PROVINCE OF MANITOBA

DEPARTMENT OF MINES AND NATURAL RESOURCES

HON. J. S. M DIARMID
Minister

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PUBLICATION 51-6

ORDOVICIAN GEOLOGY

of

LAKE WINNIPEG and ADJACENT AREAS

MANITOBA

by

ANDREW W. BAILLIE

Winnipeg, 1952

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PREFACE

The present report is the result of the third year's work of a project undertaken to provide a detailed account of the stratigraphy, structure, and economic resources of the Palaeozoic formations in outcrop in central and southern Manitoba.

Ordovician strata as they occur in outcrop are described in detail and many measured sections are included. The sections are used to establish a stratigraphic succession that is given in the form of a composite columnar section.

A regional Time-Rock correlation chart is included and the relation of the Ordovician outcrop section to the basinal deposits of the Williston basin and adjacent areas is discussed.

Faunal lists compiled from the literature, supplemented by recent fossil collections, are included in the report.

G. H. Charlewood
CHIEF GEOLOGIST

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INTRODUCTION

GENERAL STATEMENT

During the field season in 1951 the writer studied and mapped much of the Ordovician strata exposed along the west shore of Lake Winnipeg and in the area north of The Pas. The Ordovician formations outcrop in a linear belt that averages 35 miles wide and is approximately 450 miles long. In the southern part of the map-area the belt trends north 30 degrees west and follows the west shore of Lake Winnipeg. North of latitude 54 degrees north the belt trends more to the west at about north 80 degrees west. The southern limit of the outcrop area is a few miles north of Winnipeg at about latitude 50 degrees north. The northern limit is at about 54 degrees 40 minutes north, some 50 miles north of The Pas. The outcrop belt is bounded on the west by Silurian strata and on the east and north by Lake Winnipeg and the Precambrian shield.

Ordovician strata are also exposed in the Hudson Bay area in northeastern Manitoba and have been described by Savage and Van Tuyl (1919)[1].

PREVIOUS WORK

One of the first geological reports that includes the area was made by Dowling (1900) for the Geological Survey of Canada. Ordovician strata that outcrop on the west shore and islands of Lake Winnipeg are described. The report includes detailed descriptions of many measured sections, comprehensive faunal lists, and extracts from the notes of J. B. Tyrrell. Dowling divided the Ordovician strata into the following divisions and correlated them with the Minnesota section as follows:

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1 Dates, names, and pages in parenthesis refer to publications listed in Bibliography on page 5.

Minnesota	Manitoba
Richmond Group	Stony Mountain
Trenton	Upper Mottled Limestone Cat Lake Limestone Lower Mottled Limestone
Black River ?	Winnipeg Sandstone and Shale

Tyrrell (1903) briefly described Ordovician strata that outcrop on Namew, Wekusko, Reed, and Athapapuskow Lakes in the northern part of the map-area.

The first major palaeontological contribution to the study of Manitoba Ordovician strata was made by Whiteaves (1895 and 1897) from the faunal collections of Tyrrell and Dowling. In Whiteaves' report systematic faunal lists are included and many new species are described and illustrated.

Foerste (1928) discussed the Ordovician fauna of Manitoba in relation to the fauna of Baffin Island. He proposed the name Red River formation to include the Lower Mottled, Cat Head, and Upper Mottled members. He renamed the Lower Mottled the Dog Head member, and the Upper Mottled the Selkirk member.

Okulitch (1943) described the Stony Mountain formation and divided it into four members as follows: Stony Mountain shale, Penitentiary, Gunton, and Birse. He listed fossils and described and illustrated several new species.

In 1925 Wallace published a report on the geological formations of Manitoba and briefly summarized the Ordovician stratigraphy. "Limestones of Canada, Part V", by M. F. Goudge (1944) contains many descriptions of the quarries and larger

outcrop sections in the area; chemical analyses of the limestones are also included.

Brief descriptions of the Ordovician strata that overlap the Precambrian shield in the northern part of the map-area are included in several Geological Survey of Canada and Manitoba Mines Branch publications.

PRESENT WORK

This report is part of a continuing project to study and map the Palaeozoic strata that outcrop in Manitoba. Owing to the large area of the Ordovician outcrop belt and the inaccessibility of some of it, all the outcrops were not examined. The exposures on Lake Winnipeg north of Cat Head were not visited and for this area data from Dowling's report have been used.

Fossils collected during the field season were examined and identified by R. A. C. Brown, Manitoba Mines Branch.

Lithologic samples were collected at approximately 5-foot intervals, crushed, and examined under a binocular microscope. Thin sections and polished sections were prepared to assist in textural studies.

GENERAL CHARACTER OF THE AREA AND ACCESSIBILITY

The southern part of the map-area lies in the Red River Valley plain, and the bedrock is covered by a thick deposit of alluvial clay and black soil. Erosional remnants of resistant rock in the vicinity of Stony Mountain and Stonewall project through the clay plain.

The area bordering the west shore of Lake Winnipeg lies within the interlake plain. The superficial deposits are glacial till and boulder clay modified by wave action. The surface is generally uneven and has slight local relief. The area is poorly drained and much of it is marshy. Small escarpments of bedrock which expose sections from 5 to 20 feet thick, are common on the northern part of the interlake plain. Along the west shore of Lake Winnipeg and on the islands, Palaeozoic rock is exposed in cliffs as much as 50 feet high.

Gravel beach deposits are found in parts of the area. The most prominent of these is the Lake Agassiz Gimli Beach that can be traced from the vicinity of Hodgson through Gimli

and as far south as Winnipeg. The beach is well developed in the Grand Beach and Beaconia areas on the southeast side of Lake Winnipeg (Johnston, 1946).

North of latitude 54 degrees, lakes and marshy areas are numerous. Considerable Palaeozoic rock is exposed in cliffs on the shores of the lakes. Moraine deposits are present along the west shores of Lake Atikameg, Cormorant Lake, Cowan River, and Yawningstone Lake.

The quarries in the vicinity of Garson, Stony Mountain, and Gunton, are accessible by road. Outcrops on Lake Winnipeg are accessible only by boat or pontoon-equipped aircraft.

Athapapuskow, Cranberry, and Rocky Lakes are accessible by road but the outcrops on these lakes can be reached only by water or air transportation. Other lakes north of latitude 54 degrees are accessible by canoe or aircraft.

ACKNOWLEDGEMENTS

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The writer wishes to thank Dr. L. L. Sloss, Northwestern University, for much helpful criticism and advice given during the preparation of this report.

Information and concepts derived from informal discussions in the field with Dr. W. O. Kupsch, Department of Natural Resources, Saskatchewan, and Mr. Colin B. Stearn, Geological Survey of Canada, are hereby acknowledged.

Thanks are due to Dr. J. D. Allan who critically read the manuscript.

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Thanks are also due to the quarry managers, farmers, and fishermen for assistance and information given.

BIBLIOGRAPHY

Baillie, A. D. (1951): Silurian Geology of the Interlake Area, Manitoba; Manitoba Mines Branch, Pub. 51-2.

Baker, C. L. (1947): Deep Borings in Western South Dakota; Rept. of Investigations No. 57, South Dakota Geological Survey.

Dowling, D. B. (1900): Report on the Geology of the West Shore and Islands of Lake Winnipeg; Geol. Surv., Canada, Ann. Rept. 1898, pt. F.

DuBois, E. P. (1945): Subsurface Relations of the Maquoketa and "Trenton" Formations in Illinois; Rept. of Investigations No. 105, Illinois Geological Survey.

Ehlers, A. (1943): Williston Basin Wildcat Test, Oliver County, North Dakota; Bull. Amer. Assoc. Pet. Geol., vol. 27, pp. 1618-1622.

Foerste, A. F. (1928): Contributions to the Geology of Foxe Land, Baffin Island; Contrib. from Mus. of Paleontology, Univ. Michigan, vol. 3, No. 3, pt. 11, pp. 25-69.

_____ (1929a): Ordovician and Silurian of American Arctic and sub-Arctic Regions; Denison Univ., Jour. Sci. Labs., vol. 24, pp. 27-80.

_____ (1929b): The Cephalopods of the Red River Formation of Southern Manitoba; Denison Univ., Jour. Sci. Labs., vol. 24, pp. 129-235.

Goudge, M. F. (1944): Limestones of Canada, Part V; Mines and Geology Branch, Bureau of Mines, Canada, Rept. No. 811.

Harrison, J. M. (1949): Geology and Mineral Deposits of File-Tramping Lakes Area; Geol. Surv., Canada, Mem. 250.

Hume, G. S. (1921): Great Slave Lake Area; Geol. Surv., Canada, Sum. Rept. 1920, pt. B, pp. 30B-36B.

_____ (1925): The Palaeozoic Outlier of Lake Timiskaming, Ontario and Quebec; Geol. Surv., Canada, Mem. 145.

_____ (1926): Ordovician and Silurian Fossils from Great Slave Lake; Geol. Surv., Canada, Bull. No. 44, Geol. Ser. No. 46, pp. 59-64.

Hunter, H. E. (1951): Igneous Rocks in the Lake St. Martin Area, Manitoba; Manitoba Mines Branch, Pub. 50-10.

Johnston, W. A. (1934): Surface Deposits and Ground-water Supply of the Winnipeg Map-area; Geol. Surv., Canada, Mem. 174.

Johnston, W. A. (1946): Glacial Lake Agassiz with Special Reference to the Mode of Deformation of the Beaches; Geol. Surv., Canada, Bull. No. 7.

Kay, G. M. (1929): Stratigraphy of the Decorah Formation; Jour. Geol., vol. 37, pp. 639-671.

_____ (1935): Ordovician Stewartville Dubuque Problems; Jour. Geol., vol. 43, No. 6, pp. 561-590.

_____ (1935): Ordovician System in the Upper Mississippi Valley; Rept. 9th Annual Field Conference of the Kansas Geol. Soc., pp. 281-295.

Macauley, G. and Leith, E. I. (1951): Winnipeg Formation of Manitoba (abstract); Bull. Geol. Soc. Amer., Vol. 62 pp. 1461-1462.

MacLean, A. (1913): Ordovician and Silurian of Stony Mountain and Stonewall, Manitoba; Geol. Surv., Canada, Guide Book No. 8, pt. 1, pp. 69-77.

McInnis, W. (1913): The Basins of the Nelson and Churchill Rivers; Geol. Surv., Canada, Mem. 30.

Miller, A. K. (1930): The Age and Correlation of the Bighorn Formation of Northwestern United States; Amer. Jour. Sci., 5th ser., vol. 20, No. 17, pp. 195-213.

Okulitch, V. J. (1943): The Stony Mountain Formation of Manitoba; Trans. Roy. Soc., Canada, 3rd ser., vol. 37, sec. 4, pp. 59-74.

Savage, T. E. and Van Tuyl, F. M. (1919): Geology and Stratigraphy of the Area of Paleozoic Rocks in the Vicinity of Hudson and James Bays; Bull. Geol. Soc. Amer., vol. 30, pp. 339-377.

Seager, O. A. (1942): Test on Cedar Creek Anticline, Southeastern Montana; Bull. Amer. Assoc. Pet. Geol., vol. 26, pp. 861-864.

Twenhofel, W. H. (1928): Geology of Anticosti Island; Geol. Surv., Canada, Mem. 154.

Tyrrell, J. B. (1903): Report on Explorations in the Northeastern Portion of the District of Saskatchewan and Adjacent Parts of the District of Keewatin; Geol. Surv., Canada, Ann. Rept. 1900, pt. F.

Wallace, R. C. (1913): Pseudobrecciation in Ordovician Limestones in Manitoba; Jour. Geol., vol. 21, No. 5, pp. 402-421.

Wallace, R. C. (1925): The Geological Formations of Manitoba; Nat. Hist. Soc. of Manitoba.

Whiteaves, J. F. (1895): Systematic List, with References, of the Fossils of the Hudson River or Cincinnati Formation at Stony Mountain, Manitoba; Geol. Surv., Canada, Paleozoic Fossils, vol. 3, pt. 2, pp. 111-128.

_____ (1897): The Fossils of the Galena-Trenton and Black River Formations of Lake Winnipeg and its Vicinity; Geol. Surv., Canada, Palaeozoic Fossils, vol. 3, pt. 3, pp. 129-242.

Wright, J. F. (1931): Geology and Mineral Deposits of a part of Northwest Manitoba; Geol. Surv., Canada, Sum. Rept. 1930, pt. C.

STRATIGRAPHY

GENERAL STATEMENT

The Ordovician strata in the map-area have been divided into three formations: Winnipeg, Red River, and Stony Mountain.

The Winnipeg is the oldest Ordovician formation in Manitoba and rests directly on the Precambrian basement. The formation may be divided into two lithologic units, a basal sandstone unit and an upper unit composed of sandstone and shale. The basal unit consists of pure fine-grained well-sorted unfossiliferous friable quartzose sandstone and is at least 45 feet thick. The upper unit is composed of bluish green fossiliferous shale that contains thin hard sandstone beds, and sandstone that contains numerous shaly partings. The upper unit is about 35 feet thick. The two units are separated by a thin zone which contains much iron sulphide in the form of pyrite nodules and oolites.

The Red River formation consists of about 250 feet of dolomitic limestone and dolostone that has been divided into the following three members: Dog Head, Cat Head, and Selkirk. The lowest member, Dog Head, consists of thin-bedded fossiliferous sub-fragmental mottled dolomitic limestone. The rock is bluish grey to yellowish grey and is commonly mottled to pale yellowish brown. In places the limestone is impure and may contain pyrite, argillaceous material, and quartz grains.

The Cat Head member consists of yellowish grey fine-grained calcitic dolostone that contains large nodules of chert. It may be distinguished in outcrop from the underlying and overlying members by its dolomitic nature, lighter colour, and absence of well-defined mottling.

The Selkirk member consists of thick-bedded fossiliferous dolomitic limestone that is attractively mottled. The matrix is yellowish grey limestone and the mottles are pale yellowish brown calcitic dolostone. The member contains a varied fauna that is characterized by large cephalopods and gastropods.

In the northern part of the map-area, large cliffs of dolostone underlain by sandstone are equivalent to the Red River formation but the various members cannot be recognized.

The Stony Mountain formation consists of a series of calcareous shales, argillaceous dolostones, and dolostones. The formation was divided by Okulitch into four members which are, in ascending order, Stony Mountain Shale, Penitentiary, Gunton, and Birse members. As the writer was not able to differentiate between the Gunton and Birse members in the field, all strata assigned to the Birse member by Okulitch are included in the Gunton member in this paper.

The Stony Mountain Shale member as exposed in the type section at the City of Winnipeg quarry, Stony Mountain, consists of red and greyish red highly fossiliferous calcareous shale that contains thin beds of reddish grey crystalline limestone. Only the upper 10 feet of the member is exposed, but well records show that it is at least 70 feet thick.

The Penitentiary member consists of about 20 feet of fossiliferous bedded argillaceous dolostone. The colour is variable and ranges from dusky yellow to shades of pale red and greenish yellow.

The Gunton member consists of about 50 feet of finely crystalline poorly fossiliferous bedded dolostone; in places the dolostone is nodular and slightly argillaceous. The colour is variable and ranges from greyish yellow to shades of pale red. The upper beds are argillaceous, silty, and arenaceous.

In the northern part of the map-area considerable rock that is probably equivalent to the Stony Mountain formation is exposed, but detailed correlation of these strata with the type sections is not established. The fossiliferous calcareous shales of the Stony Mountain Shale member were not seen in outcrop north of The Pas and well data indicate that they are absent or poorly developed in this area.

The Ordovician strata in the area have a regional dip of about 12 feet to the mile toward the southwest. North of 54 degrees latitude, the strata dip gently southwards. The total thickness of the Ordovician strata is nowhere obtainable by direct measurement but well data within the outcrop belt indicate a thickness of about 450 feet.

The approximate stratigraphic positions of the principal sections measured are shown in the cross-section, Figure 4 (in pocket).

TABLE OF FORMATIONS

Time-Rock Units			Rock Units		Lithology	Thickness
Era	System	Series	Formation	Member or Unit		Feet
P	Silurian	?	Stonewall formation of the Interlake Group		yellowish grey finely crystalline bedded dolostone	
PALAEOZOIC	Ordovician	Cincinnatian	Stony Mountain	Gunton	greyish yellow finely crystalline and nodular dolostone; upper beds shaly and arenaceous	50
				Penitentiary	dusky yellow argillaceous dolostone, nighly fossiliferous	20
				Stony Mountain Shale	red and green fossiliferous calcareous shale and thin limestone bands	± 70
		?	Red River	Selkirk	yellowish grey, pale yellowish brown mottled dolomitic limestone	±130
		Cincinnatian or Mohawkian		Cat Head	greyish yellow crystalline dolostone, many chert nodules	± 60
				Dog Head	yellowish grey to grey mottled dolomitic limestone	± 60
			Winnipeg	upper unit	blue green shale, interbedded with sandstone, fossiliferous	± 35
				basal sandstone unit	quartzose sandstone, friable, non-fossiliferous	± 45
PRECAMBRIAN						

DESCRIPTION OF ROCK UNITS

Winnipeg Formation

Definition

The Winnipeg formation includes all the strata that overlie the Precambrian basement and underlie the carbonate rocks of the Red River formation in the map-area. The name Winnipeg was introduced by Dowling to describe the exposures of sandstone and shale that outcrop on the islands and shores of the south part of Lake Winnipeg.

Distribution

The formation may be mapped as a narrow linear band that extends from the vicinity of Traverse Bay on Lake Winnipeg to the vicinity of The Narrows at Dog Head. Exposures of sand on Elk Island described by Dowling (1900, p. 54F) are not considered to be part of the Winnipeg formation but rather a recent deposit overlain by alluvial material. In the northern part of the map-area, fossiliferous sandstone that is possibly equivalent to the Winnipeg formation is exposed on the south shore of Lake Athapapuskow, south of Lake Amisk, Saskatchewan, on the highway near Cranberry Portage, and on the Minago River.

Relation to Underlying Rock

The Winnipeg formation was deposited on the eroded surface of the Precambrian shield. This surface was no doubt uneven and the thickness of the sandstone probably varies from place to place. Masses of Precambrian rock that protrude through the Ordovician strata, northwest of Hodgson and north of Lake St. Martin (Hunter, 1951), are evidence of an irregular Precambrian floor.

In several places outcrops of the Winnipeg formation were observed less than 100 feet from Precambrian rocks, but nowhere was the contact between the Palaeozoic and Precambrian observed.

On the east end of Punk Island, several holes were drilled to test the commercial possibilities of deposits of kaolin that were found directly underlying the sand. Several feet of white kaolin were present and were underlain by a few feet of green clay that graded downward to the underlying greenstone. The above information was supplied by Mr. V. D. Colcleugh, geologist, who was associated with the drilling venture. The kaolin is no doubt a residual clay formed by weathering in situ of the greenstone.

In some wells a few feet of arkosic material is present between the sandstone and the underlying basement rock. A thin

veneer of residual detritus probably overlies the Precambrian throughout most of the area.

Character

The Winnipeg formation in the southern part of the map-area may be divided into two units, a basal quartzose sandstone unit, and an upper unit composed of shale and sandstone. These two units are described separately below.

Basal Sandstone

The basal unit is well exposed in cliffs on Black Island and at the eastern end of Punk Island. It consists of white well-sorted friable fine-grained quartzose sandstone in poorly defined beds 1 foot to 3 feet thick. In general the grains have high roundness and sphericity values. The lower beds are slightly coarser grained and in places contain pebbles as much as ½-inch in diameter. Here and there oxidized iron nodules stain the sandstone a rusty yellow. In places the beds are ripple-marked and the top few inches of these beds is very fine grained. The sandstone is lightly bonded by a very fine silt matrix and iron oxide cement (Sections 1 and 2).[1]

Upper Unit

A series of shales, sandstones, and arenaceous shales overlies the basal sandstone unit. These strata are well exposed on Punk Island, Deer Island, and Grindstone Point.

On the north shore of Punk Island, the lowest beds of the unit are exposed and the relation to the underlying basal sandstone can be seen. As stated above, the basal sandstone outcrops in cliffs on the eastern side of the island but progressively younger strata are encountered in proceeding from east to west, as the beds dip gently west.

The upper beds of the basal sandstone unit are exposed at the water's edge about halfway along the north shore of Punk Island. They are overlain by nearly 2 feet of sandstone that contains many nodules and oolites of pyrite. In places the pyritic zone contains beds as much as 8 inches thick composed entirely of oolitic pyrite in a quartz-silt matrix. The beds overlying the pyritic zone consist of bluish green shale with thin sandstone partings, and sandstone with shaly partings (Section 3). More complete sections of the upper unit are exposed on Deer Island and Grindstone Point.

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[1] All measured sections referred to by numbers in parentheses are listed on page 42 and following.

On Deer Island there is almost continuous outcrop along the north and northeast shores and good sections were measured at the northeast extremity of the island (Sections 5 and 6).

The lowest beds exposed on the island consist of about 5 feet of greyish yellow quartzose sandstone in beds 6 to 12 inches thick. The rock is well consolidated and forms a ledge at lake level. The matrix consists of quartz silt, the cement is non-calcareous and is probably largely iron oxide. These lower beds are probably the upper part of the basal sandstone unit described above.

Overlying the well-consolidated sandstone is about 2 feet of soft friable sandstone that has a very fine silt and clay matrix. The upper foot of this sandstone is dark in colour and contains much disseminated pyrite and pyrite nodules. From 10 to 14 feet of dark greyish green shale, in irregular beds $\frac{1}{2}$ to 1 inch thick, overlies the pyritic zone. The shale is fissile and has a splintery fracture. Thin bands and lenses of sandstone 1/8 to 1 inch thick are common throughout. The sandstone is well cemented with a carbonate cement. Both the sandstone and the shale contain occasional dark brown shiny phospate nodules or "pellets". Fossils are present in both the shale and the sandstone and are exceptionally well preserved in the shale. The ratio of sand to shale in this part of the section varies considerably and, in places, this interval is actually a sandstone with thin lenses and bands of shale.

About 12 feet of impure sandstone containing shaly partings overlies the shale. In places the sandstone is fairly well cemented with a carbonate cement but elsewhere it is soft and friable. On the north shore of the island the sand has very large sweeping crossbedding.

Nearly 2 feet of argillaceous sandstone overlies the crossbedded sandstone. It is not bedded and is composed of worm-like tubes of sandstone in an argillaceous matrix. This is overlain by dolomitic limestone of the Dog Head member.

The section exposed at Grindstone Point (Section 7) is similar to the Deer Island section. At the extremity of the point and along the north side of it the contact between the sandstone and limestone is well exposed. The crossbedded sandstone is about 15 feet thick and is overlain directly by the Dog Head. The upper 2 feet of argillaceous sandstone that occurs at Deer Island is not present here. The stratigraphic relations of the sections described above are shown in the cross-section (Figure 1).

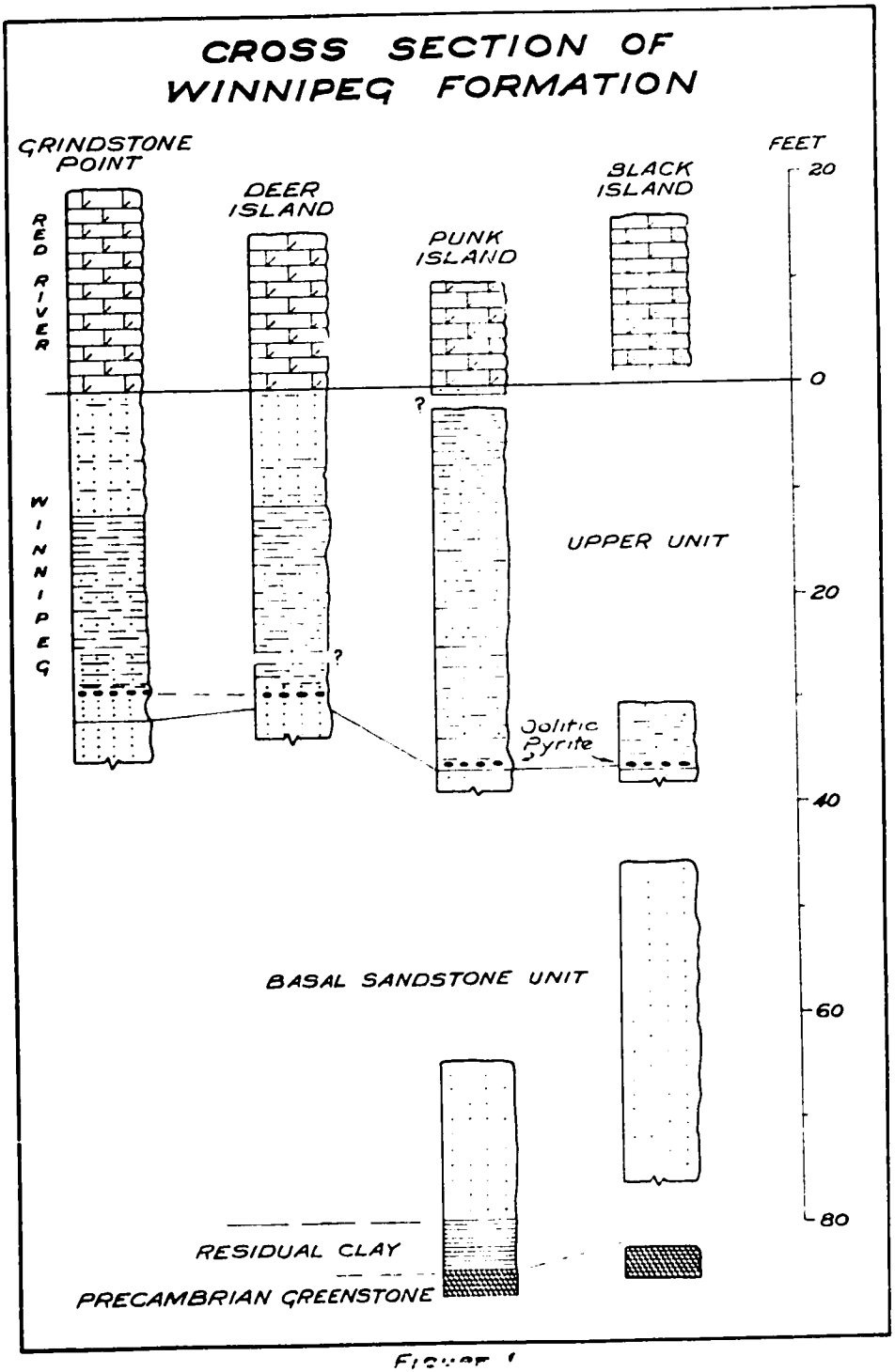
CROSS SECTION OF
WINNIPEG FORMATION
GRINDSTONE POINT
DEER ISLAND
PUNK ISLAND
BLACK ISLAND
FEET
20
0
20
40
60
80
RED RIVER
WINNIPEG
UPPER UNIT
Oolitic Pyrite
BASAL SANDSTONE UNIT
RESIDUAL CLAY
PRECAMBRIAN GREENSTONE

FIGURE 1

At Little Grindstone Point about 6 feet of argillaceous sandstone is exposed underlying a few feet of the Dog Head member. One hard sandstone bed is packed with large pelecypods (Cyrtodonta sp.)(Section 8).

Incomplete sections of the upper unit were also measured on Black Island and on Hecla Island (Sections 4 and 10).

From Grindstone Point as far north as Dog Head at The Narrows, the Winnipeg formation is poorly exposed. Blocks of limestone as large as 20 feet across have slumped towards the lake owing to erosion of the poorly resistant underlying Winnipeg formation. In one or two places the sand and shales of the formation outcrop near the water's edge.

Strong currents flowing through The Narrows at Dog Head have scoured a channel 96 feet deep in the easily eroded Winnipeg formation. This probably represents the total thickness of the formation at this locality.

Northern Area

Sandstone is exposed in several places along the northern edge of the Ordovician outcrop belt. Owing to slumping of the overlying dolostone the sandstone is poorly exposed but in places the contact between it and the dolostone can be seen. In no place was the contact between the sandstone and the Precambrian observed. The sandstone is yellowish brown, well cemented by a dolomitic and iron oxide cement, and has a quartz silt matrix. Large horn corals and Receptaculites sp. are common. The contact with the overlying dolostone is sharp and the lower two feet of the dolostone contains abundant quartz. No estimate of the thickness of the sandstone can be given, but, no doubt, it varies considerably owing to irregularities of the Precambrian floor. At mile 56 Flin Flon Highway (Section 9), on the south shore of Lake Athapapuskow, and on Cranberry Lake, the greenstone is exposed less than 100 feet from the Palaeozoic strata and at these localities the sandstone must be less than 20 feet thick. This sandstone is probably equivalent to the Winnipeg formation.

Red River Formation

Definition

The Red River formation consists of the predominantly carbonate strata between the underlying shales and sandstones of

the Winnipeg formation and the overlying argillaceous limestones and dolostones of the Stony Mountain formation. The strata comprising the formation were first described by Dowling who divided them into three divisions, Lower Mottled, Cat Head, and Upper Mottled. Foerste (1929b, p. 26) introduced the term Red River formation for these strata and designated three members, Dog Head, Cat Head, and Selkirk, to correspond with the three divisions of Dowling.

Distribution and Character

The Red River formation is well exposed throughout most of the outcrop belt, but only in the area bordering Lake Winnipeg can the three members be recognized as distinct lithologic units. The members, and the strata in the north part of the map-area, are described separately below.

Dog Head Member

The Dog Head member was named for the good exposures of dolomitic limestone in the vicinity of Dog Head, near The Narrows, Lake Winnipeg. The member is exposed in cliffs from 20 to 30 feet high on the islands and along the shores of Lake Winnipeg from The Narrows south to Elk Island. The thickest section exposed is on the north side of Black Bear Island. Much slumping has occurred owing to the nonresistant shale and sandstone of the underlying formation and it is difficult to find good sections.

The basal beds of the member are exposed on Deer Island, Hecla Island, and at Grindstone Point (Sections 5, 10, and 7). The lower few inches consists of dark grey nodular limestone that contains streaks and aggregations of iron sulphide, argillaceous material, silt, and quartz sand grains. The contact with the underlying formation is sharp.

The Dog Head member consists of yellowish grey mottled to greyish orange fossiliferous slightly dolomitic limestone in thin indistinct beds. The mottled areas, caused by secondary dolomitization, are crystalline whereas the yellowish grey areas are sub-fragmental and consist of recrystallized fossil fragments in a calcitic matrix. Large cephalopods and gastropods are commonly present on the bedding planes. The general character of the member is similar at most of the outcrops.

Sections of Dog Head strata were measured at Elk Island (Section 13), Hecla Island (Section 10), Deer Island (Section 5),

Grindstone Point (Section 7), and Black Bear Island (Section 12).

In the northern part of Lake Winnipeg, exposures of the Dog Head member have been described by Dowling. The locations of these outcrops and the thicknesses exposed are listed below.

Little Tamarack Island	11 feet
Commissioner Island	few feet
Berens Island	few feet
Jack Head Island	15 feet

According to Dowling the Dog Head strata at these localities are similar to those described farther south. On Jack Head Island the upper beds are less mottled and are somewhat similar in lithology to the Cat Head member. Goudge (1944, p. 10) states that the dolomite content increases towards the north.

Cat Head Member

The Cat Head member was named for the good exposures of dolostone that outcrop as cliffs at Cat Head and MacBeth Point on Lake Winnipeg. Apart from several cliffs at the type locality, very few outcrops of the member are known. The writer found several small outcrops that are probably Cat Head equivalents, about 6 miles north of the village of Riverton.

At the type locality at Cat Head, the member consists of light yellowish grey to greyish yellow saccharoidal to crystalline even-textured bedded dolostone that contains many large nodules of grey chert. The chert nodules are generally along bedding planes but may occur within the beds. In places the dolostone shows a faint lamination that may be continuous through the chert nodules or may be draped over them. Some beds have an uneven texture, contain recrystallized crinoid plates, and have slight vugular porosity which suggest a dolomitized fragmental rock. The largest section exposed at Cat Head (Section 14) is 40 feet thick.

Dowling (1900, p. 77) describes at least 10 feet of strata on Outer Sturgeon Island (probably McCreary Island) that he assigns to the Cat Head member. These beds are in part fragmental "resembling a sandstone but generally composed of fragments of shells". Dowling also states that the Cat Head member is present at the base of the sections measured at Howell and Robinson Points, north of Grand Rapids.

Selkirk Member

The Selkirk member overlies the dolostone of the Cat Head member and is overlain by the shale and argillaceous limestone of the Stony Mountain Shale member. The member includes the attractively mottled Tyndall limestone that is widely used as a building stone throughout Canada. Although poorly exposed in natural outcrop, good sections of the member are exposed in the quarries near the village of Garson (Section 15).

The Selkirk member consists of a yellowish grey to pale yellowish brown mottled fossiliferous fragmental dolomitic limestone in beds one foot to three feet thick. The mottled areas are pale yellowish brown or greyish orange and are composed of many small rhombs of dolomite in a calcitic matrix. The groundmass has a fragmental texture and consists largely of fossil fragments. Generally the mottled areas have a tubular shape and are connected, giving a tapestry-like effect on a polished surface. Dolomitization either before or after lithification has caused the mottling. An interesting discussion on the origin of the mottling is given by Wallace (1913). The member is highly fossiliferous and contains many large cephalopods, gastropods, and compound corals. Nodules of chert are common and are weathered to a white soft chalky material, particularly in the upper beds. According to Wallace, the member is 97 feet thick but the lower 67 feet is thinner bedded and argillaceous.

Strata of the Selkirk member are poorly exposed at Lockport, Lower Fort Garry on the banks of the Red River, and in abandoned quarries near East Selkirk. Although higher in the section, these strata are generally similar to those exposed at Garson but are locally softer and contain considerable chert. Similar strata are also exposed south of Koostatak, near the mouth of the Fisher River.

Strata of the Selkirk member outcropping on the northern part of Lake Winnipeg are described by Dowling (1900) from the following localities:

Dancing Point	4 feet	
Carscallen Point	20 feet	
Clark Point	14 feet	
Selkirk Island	12 feet	
Robinson Point	20 feet	
Three miles north of Robinson Point	32 feet	(Section 16)
Howell Point	20 feet	

At Carscallen Point and Clark Point some beds are argillaceous and contain clayey partings. At Howell and Robinson

Points the lower beds consist of a "blue argillaceous limestone which in places becomes a moderately fine conglomerate".

Northern Area

Along the northern limit of the outcrop belt that represents the erosional edge of the Ordovician strata are many large dolostone cliffs as much as 100 feet high. These strata, equivalent to the Red River formation, are underlain by sandstone that in turn lies directly on the Precambrian. Because of the less resistant nature of the sandstone considerable slumping has occurred and the lower beds are generally hidden by talus and huge slumped blocks. In many places the Precambrian rocks outcrop less than 100 feet from the base of the cliff but nowhere was the Precambrian-Ordovician contact observed. Outliers of Ordovician strata are common within 5 miles of the erosional escarpment. Wright (1930, p. 65) describes a large outlier more than 2 miles long on Limestone Point Lake about 50 miles north of the main Ordovician outcrop belt.

In general, the rock forming the cliffs consists of medium crystalline dolostone in beds 8 to 20 inches thick. The colour varies from greyish yellow to yellowish grey and commonly is mottled to shades of pale red. In places the red colour is dominant and at some outcrops the basal beds are reddish brown and contain much iron oxide. The fauna includes poorly preserved corals, Receptaculites sp., and bracniopods. Scattered vugs are probably due to solution of fossils. The largest cliffs of dolostone examined are on Lake Athapapuskow (Section 17) and on the south shore of the second Cranberry Lake.

Thickness

The thickness of the Red River formation in wells drilled west of the outcrop area is about 250 feet. As the individual members are difficult to recognize in subsurface section the thicknesses given in the Table of Formations are approximate.

Stony Mountain Formation

Distribution and Character

The Stony Mountain formation is the youngest Ordovician formation in the map-area. Its known extent in outcrop is a narrow belt that extends northwards from the city of Winnipeg to the Dauphin River. In the northern part of the map-area strata that are probably equivalent to the Stony Mountain formation are exposed on Cormorant, Atikameg, Rocky, and Namew Lakes and

may be mapped as a westerly trending belt.

The members of the formation as they occur in their type sections are discussed separately below.

Stony Mountain Shale Member

The Stony Mountain Shale member consists of highly fossiliferous calcareous shale and argillaceous limestone. This widespread argillaceous member between relatively thick sequences of predominantly carbonate strata is an excellent subsurface marker bed that has distinct lithologic and electric-log characteristics, particularly in Manitoba and North Dakota.

Owing to the lack of cliff-forming properties, natural outcrops do not afford good sections. The upper 10 feet of the member is exposed in the City of Winnipeg quarry at Stony Mountain and consists of very argillaceous limestone to calcareous shale in shades of pale greyish red with many purple streaks and bands. Thin 2- to 3-inch bands of grey to pale red medium crystalline limestone are interbedded with the shale. The argillaceous beds contain many well preserved fossils, and fossil fragments are abundant throughout (Section 18). Wells drilled in this vicinity indicate that the member is about 75 feet thick (Dowling, 1898, p. 91F).

Penitentiary Member

The red calcareous shales and limestones of the Stony Mountain Shale member grade upwards to the argillaceous dolostone of the Penitentiary member. As exposed at the Stony Mountain quarry the member consists of about 20 feet of dusky yellow fossiliferous argillaceous dolostone in beds 3 to 8 inches thick. In places the rock is strikingly mottled to shades of pale red and purple. The fauna, similar to that found in the underlying member, is preserved as internal and external molds whereas the forms in the shale member are preserved as natural casts (Section 18). The member is also exposed at Little Stony Mountain near Winnipeg, and south of Gunton (Sections 19 and 20).

Gunton Member

The Gunton member is well exposed in quarries near the city of Winnipeg, at Stony Mountain, and south of Gunton. At these localities the lower beds of the Gunton member are hard and

resistant and make sharp contact with the less resistant beds of the Penitentiary member.

The member consists of very pale orange finely crystalline dolostone in 3- to 15-inch beds. A few fossils are present but they are poorly preserved. Some beds have poor vugular porosity probably caused by solution of fossils. Chert nodules are present at some horizons. A characteristic feature of the member is the common occurrence of pale red mottled nodular bands 10 to 24 inches thick. The bands have thin irregular beds with nodular bedding planes. The coloration is very irregular and commonly small concentric alternating red and greyish green bands ("bird's eye" structures) give a characteristic appearance to the rock. The nodular beds are commonly argillaceous. The type section of the Gunton member is exposed in an abandoned quarry about a mile south of Gunton (Section 19).

About 19 feet of dolostone that is probably equivalent to part of the Gunton member is exposed in the Birse quarry 3 miles northeast of Stonewall. The quarry beds consist of yellowish grey to very pale orange finely crystalline dolostone in 2- to 4-inch beds. In places it is faintly mottled to pale yellowish brown. Chert nodules are sparingly present and some silicification of fossils was noted. The upper 20 inches is in one bed and has fair vugular porosity. Okulitch (1943, p. 66) reports an Upper Ordovician fauna from this quarry with abundant Beatricea sp.

Relation to Overlying Strata

The upper strata of the Gunton member were not observed in outcrop but a bore-hole drilled by the Winnipeg Supply and Fuel Company Limited at the Stonewall quarry in 1951 intersected these beds (Section 18). The well began in the quarry beds of the Stonewall formation of Silurian age and bottomed in the argillaceous dolostone of the Penitentiary member thus giving a complete section of the Gunton member which is 50 feet thick.

In this well the lower 40 feet of the Gunton member is dolostone and is similar to the outcrop section except that the upper several feet contain abundant quartz sand grains. These arenaceous beds grade upwards to red argillaceous dolostone, silty shale, and argillaceous siltstone 10 feet thick. The red strata are the same as those described in the pit section near No. 1 Lime Plant (Baillie, 1951, p. 11). A thin band of yellowish grey arenaceous dolostone marks the upper limit of the argillaceous and silty red beds. Overlying the arenaceous beds are the thick fossiliferous beds of the Stonewall formation.

As the contact between the red argillaceous strata and the underlying dolostone appears to be gradational and as an abrupt lithologic change occurs at the top of the sandy strata, the upper limit of the Gunton member is placed at the top of the red argillaceous beds. The writer (1951, p. 26) included these red argillaceous strata in the Stonewall formation but it is now felt that the contact should be placed where the greatest lithologic change occurs.

The stratigraphic cross-section (Figure 2) shows the relation of the bore-hole section to strata exposed in the Stony Mountain and Gunton quarries.

Fisher Branch Area

The Stony Mountain formation underlies a large area north and east of Fisher Branch and the topography reflects the nature of the underlying bedrock. The areas underlain by argillaceous strata of the lower members have little relief and form small plateaus, whereas the more resistant dolostone of the Gunton member forms small escarpments that in general trend northwest, and parallel to the regional strike.

Strata equivalent to the Penitentiary member are probably present in this vicinity but as they are difficult to distinguish from the shale member all argillaceous strata are considered together. About 6 feet of highly fossiliferous argillaceous rock of the lower members is exposed in a drainage channel 2½ miles southeast of Hodgson (Section 22). The lowest rock exposed consists of light grey finely crystalline fossiliferous dolostone in beds 10 inches thick. This is overlain by greyish orange to greyish red argillaceous dolostone to dolomitic shale that contains many well preserved fossils and fossil fragments. Outcrops of this fossiliferous horizon are abundant in the area but in no place was more than a few feet exposed so that the thickness and exact relation to the overlying and underlying rock is not known (Section 23).

In the southwest corner of township 25, range 1, East of the Principal meridan, the greyish red argillaceous rock outcrops over a large area and overlies cherty bedded dolostone of the Red River formation that forms a small escarpment less than a mile to the northeast (Section 24).

In the Fisher Branch area the Gunton member forms a prominent escarpment that may be traced for almost 20 miles in a northwesterly direction. In general the lithology is similar to that described at the type section. The nodular beds are well developed and abundant chert characterizes some horizons.

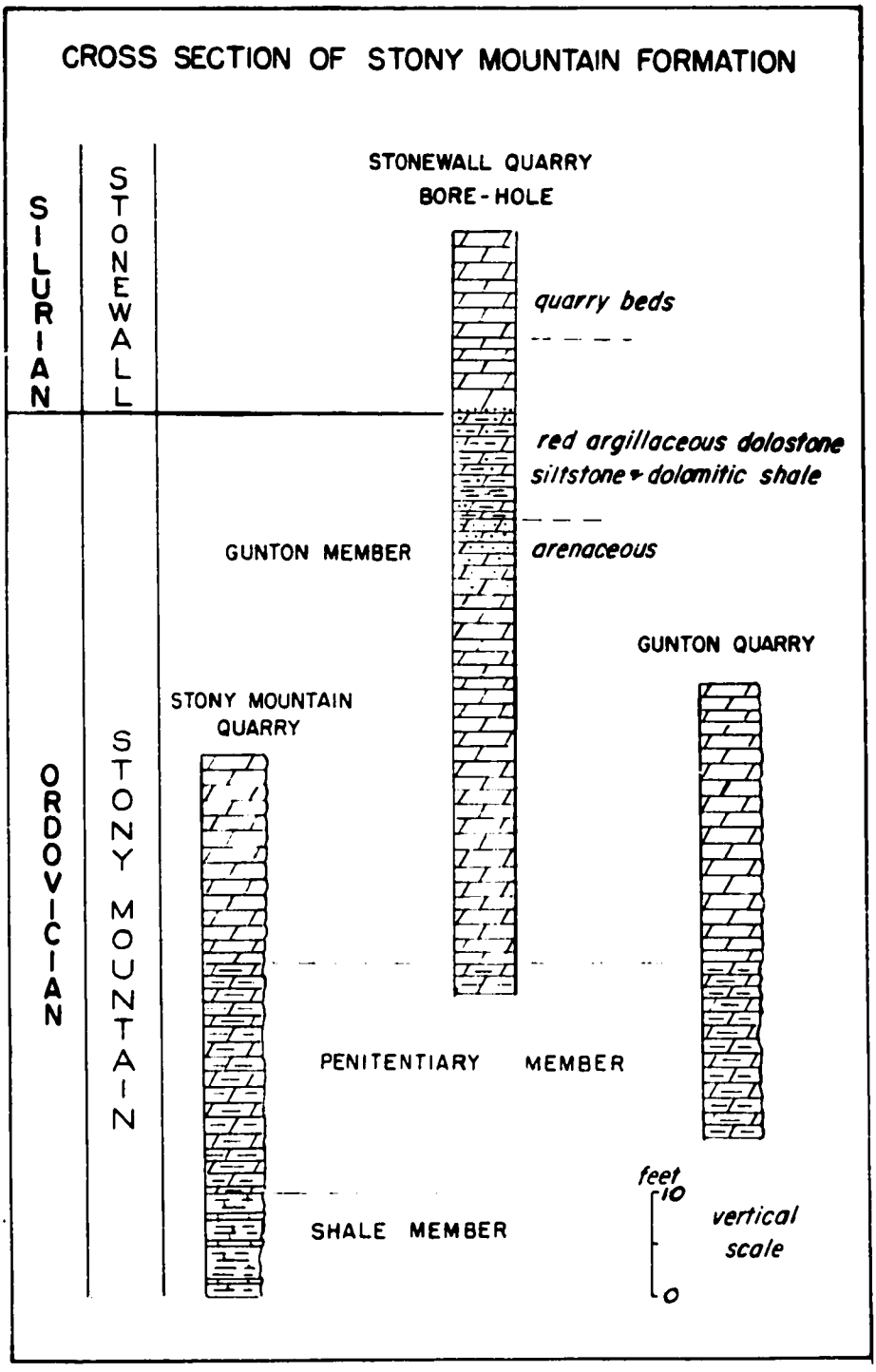
CROSS SECTION OF STONY MOUNTAIN FORMATION
SILURIAN
ORDOVICIAN
STONEWALL
STONY MOUNTAIN
STONEWALL QUARRY
BORE-HOLE
quarry beds
red argillaceous dolostone
siltstone & dolomitic shale
GUNTON MEMBER
arenaceous
GUNTON QUARRY
STONY MOUNTAIN
QUARRY
PENITENTIARY MEMBER
SHALE MEMBER
feet
10
0
vertical
scale

Figure 2.

Sections 25 and 26 describe the detailed lithology of the member as exposed in this area.

Strata of the Stonewall formation of Silurian age are also exposed in the Fisher Branch area (Baillie, 1951, p. 13) and as they are similar in lithology to the Gunton member it is difficult to distinguish between the two.

A few feet of yellowish grey finely crystalline dolostone that contains abundant quartz sand and silt is exposed on section 34, township 23, range 1, West of the Principal meridian. These arenaceous beds probably are equivalent to the arenaceous dolostone that forms the upper beds of the Gunton dolostone in the Stonewall quarry bore-hole.

What is probably the contact between the Gunton member and the overlying Stonewall dolostone is exposed on the highway about four miles north of Fisher Branch. A few inches of pale red silty dolostone is overlain by a few feet of greyish yellow dolostone. The silty rock is thin-bedded and contain 10 to 15 per cent of very fine quartz sand (Section 27). Further detailed lithologic and palaeontologic work will have to be done in this area before definite formational boundaries can be established.

Northern Area

In the northern part of the map-area, strata equivalent to the Stony Mountain formation outcrop on Cormorant, Atikameg, Rocky, and Namew Lakes. The most complete section of these strata is exposed on an island in Namew Lake where a thickness of more than 50 feet was measured (Section 28).

The lowest beds exposed on the island consist of about 12 feet of grey argillaceous dense dolostone and red dolomitic shale. The argillaceous beds are overlain by about 6 feet of rock that shows considerable variation in texture and structure. Abundant chert nodules and silicified dolostone are present near the base of the unit which, in the island section, grades upward into greyish orange to pale yellowish brown crystalline dolostone that has fair vugular porosity owing to solution of fossils. On the mainland, about a mile southeast of the island, the rock overlying the chert zone is largely a breccia formed of fragments of the crystalline rock and of the underlying dense dolostone in a dense matrix. The beds overlying the breccia have a fragmental texture and appear to be composed of detritus derived from the breccia. The fragmental rock is well bedded and the fragments show evidence of transport. The contact with the overlying beds is disconformable and the upper beds are commonly truncated.

In the section on the island the crystalline dolostone is overlain by about 35 feet of yellowish grey finely crystalline dolostone in beds 3 to 9 inches thick. In places the rock is nodular and is streaked with shades of pale red. The lower 6 fee contains poorly preserved corals and cephalopods and the weathere surface shows that many finely comminuted fossil fragments are present throughout.

Many large cliffs of dolostone that outcrop on Rocky Lake are similar in character to the upper 35 feet of the Namew Lake section. The detailed lithology of the Rocky Lake section is described under Section 29.

On the Hudson Bay Railway between miles 37 and 87 are several exposures of Ordovician rock. In general these strata consist of slightly nodular thin-bedded finely crystalline dolostone in shades of grey and pale red. Fossils are poorly preserved and the weathered surfaces show that in places the rock contains many finely comminuted fossil fragments. The few fossils collected suggest that the beds are faunally related to the Stony Mountain formation. At mile 39 near Cormorant Lake the rock is dense and very hard and is in beds up to 3 feet thick.

The thicknesses and locations of the larger sections are as follows:

Mile 39	20 feet	(Section 30)
Mile 41.5	6 feet	
Mile 63	8 feet	
Mile 69.5	16 feet	
Mile 86.7	14 feet	(Section 31)

The nature of the contact between the Ordovician and Silurian strata in the northern part of the area is not known. At mile 26.7 on the Flin Flon Highway about 20 feet of strata are exposed that were included by the writer (1951, p. 13) in the Stonewall formation of Silurian age. The Orodovician-Silurian contact is tentatively placed at the red shale near the base of this section. Fossils collected by the writer in 1951 from these strata were not diagnostic although some of the faunal elements suggested a possible correlation with the Stonewall formation. Further detailed collecting and palaeontological study is necessary before a definite age designation for these strata can be made (Section 32).

In the Lake St. Martin area near the Precambrian inlier and evaporite deposits (Baillie, 1951, p. 35) are several poor exposures of strata probably equivalent to the Stony Mountain

formation. Southeast of The Narrows at Lake St. Martin, varicoloured thin-bedded finely crystalline limestone outcrops in small cliffs. Fossils are poorly preserved but many crinoid stems and finely comminuted fossil fragments are evident on the weathered surface. The Ordovician strata in the area are probably thin as Precambrian granite is exposed within a few hundred feet of the Orodovician outcrop.

FAUNA

The fauna of the Manitoba Ordovician is abundant and varied and many faunal lists have been published. As these lists are contained in a variety of publications, some of which are not easily obtainable, complete faunal lists for each formation are included in this report. The identifications in these lists from the work of Whiteaves (1895-1897) Foerste (1929) and Okulitch (1943) are not revised, although new palaeontological data and correlation problems have shown the need for revised and more detailed study of Manitoba Ordovician fauna. The forms present in the northern part of the map-area are listed separately and collecting localities are given. Preliminary faunal studies indicate that the northern strata have a faunal succession similar in part to that present in southern Manitoba but further collecting and studying is necessary before the faunal relationships of the two areas are definitely established.

WINNIPEG FORMATION FAUNA

The following fossils occur in the upper unit of the Winnipeg formation in the southern part of the map-area. The list is taken largely from Macauley[1]. Those marked by an asterisk were collected by the writer and identified by G. J. Genik, University of Manitoba.

Coelenterata
- Climacograptus typicalis Hall
- Climacoconus cf. clarki Sinclair
- *Conularia crustula White
- Conularia formosa Miller and Dyer
- Conularia sp.
- Streptelasma simplicitas n. sp.
- Streptelasma winnipegensis n. sp.

Echinodermata
- Glyptocrinus sp.

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[1] George Macauley: personal communication; list to be included in Master's thesis, University of Manitoba.

Annelida
  Scolithus sp.
  Serpulites dissolutus Billings
Bryozoa
  Escnaropora sp.
  Hallopora multitabulata (Ulrich)
  Rhinidictya mutabilis (Ulrich)
Brachiopoda
  Cyclospira bisulcata (Emmons)
  Dalmanella sp.
  Lingula sp.
  Hesperorthis tricenaria Conrad
  Platystropnia reversata King
  Plectorthis plicatella (Hall)
  Rhynchotrema inaequivalvis (Castelnau)
  R. inaequivalvis var. laticostata Winchell and Schuchert
  Sowerbyella sp.
  Strophomena sp.
 *Trematis cf. oblata ? Ulrich
 *T. cf. ottawaensis ? Billings
Pelecypoda
 *Clidophorous ? cf. stoningtonensis (Hussey)
 *Ctenodonta sp.
  Cyrtodonta sp.
  Modiolodon patulus Ulrich
Gastropoda
 *Cyrtolites cf. ornatus Conrad
  Hormotoma gracilis (Hall)
  Hormotoma sp. ind. (cf. H. winnipegensis or H. major)
 *Palaeacmaea cf. orphyne (Billings)
  Salpingostoma sp.
  Sinuites cancellatus (Hall)
  Solenospira pagoda (Salter) var. occidentalis Whiteaves
Cephalopoda
  Endoceras sp.
  Ephippiortnoceras formosum Billings
  Spyroceras sp.
  Westonoceras manitobense (Whiteaves)
Trilobata
  Ceraurinus icarus (Billings)
Ostracoda
  Aparchites tyrrelli Jones
  Leperditia sp.
Algae
  Licrophycus sp.
  Paleophycus sp.

 * Forms collected by the writer and identified by G. Genik, University of Manitoba.

NORTHERN SANDSTONE FAUNA

The fossils listed below occur in the sandstone that underlies the dolostone near the erosional edge of the Ordovician outcrop belt. Forms listed from locality 1 are taken from Tyrrell (1900, p. 20F). Forms from localities 2 and 3 were collected by the writer and identified by G. Genik.

	Localities		
	1	2	3
Porifera			
Receptaculites sp.		X	X
Coelenterata			
Halysites gracilis ? Hall		X	
Streptelasma sp.		X	
Brachiopoda			
"Dalmanella" sp. ?		X	
Pionodema subaequata (Conrad)		X	
Rhynchotrema sp. ?		X	
Sowerbyella sp.		X	
Zygospira sp.			X
Pelecypoda			
Clinopistha ? antiqua (Whiteaves)		X	
Ctenodonta subnasuta Ulrich	X		
Gastropoda			
Archinacella instablis Ulrich and Schofield			X
Helicotoma sp.	X		
Hormotoma cf. gracilis Hall			X
Hormotoma or Loxonema sp.	X		
Liospira sp. ?			X
Salpingostoma cf. buelli (Whitfield)	X		X
Sinuites cancellatus (Hall)			X
Solenospira sp. ?			X
Cephalopoda			
Actinoceras cf. bigsbyi Bronn			X
Cyclendoceras annulatum (Hall)		X	
Garryoceras ? sp.	X		
Narthecoceras crassiphonatum (Whiteaves)	X	X	
Unclassed			
Cyclocrinites globosus Billings		X	

Fossil Localities

1. Minago River (Tyrrell, 1903).
2. Mile 50.1 Flin Flon Highway, just south of Cranberry Portage.
3. On road near south shore of Amisk (Beaver) Lake.

RED RIVER FORMATION FAUNA

The following list was compiled from the literature by Dr. R. A. C. Brown, Manitoba Mines Branch.

Porifera
- Aulocopella winnipegensis Rauff
- Ischadites iowensis (Owen)
- Nidulites gregarius (Billings)
- N. gregarius ? (Billings)
- Receptaculites oweni Hall
- Trichospongia hystrix Whiteaves

Coelenterata
- Calapoecia canadensis Billings
- C. canadensis Billings var. ungava Cox
- Chaetetes perantiquus Whiteaves
- Climacograptus bicornis (Hall)
- Climacograptus sp.
- Conularia asperata Billings
- Favistella alveolata (Goldfuss)
- Favistella sp.
- Halysites gracilis (Hall)
- Inocaulis canadensis Whiteaves
- Paleofavosites prolificus (Billings)
- Paleophyllum stokesi (Edwards and Haime)
- Plasmopora sp.
- Protarea (vetusta var. ?) magna Whiteaves
- P. vetusta (Hall)
- P. var. magna Whiteaves
- Streptelasma robustum Whiteaves
- S. trilobatum ?
- Stromatopora canadensis Whiteaves
- Tetradium fibratum Safford
- Thamnograptus affinis Whiteaves

Echinoderma
- Glyptocrinus sp.
- Glyptocystites sp. ind.
- Taeniaster sp. ind.

Annelida
- Arabellites sp.
- Serpulites dissolutus (Billings)

Bryozoa
- Bythotrypa laxata Ulrich
- Chasmatopora fenestrata (Hall)
- Diplotrypa westoni Ulrich
- Mesotrypa selkirkense Whiteaves
- Orbignyella wetherbyi (Ulrich)

Pachydictya acuta (Hall)
P. magnipora Ulrich
Pachydictya sp.
Ptilodictya whiteavesi Ulrich
Rhinidictya ? sp.
Trematopora sp.

Brachiopoda

Parastrophina hemiplicata (Hall)
"Dalmanella testudinaria Dalman"
Diceromyonia ? cf. storeya (Okulitch)
Diceromyonia ? sp.
Dinobolus parvus ? Whitfield
Dinorthis (Plaesiomys) subquadrata (Hall)
D. (Plaesiomys) proavita (Winchell and Schuchert)
Dinorthis sp.
Hesperorthis tricenaria (Conrad)
Hypsitycha anticostiensis (Billings)
Lepidocyclus capax (Conrad)
Lingula iowensis Owen
L. obtusa Hall
L. elongata Hall
Megamyonia unicostata (Meek and Worthen)
cf. Parastrophina hemiplicata Hall
Platystrophia biforata (Schlotheim)
P. crassa Jones
Platystrophia sp.
Rafinesquina deltoidea (Conrad)
R. leda (Billings)
R. lata Whiteaves
R. alternata (Emmons)
Rafinesquina sp.
Rhynchotrema inaequivalvis (Castlenau)
Sowerbyella sericea (Sowerby)
Sowerbyella ? sp.
Strophomena fluctuosa Billings
S. billingsi Winchell and Schuchert
S. incurvata (Shepard)
S. trilobata (Owen)
Strophomena sp.
Vellamo diversa (Shaler)
Zygospira recurvirostris (Hall)

Pelecypoda

Byssonychia intermedia (Meek and Wortnen)
Clinopistna antiqua Whiteaves
Conocardium antiqum (Owen)
Ctenodonta subnasuta Ulrich
C. astartaeformis Salter

"Edmondia" ? vetusta Whiteaves
Palaeopteria parvula Whiteaves
Vanuxemia sp.

Gastropoda

Conradella sp.
Fusispira elongata Hall
F. inflata (Meek and Worthen)
Hormotoma gracilis Hall
H. winnipegensis (Whiteaves)
cf. Hormotoma trentonensis Ulrich and Scnofield
Hormotoma sp.
Liospira americana (Billings)
L. angustata Ulrich and Schofield
Lophospira sp.
Loxonema winnipegensis Whiteaves
Maclurina manitobensis (Whiteaves)
"Pleurotomaria" margitoides Whiteaves
"Pleurotomaria" muralis Owen
"Pleurotomaria" stokesiana Whiteaves
Raphistomina ? sp.
Salpingostoma buelli (Whitfield)
Solenospira pagoda (Salter) var. occidentalis Whiteaves
Subulites sp.
Tetranota bidorsata (Hall)
Trochonema (Eunema) strigillatum (Salter)
T. umblicatum (Hall)

Cephalopoda

Actinoceras bigsbyi (Bronn)
Armenoceras richardsoni (Stokes)
A. cf. allumettense Billings
Billingsites costulatum (Whiteaves)
Calhounoceras cf. candelabrum Troedsson
Cameroceras wilsoni Foerste
Charactoceras ? plicatum (Whiteaves)
Cyclendoceras whiteavesi Foerste
Cycloceras selkirkense (Whiteaves)
Cyrtogomphoceras cf. turgidum Troedsson
C. magnum (Whiteaves)
C. whiteavesi (Miller)
C. intermedium (Whiteaves)
C. ? intermedium (Whiteaves)
Diestoceras gibbosum Foerste
D. nobile (Whiteaves)
D. cf. nobile
D. ? whiteavesi Foerste
D. whiteavesi Foerste
D. apertum (Whiteaves)
Diestoceras sp.
Discoceras canadense (Whiteaves)
Dowlingoceras gracile (Whiteaves)
Endoceras sp.

E. manitobense Foerste
Ephippiorthoceras cf. formosum (Billings)
Garryoceras semiplanatum (Whiteaves)
Huronia occidentalis Foerste
Illaenus americanus (Billings)
Kochoceras tyrrelli Foerste
Lambeoceras cf. princeps Troedsson
L. lambii (Whiteaves)
Nartnecoceras crassisipnonatum Whiteaves
N. simpsoni (Billings)
Ormoceras lambei Foerste
Ortnoceras sp.
Paractinoceras canadense (Whiteaves)
Selkirkoceras tyndallense Foerste
Selkirkoceras cuneatum Foerste
Spyroceras fritzi Foerste
S. cf. acquilonare (Troedsson)
S. cf. geronticum Foerste and Savage
Westonoceras manitobense (Whiteaves)
Westonoceras sp.
Wilsonoceras McCharlesi (Whiteaves)
Whiteavesites winnipegense (Whiteaves)
Winnipegoceras laticurvatum (Whiteaves)
W. dowlingi Foerste
Winnipegoceras ? sp.

Trilobita
Bumastus trentonensis (Emmons)
Ceraurus ? pleurexanthemus Green
Conolichas cornutus (Clarke)
Goldius lunatus (Billings)
Illaenus americanus (Billings)
Isotelus gigas (DeKay)
I. maximus (Locke)
Onchometopus susae (Whitfield)
Pterygometopus callicephalus Hall
Harpes sp. ind.

Ostracoda
Aparchites whiteavesi Jones

Unclassed
Chondrites cuneatus Whiteaves
C. cupressinus Whiteaves
C. patulus Whiteaves
C. gracillinus Whiteaves

STONY MOUNTAIN FORMATION FAUNA

In the following lists Column 1 indicates the forms that occur in the Stony Mountain shale member and Penitentiary member of the Stony Mountain formation. Column 2 indicates the forms that occur in the Gunton member. Column 3 indicates the forms that also occur in the underlying Red River formation.

	1	2	3
Coelenterata			
Aulacera undulata (Billings)		X	
Beatricea nodulosa Billings		X	
B. cf. undulifera Foerste		X	
B. undulifera intermedia Foerste		X	
Calapoecia canadensis var. anticostiensis Billings		X	
Desmograptus sp.	X		
Favosites intermedius Okulitch		X	
Holophragma anticonvexa Okulitch	X		
Paleofavosites capax (Billings)		X	
P. cf. capax (Billings)	X		
P. prolificus (Billings)	X	X	X
Paleofavosites ? sp.	X		
P. asper var.		X	
Protaraea vetusta Hall	X		X
Streptelasma rusticum (Billings)	X		
S. cf. rusticum (Billings)	X		
S. trilobatum (Whiteaves)	X		X
Echinodermata			
Glyptocrinus sp.	X		X
Bryozoa			
Arthroclema angulare Ulrich	X		
Batostoma manitobense Ulrich	X		
"Batostomella" gracilis (Nicholson)	X		
Bythopora delicatula Nicholson	X		
B. striata Ulrich	X		
Dicranopora emacerata Nicholson	X		
D. fragilis (Billings)	X		
Goniotrypa bilateralis Ulrich	X		
Helopora harrisi James	X		
Monticulipora parasitica var. plana Ulrich	X		
Nematopora ? sp. undesc.	X		
Pachydictya hexagonalis Ulrich	X		
Petigopora scabiosa Ulrich	X		
Proboscina auloporoides (Nicholson)	X		
P. frondosa (Nicholson)	X		
Ptilodictya whiteavesi Ulrich	X		X
Rhombotrypa quadrata (Rominger)	X		
Sceptropora facula Ulrich	X		
Stictopora sp. or Rhinidictya sp. (in Ulrich)	X		X

	1	2	3
Brachiopoda			
Diceromyonia ? storeya Okulitch	X		X
D. cf. jugosa subplicata Foerste	X		
Dinobolus sp.	X		
Dinorthis (Plaesiomys) proavita (Winchell and Schuchert)	X		X
D. (Plaesiomys) occidentalis Okulitch	X		
Hypsitycha anticostiensis (Billings)	X		X
H. cf. anticostiensis (Billings)	X		
Lepidocylus sp.	X	X	X
▪ "Rhynchotrema capax (Conrad)"			
▪ "R. perlamellosum Whitfield"			
Megamyonia nitens (Billings)	X		
Opikina ? cf. pergibbosa (Foerste)	X		
Rafinesquina ceres (Billings)	X		
Strophomena incurvata ? (Shepard)	X		X
S. fluctuosa Billings	X		
S. planocorrugata Twenhofel	X		
S. cf. fluctuosa Billings	X	X	
Thaerodonta sericea cf. glaber (Shaler)	X		
Pelecypoda			
Byssonychia obesa Ulrich	X		
Plethocardia (n. sp.) ?	X		
Gastropoda			
Cyclora minuta Hall	X		
Hormotoma gracilis (Hall)	X	X	X
H. bellicincta (Hall)	X	X	
Liospira sp.	X		
Lophospira cf. bicincta (Hall)	X		
Phragmolites compressus (Conrad)	X		
"Pleurotomaria" sp. uncertain	X		
Sinuites bilobatus Sowerby	X		
Sinuites sp.	X		
Trochonemopsis umbilicatum (Hall)	X	X	X
Cephalopoda			
Actinoceras sp.		X	
Antiplectoceras shammattawense Parks		X	
Armenoceras sp.	X	X	
"Ascoceras" sp. indet.	X		
Aspidoceras insigne Whiteaves	X		
Cycloceras selkirkense (Whiteaves)	X		X
Huronia cf. septata Parks		X	
Trilobita			
Ceraurinus icarus (Billings)	X		X
Encrinurus raricostatus (Walcott)	X		
Pterygometopus callicephalus Green	X		X
Ostracoda			
Aparchites minutissimus (Hall)	X		

	1	2	3
Beyrichia (Kloedenella ?) parallella (Ulrich)	X		
Eurychilina manitobensis Ulrich	X		
Leperditia subcyclindrica Ulrich	X		
Primitia (Plethoboibina ?) lativia Ulrich	X		
Primitiella unicornis (Ulrich)	X		
Tetradella lunatifera (Ulrich)	X		
T. simplex Ulrich	X		
Algae			
Buthotrephis sp. cf. succulens Hall	X		

NORTHERN DOLOSTONE FAUNA

The faunal list of the northern dolostone includes forms taken from published lists as well as forms collected by the writer. A preliminary study of the fauna at various localities indicates that probably both Red River and Stony Mountain forms are present. Further study is necessary before a faunal succession can be established.

	Localities											
	1	2	3	4	5	6	7	8	9	10	11	12
Porifera												
Ischadites sp.								X				
Receptaculites oweni (Hall)		X			X							
Receptaculites sp.			X									
Coelenterata												
Beatricea ? sp.							X					
Calapoecia canadensis Billings		X										
Favistella alveolata (Goldfuss)	X	X										
F. cf. alveolata			X									
F. cf. forbesi Milne - Edwards and Haime												X
Favosites ? sp.							X					
Halysites gracilis (Hall)		X										
H. cf. gracilis (Hall)												X
Nyctopora billingsi Nicholson				X								
Paleophyllum rugosum Billings		X										
P. cf. vaurealensis Twenhofel												X
Streptelasma robustum (Whiteaves)	X	X										
S. cf. robustum or trilobatum											X	

	1	2	3	4	5	6	7	8	9	10	11	12	13
Streptelasma sp.			X				X	X		X		X	
Stromatocerium huronense (Billings)				X									
? Zaphrentis affinis Billings Teste Lambe				X									
Bryozoa Pachydictya acuta (Hall)		X											
Brachiopoda "Dalmanella testudinaria Dalman"		X											
Diceromyonia ? sp.											X		
Dinobolus parvus ? Whitfield						X							
cf. Lepidocylus n. sp.											X		
"Leptaena" like Megamyonia unicostata Meek and Worthen						X							
Lingula sp.										X	X		
Megamyonia nitens (Billings)											X		
M. nitens ?										X			
Opikina ? pergibbosa (Foerste)											X		
Platystrophia sp.		X											
cf. Platystrophia sp.											X		
Plectortnis ? sp.								X					
"Rafinesquina"deltoidea ? (Conrad)				X									
"R."trentonensis ? Conrad				Y									
"R."cf. lata Whiteaves											X		
Rhyncotrema sp.		X		X									
Rhyncotrema ? sp.							X						
Sowerbyella sericea (Sowerby)		X				X							
cf. Strophomena planocorrugata Twenhofel								X					X
Strophomena sp.		X									X		
Thaerodonta sp.										X			
Thaerodonta ? sp.									X		X	X	
Pelecypoda Cyrtodonta sp.						X							
Gastropoda Clathrospira conica or subconica										X			
Liospira sp.						X							
Liospira ? sp.								X					
Lophospira ? sp.							X						

	1	2	3	4	5	6	7	8	9	10	11	12
Maclurina manitobensis (Whiteaves)		X			X							
* "Murchisonia" or Loxonema						X						
** "Ophileta"				X	X							
*** "Pleurotomaria" sp.				X	X	X						
Cephalopoda												
Cyclendoceras whiteavesi Foerste	X											
"Gyroceras cf. submamillatum"						X						
Lambeoceras lambii (Whiteaves)		X										
Orthoceras sp.					X							
Spyroceras sp.											X	
Trilobita												
Bumastus trentonensis (Emmons)					X							
Ceraurus pleurexanthemus (Green)					X							
Illaenus sp.											X	
Unclassed												
Cyclocrinites spaskii Eichwald				X								

Localities

1. Minago River — Tyrrell (1903)
2. Wekusko Lake — Tyrell (1903), Whiteaves (1897), McInnis (1913)
3. Tramping Lake — Harrison, J. M. (1949)
4. Cormorant Lake — McInnis (1913)
5. East side Namew (Sturgeon) Lake — Tyrrell (1903)
6. North shore Namew Lake — Tyrrell (1903)

Collected by Baillie, identified by R. A. C. Brown

7. H. B. Railway, mile 81.2 at Wekusko
8. H. B. Railway, mile 69.5
9. Atnapapuskow Lake
10. Flin Flon Highway, mile 56.1
11. Flin Flon Highway, mile 50
12. Namew Lake, 3½ miles SE of Sturgeon Landing
13. Sturgeon-Weir River, one mile north of Sturgeon Landing.

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* "Murchisonia" is now restricted to forms from the Silurian Period to the Triassic Period.

** "Ophileta" is a Lower Ordovician genus.

*** "Pleurotomaria" is not listed in Shimer and Schrock.

INTERREGIONAL CORRELATION

The correlation of Manitoba Ordovician strata with other outcrop areas has been based largely on the contained faunal assemblages. Lithologic correlation is difficult because of erosion of strata in the intervening areas, lack of subsurface data, and the difficulty of carrying lithologic units beyond one depositional province. In the following paragraphs the literature on age and correlation of the Manitoba Ordovician is briefly reviewed and some inferred interregional relationships are included.

Foerste (1928 and 1929) has shown that elements of the Red River fauna are present in strata at Great Slave Lake, Greenland, and Baffin Island. He states that the age of the Red River formation is Richmondian but that many Middle Ordovician (Mohawkian) forms are present. According to Foerste the Mohawkian fauna is an Arctic one and these forms survived in the north during early Cincinnatian deposition and recurred during Richmondian time in Manitoba.

Miller (1930) shows the equivalence of the Bighorn formation of Montana and the Manitoba Ordovician. He equates the Lander sandstone with the Dog Head member, the massive dolomite with the Red River, and the Leigh member with the Stony Mountain formation. Miller designates all these strata as Richmondian and states that the Richmondian fauna is an Arctic one which spread southward from the Arctic Ocean as far as Mexico. In early Richmondian time there was no connection between this sea and the eastern North American sea according to Miller, but the two coalesced in later Richmondian time during the deposition of the Stony Mountain and Maquoketa formations.

Kay (1935) suggests the correlation of the Red River and the Bighorn formations with the Stewartville member of the Galena formation of southern Minnesota. The Galena is Middle Ordovician (Trentonian) and is underlain by the Decorah and Platteville of Blackriveran age and is overlain by the Maquoketa of Richmondian age. Kay (1929, p. 699) also shows that the fauna of the Winnipeg formation is in part similar to the Decorah fauna of Blackriveran age.

Savage and Van Tuyl (1919) have shown that the Nelson River formation of the Hudson Bay area is equivalent to the Red River formation and that the Shammattawa limestone is equivalent to the Stony Mountain formation. Faunal and lithologic similarities indicate that the conditions of deposition were similar in these two areas.

Twenhofel (1925, p. 68) notes the striking resemblance of the Stony Mountain fauna and that of Vauréal (Richmondian)

formation of Anticosti Island. Okulitch (1943, p. 68) states that the upper part of the Stony Mountain formation (Gunton member) may be a time-equivalent of the Ellis Bay formation (Gamachian) of Anticosti Island. The age and correlation of the Gunton member and the overlying Stonewall formation is not well understood at the present time. The Stonewall formation contains Ordovician and Silurian faunal elements and it has been suggested that these strata may be transitional in nature between Richmondian and Alexandrian as is the Ellis Bay formation (Baillie, 1951, p. 52). This relationship has been suggested by Okulitch (1943, p. 68).

In the Great Slave Lake area about 35 feet of sandstone resting on Precambrian is overlain by dolomitic limestone that contains Receptaculites sp. and cephalopods. The limestone is correlated with the Manitoba Ordovician strata by Hume (1926, p. 61). Hume (1925, p. 24) also has correlated the Liskeard formation of the Palaeozoic outlier of Lake Timiskaming with the Red River formation of Manitoba.

The Maquoketa (Richmondian) formation of Iowa and Illinois is correlated with the lower members of the Stony Mountain formation. The faunas and general lithologic character are strikingly similar.

Macauley and Leith (1951) show that there is a similarity between the Winnipeg and Red River-Stony Mountain faunas, thus indicating a relationship to these higher formations. Macauley[1] has shown that many of the forms present in the Winnipeg formation are evolutionary forerunners of the Red River and Stony Mountain forms, although few actual species are common throughout. He states that most of the species present in the Winnipeg formation also occur in the Galena (Trentonian) but that they indicate a degree of faunal development beyond that represented in the Trenton types.

The major lithologic units of the Winnipeg and Red River formations can be traced in the subsurface as far south as the Black Hills area and correlated with the Whitewood dolomite and the underlying green "Black River" shales and sandstones. The similarity of this lithologic section of the Black Hills area and the Middle Ordovician strata south of the Siouxia uplift strongly suggests that the mid-continent area and the Manitoba-North Dakota area were all part of one depositional province during Middle Ordovician time. Post-Ordovician uplift and subsequent erosion have removed these strata from much of North Dakota and Nebraska.

An interregional study of the stratigraphy of this large depositional province suggests the following sequence of geological events. Widespread emergence and erosion at the

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1 Personal communication

close of the Lower Ordovician throughout much of the central part of North America was followed by the unconformable deposition of Middle Ordovician strata on rocks ranging from Precambrian to Lower Ordovician. Whether Cambrian and Lower Ordovician strata were removed by erosion from the Manitoba area or whether these seas did not extend into Manitoba is not known.

Following the hiatus, the eroded area was slowly inundated by a transgressive sea that spread over the margins of the Canadian Shield. The resistant detrital material was repeatedly reworked and a thin veneer of clean, well-sorted quartzose sandstone formed the basal deposit over the unconformity. Sand dunes and littoral deposits were probably intermingled with the marine sediments and, in places, the sandstone may have a non-marine aspect although in general the environment of deposition is marine. Greater thicknesses are to be expected in low places of the eroded areas whereas on some of the highs the sandstone may be very thin or absent.

This widespread basal sandstone is represented by the St. Peter formation in Illinois and Iowa, by the lower part of the Simpson group in Kansas, and by the lower part of the Winnipeg formation in North Dakota and Manitoba. As all these sandstones represent the first deposition on the unconformity they are in that respect equivalent, although they may differ in age.

Following the deposition of the basal sandstone under generally stable conditions, parts of this great area began to subside more rapidly than others. Tectonic differentiation into basin and shelf areas can be recognized by the variation in thickness and the general character of the deposits. Basin deposits are generally darker in colour and are of mixed lithology. Basinal limestones are dense, argillaceous, and contain disseminated organic matter; shales are silty, and sandstones are silty and argillaceous. Shelf deposits are generally lighter in colour, are well bedded, and clastic units are better sorted. Shelf limestones are commonly fragmental and fossil fragments are abundant. Basin deposits are thicker than the corresponding shelf deposits and some relatively thick units in the basin may not appear to be present on the adjacent shelf. Basins are characterized by more or less continuous deposition whereas many unconformities and diastems are common on the shelf areas.

Middle Ordovician basin deposits are recognized in southern Illinois in the Illinois basin, and in North Dakota in the Williston basin. A comparison of the stratigraphy of these two basins and their adjacent shelf areas shows some interesting parallels and is an aid in understanding subsurface Ordovician stratigraphy of the Williston basin where few data are available.

In southern Illinois the pre-Galena post-St. Peter interval is 1100 feet thick, whereas the same interval in northern Illinois and Iowa is about 100 feet thick (Dubois, 1945).

Two formations, the Dutchtown and the Joachim, that consist of the dark shales, silty limestones, and impure sandstones typical of basin deposits are absent in northern Illinois and Iowa. The Platteville also thins towards the north and displays more shelf-like characteristics as it is traced from south to north. The stratigraphic section of the shelf area is relatively simple and consists of a basal sandstone overlain by a dark green shale that is in turn overlain by a light coloured limestone or dolostone. Contacts between lithologic units are sharp and there is evidence of unconformities. Ordovician strata have been eroded from much of the area that separates the Illinois and Williston basins but the sequence of strata on both sides of the eroded area is similar.

Near the Black Hills in South Dakota, a clean quartzose sandstone underlies a green shale which is overlain by a light coloured dolomite (Baker, 1947, p. 3). This Middle Orodovician section is unconformably overlain by Mississippian. In the Manitoba outcrop section northeast of the Williston basin, a similar Ordovician sequence is present overlain by the Stony Mountain formation. These shelf sequences when traced into the Williston basin thicken considerably and lithologic changes occur. Thus, the parallelism between the Ordovician outcrop areas of the Black Hills and Manitoba with the shelf successions of northern Illinois and Iowa is apparent.

The Winnipeg formation is about 100 feet thick in the outcrop section and 500 feet of sandstone corresponding in stratigraphic position to the Winnipeg formation is present in the Williston basin. In the Carter-Semling well it is represented by green shales, glauconitic sandstones, and sandy limestones (Ehlers, 1943). In the Carter North Pacific well in eastern Montana the equivalent of the Winnipeg formation consists of green shales, silty sandstones, and several limestone units some of which are sandy (Seager, 1942). When more subsurface data are available no doubt several formations will be named within the basin that are not present on the adjacent shelf areas.

The Red River formation also increases basinwards from about 250 feet in the outcrop area to more than 600 feet in the wells mentioned above. The lithology also changes basinwards, and shales, sandy limestones, and evaporites are present in the well sections.

The tectonic pattern of the two basins (Illinois and Williston) and adjacent shelf areas is no doubt similar but the contemporaneity of the tectonism is not definite. Additional faunal studies will probably aid in solving the age relationships.

The Time-Rock Correlation Chart (Figure 3) shows the probable time correlatives of the Ordovician outcrop section.

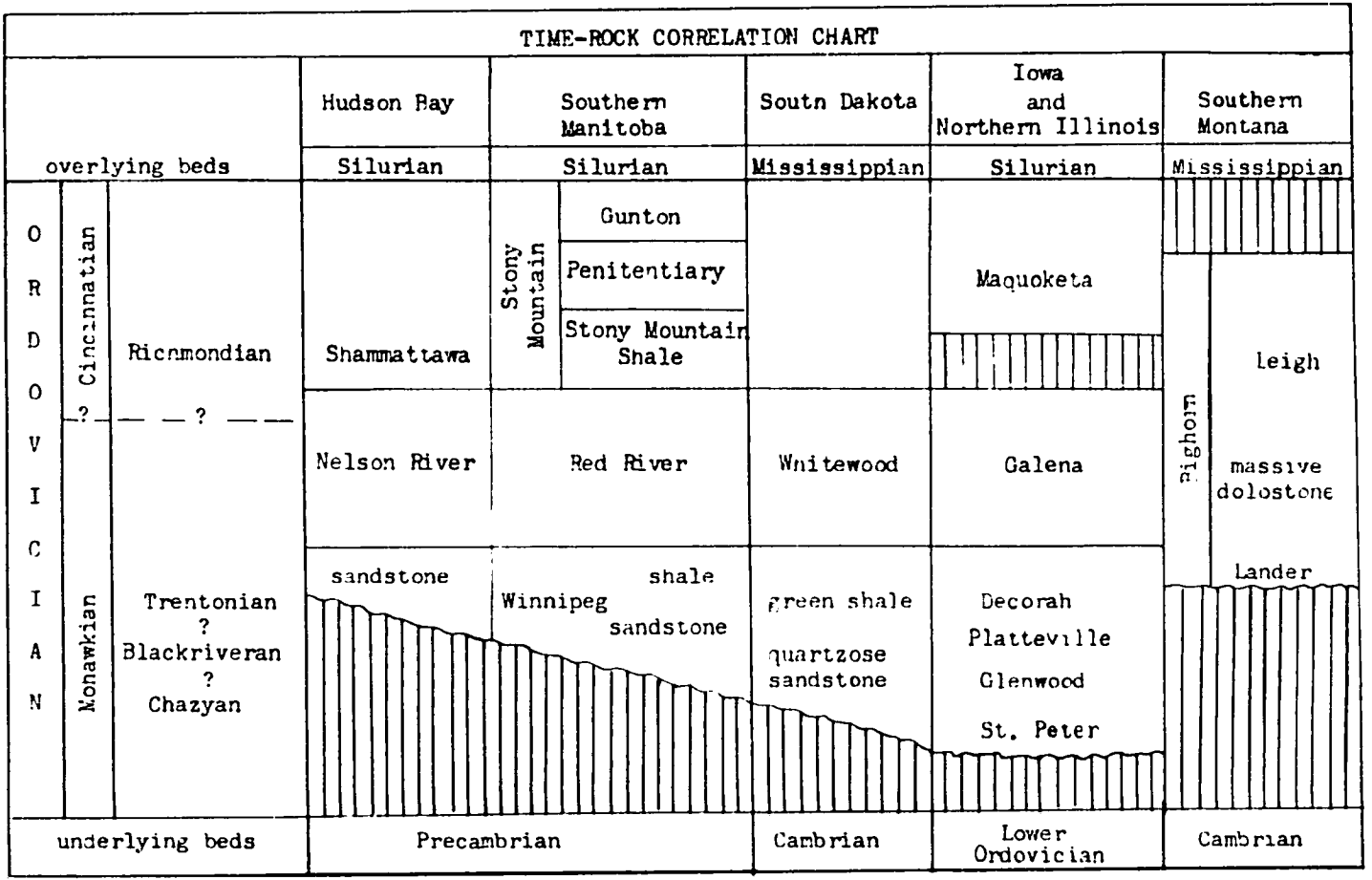

Figure 3. Time-rock correlation chart

MEASURED SECTIONS

Section 1

South shore of Black Island, Lake Winnipeg.

Cliff exposes 31 feet of white to yellowish grey quartzose sandstone in indistinct beds 1 foot to 3 feet thick. Quartz grains are generally frosted, well rounded, have fair sphericity, and range in size from 0.1 to 1.5 mm. The sandstone is poorly consolidated and friable. In places nodules of pyrite and iron oxide are present. The lowest bed exposed has a very undulating upper surface and contains quartz pebbles up to ½ inch in diameter.

Section 2

East side of Punk Island, Lake Winnipeg.

Cliff exposes 10 to 15 feet of sandstone similar to that described in Section 1. In places, upper few inches of beds is silty and ripple-marked.

Section 3

North shore of Punk Island, Lake Winnipeg, east side of prominent point; section poorly exposed.

Unit	Thickness Ft.	In.
6. Shale, greyish green (5G5/2)[1], blocky to splintery fracture	8	0
5. Argillaceous sandstone, grades upwards to a dark brown sandy shale	1	3
4. Argillaceous sandstone containing many nodules of pyrite, resistant bed	0	6
3. Argillaceous sandstone, soft and unconsolidated, poorly exposed	± 24	0
2. Sandstone, containing many pyrite oolites and nodules ..... exposed	2	0
200 feet east		
3a. Argillaceous silty sandstone	2	0

[1] The symbols in parentheses following a rock colour refer to the numeral designation used in the Rock Color Chart (1948) distributed by the National Research Council, Washington, D. C.

2a.	Sandstone and oolitic pyrite. Oolites show concentric banding and are in a matrix of very fine quartz silt; similar to Unit 2 above ..	± 3	0
1.	Quartzose sandstone poorly exposed	± 2	0
	Total thickness of section	± 38	9

A short distance east of Section 3 about 10 feet of Dog Head limestone is exposed 30 feet above lake level.

Section 4

South side of Black Island, Lake Winnipeg, about 4 miles from southwest corner.

4.	Silty sandstone, shades of grey, slightly argillaceous, well bonded by a silt and clay matrix; some iron sulphide nodules	4	2
3.	Argillaceous siltstone, medium light grey, smooth fracture, unevenly bedded; some iron sulphide nodules	1	8
2.	Silty sandstone, shades of grey, well cemented; oolites and nodules of iron sulphide make up 50 per cent of the bed	0	5
1.	Quartzose sandstone, yellowish orange, fairly well cemented, slightly friable, fine to medium-sized grains, well rounded ..... exposed	0	10
	Total thickness of section	7	1

Section 5

Deer Island, Lake Winnipeg, north extremity of island.

Dog Head member, Red River formation

7.	Dolomitic limestone, impure greyish orange and dark yellowish grey, crystalline with many fossil fragments, in 4- to 6-inch beds	10	0 +
6.	Dolomitic limestone, as above with iron sulphide nodules and thin silty partings; quartz grains		

	abundant; contains dark grey streaks of disseminated pyrite. Lower 6 inches is very dark grey and nodular and makes sharp contact with underlying sandstone	4	6
	Winnipeg formation		
5.	Argillaceous sandstone, pale greenish yellow (10Y8/2) to greyish orange (10YR7/4), friable, poorly cemented with iron oxide, many worm-like tubes of sand in an argillaceous matrix	1	6
4.	Quartzose sandstone, fine to medium, poorly consolidated, discoloured by iron oxide nodules	4	5
3.	Quartzose sandstone with clay partings 1 inch to 2 inches thick, friable, some beds are well consolidated with a carbonate cement; some pyrite nodules	5	5
2.	Shale, greyish green (5G5/2), soft and plastic, similar to underlying shale but contains no arenaceous bands	4	3
1.	Shale, dark greenish grey (5G4/1), non-calcareous, breaks in laminae 2 to 3 mm. thick, contains many thin bands and nodules and worm-like tubes of sandstone with carbonate cement. Iron sulphide nodules and dark brown phosphatic pellets are common. Fossils are present in shale and sandstone .... exposed	9	7
	Total thickness of section	39	8

Section 6

Deer Island, Lake Winnipeg, ½ mile southeast of Section 4.

7.	Shale, dark greyish green, breaks in laminae 1 to 2 mm. thick, contains many thin partings of sandstone; fossiliferous - bracniopods, gastropods, and pelecypods	5	0
6.	Sandstone, well consolidated with calcareous cement; contains phosphatic nodules and small masses of pyrite crystals	1	0

5.	Sandstone, pale reddish brown (10R5/4), very soft and friable with clay matrix, contains bands and pockets of clay	6	0
4.	Shale, similar to Unit 7 above	7	6
3.	Sandstone, contains many pyrite nodules and disseminated pyrite, very resistant bed; upper 4 inches is softer and contains pockets of soft green clay	1	8
2.	Sandstone, light grey, in thin irregular beds, poorly cemented with a clay matrix	1	0
1.	Sandstone, greyish yellow, in 6- to 12-inch beds, well consolidated with a matrix of quartz silt and iron oxide cement, forms a resistant ledge ..... exposed	3	0
	Total thickness of section	25	2

Section 7

Grindstone Point, Lake Winnipeg, 200 feet south of point.

Dog Head member, Red River formation

8.	Dolomitic limestone, impure greyish orange to yellowish grey, fossiliferous, lower 6 inches is nodular, dark grey and contains iron sulphide; makes sharp contact with underlying unit	14-20	
7.	Sandstone, greyish yellow, soft and unconsolidated, contains many greyish green shaly partings 1/8 inch to 3 inches thick, locally cross-bedded	12	0
6.	Shale, dark greenish grey, contains many nodules and lenses of sandstone cemented by carbonate. In general, the unit is about 75 per cent shale but may grade laterally to a sandstone with many shaly partings	14	0
5.	Sandstone, dark greyish brown, many shaly partings	2	0
4.	Shale, dark greenish grey, fissile to blocky, contains iron sulphide	0	4

3.	Pyritiferous band with some sand and silt. Pyrite is in nodules and disseminated	0	4
2.	Sandstone, soft and friable, dark grey to dark orange, contains considerable iron sulphide and oxide	2	10
1.	Quartzose sandstone, massive to thick-bedded, silty matrix, forms a resistant ledge ..... exposed	4	0
	Total thickness of section	49	6

Section 8

Little Grindstone Point, Lake Winnipeg, northwest of Deer Island.

3.	Dolomitic limestone similar to lower Dog Head beds on Deer Island	4	4
2.	Argillaceous sandstone, much discoloured by iron oxide, unevenly bedded, along bedding planes are many calcite prism-like structures which may be organic. Upper 1 inch of unit is packed with large pelecypods ...	1	4
1.	Sandstone, poorly cemented with calcareous cement, nodular in part; contains some shaly bands ..... exposed	4	7
	Total thickness of section	10	3

Section 9

Mile 56.2, Flin Flon Highway, south of Cranberry Portage.

3.	Dolostone, yellowish grey faintly mottled to greyish orange, medium crystalline, in 8- to 10-inch beds	2	0
2.	Arenaceous dolostone, mottled as above, in 3- to 7-inch beds, fossiliferous, brachiopods and Receptaculites sp.	2	0
1.	Quartzose sandstone, yellowish brown, medium to fine-grained, dolomitic and iron oxide cement,		

quartz silt matrix, fossiliferous, horn corals and Receptaculites sp. ..... exposed	2	0
Total thickness of section	6	0

Section 10

Northwest extremity of Hecla Island, Lake Winnipeg.

3. Dolomitic limestone, olive grey mottled to greyish yellow, crystalline to fossiliferous, fragmental, slightly nodular, in 3- to 5-inch beds; thin shaly partings at 2-foot intervals; lower 8 inches is silty and argillaceous	8	9
2. Argillaceous and silty dolomitic limestone, very nodular, contains nodules and aggregations of iron sulphide	0	6
1. Sandstone, poorly cemented with carbonate, grains are fine to medium and well rounded	0	6
Total thickness of section	9	9

Ten feet below the above section about 3 feet of blue-green shale underlain by sandstone is exposed.

Section 11

North side of Hecla Island at abandoned quarry; sec. 27, tp. 25, rge. 6, E. Principal mer.

4. Limestone, yellowish grey mottled to pale greyish yellow, sub-fragmental, many fossil fragments in a medium-grained matrix, in 3- to 5-inch beds, bedding planes uneven and nodular	6	5
3. Limestone as above, some iron sulphide nodules, pale greyish yellow, mottles are more crystalline than matrix and contain small rhombs of dolomite in a calcitic matrix	5	9
2. Limestone, medium grey indistinctly mottled to greyish orange, texture as above, contains many aggregates of iron sulphide	4	4

1.	Limestone, medium to dark grey, medium-grained, much disseminated iron sulphide ..... exposed	0	8
	Total thickness of section	17	2

Section 12

North shore of Black Bear Island, Lake Winnipeg.

4.	Dolomitic limestone, light yellowish grey, medium crystalline to sub-fragmental, contains some fossil fragments and poorly preserved fossils, in 3- to 8-inch beds; scattered iron sulphide nodules; many vertical fractures	14	0
3.	Dolomitic limestone, yellowish grey mottled to greyish orange, sub-fragmental, numerous fossil fragments and many crinoid columnals altered to clear calcite in a matrix of small dolomite crystals	4	3
2.	Dolomitic limestone as above, prominent bedding planes at top and bottom of this unit	5	8
1.	Dolomitic limestone, dark yellowish grey, faintly mottled to pale greyish orange, sub-fragmental, many fossil fragments, scattered nodules of pyrite, slight argillaceous residue	5	0
	Total thickness of section	28	11

Section 13

Southwest extremity of Elk Island, Lake Winnipeg.

4.	Dolomitic limestone, light olive grey mottled to dusky yellow, slightly nodular, crystalline to fragmental, in thin uneven beds 2 to 3 inches thick; brachiopods and gastropods	3	0

3.	Dolomitic limestone, yellowish grey, argillaceous, some shaly partings, contains many pits filled with iron oxide, nodular as above	3	0
2.	Dolomitic limestone, light grey mottled to greyish orange; light grey areas are crystalline to fossiliferous-fragmental, greyish orange areas more crystalline and dolomitic, becomes shaly toward top of unit	1	11
1.	Dolomitic limestone, medium grey (N5) to greenish grey (5GY6/1), texture as above, containing nodules of iron sulphide, in 3- to 6-inch beds; well preserved fossils ... exposed ..	6	11
	Total thickness of section	14	10

On the mainland one and a half miles south of Elk Island, large blocks of limestone similar to the Dog Head member are found along the shore. Fossiliferous shales and sandstones of the Winnipeg formation are exposed at this locality during times of extremely low lake level.

Section 14

Cat Head, Lake Winnipeg.

3.	Dolostone, light yellowish grey slightly mottled to yellowish grey, medium saccharoidal to medium crystalline, in beds 2 to 3 feet thick, contains scattered nodules of chert and disseminated flakes of hematite, uneven texture that results in an irregular weathered surface; some fossils and fossil fragments	20	0
2.	Dolostone, light yellowish grey, saccharoidal to medium crystalline, in 5- to 12-inch beds, contains some finely sub-fragmental beds that show an indefinite lamination, contains chert nodules that are less abundant in the fragmental beds	12	0
1.	Dolostone, light yellowish grey to very pale yellowish brown, finely saccharoidal, laminated appearance, in beds up to 30 inches thick, contains abundant irregular chert nodules as much as one foot long. Nodules are more abundant along bedding planes but may occur within		

the beds. Laminations are sometimes continuous through the chert nodule but may be curved around it	11	8
Total thickness of section	43	8

Section 15

Gillis quarry, near village of Garson; ls. 13, sec. 3, tp; 13, rge. 6, E. Principal mer.

6.	Dolomitic limestone, yellowish grey mottled to greyish orange, yellowish grey areas are fragmental to sub-crystalline and contain many fossil fragments altered to calcite, greyish orange areas are medium crystalline and are composed of many small dolomite rhombs in a calcitic matrix, in 3- to 10-inch beds	5	7
5.	Dolomitic limestone, texture as above, in beds as much as 3 feet 6 inches thick, fossiliferous, many large colonial corals, Receptaculites sp. and gastropods, occasional large laminated masses resembling stromatoporoid or algal material, contains nodules of white chert that are generally decomposed to a white chalky material	6	0
4.	Dolomitic limestone, dark yellowish grey mottled to pale yellowish brown, texture as above, in beds 2 to 5 feet thick, many stylolitic bedding plane surfaces, fossiliferous as above, scattered vugs filled with calcite	4	9
3.	As above, mottling less distinct; some white chert nodules	1	10
2.	As above, in indistinct beds one foot thick	2	9
1.	Dolomitic limestone, dark yellowish grey mottled to pale yellowish brown, fragmental to sub-crystalline as above ..... exposed	4	9
	Total thickness of section	25	8

According to Wallace (1925, p. 18) bore-hole information indicates a thickness of 97 feet for the Selkirk member at this locality.
The lower 62 feet is thin-bedded and argillaceous.

Section 16

Two miles north of Robinson Point, Lake Winnipeg from Dowling, 1900, p. 87F).

4.	Thick and evenly bedded, even grained yellow dolomitic limestone ..... Thin band holding considerable quantities of pyrite.	28	0
3.	Thin-bedded limestone, generally hard but with many pits or impressions of salt crystals	4	0
2.	Yellow, porous, thick-bedded limestone	2	0
1.	Moderately thin-bedded blue clayey limestone ...	1	0
	Total thickness of section	35	0

Section 17

South shore of South Bay, Lake Athapapuskow.

4.	Dolostone, yellowish grey to very pale yellowish brown, fine to medium crystalline, in irregular beds 10 to 18 inches thick	14	0
3.	As above, in 3- to 8-inch beds	8	0
2.	Dolostone, pale yellowish brown, medium crystalline, scattered vugular porosity associated with indistinct fossil remains, in 1- to 2-foot beds	20	0
1.	Dolostone, greyish yellow, slightly mottled to yellowish grey, medium crystalline, bedded as above, irregular texture, intergranular and poor vugular porosity; some poorly preserved bracniopods ..... exposed	8	0
	Total thickness of section	50	0

Section 18

City of Winnipeg quarry, Stony Mountain; sec. 14, tp. 13, rge. 2, E. Principal mer.

Gunton member

8.	Dolostone, very pale orange, faintly mottled, finely crystalline, in indistinct beds 3 to 7 inches thick, lower inch of unit is slightly argillaceous	7	1
7.	Dolostone, light yellowish grey, finely crystalline, very hard and resistant, in beds 1 foot to 3 feet thick; some beds have a brecciated appearance; scattered salt crystal impressions; slightly porous bands associated with poorly preserved fossils	10	6
6.	Dolostone, pale greenish yellow faintly mottled to pale yellowish orange, finely crystalline, in poorly defined beds 8 to 12 inches thick	2	0

Penitentiary member (main floor of quarry)

5.	Slightly argillaceous dolostone, strikingly mottled, light greyish green to reddish brown and purple, finely crystalline, in thin uneven beds 3 to 5 inches thick; many fossil molds and impressions	± 8	0
4.	Dolostone, dusky yellow to greyish orange, argillaceous, slightly calcitic, in 4- to 8-inch beds abundant molds and casts of fossils	6	11
3.	Argillaceous, calcitic, dolostone to calcareous shale, dusky yellow; many fossils and fragments of clear calcite; upper few inches is an ocherous calcareous shale	6	5

Stony Mountain Shale member

2.	Argillaceous limestone to calcareous shale, dusky yellow, in thin uneven nodular beds, soft and friable; many fossils and fossil fragments of clear calcite	?	1
1.	Calcareous shale, pale red and greenish yellow with many dark streaks, in thin uneven beds one inch to two inches thick; contains thin bands		

of grey to pale red medium crystalline limestone. Many well preserved fossils are in the shale and fossil fragments are abundant throughout	8	1
Total thickness of section	51	1

Section 19

Gunton quarry; SE¼ of sec. 28, tp. 15, rge. 2, E. Principal mer.

Gunton member

9. Dolostone, greyish yellow, finely crystalline, in 3- to 4-inch beds, upper bed is 16 inches thick, scattered porosity associated with poorly preserved fossils; drusy dolomite in vugs ..	11	1
8. Dolostone, greyish yellow to pale red, finely crystalline, nodular, nodules are surrounded by greyish green clay films	0	10
7. Dolostone, greyish yellow, finely crystalline, in 2- to 3-inch beds; slightly porous band near bottom of unit which appears brecciated	2	9
6. Dolostone, greyish yellow, in well-defined beds 6 to 10 inches thick, some beds are slightly nodular and are pale red in places; scattered vugular porosity as above, occasional nodules of grey chert	5	8
5. Dolostone, greyish yellow to shades of pale red, finely crystalline, bedding planes uneven and nodular; weathered surface is nodular	1	4
4. Dolostone, yellowish orange to greyish orange, finely crystalline, in 3- to 8-inch beds, some beds slightly nodular	4	9

Penitentiary member

3. Argillaceous dolostone, shades of greyish green, orange and pale red, many dark purple bands and streaks, in irregular indistinct beds; scattered fossils	6	10

2.	Argillaceous dolostone, colour as above, more argillaceous than above, fissile in places	3	7
1.	Argillaceous dolostone, dusky yellow with shades of red, in poorly defined beds; abundant fossil molds and casts ... exposed	6	0
	Total thickness of section	42	10

Section 20

Little Stony Mountain; ls. 3, sec. 34, tp. 11, rge. 2, E. Principal mer.

Gunton member

6.	Dolostone, pale yellowish brown faintly mottled to greyish yellow, finely crystalline, in beds one inch thick, few scattered vugs	3	0
5.	Dolostone, greyish yellow with shades of pink, finely crystalline; some poorly preserved fossils	6	5
4.	Dolostone, light yellowish grey, finely crystalline, in beds as much as 20 inches thick, fair porosity; several poorly preserved colonial-type corals	2	7
3.	Dolostone as above, in 4- to 6-inch beds, very hard and resistant, upper few inches is brecciated.....	3	0
	.....covered.....	± 2	0

Penitentiary member

2.	Argillaceous dolostone, dusky yellow mottled in places to red and purple, fossiliferous, many external and internal molds, nodular in places	3	9
1.	Argillaceous dolostone, dusky yellow to yellowish orange, highly fossiliferous as above, in thin uneven beds 2 to 3 inches thick, soft and friable in places ..... exposed	0	11
	Total thickness of section	21	8

Section 21

Winnipeg Supply and Fuel Company Limited quarry at Stonewall; description of bore-hole section.

Depth in Feet

SILURIAN

Stonewall Formation

0 - 1 Dolostone, white to greyish yellow, finely crystalline, few scattered vugs; occasional iron stain

1 - 4 Dolostone, light yellowish grey, finely crystalline, scattered vugs; some salt crystal impressions

4 - 5 As above, some scattered vugs; corals ?

5 - 7 As above, very light yellowish grey to greyish yellow

7 - 9 Dolostone, light yellowish grey, finely crystalline, partly fragmental, more porosity than above

9 - 10 As above, greyish yellow with more pyrite and iron oxide; some pyrite nodules

(Main quarry floor)

10 - 12 Dolostone, very pale orange to greyish orange (10YR7/3), crystalline; some small pyrite crystals

12 - 13 Dolostone, pale red to pale yellowish orange, and streaks of greyish red purple, some fine nodular structures (This represents the nodular reddish bed that is exposed on the floor of the quarry in places and also at the pit section near No. 1 Lime plant; Baillie, 1951, p. 10)

13 - 14 Dolostone, pale greyish orange (10YR8/5), crystalline, fair vugular porosity probably due to corals although highly recrystallized

15 - 17 Dolostone, brownish orange (10YR7/3), crystalline, scattered vugular porosity

17 - 19 As above and arenaceous dolostone to dolomitic sandstone, yellowish grey, quartz grains are fine to very fine, also quartz silt

Stony Mountain Formation

Gunton member

19 - 21 Dolostone, very pale red to greyish orange pink

21 - 23 Very argillaceous and silty dolostone to dolomitic shale, very pale red

23 - 25 Argillaceous to silty dolostone, pale reddish brown mottled to greyish orange, shaly in places

25 - 27 As above, contains flecks of greyish purple

27 - 29 Arenaceous dolostone, light yellowish grey, 10-15% quartz grains, very fine, well rounded
29 - 31 As above, 5-10% of very fine quartz, dolostone is medium crystalline; quartz occurs as scattered grains and in bands and streaks
31 - 33 As above, light yellowish grey to moderate orange, some purple flecks; quartz is unevenly distributed and may occur as aggregates of grains
33 - 35 Dolostone, light yellowish grey, few red streaks, slightly arenaceous, dense to finely crystalline
35 - 38 Dolostone, light yellowish grey to very pale orange, dense to finely crystalline, scattered vugs
38 - 42 Dolostone, as above, finely crystalline; scattered small nodules of pyrite
42 - 51 As above, very light yellowish grey, finely crystalline
51 - 59 As above with some slight pinkish tinge
59 - 61 Dolostone, greyish yellow to shades of pale red, crystalline
61 - 63 Dolostone, light yellowish grey to very pale orange, crystalline
63 - 65 Dolostone, very pale orange to shades of pale red, crystalline; occasional nodule of pyrite
65 - 69 Dolostone, pale greyish orange mottled to pale red, crystalline

Penitentiary member

69 - 72 Dolostone, slightly argillaceous, dusky yellow to greyish orange, soft and crumbly

Section 22

Drainage channel, 1½ miles east, 2¼ miles south of Hodgson; NW¼ of sec. 22, tp. 25, rge. 1, W. Principal mer.

3.	Argillaceous calcitic dolostone, dirty greyish orange to greyish red, in 1- to 4-inch beds, highly fossiliferous, brachiopods, pelecypods, graptolites, and gastropods; contains many shaly partings	3	0
2.	As above, brownish grey; abundant fossils and fossil fragments	1	0
1.	Dolostone, greyish orange and light grey, finely crystalline, very hard and resistant, fragmental in part; small aggregates of pyrite .... exposed	1	4
	Total thickness of section	5	4

Section 23

1½ miles east, 0.9 miles south of Hodgson; S½ of sec. 33, tp. 25, rge. 1, W. Principal mer.

3.	Dolostone, slightly argillaceous, dusky yellow to pale sec, in 4- to 5-inch beds, contains fossils similar to those present in lower members of Stony Mountain formation	± 2	0
2.	Argillaceous dolostone, slightly calcitic, varicoloured, nodular, fossilifersou as above	± 2	0
1.	Dolostone, pale yellowish orange, very finely crystalline, nodular; poorly peeserved fossils .	± 2	0
	Total thickness of section	± 6	0

Section 24

13 miles east, 4 miles north of Fisher Branch; SW¼ of sec. 7, tp. 25, rge. 2, E. Principal mer.

2.	Calcitic dolostine, greyish orange, fine to medium crystalline, uneven texture, fair vugular and intergranular porosity, contains many irregular nodules of white partly weathered chert, brecciated appearance, fossiliferous, Paleofavosites ? sp., Streptelasma robustum ?, and Calapoecia canadensis	± 7	10
1.	As above with more regular bedding, less brecciated ..... exposed	1	0
	Total thickness of section	8	10

Fossiliferous argillaceous strata of the Stony Mountain formation outcrop about a mile south of this locality and probably overlie the strata of section 24.

Section 25

7½ miles east of Fisher Branch; S½ of sec. 19, tp. 24, rge. 1, E. Principal mer.

8.	Dolostone, light yellowish grey, finely crystalline, in 5- to 8-inch beds; poorly preserved corals present	4	9
7.	Dolostone, very pale orange, some pale red tinges, medium to finely crystalline, few scattered vugs	2	0
6.	Dolostone, pale yellowish orange and red, streaks of purple, nodular, uneven fracture	1	0
	.....covered	3	0

5.	Dolostone, pale yellowish orange to pale red, finely crystalline, slightly nodular, in poorly defined beds 3 to 5 inches thick	2	9
4.	Dolostone as above, resistant bed forms top of escarpment	1	2
3.	Argillaceous dolostone, pale yellowish orange, nodular, less resistant than overlying and underlying beds	1	10
2.	Dolostone, greyish orange, dense to finely crystalline, in 6- to 8-inch beds, contains small chert nodules	1	10
1.	Dolostone, dusky to greyish yellow, in thin beds, slightly argillaceous, nodular, much irregular colour banding and "bird's eye" structures ..... exposed	2	0
	Total thickness of section	20	4

Section 26

Escarpment 2 miles east, 6 miles north of Fisher Branch; NE¼ of sec. 18, tp. 25, rge. 1, W. Principal mer.

5.	Dolostone, very pale orange, finely crystalline, in thin uneven beds, scattered vugs lined with drusy dolomite	3	4
4.	Dolostone, shades of pale red, mottled with "bird's eye" structure, nodular	2	0
3.	Dolostone, very pale orange to pale yellowish brown, finely crystalline, contains abundant small chert nodules, in 4- to 6-inch beds	2	2
2.	As above, in thin nodular beds, argillaceous material around nodules, contains many small chert inclusions	2	1
1.	Dolostone, yellowish grey to greyish yellow, finely crystalline, in thin uneven beds, slightly nodular, few scattered vugs, poorly preserved fossils ..... exposed	2	9
	Total thickness of section	12	4

Section 27

Small escarpment on highway near forestry tower; 4½ miles north of Fisher Branch; ls. 5, sec. 7, tp. 25, rge. 1, W. Principal mer.

About 6 inches of pale red silty dolostone that contains 5-20% of very fine quartz sand to quartz silt, overlain by very pale orange finely crystalline dolostone.

Section 28

Namew Lake, north side of island, southeast of Sturgeon Landing.

12.	Dolostone, yellowish grey to light olive grey, finely to medium crystalline, in 2- to 12-inch beds, weathered surface shows that the rock contains many finely comminuted fossil fragments including many crinoid stems	15	6
11.	Dolostone, yellowish grey with some pale red streaks, finely crystalline, in beds one foot to two feet thick	8	9
10.	Dolostone, yellowish grey and shades of pale red, dense to finely crystalline, slightly nodular, in thin uneven beds	6	4
9.	Dolostone, yellowish grey with many purple streaks and mottled, finely crystalline, in beds up to 3 feet 6 inches thick, contains scattered fossils including horn corals	5	3
8.	Dolostone, greyish orange to pale yellowish brown, medium crystalline, in 2- to 6-inch beds, beds are irregular and pinch and swell, fair vugular porosity, fossiliferous; lower few inches contains nodules of chert and the rock surrounding the nodules is silicified in part	5	7
7.	Argillaceous dolostone, light grey to pale red, breaks in blocky fragments, argillaceous content varies and here and there the unit approaches a shale	2	6
6.	Slightly argillaceous dolostone, pale red and grey, dense; weathered surface shows laminations	0	10

5.	Dolomitic claystone to argillaceous dolostone, yellowish grey to pale red, breaks in blocky fragments	0	7
4.	Slightly argillaceous dolostone, yellowish grey, lower 2 inches is soft and fissile ..	1	2
3.	Dolostone, pale yellowish brown, dense to lithographic, conchoidal fracture, in indistinct beds 2 to 6 inches thick	4	9
2.	Dolostone, pale yellowish brown, dense to finely crystalline, scattered vugular porosity	2	5
1.	Dolostone, light yellowish grey, finely saccharoidal .....exposed	0	6
	Total thickness of section	54	2

Section 29

North shore of Rocky Lake.

5.	Dolostone, very pale orange and shades of pale red, finely crystalline, nodular fracture, in 3- to 8-inch beds	12	0
4.	Dolostone, yellowish grey to pale greyish orange, finely crystalline, slightly nodular, contains occasional large dolomite rhombs..	4	3
3.	Dolostone, very pale orange to greyish orange, medium crystalline, in beds 3 to 4 feet thick, weathered surface shows that the rock contains many finely comminuted fossil fragments	8	0
2.	Dolostone, very pale brownish grey, medium crystalline, poorly preserved horn and tabulate corals	2	3
1.	Dolostone, very pale brownish grey with streaks of pale red, slightly mottled, some "bird's eye" structure, finely crystalline, in 1- to 3-foot beds; one bed near base of unit contains favositid coral and cephalopods	4	6
	Total thickness of section	31	0

Section 30

Mile 39, Hudson Bay Railway.

About 20 feet of dolostone outcrops at mile 39. The upper 12 feet is well exposed in an abandoned quarry and consists of light olive grey and pale red dense dolostone in beds as much as 3 feet thick. The rock is very hard and takes a brilliant polish. Between 1929 and 1939 these beds were quarried at times to obtain a decorative "marble".

Section 31

Mile 86.7, Hudson Bay Railway.

Cliffs from 14 to 20 feet high outcrop along the north shore of Hargrave Lake near mile 87, Hudson Bay Railway. The cliffs are composed of pale red mottled to olive grey dolostone in beds 1 foot to 4 feet thick. On the fresh surface the texture is finely crystalline but the weathered surface shows the presence of many finely comminuted fossil fragments. A few poorly preserved corals and a cephalopod were seen.

Section 32

Mile 25.7, Flin Flon Highway.

6.	Dolostone, pale yellowish brown, fragmental, some areas conglomeratic containing rounded finely crystalline dolomitic pebbles, fairly porous; patches of greyish green clay in some vugs	± 6	0
5.	Dolostone, dark yellowish orange (10YR6/6), dense to finely crystalline, in thin uneven beds 1 to 2 inches thick	6	0
4.	Dolostone, pale yellowish brown mottled to dark yellowish orange, crystalline, massive, fair to good vugular porosity, friable in places, fossiliferous with many tabulate corals	± 6	0
3.	Argillaceous dolostone, pale red to pale olive with streaks and patches of purple, bedding indistinct; grades upwards to a light olive grey finely crystalline dolostone containing a few flecks of hematite	2	3
2.	Poorly consolidated brownish red claystone	± 0	5

1.	Dolostone, olive grey to pale red, dense to finely crystalline, in beds as much as 8 inches thick; in places the rock is fractured and the fractures are filled with shale and clay. These beds have local dips of as much as 20° ... . exposed	1	6
	Total thickness of section .....±	22	2

Section 33

Description of diamond drill core, 565-1080 feet, Hudson Bay Mining and Smelting Mafeking No. 1; sec. 14, tp. 44, rge. 25, W. Principal mer.

(Core descriptions, 700-1080 feet, taken from written logs supplied by Geological Survey of Canada).

Depth in Feet

565 - 585	Dolostone, yellowish grey, dense to finely crystalline; a few inclusions of iron sulphide
585 - 600	Dolostone, yellowish grey, finely crystalline; inclusions of tripolitic chert
600 - 604	Core missing
604 - 610	Dolostone, yellowish grey to pale yellowish brown, dense to finely crystalline; some small pyrite crystals
610 - 625	Dolostone, yellowish grey, finely crystalline, poor intergranular porosity, some salt crystal impressions
625 - 635	Dolostone, light yellowish grey, medium crystalline, slightly porous; poorly preserved Streptelasma and favositid coral
635 - 640	Dolostone, bluish grey, argillaceous with angular fragments of yellowish grey dolostone, contains many large rounded quartz sand grains; where quartz is abundant the matrix is composed mostly of silt or clay

ORDOVICIAN (?)

640 - 645	Dolostone, yellowish grey, medium crystalline to finely saccharoidal; streaks and patches of bitumen
645 - 650	Dolostone, yellowish grey, crystalline, fair vugular porosity
650 - 659	Dolostone, yellowish grey, crystalline, vugular porosity, some large vugs lined with white crystalline chert

659 - 664	Dolostone, yellowish grey, crystalline, good vugular porosity
664 - 672	Dolostone, bluish grey mottled to dark grey, argillaceous
672 - 675	Dolostone, olive grey to pale red, dense even texture (similar to the "marble" at Mile 39, Hudson Bay Railway)
675 - 700	Dolostone, pale yellowish brown to yellowish grey, finely crystalline; some shaly partings
700 - 750	Dolostone, very pale yellowish brown, finely crystalline with bituminous partings and argillaceous streaks, partings are irregular and do not follow bedding planes
750 - 775	Dolostone, light grey, dense to finely crystalline; much irregular lamination
775 - 795	Argillaceous dolostone, many angular inclusions of greenish grey chert and argillite
795 - 800	Dolostone, light brown, many shaly partings, brecciated

Red River Formation (?)

800 - 830	Dolostone, pale yellowish brown, irregular texture, mottled, slightly porous
830 - 850	Dolostone, pale yellowish brown with darker mottles; lower few feet has greenish mottles and fair porosity
850 - 900	Dolostone, pale yellowish brown with greenish grey mottles; many irregular green streaks and "bird's eye" structures
900 - 925	Dolostone, very pale yellowish brown with pale yellowish brown mottles, scattered porosity
925 - 975	As above, mottling is darker and has irregular outline
975 - 1000	As above, but less distinctly mottled; coarsely costate brachiopod (Rhyncotrema ?) common
1000 - 1020	Dolostone, pale yellowish brown, irregularly mottled to yellowish brown, finely crystalline; at 1020' thin streaks of black bituminous sandy shale

Winnipeg Formation

1020 - 1025	Dolomitic sandstone, fine to medium grained; contains pyrite and bituminous material
1025 - 1050	(Poor recovery) Interbedded sandstone, grey shale and silt

1050 - 1075	Grey shaly sandstone with many nodules of iron sulphide
1075 - 1080	White quartzose sandstone

ECONOMIC GEOLOGY

The Red River formation has been the source of a high quality building stone since 1832. Prior to 1900 most of the stone was obtained from quarries at East Selkirk and from outcrops along the banks of the Red River. Since 1900 the stone has been quarried in the vicinity of Garson and Tyndall and the attractively mottled "Tyndall stone" from these quarries is well known and is marketed throughout Canada.

The Stony Mountain formation is the source of considerable crushed stone that is used for concrete aggregate and road ballast. A large quarry and crusher plant is operated by the City of Winnipeg at Stony Mountain. The Penitentiary member beds exposed in this quarry are strikingly mottled and in recent years have been in demand as a decorative building stone.

Crushed stone, rubble, and some stone suitable for making lime was also obtained from quarries south of Gunton, northeast of Stonewall, and northwest of Winnipeg. These quarries are not operating at present.

The varicoloured mottled dolostone of the Gunton member has been quarried for "marble" as the stone takes an excellent polish. Large blocks are difficult to quarry as the apparently thick beds tend to part along incipient bedding planes. Abandoned "marble" quarries are located a few miles south of Hodgson and at miles 39 and 69.5, Hudson Bay Railway.

A full description of all the quarries is contained in the report "Limestones of Canada" by Goudge (1944). Quarrying methods, chemical analyses, and stone properties are included in the report.