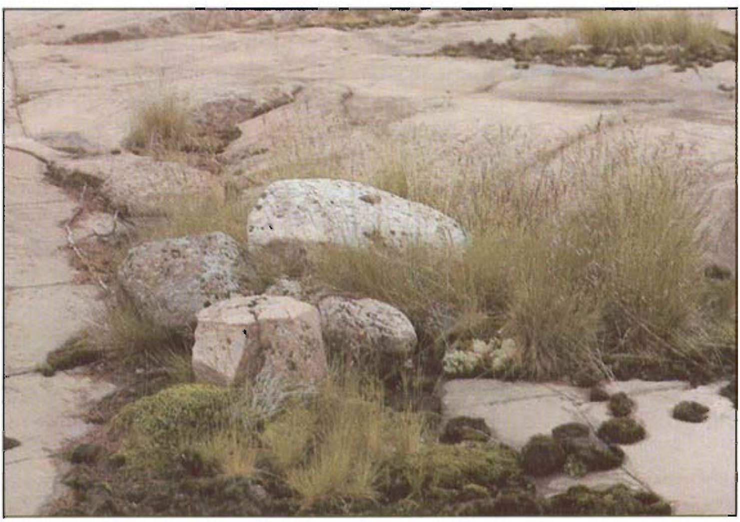


Photo 78. *Outcrop of gneissic granite exposed near the mouth of the Chikanishing River showing scars where rock has spalled or exfoliated from the surface of the outcrop. The spalled pieces are up to 1 cm thick on the outcrop. Elsewhere in the Killarney Provincial Park area, spalled pieces up to 60 cm thick can be seen.*

Photo 79. *Orthoquartzite, granite and diabase glacial erratics lying on gneissic granite at the mouth of the Chikanishing River.*

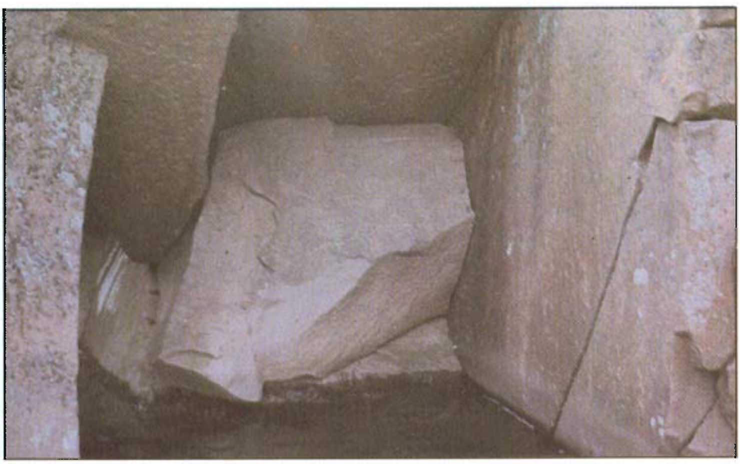


Killarney Bay

Killarney Bay is a broad bay lying north of the peninsula on which the town of Killarney is situated (Map 12). It generally overlies the contact between the Southern Province and the Killarney Batholith. Outcrops in which the contact occurs are exposed in several localities along the shore.

The south shore of the main part of the bay is underlain by granitic rocks of the Killarney Batholith. The north shores of the islands and the bay, as well as the south shore of the east end of the bay, are underlain by rocks of the Southern Province. The contact between the rocks is best exposed in outcrops along the east side of the channel east of Pine Island, the largest island in Killarney Bay. In the outcrops in which the contact is exposed, granitic rocks of the Killarney Batholith may be seen intruding

Photo *80. The faded paintings on the rock face in the centre of the photograph were done little more than 25 years ago by students working in the area during the summer. These paintings, which are on the north shore of Killarney Bay have been incorrectly called Indian pictographs in the past.*

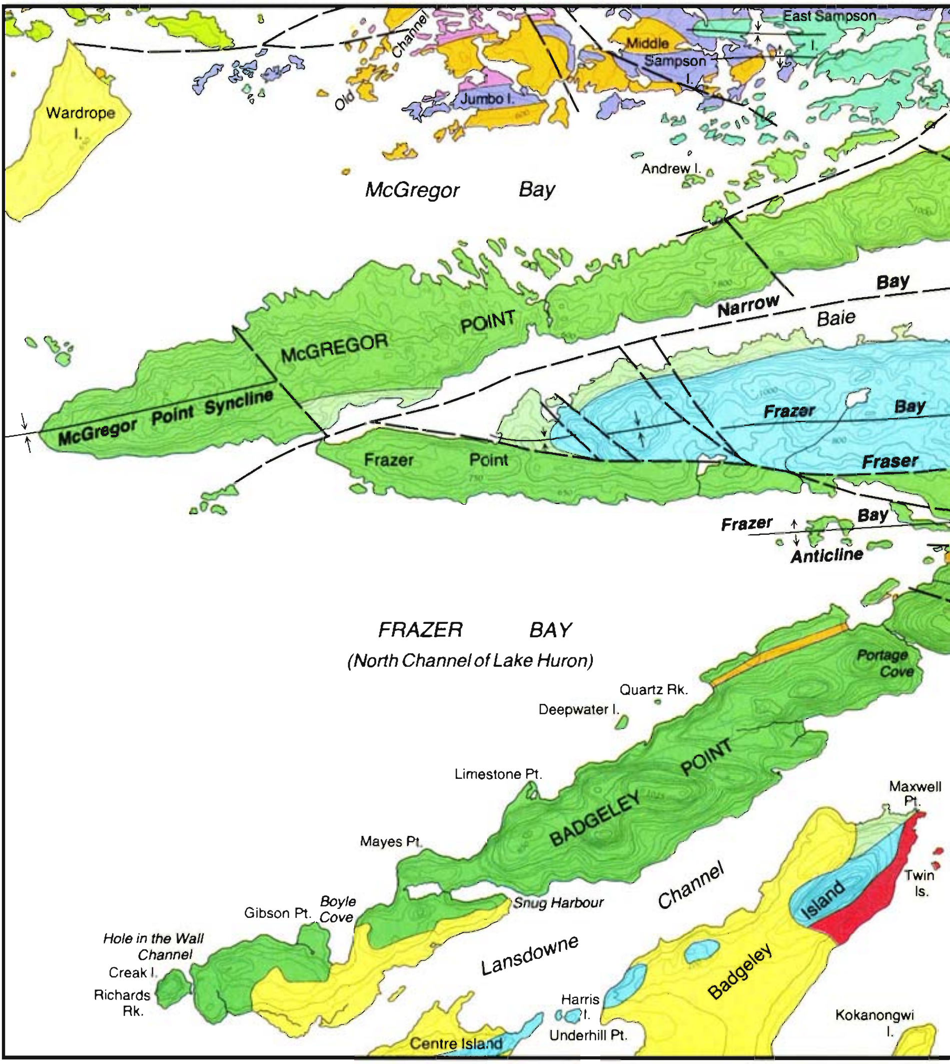


orthoquartzite of the Bar River Formation. The contact is sharp but irregular, with numerous small tongues of granitic rock extending from the main body of granitic rock into the orthoquartzite. East of Pine Island, exposures of rocks of the Gordon Lake and Bar River Formations occur on both sides of the bay. At the east end of Killarney Bay, where it narrows and leads through a channel to Lamorandiere Bay, however, a different rock type is exposed. Outcrops along the sides of the channel are of a dark, coarse-grained igneous rock. It is thought that the rock was originally Nipissing Diabase, but was altered to its present state by the heat during the intrusion of the nearby Killarney Batholith.

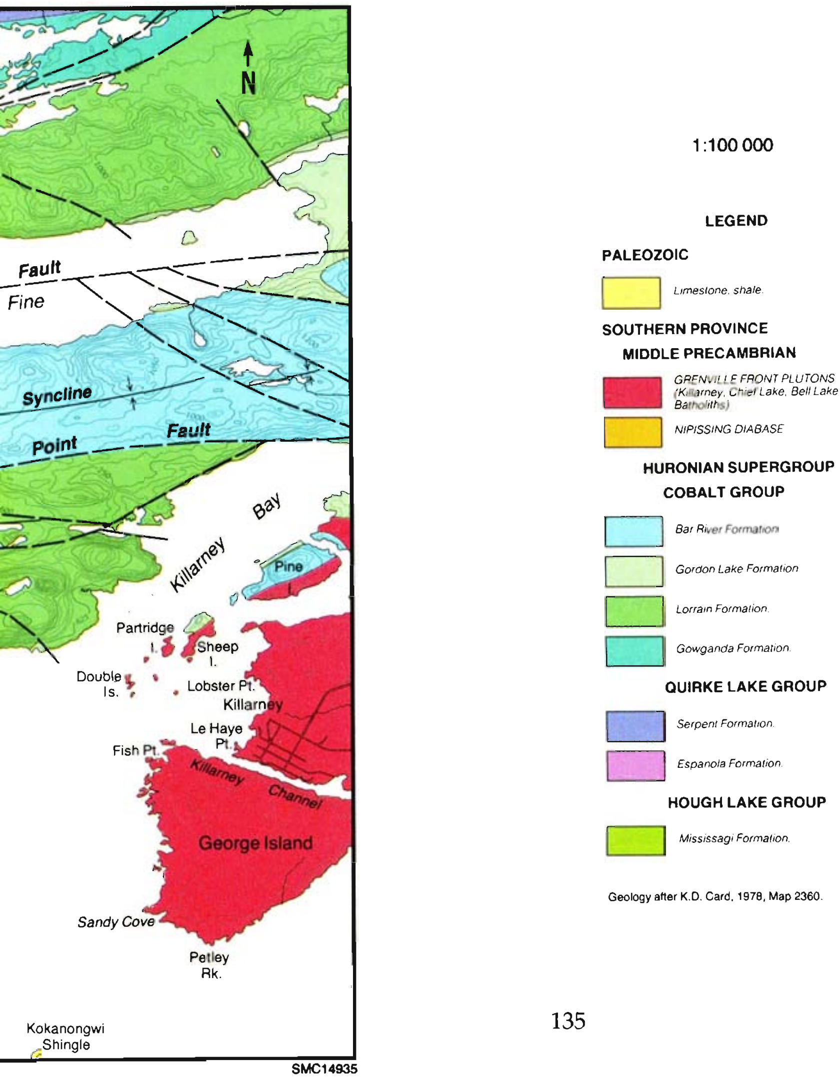
Evidence of prehistoric occupation of the Killarney Bay area has been found in raised beaches left by glacial Lake Nipissing. At one locality on Killarney Bay, a mound containing nine burials was found. Artifacts associated with the burials include copper beads, a copper beaver effigy, copper chisels, a pipe, flint spearheads, a copper axe, beaver fur, and parts of woven baskets or mats. Radiometric dating suggests that the burial mound was used approximately 2000 years ago.

There are stories of ancient Indian paintings to be found on the south shore of Killarney Bay. These stories are, however, just

Map 12. *Killarney Bay, Lansdowne Channel, Frazer Bay, Baie Fine, and McGregor Bay.*



that, for the paintings are neither Indian nor ancient. Although they are so faded that they are now almost impossible to recognize, the paintings are little more than 25 years old (Photo 80). They were painted by archeology students during their spare time while they worked at summer jobs excavating archeological sites in the area. It is perhaps remarkable that any Indian paintings survive in the area at all considering the materials with which the Indians worked. They used iron oxides and grease, while a cottager who has reproduced famous prehistoric art work from all over the world on outcrops on his property commented that the best modern paints available have faded considerably since he started his work in the 1950s.



Lansdowne Channel

Lansdowne Channel is the protected channel approximately 10 km long which leads from Killarney Bay to Frazer Bay and the North Channel of Lake Huron (Map 12). The channel lies between Badgeley Point to the north and Badgeley, Centre, and Partridge Islands to the south.

The geology underlying the areas north and south of the channel is varied. This is the first area described in the guidebook where exposures of Paleozoic rocks may be examined, and the topographic characteristics of areas underlain by such rocks noted. North of Lansdowne Channel, orthoquartzite of the Lorrain Formation underlies the east end of Badgeley Point. The Killarney Quarry extracted the orthoquartzite intermittently for a period of over 50 years. Although operations have ceased at the Killarney Quarry, a new quarry has been started on Badgeley Island across Lansdowne Channel from the old quarry. The material removed from Badgeley lsland is, however, part of the Bar River Formation. As in other parts of the guidebook area, the Gordon Lake Formation, which lies between the two orthoquartzite-bearing formations, has weathered to a low elevation and is mostly covered by the water of the channel. Rocks of the Gordon Lake Formation are exposed on the east end of Badgeley Island, and on the numerous tiny islands called Badgeley Rocks. Excellent examples of contact metamorphism of the siltstones of the Gordon Lake Formation caused by the intrusion of the nearby Killarney Batholith can be examined there. One of the few exposures of ***Paleozoic*** rocks in the area occurs at the loading docks of the Badgeley Island Quarry. There, the horizontal bedding, blocky fracture pattern, and buff to grey colour of the ***limestone***, ***dolostone***, and ***shale*** can be seen. Elsewhere along the shores of Lansdowne Channel, there are few outcrops of Paleozoic rocks. Because they weather easily, and have horizontal bedding, they tend to form flat, pavement-like areas with a covering of soil. Such areas may be seen on the south side of the west end of Badgeley Point, and on Centre and Partridge Islands. The thin layer of soil which covers the rocks is rich in calcium due to the chemical composition of the limestone and dolostone. The conspicuous difference in the type of vegetation which grows on areas underlain by Paleozoic rocks, as compared with the type which grows on those underlain by Huronian sedimentary rocks, reflects the different nutrients in the covering of the soil. Cedar trees, juniper bushes, sumach bushes, and incidentally, poison ivy thrive in calcium rich soil.

Frazer Bay

Frazer Bay is a broad "V" shaped bay bounded on both sides by high ridges of orthoquartzite. Frazer Bay may be reached from Lansdowne Channel by either travelling into open water and around the islands west of Badgeley Point, or by following the narrow passage between Badgeley Point and Creak Island called Hole in the Wall Channel (Map 12). Although the channel is narrow and winding, it has been deepened by blasting and can be successfully negotiated by fairly large craft.

The shape of Frazer Bay has been determined by a major geologic fold structure, the Frazer Bay Anticline, which plunges to the east. The structure is similar to the anticline which controls the shape and location of Threenarrows Lake. In the Frazer Bay Anticline, erosion has levelled all but the resistant rocks of the Lorrain Formation. Outcrops of orthoquartzite are well exposed along both the north and south shores of Frazer Bay. Diabase dikes may be seen cutting across the orthoquartzite in several localities.

Baie Fine (Western Part)

As its name implies, Baie Fine is a long, thin body of water. The main, western, portion of Baie Fine is approximately 13 km long, and is consistently less than 1.5 km wide (Map 12). The eastern part of the bay is an even narrower body of water which leads a further 3 km east. The eastern extension of Baie Fine is described more fully in the Killarney Lake to Baie Fine section of the guidebook.

The entrance to Baie Fine lies between McGregor Point and Frazer Point, directly across Frazer Bay from Hole in the Wall Channel. The spectacular scenery of Baie Fine is a result of its location between two high ridges of orthoquartzite. North of the bay, on McGregor Point, orthoquartzite of the Lorrain Formation is exposed. South of the bay, orthoquartzite of the Bar River Formation is exposed. A ***fault*** separates rocks of the Bar River Formation on the north side of Frazer Point from rocks of the Lorrain Formation on the south side of Frazer Point. Rocks of the Gordon Lake Formation underlie Baie Fine itself, and are exposed along its south shore, and at its east end. Sedimentary structures such as ***cross laminations***, ***ripples***, ***starved ripples***, parallel laminations and ***mud cracks*** can be seen in some of the outcrops. Diabase dikes crosscut the orthoquartzite in several places on both the north and south sides of Baie Fine.

McGregor Bay

McGregor Bay (Photo 81) is a large bay containing a myriad of large and small islands and channels (Map 12). Visitors can reach McGregor Bay by travelling north past McGregor Point, or by travelling down Kirk Creek from Threenarrows Lake. McGregor Bay can also be reached from Howry Creek and the Whitefish River by way of Bay of Islands and Iroquois Bay (Photo 82). Visitors planning to travel in McGregor Bay are advised to obtain good maps of the area first, to avoid becoming lost. Similarly, visitors wishing to examine the geology of the area are advised to obtain copies of the excellent geological maps of the area, such as Maps 2316, 2317, 2318, and 2360 and Reports 138 and 160 (see bibliography, under Card, K.D.), as the geology is too complex to be described here.

The area is underlain by rocks of the Southern Province. Ex-

Photo 81. *McGregor Bay, looking across Blue Ridge. The boats in the foreground are travelling out of Baie Fine. Photo courtesy D.G. Innes.*

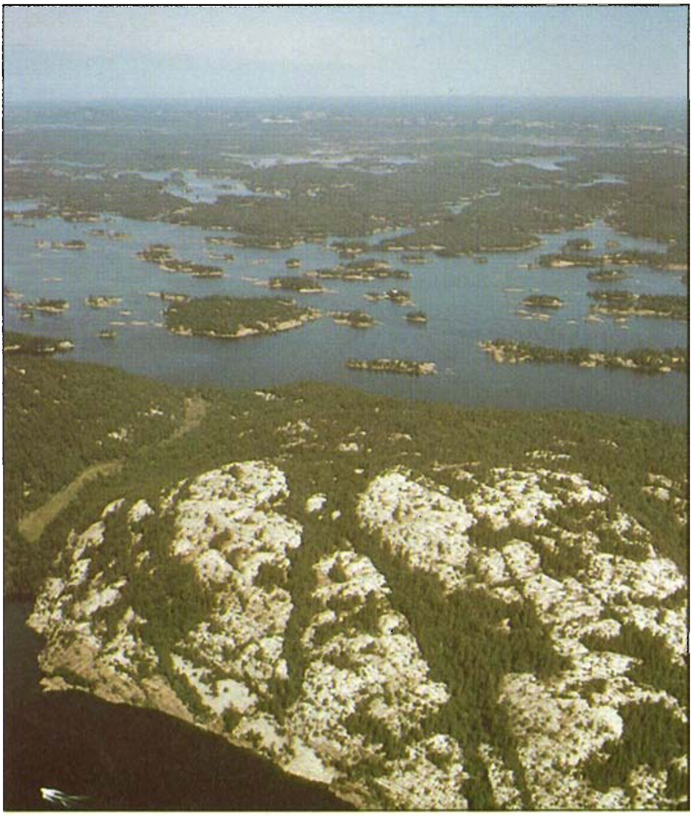


Photo 82. *View of Blue Ridge and McGregor Bay, looking east from Dreamers Rock near the town of McGregor Bay.*
Note: Dreamers Rock is on the Whitefish Indian Reserve. Permission to visit this site must be obtained from the Band Council.

posures of rocks of the Mississagi, Bruce, Espanola, Serpent, Gowganda, and Lorrain Formations can be examined in the area. Dikes of Nipissing Diabase and olivine diabase intrude the sedimentary rocks in several localities. Paleozoic rocks overlie the deformed rocks of the Southern Province in a few places in the southwestern part of McGregor Bay.

Travellers continuing to the west should consult Guidebook No. 4, *Geology and Scenery, North Shore of Lake Huron Region.*

PART 4

Glossary, Bibliography

Glossary

Actinolite. A bright-green or greyish green mineral of the *amphibole* group. It occurs in long, slender, needle-like crystals and in fibrous forms (e.g. asbestos).

Agmatite. A rock composed of angular rock fragments cemented by an intrusive igneous matrix.

Inset 6 — Agmatite

Agmatite is formed when intruding magma breaks off and surrounds blocks of host rock, but does not completely melt or digest them. The result is a type of breccia, with fragments of host rock of any type surrounded by a matrix of the intruding igneous rock. In this case, fragments of paragneiss are surrounded by gneissic granite.

Almandine. A mineral of the *garnet* group, rich in iron and deep red to purplish in colour. It occurs in metamorphosed rocks.

Amphibole. A group of rock-forming minerals of complex composition, usually with aluminum, calcium, iron, magnesium, silica, and water. Characterized by columnar or fibrous prismatic form.

Amygdule. A tiny gas cavity in a volcanic rock filled with late formed minerals.

Andalusite. An aluminum silicate mineral found in some metamorphic rocks.

Anticline. A fold structure in which the rocks are arched, generally sloping away in opposite directions from a common ridge.

Argillaceous. Applied to rocks having a notable proportion of clay in their composition.

Argillite. A moderately metamorphosed mudstone.

Ball-and-pillow. A sedimentary structure formed when "pillows" of sand with round bottoms slump into mud or shale underlying the sand.

Basalt. A volcanic rock of dark colour made up mainly of the minerals pyroxene or amphibole, and feldspar.

Batholith. A mass of igneous rock such as granite which solidified deep within the Earth, and which occupies an area greater than 100 km^2.

Bedding. A primary depositional layering within sedimentary rocks.

Biotite. Black-brown mica.

Brachiopod. A marine shellfish somewhat similar to a clam or oyster but with shells that are each symetrical about a central axis, i.e. the left and right sides of each half shell are mirror images. Fossils of brachiopods are found in Paleozoic and younger rocks. They are useful for identifying specific stratigraphic levels.

Breccia. A fragmental rock composed of large angular broken fragments embedded in a finer grained matrix.

Bryozoan. A tiny invertebrate marine animal which grows in colonies and has a calcareous skeleton. It has lived from Paleozoic time up to the present.

Calcareous. A substance containing calcium carbonate ($CaCO_3$).

Calcite. A common rock-forming mineral having the composition of calcium carbonate ($CaCO_3$). It is the principal constituent of limestone.

Cenozoic. The youngest era of geologic times, which has lasted from approximately 65 million years ago to the present.

Chert, jasper. An extremely fine-grained form of silica (quartz). Chert may form by precipitating out of solution. Jasper is a form of chert containing iron impurities which give it a reddish colour.

Chlorite. A platy rock-forming mineral, usually greenish in colour, and made up of aluminum, iron, magnesium, silica, and water.

Chloritoid. A dark green mineral made up of iron, aluminum, silica, and water, and found in some metamorphosed sedimentary rocks.

Cleavage. Closely spaced planes in a metamorphic rock along which the rock splits easily.

Climbing ripples. A sedimentary structure in which ripples climb up the back of the next ripple downstream.

Conformable. The relationship between units of sedimentary rocks in which the bedding is consistently parallel, indicating no break in the depositional history of the rocks.

Conglomerate. A sedimentary rock composed of boulders and pebbles in a matrix of compacted sand, silt, or clay, and sometimes called puddingstone.

Contact metamorphism. A type of metamorphism which occurs over a small area, close to igneous intrusions. The changes in mineralogy and texture are caused mainly by the heat of the intrusion.

Convolute bedding. Wavy, intricately crumpled and folded laminae within a single well-defined, undeformed layer of silt, overlain and underlain by parallel undisturbed layers. Caused by slumping or deformation of the still-plastic sediment shortly after deposition.

Crag-and-tail. An elongate hill produced by glaciation, in which a knob or crag of resistant bedrock occurs on the upstream side of ice flow, and a deposit of weaker rock or till occurs on the downstream side of ice flow, protected from glacial erosion by the crag.

Crossbedding. An arrangement of layers within individual beds formed as a result of currents at the time the bed was formed, usually in sandstone. The layers are sloped at an angle to the bed.

Cross laminations. Crossbedding in which the sloping beds are less than 1 cm in thickness.

Deformation. A general term for the process of folding, faulting, shearing, compression or extension of the rocks as a result of various Earth forces.

Deposition. The laying down of rock-forming material.

Detritus. Material produced by the disintegration and weathering of rocks that has been moved from its site of origin.

Diabase. A mafic intrusive igneous rock having the composition of gabbro, and usually characterized by blade-shaped feldspar grains.

Dike. A tabular mass of intrusive igneous rock cutting across older rock (Photos 83, 84).

Photo 83. *Diabase dike crosscutting quartzite of the Lorrain Formation, north shore of Narrow Bay.*

Photo 84. *Diabase dikes marked by rows of trees cut across orthoquartzite north of Killarney Lake.*

Diopside. A calcium and magnesium bearing pyroxene found in metamorphosed limestone.

Diorite. An intrusive igneous rock composed mainly of hornblende and plagioclase feldspar.

Dip. The angle a structural surface such as a bedding plane makes with the horizontal.

Disconformity. An *unconformity* in which beds above and below the break are essentially parallel, indicating an erosional interval during which the lower, older rocks were not structurally disturbed (folded or tilted).

Dolomite. A rock-forming mineral having the composition of calcium magnesium carbonate ($(Ca, Mg) CO_3$).

Dolostone. The rock composed predominantly of the mineral dolomite.

Dropstone. Relatively large rock fragments which have been dropped into fine-grained, bedded sediments and have disrupted this bedding. These most commonly originate as fragments embedded in the bottom of glacial ice. When the ice is pushed out over a sea or large lake, the floating ice melts and the fragments drop into the sediments which have been accumulating on the sea floor.

Eon. The largest geologic time unit.

Epidote. A green rock-forming mineral made up of aluminum, calcium, iron, silica, and water.

Epoch. A subdivision of a Period of geologic time.

Equigranular. Said of rock composed of grains of about the same size.

Era. A division of geologic time next in order of magnitude below an Eon.

Erratic (glacial). A rock fragment carried by glacial ice and deposited when the ice melted at some distance from its source. The fragments range in size from pebbles to house-size blocks, but are generally boulders.

Esker. A long, sinuous, steep sided ridge of stratified sand and gravel deposited by a stream flowing within or under a glacier.

Exfoliation. The process by which thin concentric shells of rock are successively broken loose from the outer rock surface. It is usually caused by rapid temperature changes in the rock.

Inset 7 — Exfoliation

Exfoliation is the result of repeated heating and cooling of the outcrop. Overnight, the outcrops are cooled to the temperature of the surrounding air. The following day, they are heated by the surrounding air, and the rays of the sun. On warm, sunny days, the surface temperature of the outcrop may rapidly increase by many degrees. It takes time, however, for the warmth to penetrate far into the rock. Like air, concrete, and metal, rock responds to an increase in temperature by expanding. It is this response which causes exfoliation to occur. When the surface temperature of the outcrop is increased rapidly, the outer part of the outcrop expands more rapidly than does the inner part. If this difference in expansion is great enough, an unbearable stress occurs in the rock causing it to break along the interface between the warmer and cooler parts of the rock. The surface along which the rock breaks is usually parallel to the outer surface of the outcrop, and only a few centimetres from it. The sound of the rock breaking is a sharp crack, much like a rifle shot.

Extrusive. Igneous rock which has been ejected onto the Earth's surface.

Fault. A fracture or zone of fractures along which the wall rocks have been displaced.

Feldspar. Common rock-forming minerals such as orthoclase, microcline, and plagioclase, made up of calcium, sodium, potassium, aluminum, and silica.

Feldspathic. Containing feldspar as a principal component.

Felsic rock. A term applied to light coloured igneous rocks containing an abundance of one or all of feldspars, feldspathoids, and silica.

Festoon crossbedding. A form of crossbedding in which the bedding surfaces are trough-shaped in cross-section. See Figure 7.

Flame structures. Projection of silt or clay into the base of an overlying sandstone bed.

Foliation. A general term for a planar arrangement of textural or structural features in any type of rock, most commonly applied to metamorphic rocks.

Formation. An assemblage of sedimentary or volcanic rocks which is easily recognized and mapped over a wide area.

Fossil. Remains or traces of a plant or animal preserved in the Earth's crust.

Gabbro. A coarse-textured igneous rock having the same composition as basalt, but intrusive, commonly as dikes or sills.

Garnet. A mineral group with varieties made up of calcium, iron, magnesium, aluminum, and silica. Most common varieties are reddish and occur in metamorphic rocks.

Gastropod. A mollusk having a distinct head with eyes and tentacles and usually an asymetrical calcareous shell which may be spiralled, e.g. a snail.

Gneiss. A metamorphic rock containing bands rich in granular minerals alternating with bands rich in platy or micaceous minerals.

Gneissosity. The banding in a gneiss.

Graded bedding. A type of stratification in which each layer displays a gradation in grain size from coarse below to fine above.

Granite. Igneous rock made up mainly of one or more feldspars, and quartz, with lesser mica and/or hornblende. It is usually found in batholiths, and is a felsic rock with a high silica content.

Granodiorite. An igneous rock similar to granite, but with two-thirds of the feldspar of intermediate plagioclase composition.

Graptolite. An extinct, small, colonial, marine organism which lived in Paleozoic times. Their fossils are found in shales and resemble small branches of ferns.

Greenstone. An altered or metamorphosed mafic igneous rock, usually basalt, rich in greenish minerals such as chlorite and some amphiboles.

Greywacke. A type of sandstone containing rock fragments, and resulting from rapid erosion and rapid deposition.

Group. A stratigraphic division consisting of two or more formations.

Hematite. A common iron oxide mineral and iron ore mineral; contains 70 percent iron (Fe_2O_3).

Hornblende. A dark green or black mineral, a variety of *amphibole.*

Igneous rock. Rock formed by the crystallization of magma.

Intrusion. A body of igneous rock that has invaded older rocks.

Invertebrate. Animals without backbones or spinal columns.

Iron formation. A thin bedded or finely laminated sedimentary rock. It is similar to and is often interlayered with chert, and contains 15 percent or more iron of sedimentary origin.

Isostatic rebound. During the ice age, the weight of the ice depressed the continents; when the ice melted, the continents rose again or rebounded because of their buoyancy with respect to the denser rocks forming the Earth's mantle.

Jasper. See “Chert”.

Photo 85. *Perpendicular joint sets in gneissic granite at the mouth of the Chikanishing River.*

Joint. A fracture that cuts across the rock, but along which no appreciable movement has occurred (Photo 85).

Kyanite. A blue or light green mineral made up of aluminum and silica. It occurs in long, thin bladed crystals and crystalline aggregates in schists, gneisses, and granite pegmatites.

Lava. Molten rock which reaches the Earth's surface, such as that which issues from a volcano.

Limestone. A sedimentary rock made up largely of the carbonate mineral calcite.

Lineation. Parallel or subparallel orientation of linear features such as the intersection of bedding and foliation, or elongate minerals such as hornblende.

Lithology. The physical character of a rock.

Lit-par-lit. Describes layered rock, the laminae of which have been penetrated by numerous, thin, parallel sheets of igneous rock.

Load casts. Irregularities at the base of a sandstone bed which project into an underlying silt or clay bed, and are caused by slumping.

Mafic rock. A term applied to dark coloured igneous rocks composed dominantly of the ferromagnesian silicate minerals.

Magma. A mass of molten or partially molten rock constituents, formed at high temperatures within the Earth.

Magnetite. A magnetic iron oxide and ore mineral of iron (Fe_3O_4).

Massive. When applied to sedimentary rocks, this term is used to describe a stratified rock that occurs in thick homogeneous beds without internal structure.

Matrix. In a rock in which certain grains are much larger than others, the grains of smaller size are the matrix.

Member. A stratigraphic division lower in rank than a Formation. Formations are subdivided into members.

Mesozoic. The era of geologic time which extended from 225 million to 65 million years ago.

Metamorphic rock. Any rock derived from pre-existing rocks by mineralogical, chemical or structural changes essentially in the solid state, as a result of changes in temperature, or pressure, or both at depth in the Earth's crust.

Metamorphism. The adjustment in the mineralogy and texture of a rock in response to heat and pressure imposed on the rock when it is buried at depth in the Earth's crust.

Mica. The family of rock-forming minerals which split readily into flat sheets, and are made up of potassium, iron, magnesium, aluminum, silica, and water.

Moraine. A mound of unsorted till deposited by a receding glacier.

Mud cracks. An irregular fracture in a polygonal pattern, formed by the shrinkage of clay, silt or mud upon drying when exposed to air. Frequently infilled with sand and preserved in rocks.

Muscovite. Transparent white mica.

Olivine. A group of rock-forming minerals composed of silica and either or both of iron and magnesium.

Ordovician. The Period of geologic time from 500 million to 435 million years ago.

Orogeny. The cycle of events during which mountains are formed.

Orthogneiss. A gneiss formed from a pre-existing igneous rock.

Orthoquartzite. A type of sandstone consisting almost entirely of well-rounded quartz and chert grains. Indicative of considerable transport and washing action by water.

Paleozoic. The Era of geologic time which extended from 570 million to 225 million years ago.

Paragneiss. A gneiss formed from a pre-existing sedimentary rock (Photo 86).

Photo 86. *Pink and grey banded paragneiss.*

Pegmatite. An exceptionally coarse-grained igneous rock, generally of granitic composition.

Pelecypod. An aquatic mollusk characterized by a bilaterally symetrical bivalve shell. Each half shell is the mirror image of the other half shell. Clams and oysters are pelecypods.

Peneplain. A land surface worn down by erosion to a nearly flat plain.

Period. A fundamental unit of geological time, smaller than an Era.

Phanerozoic. The Eon of geologic time which includes the Paleozoic, Mesozoic, and Cenozoic Eras.

Phenocryst. A relatively large crystal in a finer grained igneous rock. Normally phenocrysts crystallized early, and changes in conditions have caused rapid crystallization of the remaining magma.

Pleistocene. The Epoch of geologic time between 1.8 million and 10 000 years ago during which the last ice age occurred.

Pluton. A body of igneous rock that has formed beneath the surface of the Earth.

Porphyry. An igneous rock characterized by an abundance of phenocrysts.

Precambrian. The Eon of geologic time which encompasses all time prior to 570 million years ago.

Pyrite. An iron sulphide mineral (FeS_2) with a pale bronze or brass-yellow metallic lustre, often called “fool's gold”.

Pyroxene. A family of rock-forming minerals made up of aluminum, calcium, iron, magnesium, and silica.

Pyrrhotite. A weakly magnetic iron sulphide mineral (FeS) with a brownish bronze, metallic lustre.

Quartz. A rock-forming mineral composed of silica.

Quartzite. A silica-rich sandstone.

Quartz diorite. An intrusive igneous rock having the composition of *diorite* but with an appreciable amount of quartz.

Quartz monzonite. An igneous rock similar to granite, containing approximately equal amounts of quartz, potassic feldspar, plagioclase feldspar, and 5 to 10 percent of iron and magnesium silicate minerals.

Quaternary. The second period of the Cenozoic Era, covering the time span from 1.8 million years ago to the present.

Radiometric age determination. The determination of the time that has elapsed since the formation of the rock by the study of the amounts of various radioactive isotopes in the rock.

Recent. The Epoch of geologic time since the disappearance of the continental glaciers from North America.

Rhyolite. A volcanic rock having a composition similar to that of granite, and usually light in colour.

Ripple marks. Undulating wave-like surfaces formed in sand or mud by water currents or waves.

Sandstone. A rock made up of compacted sand grains, with a high proportion of quartz grains.

Scapolite. A complex mineral made up of calcium, sodium, aluminum and silica, and found in some metamorphosed calcareous rocks.

Scree. A heap of rock fragments accumulated at the base of a cliff, broken off from the cliff by frost action.

Sedimentary. A term used to describe rocks formed of compacted detritus, or by precipitation from solution.

Sedimentary dike. A tabular body of sedimentary rock crosscutting the sedimentary layering. Formed when water-laden sand is squeezed up through a crack in an overlying muddy layer.

Shale. A laminated rock composed of compacted or cemented mud.

Silica. A common term for silicon dioxide (SiO_2).

Sill. A tabular mass of igneous intrusive rock which is parallel to the pre-existing structures of the host rock.

Silimanite. A mineral with the composition Al_2SiO_5 often found in schists and gneisses.

Siltstone. A sedimentary rock made up of very fine silt-sized mineral grains.

Silurian. The Period of geologic time from 435 to 400 million years ago.

Slate. A metamorphosed mudstone having a cleavage not necessarily parallel to the original bedding.

Slump structures. Structure formed when soft sediments are deformed by the influence of gravity.

Starved ripples. Isolated crests of ripple marks, formed when there is an insufficient supply of sand to form fully developed ripples.

Staurolite. A metamorphic mineral formed of iron, aluminum, silica, and water which often forms cross-shaped crystals.

Stock. An igneous intrusion resembling a *batholith* but smaller in size (less than 100 km^2).

Strata. A section in a sedimentary succession of consistent composition.

Striae. Long, straight, finely cut, parallel scratches or grooves inscribed on the bedrock surface by rock fragments embedded at the base of a moving glacier. Striae can be used to determine the direction the glacier moved.

Strike. The bearing of an inclined bed or other structure at its intersection with a horizontal plane.

Syncline. A fold in which the fold limbs slope towards each other to form a trough-like structure.

Tertiary. The first period of the Cenozoic Era, covering the span of time from 65 to 1.8 million years ago.

Till. Unconsolidated material carried and deposited by a glacier.

Transgression. The spread of the sea over land areas. It is marked by marine deposits overlying land deposits, or deep water deposits overlying shallow water deposits.

Tremolite. An amphibole found in metamorphosed carbonate-bearing rocks.

Trilobite. An extinct marine animal related to present day crabs and lobsters. Its shell was characterized by three lobes (head, body and tail). Trilobites are preserved as fossils in Paleozoic rocks and certain varieties can be used to identify specific stratigraphic levels.

Turbidity current. A turbid, sediment-laden current, which flows under the influence of gravity along the bottom of a body of water.

Unconformity. A surface of erosion separating younger deposits from older rocks.

Varve. A thin layer of sediment consisting of a coarser light layer grading into a finer dark layer, and related to seasonal deposition in glacial lakes.

Volcanic rocks. Igneous rocks that have been poured out or ejected at or near the Earth's surface, i.e. produced by a volcano or volcanic agencies.

Bibliography

In the preparation of the guidebook, considerable use was made of the extensive literature available on the geology of the region. For those who wish to pursue their studies beyond the scope of this compilation, the reports considered to be the most comprehensive and pertinent are included in the following list of publications. Many of these reports contain coloured maps.

Publications of the Ontario Ministry of Natural Resources and the former Ontario Department of Mines are available from the Map Unit, Public Service Centre, Whitney Block, Queen's Park, Toronto, and the Ontario Government Bookstore, 880 Bay Street, Toronto. Publications of the Geological Survey of Canada are available from Printing and Publishing, Supply and Services Canada, Ottawa, Ontario, K1A 0S9, or Geological Survey of Canada, 601 Booth Street, Ottawa, K1A 0E8, or from booksellers who are agents for Supply and Services Canada.

Bell, R. 1891: The Laurentian and Huronian systems north of Lake Huron; Ontario Bureau Mines, Vol. 1, p.63-94 (published 1892).

Brooks, E. 1967: Multiple metamorphism along the Grenville Front, north of Georgian Bay, Ontario; Bulletin Geological Society America, Vo1.78, p.1267-1280.

Card, K.D. 1975: McGregor Bay, North Channel of Lake Huron, Sudbury and Manitoulin Districts; Ontario Division Mines, Map 2317, scale 1 inch to ½ mile.[1]

1975: Badgeley Point, Manitoulin District; Ontario Division Mines, Map 2318, scale 1 inch to ½ mile.

1976: Geology of the McGregor Bay—Bay of Islands Area, Districts of Sudbury and Manitoulin; Ontario Division Mines, Geoscience Report 138, 63p. Accompanied by Maps 2316, 2317, 2318 (coloured), scale 1 inch to ½ mile.[1]

1978: Geology of the Sudbury-Manitoulin Area, Districts of Sudbury and Manitoulin; Ontario Geological Survey, Report 166, 238p. Accompanied by Map 2360 (coloured), scale 1 inch to 2 miles, and 4 charts.[1]

1978: Sudbury and Manitoulin Area, Districts of Sudbury and Manitoulin; Ontario Geological Survey, Map 2360. scale 1 inch to 2 miles.

[1]Note that maps are also available separately.

Card, K.D., Innes, D.G., and Debicki, R.L. 1977: Stratigraphy, Sedimentology, and Petrology of the Huronian Supergroup in the Sudbury-Espanola Area; Ontario Division Mines, Geoscience Study 16, 99p.

Collins, W.H. 1925: The North Shore of Lake Huron; Geological Survey Canada, Memoir 143, 160p. (Reprinted 1956).

Frarey, M.J., and Cannon, R.T. 1969: Notes to accompany a map of the geology of the Proterozoic rocks of Lake Panache-Collins lnlet map areas, Ontario; Geological Survey Canada, Paper 68-63, 5p. Accompanied by Map 21-1968, scale 1:50000.

Hewitt, D.F. and Freeman, E.B. 1972: Rocks and Minerals of Ontario; Ontario Department Mines and Northern Affairs, Geological Circular 13, 135p.

Krogh, T.E., and Davis, G.L. 1969: Old lsotopic Ages in the Northwestern Grenville Province, Ontario; Geological Association Canada, Special Publication No. 5, p.189-192.

Lumbers, S.B. 1975: Geology of the Burwash Area, Districts of Parry Sound, Nipissing, and Sudbury; Ontario Division Mines, Geological Report 116, 160p. Accompanied by Map 2271, scale 1 inch to 2 miles.

Murray, A. 1857: Plans of various lakes and rivers between Lake Huron and the Ottawa River to accompany the geological reports for 1853 to 1856; Geological Survey Canada, Report of 1853-1856.

Quirke, T.T. 1924: Correlation of Huronian and Grenville Rocks; Journal of Geology, Vo1.32, No. 4, p.316-335.

Rankama, K. 1955: Geologic evidence of chemical composition of the Precambrian atmosphere; Geological Society America, Special Paper 62, p. 651-664.

Reineck, H.E. and Singh, I.B. 1973: Depositional Sedimentary Environments; Springer-Verlag, New York, 439p.

Robertson, J.A. and Card, K.D. 1972: Geology and Scenery, North Shore of Lake Huron Region; Ontario Division Mines, Geological Guidebook No. 4, 224p.

Roscoe, S.M. 1973: The Huronian Supergroup, a Paleoaphebian succession showing evidence of atmospheric evolution; Geological Association Canada, Special Paper No. 12, p.31-47.

Selley R.C. 1976: An Introduction to Sedimentology; Academic Press, New York, 408p.

Storck, P.L. 1974: Two Probable Shield Archaic Sites in Killarney Provincial Park, Ontario; Ontario Archaeology, No. 21, p.3-36.

Wright, J.V. 1972: Ontario Prehistory: An 11,000-Year Archaeological Outline; Archaeological Survey of Canada, National Museum of Man, Ottawa, 120p.

Young, G.M. 1970: An extensive early Proterozoic glaciation in North America; Paleogeography, Paleoclimatology, Paleoecology, Vol.7, p.85-101.

Young, G.M. and Church, W.R. 1966: The Huronian System in the Sudbury District and adjoining areas of Ontario—a review; Geological Association Canada, Proceedings, Vo1.17, p.65-82.

Ministry of
Natural
Resources

Ontario

7994

GUIDEBOOKS OF THIS SERIES

Geological Guidebook No. 1. Geology and Scenery; Rainy Lake and East to Lake Superior.

Geological Guidebook No. 2. Geology and Scenery; North Shore of Lake Superior.

Geological Guidebook No. 3. Geology and Scenery; Peterborough, Bancroft, and Madoc Area.

Geological Guidebook No. 4. Geology and Scenery; North Shore of Lake Huron Region.

Geological Guidebook No. 5. Amethyst Deposits of Ontario.

Geological Guidebook No. 6. Geology and Scenery; Killarney Provincial Park Area.

Geological Guidebook No. 7. Geology and Fossils of the Craigleith Area.