

GEOLOGICAL SURVEY OF CANADA

ROBERT BELL, M.D., D.Sc., LL.D., F.R.S., DIRECTOR.

REPORT

ON THE

GEOLOGY

AND

NATURAL RESOURCES OF THE AREA

INCLUDED IN THE

MAP OF THE CITY OF OTTAWA AND VICINITY

BY

R. W. ELLS, LL.D., F.R.S.C.



OTTAWA

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ROBERT BELL, M.D., D.Sc., LL.D., F.R.S.,
Director, Geological Survey of Canada.

SIR,—I beg to submit herewith a report on the Geology and Natural resources of the area included in the map of Ottawa city and vicinity. This map is on a scale of one mile to an inch, and is nearly in the form of a square, being twenty by twenty-two and a half inches, embracing a total area of 450 square miles, the city of Ottawa being taken as the central point. The geological structure is in places rendered quite complicated by the presence of several faults, some of which are of considerable extent, while over much of the district there are heavy deposits of clay and sand, which conceal the underlying rocks. In this case, information has been obtained by wells and by bore-holes, which have been sunk to the rock formation, and in some cases have penetrated these for several hundred feet. The accompanying lists of fossils, to illustrate the palæontology of the area, have been prepared by Dr. H. M. Ami.

I have the honour to be, sir,
Your obedient servant,

R. W. ELLS.

OTTAWA, September 26, 1901.

NOTE.—*The bearings given throughout this report refer to the true meridian.*

REPORT
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MAP OF THE CITY OF OTTAWA AND VICINITY

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The accompanying map of Ottawa city and vicinity is one of a series, contemplated for some years by the Geological Survey and intended to depict the geology and topography of the leading cities of eastern Canada. The topographical portion was commenced some years ago by the late chief-draughtsman, Mr. Scott Barlow. On his death, the work was taken up by his successor, Mr. James White, by whom the principal points in the compilation were determined, and the final compilation has been done by the present chief-draughtsman, Mr. C. O. Senécal. The necessary surveys have been made from time to time by different members of the staff, including the gentlemen mentioned, and completed by the writer of this report, in connection with his work in the areas along the Ottawa river, while large collections of fossils have been made throughout the area by Dr. H. M. Ami and others.

Compilation
of the map.

The locality represented is a most interesting one from a geological standpoint. All the Palæozoic formations are present in the district from the base of the Potsdam sandstone to the Medina, and most of these are highly fossiliferous. The area more immediately about Ottawa has been affected by a great series of disturbances which have produced complications of structure through faults and foldings of the strata. Some of these dislocations are merely local displacements, but several are of greater vertical extent, affecting all the formations to the top of the Lorraine. That other overlying formations at one time existed in the area, may be inferred from the presence of

Formations
represented.

isolated patches of red shales, now resting upon the Lorraine, and regarded as of Medina age. These outcrops of the Medina are, for the most part, situated a short distance to the south-east of the map-sheet, but one small area of the red shales is found in the bed of a brook near the south-east angle.

Drift.

Much difficulty has been found in the attempt to accurately map the several geological boundaries throughout the area owing to a very widespread mantle of drift. This consists largely of clay and sand, the thickness of which is in some places very great. This feature will be readily seen from the description of a number of bore-holes made quite recently in the country south of the Ottawa river.

Area included in map and report.

The area of the map-sheet is 450 square miles, the city of Ottawa being taken as the centre. It includes in the province of Quebec, portions of the townships of Hull and Templeton, and in Ontario, which lies to the south of the Ottawa river, a large part of the townships of Gloucester and Nepean, with small portions of Osgoode, Cumberland and March. The Ottawa river flows diagonally across the area from south-west to north-east, while the southern half is traversed by the lower part of the Rideau river, which joins the Ottawa in that part of the city known as New Edinburgh. The northern portion is also traversed by the Gatineau river which enters the Ottawa opposite the lower part of the city, and by the Blanche river, which joins it near the eastern limit of the map. Both these streams for the greater part of their course flow through the region occupied by the crystalline rocks, while the Ottawa and Rideau traverse the Palæozoic area.

Railway lines.

The country south of the Ottawa is generally level or slightly undulating. It is crossed by several lines of railway, including the Canadian Pacific (South shore), the Ottawa and Prescott branch and the main line of the Canadian Pacific west of the city, by the New York and Ottawa southward, and by the Canada Atlantic (O., A. & P. S. Ry.) westward. The area north of the Ottawa is also traversed by the Canadian Pacific (North shore), by the Ottawa, Northern and Western (G. V. Ry.), which follows the west bank of the Gatineau river for some miles north, and the Pontiac and Pacific Junction, a part of the latter system, which follows up the north side of the Ottawa.

Elevations above sea-level.

For convenience in determining future measurements, the following lists of elevations along the principal lines of railways which radiate from Ottawa city may be given. They have been furnished through the courtesy of Mr. James White, geographer to the Department of

the Interior. There are three railway stations in the city, viz., the Central, with an elevation of 212 feet above sea-level, located at Sappers bridge, the Sussex street station, 190 feet, and the Union station, near the Chaudière, with an elevation of 175 feet. Most of the railway lines now start from the Central station.

Along the Canadian Pacific (South shore), the elevations of the principal stations and crossings eastward, are as follows :—

Canadian
Pacific (south
shore).

	Feet.
Central station.....	212
Crossing of Rideau river.....	198
" Greens creek	218
Blackburn station.....	230
Navan "	240
Brook crossing, one mile east.....	260
Leonard station.....	272
Summit, three miles east.....	279
Crossing of Rockland branch, Hammond station.....	220

The latter point is $22\frac{1}{2}$ miles east of the Central Station, Ottawa.

On the Canada Atlantic railway, which starts from the same station, the elevations are :

Canada
Atlantic east.

	Feet.
Crossing of the Rideau river.....	194
" Ottawa and Prescott branch.....	197
" Greens creek	219
Eastman station.....	225
Summit, $4\frac{1}{10}$ miles east.....	254
Bearbrook station.....	249
South Indian, junction Rockland branch	232

The latter point is 22 miles east of the Central Station, Ottawa.

On the New York and Ottawa railway, also starting from the same station, the elevations are :

New York
and Ottawa.

	Feet.
Junction with C.P.R. south of Rideau river.....	200
Hawthorne station, crossing of C.A.R.....	220
Russell road, at Ramsays Corners.....	240
Summit, $1\frac{1}{2}$ miles south.....	266
Piperville crossing.....	261
Edwards station.....	258
Russell station.....	236
Embrun station, near the Castor river	223

The latter point is 23 miles from the Central Station, Ottawa.

Ottawa
and Prescott
branch.

On the Ottawa and Prescott branch of the Canadian Pacific railway, starting from the Sussex street station, at an elevation of 190 feet, we have :

	Feet.
Rideau river crossing.....	190
Montreal road crossing, Janeville.....	187
" and Ottawa Junction.....	198
Chaudière Junction with line to Union station.....	274

On the same line, starting from the Union station, at an elevation of 175 feet, we have :

	Feet.
Crossing of the Rideau canal.....	216
" Rideau river.....	213
Chaudière Junction with Sussex street branch.....	274
Gloucester station.....	345
Summit, $\frac{1}{2}$ of a mile south.....	353
Manotick station.....	327
Osgoode station.....	301
Sabourin station.....	284

This point is $24\frac{3}{5}$ miles from the Union station.

Canadian
Pacific west.

On the Canadian Pacific main line west, also from the Union station, at 175 feet, we have :

	Feet.
Skead station.....	214
Britannia station.....	199
Bells Corners station.....	299
Stittsville station.....	396
Summit, $3\frac{7}{10}$ miles south.....	487
Ashton station....	446
Carleton Junction.....	447

This point is $27\frac{3}{10}$ miles from the Union station.

Canada
Atlantic, O.
A. & P. S. Ry.

On the Canada Atlantic, O., A. and P. S. railway, starting from the Central station at 212 feet, we have :

	Feet.
Elgin street station.....	218
Chaudière Junction on Rochester street.....	206
Crossing of Ottawa and Prescott branch at 207 feet.....	229
Summit, $3\frac{1}{10}$ miles west.....	279
Crossing of Richmond road.....	225
South March station.....	285
Carp station.....	311

This point is $22\frac{4}{10}$ miles west of Ottawa.

All these roads traverse the area south of the Ottawa river

Of the roads which cross the Ottawa and traverse the northern portion of the map-sheet, the following may be given :—

Canadian Pacific Railway (North shore), starting from the Union station, at 175 feet. Canadian Pacific (north shore).

	Feet.
Ottawa river, bridge.....	188
Hull station.....	189
Gatineau river, bridge.....	181
Gatineau station.....	174
East Templeton station.....	159
Crossing of Blanche river.....	150
L'Ange Gardien west, station.....	183
Crossing of Lièvre river.....	183
Buckingham station.....	183

This point is $20\frac{1}{2}$ miles east of Union station.

On the Ottawa, Northern and Western railway, we have the following :— Ottawa, Northern and Western (Gat. Val. Ry).

	Feet.
Ironsides station.....	182
Crossing of stream, half a mile east.....	194
Chelsea station.....	365
Summit, $\frac{1}{2}$ mile north.....	395
Depression near the Gatineau, $1\frac{1}{10}$ miles north.....	288
Kirks Ferry station ..	294
Summit $2\frac{1}{2}$ miles north.....	363
Cascades station.....	304
Patterson creek crossing.....	317
Rockhurst station.....	327
Wakefield station.....	326

This point is $21\frac{8}{10}$ miles from Union station.

On the Pontiac and Pacific Junction railway, same system, starting now from the Central station at 212 feet :— Pontiac and Pacific Junction railway.

	Feet.
Interprovincial bridge.....	190
Hull station.....	163
Deschênes station.....	198
Aylmer station.....	217
Crossing of brook $1\frac{1}{2}$ miles west.....	224
Crossing of Breckenridge creek.....	214
Breckenridge station.....	215
Tremblay station.....	211
Eardley station ..	215
Parker crossing.....	232
Mohr station.....	226
Quyon station.....	275

This point is 23 miles west of Aylmer station.

These levels are given beyond the limits of the map-sheet, including a radius of practically twenty miles from the several stations in the city. They will serve as a basis for future work for local observations in working out the surface geology of the district.

Borings.

In this connection it may be mentioned that the depths of the overlying clays and sands has been ascertained over quite a large area by means of numerous borings. These have in many cases been sunk to the underlying rock in the search for water or in explorations for gas or oil, work for this object being now carried on at several points in the area south of the Ottawa.

Provisional boundaries.

This widespread area of drift has interfered very considerably with the exact delimitation of boundaries in the district both to the north and south of the Ottawa river. In certain cases therefore the extension of the formation lines is necessarily conjectural and must be held to be subject to revision as new data are obtained.

Boring near Ramsays Corners.

Among the many borings which have been put down through the drift in the area near the city may be mentioned that recently made by a company now boring for gas and oil in the township of Gloucester, a short distance south of Ramsays Corners, on lot 18, range VII., Ottawa Front. Here a thickness of 186 feet of clay was passed through, underlain by eighteen feet of gravel which rested on the denuded surface of the Lorraine formation. At the new Rockcliffe rifle range also the clay deposit near the Ottawa river has a thickness of 169 feet, beneath which there were three feet of gravel before reaching the rock, which here is presumably the Chazy shale.

Rockcliffe rifle range.

Of former borings in the district several records have been handed to the writer through the courtesy of the Hon. Senator Poirier. The principal of these have been summarized and may be here given.

Borings near Montreal road

Thus at a point about five miles north-east of Eastman Springs the drill passed through 125 feet of blue clay. Another boring near the village of St. Joseph d'Orléans had 124 feet of clay, and yielded a strong overflow of saline water, and a third boring on the road between Gloucester and Cumberland, about two miles south of Orleans village, reached the rock at fifty feet, with a flow of fresh water.

In the south-east corner of Gloucester township the clay has a thickness of 110 feet. On the road to Greens creek, about four miles from Cummings Bridge, the blue clay is 125 feet thick, and near the line between Cumberland and Gloucester, about one mile from the Mon-

treel road, the thickness is 150 feet with a strong overflow of fresh water which was also found in several other wells in the vicinity.

One mile north-west of Veighton, on the property of Alex. Murray, the clay has a depth of 114 feet, with very salt water, and at the bottom about five feet of gravel was found. South of this about one mile, in the north-west corner of Russell township, several holes were bored to depths of sixty to seventy-five feet, passing through red clay with an underlying gravel and yielding fresh water.

At Cumberland village the depth of the clay was found to be eighty feet with two feet of gravel at the bottom, while several other wells in the vicinity show the gravel to be absent. At Sarsfield in an area from about one mile north to two miles south, the drift was only forty feet thick with twelve feet of gravel at the bottom. Three miles north of Sarsfield the drift ranged from twenty-five to thirty feet and had an underlying gravel, yielding fresh water. Near Bearbrook several wells ranged from seventy-five to one hundred feet in depth, with the gravel at the bottom. This is probably underlain by Lorraine or Utica.

In order to show the wide areas of this drift a few notes of borings further east may be given. Thus in the township of Clarence, one mile south of Rockland, borings at several points gave a thickness of clay of seventy-five to one hundred feet, with eighteen to twenty inches of gravel at the bottom. At Hammond, ten miles south of Rockland, one hundred feet of blue clay with a heavy stratum of quicksand at the bottom. At Cheney, two miles south of this place and four miles north of South Indian, on the Rockland branch railway, three wells gave 103 feet, including twenty feet of quicksand at the bottom. In the vicinity of Cobbs lake, several holes showed 110 feet of clay but no gravel, the lower part passing through black clay which probably represents the top of the Utica shales. On what is known as the Brook, five wells gave depths of 130 to 135 feet, with nine to ten feet of gravel at the bottom. At Wendover near the Ottawa river, the clay was 160 feet deep. At Pendleton, south of this and near the South Nation river, 116 feet of blue clay with two feet of gravel, were found. At Plantagenet village the clay was 112 feet thick, with saline water, and a short distance east of the village of Curran, two wells gave 150 feet of clay with four feet of gravel, yielding saline water; while on the north bank of the Nation river, at the ferry to Fournierville, the clay had a depth of 180 feet, and the boring yielded quantities of saline water and gas. Two miles east of this another boring passed through 186 feet of clay and also produced saline water and gas.

Old channel
of the Ottawa.

The records of these wells furnish some important information, not only as showing the character of the waters at different points in the district, but as proving very clearly the great amount of denudation which has taken place in the area south of the Ottawa. They seem to indicate that an old channel of the river passed in this direction a few miles south of the city, extending across the area now occupied by the Mer Bleue and thence eastward along the stream known as the Brook, which takes its rise in the bog and joins the Nation river at the great bend south of Pendleton village, a few miles north of Casselman.

Clays north of
the Ottawa.

North of the Ottawa the clay areas while extensive, are probably much less in depth. The range of the crystalline rocks approaches quite close to the river, and rock ledges are seen in close proximity in several places. The thickness of the clay deposits between Ironsides and Chelsea is, however, great.

Sand
deposits near
the Rideau.

Great deposits of sand also occur at a number of points in the area south of the Ottawa. They are well seen along the Rideau river and for some miles east and west of that stream. Thus in the township of Nepean in rear of the village of Merivale, these deposits are heavy,

Marine shells.

and large sand dunes are a prominent feature. These sand deposits cross the Rideau a short distance below and at Black Rapids about four miles south of Hogs Back, and at one point near the base, or at the contact with the clays, are large deposits of marine shells. This sand is used in Ottawa for building purposes. To the south of Bowesville, east of the Rideau, similar large deposits of sand occur over a considerable area, and they also appear along the road which skirts the north side of the Mer Bleue, as also in the southern part of the township of Gloucester, near the line of Osgoode.

Mer Bleue
peat bog.

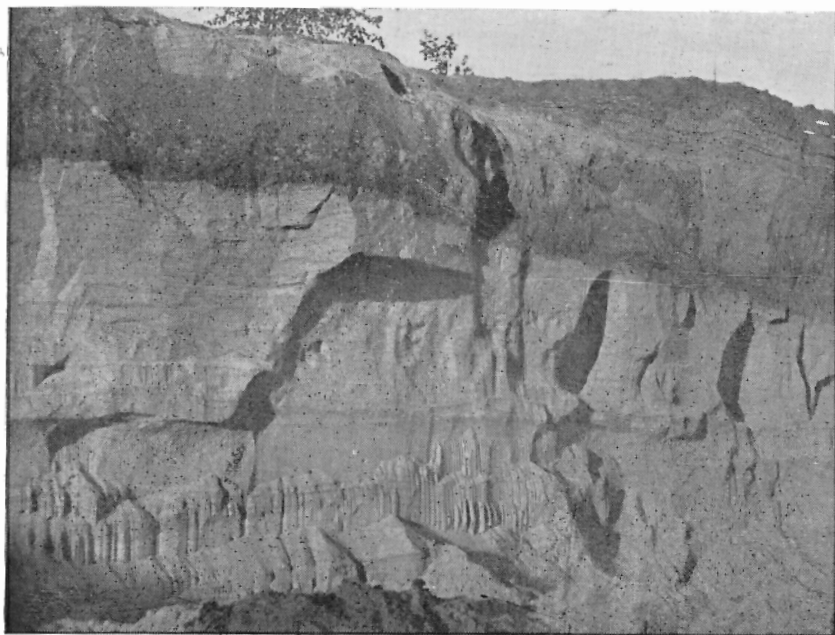
Large deposits of excellent peat are found at several places. The most important of these is that known as the Mer Bleue bog which lies between the Canada Atlantic and Canadian Pacific railways, to the north of the road leading to Eastman Springs. It extends across into the township of Cumberland and embraces an area of several thousand acres. The depth of the bog in places reaches nearly or quite thirty feet. Two streams rise in the bog, the Brook flowing east has already been referred to, while Greens creek flows from the western end and joins the Ottawa river about seven miles east of Ottawa city.

Gloucester
and Osgoode
bogs.

Another bog of large size is found on the town line between Gloucester and Osgoode, on range IV., about four miles east of the Rideau. This extends southward into Osgoode for several miles, while a third but apparently shallow bog is crossed by the Ottawa and Prescott railway, several miles south of Chaudière Junction.



H. M. AMI.—Photo. 1900.
MARLS, GRAVEL AND SAND IN CLIFF, SOUTH SHORE HEMLOCK LAKE,
OTTAWA, ONT.



H. M. AMI.—Photo. 1900.
SECTION IN SAND DUNE, RIDEAUVILLE, SOUTH OF RIDEAU CANAL.

Rock outcrops are rarely seen in the township of Gloucester south of a line from Leitrim post-office east to Blackburn, the southern part of the township being almost entirely drift-covered. The last exposure in this direction appears to be on the Russell road leading from Ottawa to Eastman Springs, about one mile south of Hawthorne corner near a church, where the Lorraine shales and sandstone are exposed in a brook, but several outcrops of the Calciferous are seen in the southern part of the township, about two miles east of the Rideau river. Rock outcrops.

The study of the geology of the district has also been made more difficult by the presence of numerous faults which traverse the area in different directions. Faulted area.

Some of these have affected the rocks of one formation only, but others have broken across all the formations from the Potsdam upward. As their presence is an important factor in the delimitation of geological boundaries, a brief description of the principal lines of dislocation may be given. Their extension is in many places entirely concealed under the mantle of drift, but several have been traced, at least as far as the conditions have permitted.

What is probably the greatest of these is known as the Hull and Gloucester fault. The eastern extension of this, lying beyond the limit of the map-sheet, need not be described, further than to remark that it proceeds westward from Rigaud mountain to the vicinity of Ottawa. This fault has been referred to in the *Geology of Canada*, 1863, page 116. Hull and Gloucester fault.

The prolongation of this fault from Rigaud enters the map-sheet near the south-east corner from the township of Osgoode. It thence follows a north-west course to within four miles of the Rideau river, to lot 10, range 3, Rideau front, when it inclines more to the north and crosses the river in the vicinity of the Canadian Pacific railway bridge. Here, on the south side of the Rideau, outcrops of Trenton limestone are seen near the bridge with a dip of N. 70° E. < 35°. Up stream, this dip gradually increases, till at a distance of seven and a half chains, it is N. 40° E. < 65°. The evidences of the dislocation are visible on both sides of the river. Extension across Gloucester to Hintonburgh.

From the Rideau crossing, the line of fault apparently follows a straight course to the Ottawa river in Mechanicsville, being well seen the Canada Atlantic (O., A. & P. S. Ry.), where the limestones dip on N. 47° E. < 57°, and in Hintonburgh, on the line of the Canadian Pacific railway, with a dip of N. 50° E. < 57°. Along the west side of the deep cove at the little Chaudière rapids, the Black River lime-

stone dips N. 65° E. $< 47^{\circ}$. It here crosses the river to Tétreauville where the limestones dip N. 55° E. $< 45^{\circ}$ - 60° , the strata along the river thence east to Hull being much disturbed and several other minor dislocations occurring in the area.

Fault from
Tétreauville
north.

Thence the fault inclines more to the east and continues to Fairy lake, keeping west of the Beaver meadow. At the north-east end of the lake the limestones dip N. 50° E. $< 50^{\circ}$. Continuing north, it comes against the east flank of the crystalline rocks, about two and a half miles north of the Ottawa, and then apparently turns off at an angle north-east to the Gatineau river, which it is supposed to reach a short distance south of Wrights Bridge, about three miles above the mouth of that stream.

Inclined
strata.

It will be noticed that along the line of this fault the strata are everywhere highly inclined. At the first contact with the Utica on lot 10, range 3, the dip of the Calciferous is N. 35° E. $< 65^{\circ}$. Along that part of its course south of the Rideau, it brings the Calciferous against the Lorraine and Utica, and further north it involves the Chazy, Black River and Trenton, and brings them against the latter formation.

Fault in
Nepean
township.

In the description of this fault and anticlinal given in the Geology of Canada, it is stated that the extension of this line of disturbance is supposed to cross the southern portion of Gloucester and Nepean townships, and to extend westward through Huntley and Fitzroy. In the two townships first named, it apparently affects only rocks of Calciferous age, which occupy the country on both sides of the Rideau for some miles. But in the central part of Nepean, what may be an extension of this line of fracture, comes into view on lot 23, range IV., and here brings up the Black River and Trenton limestones against the Calciferous dolomite and Potsdam sandstone. Thence the fault extends westward towards Hazeldean, and continues along the southern flank of a prominent ridge of granite and other crystalline rocks for some miles.

Cross fault.

A transverse fault comes to that just described in Nepean township, near the line between ranges III. and IV., lot 22. This affects the Chazy, Black River and Calciferous formations. This fracture extends south-west into the township of Goulburn, where it apparently dies out in the Calciferous.

The faults just described are the most extensive in the area south of the Ottawa river. In the vicinity of the city, however, several others are known to exist which have had a marked effect in the distribution of the several formations there developed.

Some of these are mere local displacements of strata affecting merely one formation ; but in the vicinity of Rockcliffe park, in the eastern part of the city, several important breaks are seen. They are visible on the shores of the Ottawa river below New Edinburgh, as well as at several points inland. They have not, however, the same amount of displacement as in the case of those recently described. Minor faults.

Among the most important of these near Rockcliffe is one seen on the shore near the end of the point below Governor's bay. Here several minor breaks in the strata occur, but the principal one cuts across the Trenton limestone with a dip of S. 10° W. $< 42^{\circ}$. It extends almost due east to the line of the Electric railway where it meets another line of fracture which follows along a depression which leads down to the shore in the bottom of a cove east of the point mentioned. Here the Trenton or possibly Black River limestone is brought against the Chazy shales by the cutting out of the great bulk of the Chazy limestone. From the point of intersection of the road it continues south-west for about twelve chains. Then it inclines sharply to the west passing to the south of the rear entrance to Rideau Hall to the corner of the roads at Ercildoun cottage, where it separates the Chazy limestone from those of Trenton age. At the latter point the Utica shales are supposed to be in contact with the former. Thence it takes a south-east course to the rear of Clarkstown where it is about twenty-five chains south-west of St. Patrick street bridge. Here it again turns to the north-east and reaches the entrance of Beechwood cemetery, where the Chazy limestone at a high angle is in contact with Utica shale. Another fault extends from this point north-east past the head of Hemlock lake in the direction of the Ottawa river which cuts out a portion of the Chazy limestone. Rockcliffe.
New
Edinburgh.
Beechwood.

A second line of fracture comes to the south side of Governors bay from the rear of the Rideau Hall grounds which apparently affects the Trenton formation only. The course of this fault from the river is a few degrees south of west and it meets that just described on the back road east of the Rideau Hall grounds. Rideau Hall
grounds.

To the north of Beechwood cemetery there is also probably a line of fault, separating the Trenton limestone in part from the Utica shale. This extends in the direction of the Montreal road but owing to the drift its exact position cannot be accurately laid down. Montreal
road.

Further east in the direction of Greens creek another small dislocation is seen with an apparent throw to the north-east. This extends from the shore of the Ottawa to the Montreal road where it crosses Greens Creek
fault.

to the south about one and a half miles west of the bridge over Greens creek. This traverses all the formations from the Chazy to the Utica both inclusive, the underlying Calciferous not being exposed owing to the clay covering which is heavy towards the river.

Hogs Back
fault.

In the area south of the city along the Rideau river, near Hogs Back several other faults also occur. One of these is seen on the east bank of the river near the bridge across the dam at the entrance of the canal where it cuts out a large portion of the Chazy and Black River limestones. There is in the river at this place a well-defined sharp anticlinal in the lower part of the Chazy from which the place evidently takes its name. This fault can be traced down along the east bank of the river for half a mile, the strata at one point dipping S. 80° W. $<60^{\circ}$. South of the Hogs Back the continuation of this break can be observed in a small knoll about a fourth of a mile distant, where the Black River limestone is tilted at an angle of 65° , the dip being N. 10° E. The Trenton limestone alongside to the east dips east $<4^{\circ}$ – 10° . Above this along the Rideau river two other faults are seen which occur in limestones of Black River or Chazy age, but these are apparently local in character or are so obscured by drift that they cannot be traced to any distance.

Faulted area
south.

Old rifle
range.

In the excavation for the main sewer across the old rifle range near the Rideau river, a small fault was noticed in the Utica shales, which has displaced the rocks to some extent. The fossils found on either side of the break are different in character, but the amount of the throw is probably less than fifty feet. On the west side of Parliament hill there is also a fault in the Trenton limestone, referred to in the Geology of Canada, 1863, page 166, which has caused a dislocation of the strata for seventy feet.

Dows lake.

A well-defined fault is seen on the east side of Dows lake, extending through the lumber-piling grounds from the end of LeBreton street south-east, and showing in a broken anticline northward near the crossing of the Canada Atlantic railway, at Rochester street, in the west part of the city. Along the contact near the pond, the Trenton limestone is much broken up for a breadth of six to eight feet, where it is in contact with the Utica shales. Several small faults are seen in the Utica formation south of Billings Bridge, in the exposures along the small brook at that place, but while probably other minor faults occur, it is thought that those already described include the most important lines of fracture in the vicinity of the city.

Billings
Bridge.

The deposits of sand and clay, which are widespread, have already been referred to. The latter is, undoubtedly of marine origin, since fossils are found in them at a number of places. In certain of the sands also, marine organisms have been obtained, as also in the interstratified gravels. Over large areas, however, these deposits are apparently barren of organic remains.

Among localities where such organisms have been found, though the list is not regarded as complete, may be mentioned several points along the south shore of the Ottawa, near the mouth of Greens creek and at Besserers wharf, where the clay banks contain an abundance of clay nodules of different shapes and sizes. Some of these are round and apparently devoid of fossils, but others are elongated, flattened and kidney-shaped, and from these a great variety of organic remains has been obtained. These include the bones of seals, the remains of fishes of the genera *Cottus* and *Mallotus*, shells of several kinds, the feathers of birds, the remains of plants, leaves, etc., and other organisms around which the concretinary masses have been formed. These localities have long been noted for the occurrence of these remains.

In some of the brickyards also these organisms are abundant, notably at that of Mr. Odell, in Ottawa east. Here, also, the bones of seals have been collected, with shells, sponges, etc., in abundance. In the clay excavations at different points throughout the city, shells are also obtained, and along the canal, at the Deep Cut. In the city of Hull, there is a stratum of clay, in a portion of a boulder ridge, which contains similar organisms showing its marine origin, in part at least. At the summit, half a mile north of Chelsea station, on the Ottawa, Northern and Western railway, shells are found in the base of the sand and gravel at an elevation of 395 feet above the sea. Along the Rideau river, about two miles above Hogs Back, a section of Leda clay, sand and gravel, 110 feet thick, on the west bank, contains a considerable variety of marine forms near the contact of the clay and sand. At Hintonburgh, a cutting on the Electric railway, near the junction with the Britannia branch, shows shells in gravel. They are also found in sand with clay partings, about the shores of Hemlock or Mackay lake, near Rockcliffe park, and in a gravelly soil near Chaudière Junction, on the Ottawa and Prescott branch of the Canadian Pacific railway.

Two interesting ridges of drift are seen in the northern portion of Hull. They are crossed by Chaudière street, from the intersection of Regent street north. The more southerly is composed chiefly of large blocks of Trenton and Black River limestone, in broad flat masses, and

has a breadth of about three chains ; the second is made up largely of boulders of the crystalline rocks, derived from the mountain ridge to the north. It is in the former that the marine shells are found. These ridges can be traced across the portion of the city north of Lake Flora and are conspicuous features in this area.

Striæ.

Striæ are rarely observed in the district. The ice movement is nearly southerly. They have been noted near Old Chelsea with a direction of S. 10° E. and S. 20° E. In the bed of a brook which crosses the road west of the Rideau near Black Rapids lock, two sets were observed with a course of S. 20° E. and S. 55° E. ; and on the crystalline rocks near South March station, on the Ottawa and Parry Sound railway, the course of the striæ is S. 10° E., and on the shore road half a mile west of Britannia, two sets, the direction being S. 55° E. and N. 73° E.

GEOLOGY.

Formations represented

The various formations recognized in the area included in the accompanying map may be thus stated :—

Medina red shales.
Lorraine shales and sandstone.
Utica shale.
Trenton limestone.
Black River limestone.
Chazy limestone.
Chazy shale.
Calciferous, mostly dolomite.
Potsdam sandstone.
Archæan.

Fossils

Large collections of fossils have been made from the rocks of all the formations in the district, except the Medina, by various officers of the Geological Survey and by other residents in the city interested in the subject, among whom may be mentioned Sir James Grant, Mr. Walter Billings, Mr. Walter Odell and Mr. T. W. E. Souter. The earlier collections were identified by the late Palæontologist of the Survey, Mr. E. Billings, and the more recent ones have been tabulated by Dr. H. M. Ami. His lists from the several formations are given in an appendix.

MEDINA SHALES.

The outcrops of the Medina indicated on the map-sheet are but small. The principal outliers are located a short distance to the south-east in the direction of Bearbrook. One small area is, however, found near the southern margin of the map, on the fourth lot of the eighth range of Osgoode, where the brook crosses the road to Metcalfe. This place is referred to in the Geology of Canada, 1863, page 219, under the head of Utica and Hudson formations. The red shales at this place, as also similar shales further east, overlie the Lorraine shales, and they are identical in character with the rocks classed as Medina in the area east of the St. Lawrence river, on the Bécancour, and described in the report on that locality in the Annual Report, Geol. Surv. Can. 1887-88, vol. III, page 118, part K. No fossils have been found in these shales as yet, and their horizon is therefore based on their position and lithological character.

At the locality mentioned the shales do not now show at the surface which is here drift-covered. The debris is, however, seen in the bank of the brook at the road crossing, and the rock itself was observed by Mr. James Richardson in his traverse of the district in 1853, in an excavation for a mill site, traces of which still remain.

Further to the south-east, however, near Dickenson post-office, the shale can be seen in several excavations and has a thickness probably of nearly 100 feet.

The locality in Osgoode township is in close proximity to the Calcareous dolomite, and is supposed to be in contact with that formation along the line of the Hull and Gloucester fault.

LORRAINE FORMATION.

The shales and sandstones of this formation have been separated from the underlying Utica into which they pass downward gradually. They form a distinct series both in physical character and also in the contained fossils. The shales lack the black colour of the Utica and also their bituminous aspect, being generally some shade of gray, while they are distinctly sandy and have associated beds of sandstone. Occasional bands of a grayish dolomitic limestone are interstratified with the grayish dark shales.

Outcrops of
shale.

Outcrops of the Lorraine proper are found on the road to Eastman, in a brook near the church between Hawthorne and Ramsays Corners, and the strata at this place contain an abundance of the fossils characteristic of the formation. On the road west of Ramsays Corners between lots 5 and 6, range V., Rideau Front, the gray shales are also exposed, and also on the road west of Hawthorne, where they pass down conformably into the Utica shale.

Canada
Atlantic
railway.

On the line of the Canada Atlantic railway, about one mile south of the crossing of the Rideau river, the grayish shales are again seen in a small cutting, and on the road towards Billings Bridge from the Hawthorne toll-gate the lowest members of the formation are exposed near the crest of the ridge, also indicating the passage beds to the Utica.

Areas
in Russell
township.

The rocks of this formation are supposed to occupy a large part of the township of Gloucester, crossing into Cumberland and Russell townships. Owing to the fact that most of this area is covered by drift and by the Mer Bleue bog, the outcrops are not seen at points other than those mentioned, but further east, in the vicinity of Bearbrook and on the roads west near Dickenson post-office, they are well exposed, coming out from beneath the drift. They are well seen on lots 23 to 25, ranges VII. and VIII. of Cumberland, and their contact with the Utica is observed about half a mile east of Bearbrook station, as also on several of the roads a short distance west of that place. They here contain fossils and the structure of the area appears to be basin shaped, of which the northern edge is defined by a curving line along the north side of the Mer Bleue. Southward the basin extends to the line of the Hull and Gloucester fault, and in support of this view a small outcrop of the shales was noticed near the east line of Osgoode, about lot 20, in close proximity to the Calciferous.

Extent and
thickness
of Lorraine.

The breadth of the area in the township of Gloucester should therefore be about eight miles. A recent boring at Ramsays Corners confirms the supposition that the formation is basin-shaped, and that it has a considerable thickness. This boring, on lot 18, range VII., Ottawa Front, passed through 204 feet of drift to the grayish shales. In this the drill penetrated to a further depth of 250 feet and apparently reached the top of the Utica at about 450 feet from the surface. As the Lorraine probably forms the rock at the surface, since it is seen about one mile to the north-west, this boring would give a thickness of 440 to 450 feet for this formation at this point.

This is the only opportunity yet afforded for ascertaining the thickness of these rocks in the whole of the area. At an assumed dip of

two degrees from the contact with the Utica near Greens creek, and supposing the inclination of the strata to be regular, this would be about the thickness of the formation at the bore-hole by calculation, so that there is no occasion for introducing a fault to account for this thickness in the Lorraine.

UTICA SHALE.

The Utica shales differ from those of the preceding formation in the presence of carbonaceous matter, rendering them for the most part bituminous, and in their black or dark-brown colour. They underlie the Lorraine on the north and north-east throughout, and on the west near the city of Ottawa, as also on the south-west till they meet the Hull and Gloucester fault near the Osgoode line. The thickness of the Utica has never been satisfactorily determined, owing in part to the paucity of exposures over large areas, and also to the presence of numerous small faults which affect the shales. These are generally local in extent, but sometimes they continue into the adjacent formations.

As a rule the rocks lie nearly flat. Allowing a similar dip of two degrees as in the case of the Lorraine, the thickness of the formation in the north part of the basin would not be far from 400 feet, but this in the present state of our knowledge must be regarded as an approximation only, since it may be affected by faults not visible at the surface. No section exists anywhere in the area where the actual thickness can be measured.

Probable thickness.

While the surface breadth of the Utica in the area comprised by the map is rarely much more than two miles and a half, this is much greater in the township of Cumberland to the east. Here the shales spread over a wide area and, between the villages of Russell and Sarsfield, are exposed at intervals for about eleven miles across the strike, forming a broad and generally level district, broken only by low hills.

Extent of the formation.

The western outline of the formation is found in the city of Ottawa. Here the contact with the Trenton can be well observed on Preston street to the north of Dows lake. On the road to the Experimental Farm the breadth of the most westerly exposure is seven chains, and it extends north-westerly across Preston street to a short distance beyond Willow street, a distance of twenty-six chains. The rocks lie in a basin-shaped syncline, apparently conformable upon the upper part of the Trenton on both sides, the latter here forming a low anticline.

Small areas near Dows lake.

Faulted
contact with
Trenton.

A second small area of the shales is seen near the north-east angle of the lake. The contact of the Trenton occurs in the piling ground at the end of LeBreton street where there is a well marked fault. This area has a breadth of five chains on the lake and extends north-west for twenty chains, crossing Norman street and almost reaching Rochester street. The contact with the Trenton on the west is apparently a conformable one, while the line of fault on the east side continues north-west and is seen in a broken anticline just north of the Canada Atlantic railway. Southward the fault can be traced through the lumber piling grounds east of the lake, the shales being in contact with the broken edge of the underlying limestones for some distance.

Yet another small area of these shales occurs in this vicinity and is seen to the east of Preston street between Eliza and Poplar streets, beginning about three chains north of the Canada Atlantic railway and extending twenty-two chains north-west. The breadth of this outlier, which rests on the Trenton, is not more than three chains at the widest observed point.

Western
outline of
Utica shale.

The western edge of the Utica from the Preston street basin continues across Dows lake and swamp and crosses the Rideau river a few chains east of the railway bridge. Thence southward it is affected by the line of the Hull and Gloucester fault, and is in contact successively with the Trenton, Black River and Chazy limestones, Chazy shales and Calciferous dolomites, to a point about ten miles south of the Rideau River crossing, where it is probably overlain by the Lorraine shales near the line between Gloucester and Osgoode townships, on range VII. of the latter.

Exposures.

The shales of the formation are well exposed in the area north of Dows lake as also about Billings Bridge, Hurdman's Bridge and along the Metcalfe road in several places as far south as lot 17, range V, Rideau Front, and on a road east from this point between lots 15 and 16, for about one mile.

The formation underlies a large portion of Ottawa city but here the outlines are somewhat difficult to trace. Much information has been obtained from time to time, chiefly by Dr. Ami, from sewer excavations, as the rock outcrops rarely appear at the surface.

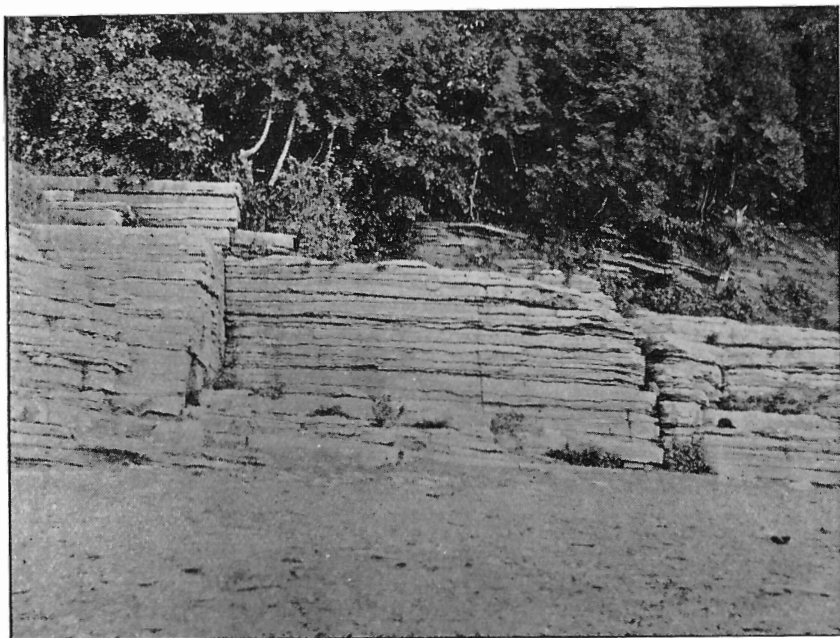
Area in New
Edinburgh
and at
Beechwood.

In New Edinburgh the contact with the Trenton limestone is conformable and occurs near the line of Charles street, two streets east of Sussex street. Here the outline of the shales appears to make a sharp curve forming a shallow basin the northern margin of which extends westward along the face of the escarpment north of McKay



H. M. AMI.—Photo. 1900.

UTICA SHALE.—EXCAVATION ACROSS OLD RIFLE RANGE, OTTAWA, ONT.



H. M. AMI.—Photo. 1900.

TRENTON LIMESTONE.—FOOT OF PARLIAMENT HILL, OTTAWA, ONT.

street to the entrance to Beechwood cemetery being in contact for a portion of the distance with Chazy limestone, by the fault which extends west from the Government House grounds. Thence westward they continue through the flat north of Beechwood to the Montreal road, through a part of Notre Dame cemetery, the conformable contact with the Trenton being seen about six chains north of the Montreal road on a road leading past the east side of the cemetery. The contact with the Trenton thence keeps to the north of the Montreal road for about three-fourths of a mile and crosses to the south on lot 24, eleven chains east of the road leading to the shore of the Ottawa between lots 24 and 25. The dip of the Utica at the contact with the Trenton near the Roman Catholic cemetery is S. 40° E. < 3°-4°, and at the contact on lot 24 the dip of the underlying limestone is also about S.E. < 2°-3°, but several low undulations here occur.

Thence it keeps to the south of Robillard's limestone quarries for a short distance and then curves again to the north after passing the crest of the hill on the road to Greens creek, where it apparently meets a line of fault one mile and a half west of the road crossing that stream.

From this point eastward the northern margin of the basin is largely concealed by drift to the road leading north from Navan village where the direct and apparently conformable contact with the Trenton is seen at a point three fifths of a mile north of Navan corner, the underlying rocks dipping S. 50° W. < 5°.

From New Edinburgh the western limit of the basin can not be well traced, but it has been followed as fully as possible from notes of excavations and from occasional outcrops. It crosses the Rideau river a short distance below Porters island, which is composed of the black shales, and thence it keeps across what is known as Sandy Hill or the eastern part of the city, apparently not far from the line of Chapel street. It should cross Theodore street near the intersection of Chapel, the part of the city thence eastward to Cummings Bridge being underlain by the Utica shale which is well exposed along the Rideau at this place. The outline of the formation keeps to the south of Theodore street for about three streets and then turns west towards the canal which it is supposed to cross near Laurier bridge. The shales occupy all the area of the old rifle range, and cross the river east to the Montreal road occupying all the surface through Cyrville and up to Billings Bridge.

In what is known as Centre town, from the crossing of the canal, the Utica shales apparently extend west to the vicinity of Wellington

street Thence the northern outline curves to the south-west and the shales occupy the area southward nearly to the intersection of Lisgar with Percy streets. The outline here is limited by the Trenton of Ashburnham hill which is well seen on the line of the Canada Atlantic railway and in several of the sewer excavations in the vicinity. It however should cross the line of this railway between Bank and Kent streets and cross the former near the bridge over Patterson creek, extending thence east for about ten chains and crossing back again about five chains north of the canal bridge, whence it keeps north of the canal to the line of fault east of Dows lake.

Faulted
character.

The breadth of the Utica basin about two miles east of the Rideau river is not far from seven miles. Attempts to ascertain the thickness of the formation have been made at several points. While the rocks undoubtedly lie in a broad and probably somewhat shallow basin beneath the Lorraine, the shales are affected by numerous small faults, some of which can be readily seen. These are for the most part merely local, but have made the determination of the actual thickness of the formation largely conjectural.

Fossils.

The characteristic fossils of the Utica are found everywhere throughout the area. At Billings Bridge they may be obtained from the exposures along the small brook in the rear of the village. At the old rifle range, crossed by Chapel street they are abundant in the material excavated for the deep sewer as also at New Edinburgh. They are found also on the Montreal road, at Cyrville and on the Metcalfe road near Leitrim post-office. From most of these places collections have been made by Dr. Ami and by other officers of the Geological Survey which have been tabulated.

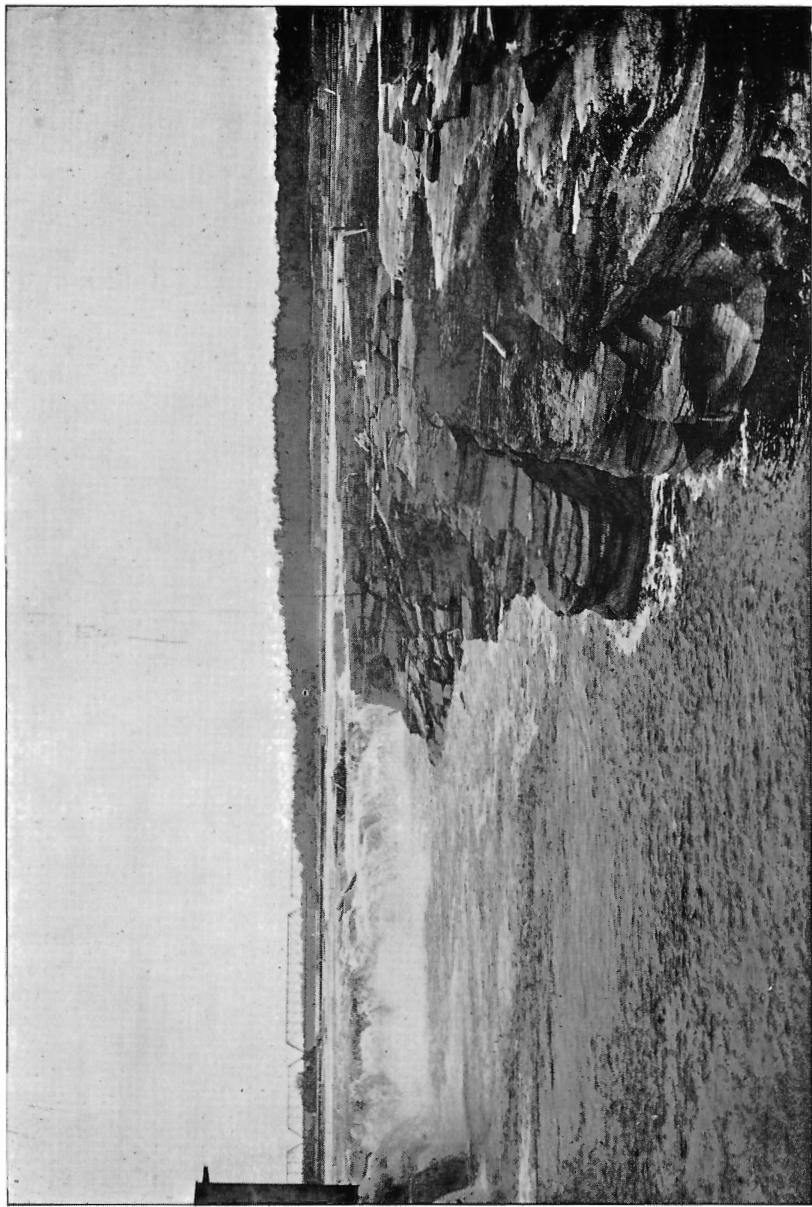
TRENTON LIMESTONE.

Trenton
limestone.

The areas of Trenton limestone found in this map, though well exposed, are of no very great extent. Their distribution is also largely affected by numerous faults. Generally the strata are in a nearly horizontal attitude or lie in low undulations, but when near the lines of faulting, they are often highly inclined.

Areas.

The principal area is in the city of Ottawa and in Hull, whence it extends to the line of the fault northerly from Tetreauville to the contact with the crystalline rocks. On the west, this formation is bounded by an outcrop of Black River limestone which is seen in the village of Tetreauville, and thence north to Fairy lake, where this fault is well seen.



C. O. SÉNÉCAL.—Photo. 1901.

TRENTON LIMESTONE.—TABLE ROCK, CHAUDIÈRE FALLS, OTTAWA RIVER.

The northern limit of the formation yet recognized is about two miles north of the Ottawa river, though as this area is in places largely drift-covered, the exact line of the boundary is to some extent conjectural.

Northern
limit conceal-
ed in part.

The formation is bounded on the north by a fault which separates it from the Chazy, and which extends eastward towards the north end of Leamy's lake, where it meets the northward extension of the fault seen on the point east of Governor's bay, near Rockcliffe park. East of this several faults are seen, and the Trenton is cut out for some distance in the direction towards Beechwood cemetery. The limestones again come into view in the cemetery and continue to the Montreal road in a somewhat narrow band with a curving outline to the fault west of Greens creek. The lime quarries of Mr. Robillard are in this formation, which extends south of the road for about twelve chains to the overlap of the Utica shales.

Montreal
road.

By the Greens creek fault, the limestones of this formation are probably thrown some distance to the north. East of this they are concealed over a considerable interval by drift, but the area apparently widens, probably through flattening of the strata. The rock again appearing on the road north from Navan, fifty chains from the village, in a somewhat bold escarpment rising from the clay flat northward, and the formation should underlie this flat to a point within two and a half miles of the Ottawa river, where there is a probable contact with the Black River limestone. The area of the Trenton apparently becomes much broader as the township of Cumberland is crossed, occasional outcrops of the limestone being seen.

Navan.

Along the Rideau river the Trenton is but slightly developed. The limestones are seen at the Canadian Pacific railway bridge across that stream below the Hogs Back, where they are overlapped by the Utica shales. They are affected by several faults at this place and also at the outcrops near the Hogs Back, where they are in contact with the Black River limestone, just below and above the dam. The structure of the area along this part of the Rideau river is somewhat complicated by these breaks, and the details can only be shown on a map of large scale. Near this place are several large quarries in the formation. Those on the Montreal road have already been referred to, and the principal quarries in Hull are also in these limestones.

Areas along
the Rideau
river.

Quarries

In Ottawa city the southern outlines have already been indicated by the limits of the Utica already described. The cliffs along the south side of the river, as at Parliament hill and Nepean point, as

Area in
Ottawa city.

well as further east, are also of Trenton limestone. Along the north shore of the Ottawa, between Hull and Tétreauville, the strata are much broken up, especially above the Canadian Pacific railway bridge, and sharp folds with faults are seen on this line of section, which, however, can only be examined at low stages of water. These disturbances are also observed in several of the islands above the bridge and also in Hintonburgh.

Thickness.

The exact thickness of the Trenton limestone in this area can not be definitely made out. In the *Geology of Canada*, 1863, page 166, it is stated that 187 feet are exposed in Parliament hill. There is near here a fault with a displacement of seventy feet, but the assumption is made that the total thickness of the formation is not far from 600 feet. This is supported by evidence obtained in the area south of the Ottawa river further east.

The best exposed outcrops of the formation in the city itself are seen in the western part. The cliffs along Wellington and at the end of Maria streets, with the cuttings along the Canada Atlantic railway, show good partial sections.

Areas
in Nepean
township.

In the western part of the township of Nepean, these rocks are again exposed. They are separated from the Calciferous which occupies a large portion of the northern half of the township, by a fault which has been stated to continue along the south flank of the ridge of crystalline rocks, through the townships of Huntley and Fitzroy. The characteristic limestones are seen at several points along the Richmond road south of this fault and on several roads north of Fallowfield, and the breadth of the formation here is about two miles.

Huntley.

West of this place they are seen along the roads in the east part of Huntley where they form a belt about three miles in breadth which continues westward into Fitzroy. These rocks represent apparently only the lower members of the formation.

BLACK RIVER LIMESTONE.

Black River
limestone.

The limestones of this formation were formerly classed with those of Trenton age, forming their lower portion. As they are however somewhat different in physical character and contain fossils which do not range upward into the Trenton proper, they may now be regarded as a separate division.

New
Edinburgh.

On the north side of the Trenton, below New Edinburgh, the limestones of this division are seen in a small area near the line of the

Electric railway below Governor's bay. The area is of limited extent, and though the characteristic fossils of the formation have not yet been collected at this place, the features of the rocks are similar to those observed in other localities where this formation is well developed. These rocks come directly against the Chazy shales at this place and there is an old quarry in a cutting of Trenton limestone to the south of the road.

At the entrance to Beechwood cemetery a bluff about thirty feet in height occurs to the east of the road leading to Hemlock lake. The rocks in this escarpment are characteristic Black River limestone. They here dip S. 65° E. < 7°. The rocks of the escarpment pass beneath the Trenton which is found inside the cemetery. A fault occurs here which cuts out a part of the Chazy limestone in the direction of Hemlock lake. Beechwood cemetery.

From this point the band of the Black River limestone continues east, keeping to the north of the Trenton outcrop in the direction of Greens creek. It is seen in a low escarpment to the north of the road past Robillard's quarries, near the summit of the rise adjacent to the line of the Greens Creek fault.

By this fault the formation is supposed to be thrown to the north about twelve chains; but east of this place it continues across Greens creek and is seen at the end of a short road on the concession line south of the Montreal road between lots 10 and 11. Dislocations.

The limestones also appear along the road between ranges II and III, east of Blackburn post-office, where they form broad ledges for nearly a mile in an eastward direction. Blackburn.

East of this again toward Cumberland the band gradually widens, probably from flattening of the strata. There is a somewhat sharp bend to the north at the crossing of the township line between Gloucester and Cumberland, and here the formation approaches the Ottawa to within a mile of the shore. The breadth of the Black River formation here is about one mile. Cumberland township.

North of the Ottawa the small area which has been noted as occurring at Rockcliffe park, where it is cut off by a fault, presumably extends north-westerly, crossing the Gatineau, though here concealed by drift, and terminating against the fault which is supposed to strike south from the north end of Leamy lake. Extension north of the Ottawa river.

West of Hull these limestones again appear in Tétreauville near the same line of fault, the strata being much tilted and broken near Tétreauville.

the contact. The dip of the strata at this place is N. 55° E. < 45°-50°. Northward the formation extends west of the Beaver meadow showing in broad ledges north of the Aylmer road, in the direction of Fairy lake. Further west it rests upon the Chazy limestone of the area east of Aylmer.

Area north of Aylmer. North of this place and capping the ridge there is an outlier, about two miles in length, by one and a half in breadth, of roughly oval shape. The rocks at this place pass upward into the basal beds of the Trenton proper, *Receptaculites* being found in the highest portion.

Areas south of the Ottawa river. South of the Ottawa river the continuation of this area, after crossing the river into Mechanicsville, where it is seen along the west side of the deep inlet near the Little Chaudière rapids, continues in a widening belt to the line road between the river range of lots and

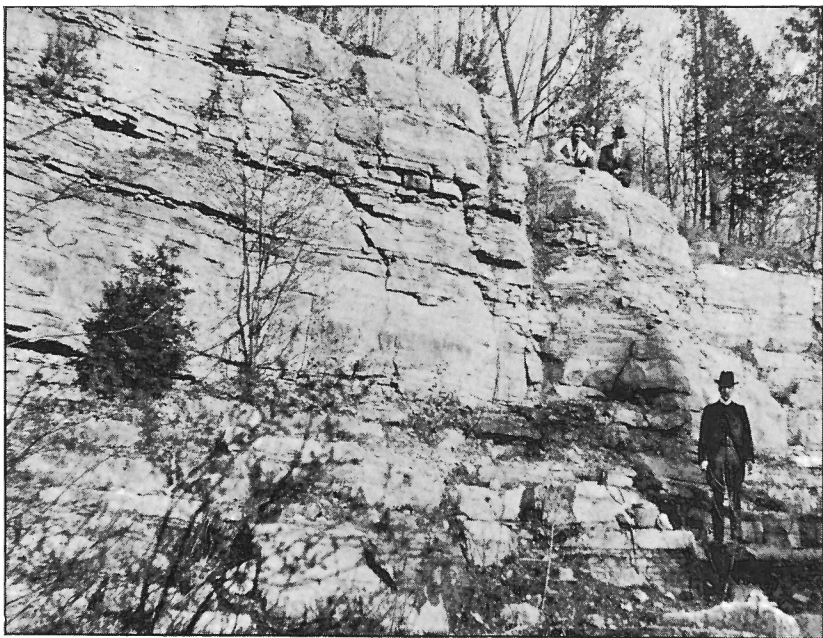
Hintonburgh. those in Nepean proper near City View. The rocks apparently underlie the whole of the Experimental farm west of the Ottawa and Prescott branch of the Canadian Pacific railway, and are well exposed to the west of Hintonburgh near the main line of the Canadian Pacific in broad ledges. They form a bold escarpment to the north of City View post-office and are also exposed in a bluff to the south of that place in which a small quarry is located. Here they rest conformably upon the Chazy limestones.

Richmond road. Along the south shore of the Ottawa river they occupy a breadth of about half a mile west of Mechanicsville. Thence they extend across the Richmond road, their contact with the underlying Chazy being about three-fifths of a mile east of Westborough.

Hogs Back. Near the Hogs Back these limestones also appear in a narrow outcrop on the east side of the dam in contact with the fault at this place, and on the hill-side to the south. In this knoll to the south, several hundred yards distant, their contact with the Trenton can be observed. South of this they can also be seen at several points on the road up the east side of the Rideau river, more particularly in an old quarry on lot 3, of the second range facing the river, where the fossil *Tetradium* is abundant. They again appear on the straight road between ranges II and III, on lots 3 and 4, in an escarpment with an old quarry and in broad ledges in the fields adjacent, and also on lot 23 of the Junction gore near the Rideau river, east of Hogs Back.

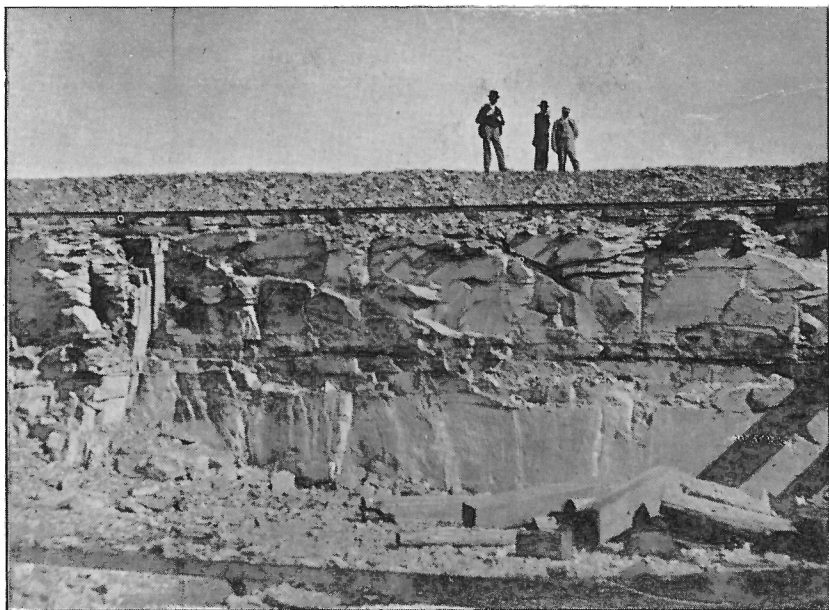
Areas south of the Rideau river.

Heavy faults occur in this area and they have affected the horizontal extent of the formation.



H. M. Aml.—Photo. 1900.

BLACK RIVER LIMESTONE.—CLIFF NEAR ENTRANCE TO BEECHWOOD CEMETERY, OTTAWA, ONT.



H. M. Aml.—Photo. 1900.

CHAZY SHALE AND SANDSTONE IN EXCAVATION AT BRITANNIA POINT, NEPEAN TOWNSHIP, CARLETON COUNTY, ONT.

In the eastern part of the area covered by the map these rocks are not seen, but they again come into view to the east of Russell village.

CHAZY LIMESTONE.

A separation has now been made between the limestones of the Chazy formation which form its upper portion and the shales and sandstone which constitute the lower member. The principal area of the former is found in the western part of the map-sheet north of the Ottawa river from Tétreauville westward. They are concealed over a large portion of their development by heavy deposits of clay and sand, but are supposed to extend north from Aylmer, with a breadth of three miles and a half, or nearly to the foot of the ridge of crystalline rocks which form Kings mountain and its extension to the north-west; while from east to west they occupy the country for about ten miles or from Tétreauville nearly to Breckenridge station, on the Pontiac and Pacific Junction railway.

Chazy limestone.

Aylmer and vicinity.

Along the north shore of the Ottawa the limestones appear from beneath the Black River formation in nearly horizontal strata and continue along the shore from a point just west of Tétreauville, for a mile and a half to the underlying shales.

Tétreauville west.

West of this with a curving outline the southern margin should cross the road from the Aylmer road to Deschênes, about midway between the latter road and the Electric railway. Thence the outline continues north-west and crosses the Aylmer road three-fourths of a mile east of the town of Aylmer, and the contact with the shaly portion of the formation is seen on the road north of this place at about the same distance from the main street.

Deschênes and Aylmer road.

The course of the contact with the shales is thence apparently quite straight for several miles. It crosses the road leading up the north side of the Ottawa near the crossing of the Eardley township line, and, keeping a few chains to the south for a couple of miles, it crosses again to the north of this road and the outcrops disappear beneath the drift.

West of Aylmer.

The contact of the sedimentary rocks with those of the mountain range to the north is not directly seen at any known point. It is impossible therefore to say definitely whether this contact with the granite is by a fault or not, but this seems to be the case, since along the river near Breckenridge the Chazy shales are in contact along the shore, as far as can be ascertained, with the granite, while further

Contact with Chazy shales.

west the Calciferous and Potsdam sandstones appear again near the village of Quyon.

The most easterly recognized outcrop of the limestone of the formation of this area is near the brick and tile works on a small creek which crosses the road between lots 8 and 9, ranges III, and IV., Hull township. Fossils are found in these rocks which are dolomitic. This point is about one mile south of the crystalline rocks and the lower shales appear in a small brook twenty-five chains north.

Areas south of
the Ottawa
river.

The Chazy limestone of the area west of Tétreauville crosses the Ottawa river in a band with a surface breadth of about one mile. On the south side of the river it contains the large quarry from which the cement stone for Mr. Wright's works is obtained. The limestones are in low undulations at this place with dips of two to three degrees. The quarry is rather more than half a mile from the end of the road to the river at Mechanicsville, above the Little Chaudière rapids. The western line of the formation is seen near the point on which the old Skead mill was situated, where it passes down into the shales.

Westborough.

Thence south the limestone band occupies a considerable area along the Canadian Pacific railway and is seen about Westborough. Good exposures are visible on the road leading south from this place in an escarpment cut through by the Electric railway, the dip not being more than two degrees to the south. They form an area rather more than a mile in breadth to the south-west of the Black River outlier at City View, and follow that outcrop round by the south, turning to the east again and coming to the Rideau river, below Hogs Back, where they are exposed below the dam and in the bed of the stream near the road crossing; they are here fossiliferous and presumably represent the transition beds between the shales and limestones.

Hogs Back.

Contacts.

East of the Rideau river a small area occurs near the line of the Hull and Gloucester fault, overlain by the Black River limestone. The Chazy limestone apparently terminates along this break at a point about three miles and a half south-east of Hogs Back. It is also seen at the corner of the road between ranges II and III, with that west from Chaudière Junction. Here there are several faults and the limestone is exposed along the road south in cuttings and in the hills on either side. The inclination of the Chazy near this place is about eighty degrees, the contact with the Utica shale being on the east.

Russell.

The Chazy limestone is not seen in the eastern part of the map-sheet except along the Montreal road already described. It however outcrops along the Castor river at the village of Russell a short distance

east of the limit of the sheet and here contains the characteristic fossils of the formation.

CHAZY SHALES.

The shales which form the lower part of this formation are generally Chazy shales. grayish in colour with shades of green and have a sandy texture. Occasionally beds of sandstone occur, and these become a coarse grit at the base. Reddish shades are seen in the shales along the Ottawa river at several points, with interstratified thin bands of limestone in the upper portion. They form a well defined belt of sediments resting conformably upon the Calciferous, the upper member of which also becomes shaly in certain areas. Some of the limestone bands in the Chazy are almost indistinguishable in character from certain portions of the Calciferous dolomite.

As a rule the shales are in a nearly horizontal position, but near the lines of fault they are often highly inclined as in the outcrops below Hogs Back and to the south.

East of Ottawa city these shales can be well seen on the south shore of the river at Rockcliffe park and for several hundred yards to the east and west of the Gatineau ferry, where they form a cliff along that part of the Ottawa, extending to the old wharf in the clay flat at the east end of the park. They here form an area of about three fourths of a mile in width till they are overlapped by the limestones. They are well exposed about the west side of Hemlock lake and also on the several roads leading south from the river to the Montreal road.

Although the south shore of the Ottawa below Rockcliffe park is clay-covered, it is supposed the shales occupy most of the area nearly to Cumberland village. In the area west of Greens creek they are concealed by clay, but they again appear along the Montreal road below Greens creek, the contact with the limestone keeping near this road for several miles eastward. At Orleans village they appear in a small brook north of the road and are capped by the limestone which shows in a hill between this and the river. Thence on the road to Cumberland they may be seen at intervals and are well exposed in the escarpment south of the latter village. Near the wharf they rest upon Calciferous dolomites and shales.

West of the city and north of the Ottawa they come into view on the shore about two miles east of Deschênes mills. They are well exposed along the line of railway to Aylmer in numerous cuttings, the

Aylmer. strata being nearly horizontal. Thence they form a band nearly one mile in breadth past the town of Aylmer where they are well developed and continue westward as a narrow belt to the cove below Breckenridge station. At the Aylmer Electric park they are bounded on the side next the river by a narrow margin of the Calciferous which extends west from the Cedars for several miles. Along the road west from Aylmer and also on the Pontiac and Pacific railway exposures are numerous.

Westborough and Britannia. South of the Ottawa the eastern limit of this area appears at the point by the old Skead mill at Westborough. The shales are seen along the shore west of this place past the village of Britannia where they are well exposed and the new excavations for the Metropolitan Power company are in this rock at Britannia point. Cuttings in the shale are also seen along the line of the Canadian Pacific and Electric railways. Fossils are sometimes found in calcareous bands in these shales, and collections have been made in the rocks about Aylmer especially by Mr. T. W. E. Sowter.

About half a mile above Rocky point, which is on the west side of Britannia bay, two miles west of the village, the shales are probably in contact with the underlying Calciferous, since the latter are exposed along the beach at several points a short distance further west.

South of Britannia the shales and sandstones occupy a considerable area. Along the line of the Canada Atlantic, (O., A. & P. S. railway) they are seen near the crossing of the Richmond road whence they apparently bend to the east and form a belt a mile in width extending to the Rideau river. They show on the road from City View to Merivale and there is an outcrop seen at low water on the Rideau river about one mile below Black rapids. The area of the shales increases in width as the Rideau is approached, and on this stream it has an apparent breadth of several miles or from below Hogs Back to the contact with the Calciferous above that locality. At the former place its extension eastward is terminated by the fault from Hogs Back which extends along the east side of the river below the dam, and the anticlinal there is in the upper portion of the formation.

South of Hogs Back. Further south the shales are seen on the road between ranges II and III of Rideau Front, where they are concealed southward by the limestone, but they are supposed to come to the surface again about two miles further south and should reach the prolongation of the Hull and Gloucester fault about lots 10 and 11 of the fourth range.

Thickness. The thickness of the two divisions of the Chazy may be stated as about 110 feet for the shales and 100 feet for the limestone.

There is no break between the Calciferous which is for the most part a dolomitic limestone, and the Potsdam which is a sandstone. There are from twenty to thirty feet of transition beds in which the sandy part of the latter becomes more calcareous and it is from this portion that most of the fossils which have been described as Potsdam have been obtained.

East of Ottawa city on the south side of the river the Calciferous rocks do not appear at the surface till within a short distance of the village of Cumberland. It is supposed however, that following the sinuosities of the Chazy a narrow margin rests upon the south shore in the vicinity of Greens creek though the thick deposits of clay have effectually concealed the rock outcrops.

On the north side however the characteristic dolomitic limestones of the formation are exposed at several points, notably in the vicinity of East Templeton and along the road westward to near Wabasse creek. They here form broad ledges for some distance, with a low dip to the south. They pass downward into sandstones of Potsdam age which form a prominent escarpment about 700 paces south of the Canadian Pacific railway west of Templeton station, and the contact with the crystalline rocks is seen on the branch railway leading to Templeton mills on the shore, where they have a dip S. to S. 5° E. < 5° - 7°. This changes in the village on the main road to S. 50° E. < 5°.

Directly east of the Gatineau these formations are supposed to occupy the flat clay-covered area to the foot of the ridge of crystalline rocks and to terminate westward against the Hull and Gatineau fault.

West of the Gatineau river the only outcrops of the Calciferous are seen along the Ottawa west of Aylmer. They are first observed along the Electric railway near the Cedars and in the Electric park they extend inland nearly to the line of the Pontiac and Pacific Junction railway where they are overlain by the Chazy shales. The Calciferous thence continues westward in a narrow strip following the shore and is seen in contact with the Chazy on the road along the Hull and Eardley line about three chains south of the railway crossing.

South of the Ottawa the area is much more extensive. The dolomites occupy all the shore at the point north of Shirley bay to the contact westward with the base of the Chazy about one mile and a half from that point. Eastward of the bay they are seen along the

shore at a number of places to their contact with the shales west of Rocky point.

Bells Corners.

Southward they have a breadth of about four miles to the line of the Nepean and Huntley fault, north of Fallowfield, and in this vicinity the limestones pass down into the sandstones which are well seen on the roads south of Bells Corners. The sandstone also surrounds the eastern end of the ridge of crystalline rocks, consisting of granite, gneiss and limestone with diorites, seen along the Canada Atlantic (O. A. & P. S. Ry.) in the vicinity of South March station. These formations are bounded on the south by the extension of the Huntley fault

Rideau river.

eastward to the line between ranges III and IV of Nepean. Thence they apparently occupy the entire country to the Rideau river near Black rapids, and extend southward along that river from near Black rapids lock, including the greater part of the township of Nepean, the whole of North Gower and of Osgoode and the country south to the St. Lawrence at Prescott. Ledges seen on a brook near the Black rapids lock dip N. 70° E $< 5^{\circ}$.

Black rapids.

Hull and
Gloucester
fault.

East of the Rideau they are much overlain by drift, but form an apparently unbroken area to the Hull and Gloucester fault where on lot 14, range IV, Rideau front, they dip N. 35° E. < 65 though near by the dip is to the S.W. $< 5^{\circ}$.

Potsdam of
Nepean.

The underlying Potsdam which appears along the east end of the granite ridge in the western part of Nepean forms a considerable rise, and here are located several quarries from one of which much of the stone used in the construction of the Parliament and Departmental buildings in Ottawa was obtained. Some of this stone is sufficiently free from iron to be used for glass-making and a large quantity is said to have been recently shipped for that purpose.

The breadth of the Potsdam area at this place is about two miles. Along the north flank of the granitic ridge it extends through the south part of the townships of March and Torbolton, but disappears near the south line of the latter about five miles east of Fitzroy Harbour probably by a fault, since from this point westward the Potsdam is not seen on the north side of the ridge, but appears in a small patch only at the summit on the road north from Kinburn on lot 11, range X, of the township of Fitzroy.

Contact with
granite.

Along the line of the Canada Atlantic, (O., A. & P. S. Ry.) near the east line of March township there is a cutting in these sandstones. Here the granite also appears, having broken into the sandstone, the

contacts being well seen and the latter being somewhat altered, while the granite becomes very quartzose. The Potsdam at the contact is tilted and dips S. 50° E. $<15^{\circ}$ - 20° . In the vicinity the sandstones are filled with *Scolithus* markings which are the only fossils yet recognized in this part of the formation in this district.

CRYSTALLINE ROCKS.

The crystalline rocks found in the area of the map are mostly confined to the portion north of the Ottawa river in the townships of Hull and Templeton. They have been described to some extent in earlier reports, notably in that by Mr. Vennor for 1876-77, and in the *Geology of Canada*, 1863. On the south side of the river they are represented by the rocks of the ridge which extends east from Arnprior to within nine miles of Ottawa city. In this ridge which is largely composed of reddish granite and a coarse blackish diorite, limited outcrops of limestone are seen, and likewise of reddish and grayish gneiss, some of which is highly garnetiferous. At a point 100 yards west of South March station the gneiss dips S. 10° E. $<75^{\circ}$.

Archæan north of the Ottawa.

Ridge near South March.

The area north of the Ottawa is extensive and forms the southern portion of the great Archæan complex of crystalline rocks, formerly styled Laurentian or the Grenville series. They consist of reddish, gray and dark gneisses with numerous and sometimes large bands of crystalline limestone, and these are cut by numerous intrusives, including granite, pyroxene, diorite, diabase, pegmatite, etc. Some of the gneiss is of the variety known as sillimanite.

Characters of the rocks.

The most prominent feature in this area is the great ridge known as Kings mountain which has an elevation of about 1,100 feet above sea-level. It extends westward for some miles with a bold front facing the great flat which occupies the north side of the Ottawa river, as far west as the rear of Quyon. An area extends south-eastward from Kings mountain to a point on range IV., lots 8 and 9, of Hull township. From this point the eastern front of a ridge keeps to the west of a road which leads from Hull past the Forsyth iron mines to Old-Chelsea, the country eastward to the Gatineau being heavily clay-covered. Along the road from this village to the Gatineau at Chelsea, crystalline rocks consisting of limestone, gneiss and granite are seen. The exposed crystalline rocks thus approach Hull in a long narrow ridge from the north-west to within a mile and a half of Tétreauville.

Kings mountain.

Area north of Hull.

Area east of
the Gatineau
river.

East of the Gatineau river large areas are also clay-covered. Ridges of the crystalline rocks, however, show at or near the old crossing at Wrights Bridge and also near Wabasse creek, whence they extend to Templeton station on the Canadian Pacific railway. Beyond this they are again largely concealed by drift to the eastern margin of the map-sheet.

That the granite and gneiss underlie a large part of this area is probably from occasional outcrops in the beds of several of the streams, as on the upper Blanche river so that presumably the greater part of the area is underlain by these rocks.

Limestone
bands in Hull
township.

The general strike of the gneiss both east and west of the Gatineau is north-east. The dips are sometimes reversed indicating anticlinal structures. Of the limestones several well defined bands are visible. The most extensive of these yet recognized in the district is seen on ranges VI. and VII. of Hull, along what is known as the Mountain road which leads in a north-west direction along the south-west flank of the ridge of crystalline rocks. The limestones are exposed on the west side of this ridge from lots 14 to 19, with a breadth on the road of about two miles. North-eastward on the strike the band diminishes in width, and on the road to Old Chelsea, north from the iron mines, it is scarcely more than half a mile across. With the limestones are associated masses of granite, sometimes reddish but more generally white in colour and in the form of pegmatite dykes.

Band near
Forsyth iron
mine.

A second band of limestone occurs on lot 12 on the Mountain road and extends north to the Forsyth mine which is located in this belt. On the road past the iron mines it has a breadth of a little more than a mile, and is separated from that just described by an area of granite and gneiss, a fourth of a mile in width.

Small irregular areas of the limestone are also seen on the Mountain road, south of Kingsmere, on lots 20 and 21, but their extension northward is affected by masses of granite and pyroxene in which are located several important mica mines.

Old Chelsea
bands.

On the road from Old Chelsea east, several small outcrops of the limestone are seen, but their areas are small and irregular, their distribution evidently being influenced by granite masses. On the road north-east from Old Chelsea to Kirks Ferry a narrow band of the limestone occurs which widens out at the Gatineau to nearly half a mile. This band crosses the river in the direction of Cantley, where it is seen on the road to Wilsons Corners.

East of the Gatineau there are also several other small bands. The most important of these traverses ranges IX., X. and XI. of Hull township, from lot 2, to lot 8, where it comes to the east bank of the river. A small and local outcrop is also seen on the east side of the river on lot 7, range VIII, and further south a larger band appears near Wrights Bridge, and extends north-easterly for about a mile, though what may be a narrow extension of the same is visible near the post-office of Quinville. Limestones east of the Gatineau.

The eastern part of the sheet, where not covered by drift, is largely occupied by gneissic and granite rocks. Several small and narrow bands of the limestone occur to the east of the Blanche river, in range IV. of Templeton, which extend probably towards Donaldson lake, west of Buckingham, beyond the limits of the map.

The area in the north-west angle of the map, in the direction of Meach lake. Meach lake, is largely granitic. In places this rock is foliated, but over a considerable extent this feature is lacking.

Mines of mica, apatite, iron, baryte and felspar are found at points throughout the district which will be described under the head of economic minerals.

ECONOMIC MINERALS.

The mineral deposits found in the crystalline rocks north of the Ottawa have been known for many years. Some of them have been referred to in early reports of the Geological Survey, and have been described in various papers to the scientific journals. Economic minerals.

They include mica, apatite, graphite, asbestos or chrysotile, iron ores, baryta, felspar. In addition, however, there are other economic deposits found in the Palæozoic formations which are also of great importance, such as the limestones of Chazy and Trenton age, which have been largely used for building stone and for lime and cement, the shales of the Utica which form an excellent stone for roadmaking, the granites and diabase rocks well suited for macadam, the overlying brick clays which occupy a large area, shell marl, mineral waters, etc.

MICA.

Of the minerals found in the older rocks probably the most important at the present time are the deposits of mica. Along the Gatineau, in a belt several miles in breadth on either side of the river and ex- Mica deposits.

tending northward for more than one hundred miles, this mineral is found, often in such quantity as to be of great economic value.

Kingsmere
mines.

Among localities in the limits of the map may be mentioned several mines situated about one mile south of Kingsmere. The principal deposits at this place are owned by Brown Bros., of Cantley, by Mr. Fleury, of Kingsmere, and by Fortin & Gravel.

The mica at all these mines is found in masses of pyroxene which cut the gneiss of the district and form part of a prominent hill which slopes abruptly to the Mountain road. The mica is developed in irregular fissures in the pyroxene and also near the contact of this rock with the inclosing gneiss. The interspaces have been filled in many places with calcite which is often pinkish in colour, but in some of the mica mines this calcite is almost or entirely wanting. The location of the Brown mines is on lot 18, 19 and 20, ranges VI. and VII., of Hull. The Fleury mine is on lot 20 of range VII., and the Fortin & Gravel on lot 18, of the latter range.

Gemmill
mine.

Another well known mine is located on lot 10, range XII. of Hull, on the east side of the Gatineau river. This is known as the Gemmill or Vavasour mine. It is situated in a hill of pyroxene rock with granite which cuts the red gneiss of the area. In one of the pits at this place there is a dyke of pyroxene about eighteen inches wide, the centre of which is occupied by apatite about six inches thick. This dyke cuts red gneiss. Apatite also occurs in crystals in the calcite with which most of the mica is here associated. This mine has been worked regularly for some years and has a depth of fully one hundred feet. The output of mica has been large and of excellent quality, being an amber or phlogopite variety.

Several small but apparently unimportant shows of mica occur along the road leading to Cantley but have not been developed to any extent.

Nellie and
Blanche.

One of the largest mines in this area, at one time extensively worked, is that known as the Nellie and Blanche, on lots 9 and 10, range X., Hull. The mica occurs in a large mass of pyroxene in fissures rather than as a contact deposit, as is the case with many of the mines in the Gatineau district. Though it has been idle for the last seven years it was opened to a depth of 170 feet and yielded a large quantity of large and clear crystals of the phlogopite variety, though much of the output was of small size. A small quantity of apatite is found in the workings.

On lot 1, range XII., is located an old mine worked formerly for ^{Burke's mine.} apatite and known locally as Burke's. The mica is here associated with the apatite in a pyroxene dyke which cuts the gneiss of the district, and there is a large amount of calcite. One very large crystal of pyroxene was observed in the side of the opening. In the dumps around the mine mica was seen in good sized crystals, and a large quantity had evidently been taken out which at the time of working was regarded as a waste product and so has been spoiled by long weathering. This place has been unworked for some years.

On the west side of the Gatineau, in addition to the mines mentioned near Kingsmere, several other deposits of mica are found. Among these may be mentioned those to the north of Old Chelsea and about Kirk's Ferry. This area is an interesting one for the study of contacts and the mineral is found at a number of points.

In the hills west of the Old Chelsea brook which flows past Cham- ^{Old Chelsea.} berlain's house at that village, the country-rock is for the most part a banded red and gray gneiss, in places with black bands. These are cut by many dykes of pyroxene and granite, the former carrying sometimes small quantities of dark mica and considerable deposits of red apatite. At one point there is a great mass of pyroxene crystals generally of small size. The quantity of mica as yet found in this hill is not large.

A little further along the road to Kirks Ferry and a little west of it is the Scott mine. The rock here is also a reddish gneiss and a dyke of pyroxene cuts across the strike carrying crystals of red apatite and amber mica. The gneiss strikes north-east and dips to the south-east. The amount of mica found here is also small owing probably to the small size of the pyroxene mass.

In the Scott north pit the banding of the gneiss is well defined and ^{Scott mine.} there is also a dyke of pyroxene, in places running nearly with the strike of the gneiss. The mica here is a light amber variety and some good sized crystals were obtained several years ago, about ten tons having been taken out in 1893, some of which was badly wrinkled. Other dykes of red granite and of pegmatite also occur here and in one of the openings a beautiful red jasper is found, parts of which ^{Jasper.} when polished make a beautiful ornamental stone. Red apatite is also seen.

Among other localities where mica is found in small quantity in this ^{Mines near} vicinity may be mentioned lot 15, range X., Hull, in pyroxene cut- ^{Old Chelsea.} ting gneiss, and lot 17, same range, in pyroxene and calcite, with a

small quantity of green apatite. Some of the pyroxene in this area is almost black, in which case the contained mica becomes very dark-coloured, and as a rule it may be stated that the darker the containing rock the blacker the mica.

Serpentine.

In the hill back of the Old Chelsea church the reddish and gray gneiss is also cut by pyroxene dykes. An opening here shows many small crystals of dark mica, and there is also at this place a small exposure of rensselarite similar to that found at the corner of the road to Kingsmere near Chamberlain's house. Near this corner the crystalline limestone outcrops in large ledges and in certain portions there are small irregular veins of chrysotile with serpentine, apparently of no economic importance. The serpentinized limestone resembles the rock at the asbestos mine near Perkins Mills back of Templeton. Numerous small dykes of dark diabase also occur in the rocks of this area.

On the road to Kirks Ferry the limestone is cut by small dykes of pyroxene and small crystals of mica, smooth and of good colour are seen at several points. These have been worked to a limited extent but the quantity of mica appears to be small.

Kirks Ferry.

At Kirks Ferry several mines have been opened and worked. Among these are Haycock's old mines on lots 12 and 13, range XI., Hull township. Some fine crystals have been obtained from these places, but work ceased several years ago. The mineral occurs in the usual way in pyroxene which cuts the gneiss. The latter strikes north-east with a south-east dip. Bands of limestone also occur in the vicinity, and in a cutting on the Gatineau Valley railway in front of the falls on the river, the contact of several intrusives can be well studied. In this cutting a vein of mountain cork was found several years ago but this has apparently been all extracted.

Mountain
cork.

In the mica pit west of the road, several dykes are found. Calcite occurs with the mica and fine aggregations of crystals of mica and pyroxene can be obtained. At one of the openings the pyroxene in the cutting is capped by the gneiss.

Connors'
mine.

On lot 14, range XI., of Hull, (Connors' mine), banded red and gray gneiss occupies the side of the ridge facing the Gatineau river. This is cut by small cross dykes of pyroxene from one to three feet wide, which carry mica in numerous small crystals, much of which is, however, badly crushed. At the contact of two small dykes many small crystals of red apatite are seen with others of greenish shades. Small quantities of red apatite are also found in nearly all the openings. At

one pit near the north end of the location, mica from ten to twelve inches in diameter was observed, but no pink calcite was seen at this place.

On lot 14, range XII., a short distance above the toll-gate north of Snow's mine. Kirks Ferry, there is also a mine in pyroxene cutting gneiss, owned by Mr. Snow, of Ottawa, from which several hundred tons of apatite were taken. Mica is also found here and at several places in the vicinity, but these deposits have never been developed to any extent and their value is therefore, at present, uncertain.

The above descriptions of the mica deposits are believed to cover the principal mines in the district included in the map-sheet. Several large and valuable mines, however, lie along the course of the Gatineau a short distance to the east and west as at the Cascades and near Wilsons Corners, but as they are not included in the map, need not be here described.

APATITE.

While this mineral is found in connection with the mica at nearly Apatite. all the mines in the district it is not in sufficient quantity at any observed place to make its extraction, as an individual product, profitable. In mining the mica, it is however taken out and saved, and will thus be an important asset should the market price advance sufficiently to render its handling practicable.

There does not appear to be any of the great pockety masses such as occur in the Lièvre district at High Rock and other points in the vicinity. The mineral in the Gatineau district usually occurs as crystals in the calcite with which the mica is frequently associated.

This mineral, as a rule, occurs in pyroxene dykes, often of large size, which cut the gneiss and sometimes the limestone of the Grenville series in all directions. The principal localities at which it has been found along the Gatineau have been described in the preceding chapter on mica, but there is one other place at least where apatite was extensively mined some years ago, on lot 11, range V., Templeton township, known as the Electric or McRae mine. The country-rock here is a grayish, often quartzose gneiss, with a strike N. 25° E. dipping west < 80°, and this is cut by a large dyke of pyroxene at right angles to the strike of the gneiss. Much work was done by the installation of an electric plant for drills, lights, etc., and the excavation is large. Other dykes of pegmatite occur about the mine, but the apatite, which

Mode of
occurrence.
McRae's
mine.

was found in large quantities, was confined to the pyroxene, and occurs, as is generally the case, near the contact with the enclosing gneiss. Borings with a diamond drill at this place were made to a reported depth of 176 feet in the dyke, and the mineral is said to extend to the bottom of the bore-hole. Work has been discontinued at this mine since 1892, owing to lack of market for the output.

IRON ORES.

Iron ores.

Important deposits of iron-ore are found in the township of Hull, some of which have been worked quite extensively. Of these, probably the best known are the Forsyth and Baldwin mines on lots 11 and 13 of range VI., about two and a half miles west of Ironsides village, and the Haycock mines on lot 1, range XI., of Hull, and lot 28, of range VI., of Templeton township.

The early history of these mines will be found in the report on the "Economic Minerals of Quebec," Annual Report, 1888-89, pages 8-12 K. The Forsyth and Baldwin mines occur in the belt of limestone which crosses ranges V., VI., and VII. Of these, the former is on lot 11, and is that from which the ore was chiefly taken. The Baldwin is on lot 13, and has apparently never been well developed. There is a new deposit on lot 12 which has recently been partly prospected by the Messrs. Hibbard, but the value of the deposit does not yet seem to have been fully proved. These iron outcrops are presumably all on the continuation of the same fissure.

Forsyth
mine.

At the Forsyth mine there is a large body of mixed ore, principally magnetite of good quality, with some hæmatite, which fills an irregular fissure in the crystalline limestone, and runs a little north of west. The cutting in the old workings extends west of the road to Old Chelsea for twelve chains. In places it reached a depth of over 100 feet, and the ore-body was found to be somewhat irregular in shape, being wide near the surface but diminishing as the depth increased. At the bottom of the main shaft the thickness of the ore is reported at about eighteen feet.

Of the large quantity of excellent ore taken from this place, much was shipped to the United States. A portion was, however, smelted in a small blast-furnace, which was erected near the bank of the Gatineau at Ironsides village. The old furnace was taken down nearly twenty years ago, and no work has since been done at the mine except a little prospecting. The ore contained small quantities of sulphur and phosphorus, but not sufficient to be injurious. There is also a small

percentage of disseminated graphite. Dykes of granite and greenstone are seen in the cuttings, and the ore-body is probably a large pockety or lense-shaped mass. Eastward the extension of the ore cannot be traced owing to the presence of the clay deposits, but it has here probably been largely denuded.

The ore at the Haycock location is also a mixture of magnetite and hæmatite. The quantity visible has not been found to be as large as at the Forsyth mine, but considerable work was done at this place from twenty-five to thirty years ago and a small forge was erected, the ruins of which still remain. The country-rock is a mixture of granite-gneiss and diorite, and the ore is irregularly distributed. Iron ore is also reported from lot 2, range X. of Hull, but in so far as known has never been developed.

Haycock
mine.

BARITE.

This mineral occurs in considerable quantity on lot 7, range X, of Hull. It was worked to some extent thirty years ago and was then known as the Foley mine. The vein of barite varies in width from one to two feet and has been traced north-westerly for over 100 yards. It has recently been reopened by a Montreal paint company and a large amount of the mineral has been shipped to that city. Fluorite occurs with the barite in considerable quantity. The enclosing rock is crystalline limestone which is cut by several dykes. Another outcrop of this mineral is seen near the back road on lot 4, range XII., but this has been opened to a very limited extent.

Barite.
Foley mine.

FELSPAR.

Felspar occurs as an ingredient of the pegmatite dykes which are very numerous in the Archæan area. It is sometimes found in sufficient quantity to be of economic value, but generally there is a percentage of iron which renders it unfit for the manufacture of pottery, and often the felspar is so intimately mixed with quartz that the separation is impossible.

It has been mined at two localities north of the Ottawa river. these the principal location is north of the Canadian Pacific railway about half a mile west of Templeton station. The other is on the road leading back from Gatineau point and about six miles from the line of railway.

Of Occurrences.

The mineral is generally reddish in colour due probably to a very small percentage of iron in its composition, but this passes off when the

rock is burned, and the resulting product is perfectly white. There is always a certain amount of generally white quartz in the dykes. The expenses of shipment to the United States market are such as to leave but a small margin of profit. Work ceased at both these places several years ago.

South March. On the south side of the Ottawa, a short distance south of March station on the Ottawa and Parry Sound railway, there is also a deposit of felspar, the quality of which appears to be excellent. This place is a short distance beyond the western limit of the map-sheet.

STRONTIANITE.

Strontianite
of Nepean.

This mineral is rarely found in Canada. On the south shore of the Ottawa river a short distance below the road leading down to the old Skead mill, on lot 31, concession A, of Nepean township it occurs in the form of veins, traversing the lower part of the Chazy limestone, which vary from four to six inches in width. The mineral occurs below high water line and thus can only be seen at a low stage of water in the river. It is referred to in the Annual Report of the Geological Survey, vol. vi., 1892-93, p. 23 R, where it is thus described :

"The mineral, which entirely fills the veins, has a radiating crystalline massive structure, the foci of the several divergent groupings being at either wall of the vein, the radial structure of each group extending thence inward, meeting and interlacing at their extremities with those of the similar groupings of the opposite side of the vein—or, failing that, as was occasionally found to be the case, and in the cavities thus formed, terminating in radiant groups of acicular crystals of from five to nine millimetres in length. Colour, pale yellow-green, shading into white ; translucent ; specific gravity, at 15.5° C. 3.704.

Analysis.

The analysis of the mineral by Mr. Johnston upon carefully selected material, consisting of crystals dried at 100° C. gave :

Carbonic acid.....	30.54
Strontia	65.43
Lime	3.38
Insoluble.....	0.17
	<hr/>
	99.52

"Strontianite, strontium carbonate, is of economic importance by reason of its employment for the manufacture of strontium hydrate, which is largely used in the preparation and refining of beet-root sugar, and in the extraction of crystallisable sugar from molasses. It is also employed for the manufacture of strontium nitrate, a salt much used in pyrotechny." (Page 31 R, same report.)

Among the Palæozoic rocks the principal economics are confined to the limestones. These, especially in the Trenton formation, have been quarried extensively, both for building stone and for lime-burning. The largest quarries now operated are in the city of Hull, near the line of the Canadian Pacific railway, a short distance east of Hull station, and at Robillards, on the Montreal road about three miles from Cummings bridge. Many old quarries are found which have been abandoned for some years. Large quarries are also found near Hogs Back on the east side of the Rideau river. All these are in the Trenton formation. Limestone quarries.

Among the largest in the Chazy is that known as Wright's cement quarry on the south side of the Ottawa above Mechanicsville.

Several analyses of these limestones have been made in the laboratory of the Geological Survey. (See vol. VI., 1892-93, p. 34R.) Of these the following may be given :

Wrights quarry (formerly Mahoney's) Ward No. 1, city of Hull, from the uppermost bed. This has a thickness of two feet. The material of the same, which is much broken, is chiefly, if not exclusively, used for the manufacture of lime. Hull limestone.

Structure, somewhat fine-crystalline ; colour, faintly brownish ash-gray. After drying at 100° C.,—Hygroscopic water = 0·14 per cent, it gave :

Carbonate of lime	97·66	Analyses.
" magnesia.....	1·38	
" iron.....	0·16	
Alumina.....	} 0·67	
Silica, soluble		
Insoluble matter.. ..		
	99·87	

From the third bed, thickness of the same, one foot three inches. The stone employed for building purposes. Structure, somewhat finely crystalline ; colour, bluish-gray. After drying at 100° C.,—Hygroscopic water = 0·09 per cent, it gave :

Carbonate of lime.....	96·25	
" magnesia.....	2·18	
" iron.....	0·32	
Alumina.....	0·95	} 1·33
Silica, soluble	0·07	
Insoluble matter.....	1·21	
	100·08	

From the fifth bed, thickness of same, one foot two inches. Stone employed for building purposes. Structure, fine-crystalline; colour, bluish-gray. After drying at 100° C.,—Hygroscopic water = 0·07 per cent, it gave:

Carbonate of lime.....	96·19	
" magnesia.....	1·72	
" iron.....	0·26	
Alumina.....	0·05	} 1·74
Silica, soluble.....	0·09	
Insoluble matter.....	1·60	
		99·91

From the tenth bed. Thickness of same, one foot six inches. The stone employed for building purposes. Structure, somewhat coarsely crystalline; colour, faintly brownish ash-gray. After drying at 100° C.,—Hygroscopic water = 0·08 per cent, it gave:

Carbonate of lime.....	96·92	
" magnesia.....	1·59	
" iron.....	0·25	
Alumina.....	0·07	} 2·06
Silica, soluble.....	0·02	
Insoluble matter.....	1·97	
		100·82

From an outcrop of the Chazy limestone on the south-western side of Hemlock lake in Rockcliffe park, an analysis was made by Dr. Hoffmann, as follows:—

A very fine-grained and compact greenish-gray, yellowish-brown and reddish-brown weathering, massive limestone. After drying at 100° C.,—Hygroscopic water = 0·98 per cent, it gave:

Chazy limestone of Hemlock lake.	Lime.....	19·78	
	Magnesia.....	10·55	
	Alumina.....	0·75	
	Ferric oxide.....	0·27	
	Ferrous oxide.....	1·71	
	Manganous oxide.....	0·38	
	Carbonic anhydride.....	26·03	
	Sulphuric anhydride.....	0·07	
	Phosphoric anhydride.....	0·14	
	Silica, soluble.....	0·60	
	Water.....	0·20	
	Insoluble mineral matter.....	38·81	
		99·29	

The band from which this argillaceous magnesian limestone was taken has been supposed to be an extension of the beds affording a cement stone, which are worked by Mr. C. B. Wright, on the thirty-

fourth lot of the first concession, Ottawa front, of Nepean township.
(Annual Report, vol. xi., 1900, p. 19 R.

A large quarry in the Potsdam sandstone on lot thirty-five of the fourth range of Nepean, from which the stone for the Parliament buildings in Ottawa was taken, has already been referred to. The quality of the stone is excellent, and in places sufficiently free from iron, to adapt it for the manufacture of glass. Potsdam sandstone quarry.

The black shales of the Utica formation have been found to make an excellent material for streets. The rock reduces easily to a smooth and clean surface, and has been employed on some of the streets in the eastern part of the city on Sandy Hill. It is also used for walks, as in Major Hill park, and gives excellent results. Utica shale.

Shell marl is found in considerable quantity on the shores of Hemlock lake near Rockcliffe park. It is referred to in the Geological Survey Report for 1845-46, on page 96, and is there said to have a thickness of five feet, spreading over a breadth of 200 yards, where it becomes concealed by drift. This material is now used largely in the manufacture of hydraulic cement in western Ontario. It was formerly used for brick-making, and many of the old white brick buildings in this city are said to have been made from bricks of which this marl formed an ingredient. It has apparently not been employed for this purpose in recent years. Shell marl of Hemlock lake.

An analysis made in the Geological Survey laboratory (Annual Report, vol. vii., 1894, page 23, R, is as follows:—

“The air-dried material is earthy, slightly coherent; colour, yellowish-white. It contains numerous shells, also root fibres.

(After drying at 100° C.—Hygroscopic water = 0.46 per cent.)

Lime.....	52.24	Analysis.
Magnesia	0.13	
Alumina.....	0.13	
Ferric oxide.....	0.09	
Potassa	traces.	
Soda.....	traces.	
Carbonic acid.....	41.16	
Sulphuric acid.....	traces.	
Phosphoric acid.....	0.02	
Silica, soluble.....	0.11	
Insoluble mineral water.....	1.08	
Organic matter, viz., vegetable fibre in a state of decay, and products of its decay, such as humus, humic acid, etc., and possibly a little combined water.....	4.90	
	99.86	

Assuming the whole of the lime to be present in the form of carbonate, trifling quantities of which are, however, present in other forms of combination, the amount found would correspond to 93.29 per cent carbonate of lime.

The insoluble mineral matter was found to consist of :

Silica	0.72
Alumina and ferric oxide.....	0.24
Lime.....	0.04
Magnesia	0.02
Alkalies (?)	0.06
	<hr/> 1.08"

MINERAL WATERS.

Mineral
springs.

Mineral springs are quite numerous in the vicinity of Ottawa. Among the most important may be mentioned those at Eastman, Borthwick's east of Hawthorne, and the Victoria springs, a short distance south of the Montreal road on Greens creek. They are extensively used for their medicinal properties.

BRICK CLAYS.

Brick-yards.

Brick-clays are widely developed around the city, and many important brick-yards are in operation. Two of the largest of these (Odell's and Graham's) are in Ottawa east, south of the canal. Two others are on the west bank of the canal, a short distance below the Hogs Back. Another large establishment is a short distance south of the road leading from Billings Bridge to the latter place. The brick and tile works of Mr. Wright are on a road which leads north about two miles west of the city of Hull.

Fossils.

In the clay deposits at several of these places, notably at Odell's brick-yard, marine organisms are abundant. These include shells, the bones of seals, sponges, etc., of which interesting collections have been made from time to time.

Lime kilns.

Lime kilns are numerous. They are found principally on the Montreal road, at Robillard's, and in Hull, in connection with the quarries already described.

APPENDIX

PRELIMINARY LISTS OF THE ORGANIC REMAINS OCCURRING IN THE
VARIOUS GEOLOGICAL FORMATIONS COMPRISED IN THE MAP
OF THE OTTAWA DISTRICT, INCLUDING FORMA-
TIONS IN THE PROVINCES OF QUEBEC
AND ONTARIO, ALONG THE
OTTAWA RIVER.

BY

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Assistant Palaeontologist to the Geological Survey of Canada.

APPENDIX.

LISTS OF FOSSILS TO ACCOMPANY REPORT BY DR. R. W. ELLS ON THE CITY OF OTTAWA MAP.

By HENRY M. AMI, M.A., D.Sc., F.R.S. CAN.

Assistant Palæontologist to the Geological Survey of Canada.

INTRODUCTORY.

The following lists of organic remains from various localities in the Ottawa district, are submitted as evidence obtained in the separation of the several geological formations of sedimentary origin, comprised within the area of the map accompanying the report, and also to serve as guides to collectors and students of geology and palæontology from whom numerous enquiries are constantly made to the department. These lists are by no means exhaustive, but it is confidently hoped that in the near future, more complete and systematic lists of all the species recorded or known to occur in the Ottawa district, will be published.

Excellent collections of fossils from the Ottawa District made by the late Elkanah Billings, Dr. VanCourtland, Sir James Grant, W. R. Billings, James Richardson, John Stewart, and officers of the Geological Survey department may be seen at any time in the museum of the Geological Survey on Sussex street, Ottawa.

LISTS OF FOSSILS: PLEISTOCENE.

From Green's creek, south side of Ottawa river, county of Carleton, Ont., six miles below Ottawa city, collected by Sir William Dawson and occurring in calcareous nodules from the marine clays of that locality.

1. *Potentilla Canadensis*.
2. *Drosera rotundifolia*.
3. *Acer spicatum*.
4. *Gaylussaccia resinosa*.
5. *Populus balsamifera*.
6. *Thuja occidentalis*.
7. *Potamegeton perfoliatus*.
8. " *pusillus*.
9. *Equisetum scirpoides*.

10. *Fontinalis*, sp.
11. *Fucus* or *Ulva*, sp.
12. *Carices* and *Gramineæ*, several species.

In addition to the, above, Prof. D. P. Penhallow, of the McGill College botanical laboratories, Montreal has kindly determined the following species obtained in calcareous nodules from the same locality.

1. *Acer saccharinum*.
2. *Algæ*, sp.
3. *Brasenia peltata*.
4. *Bromus ciliatus*.
5. *Cyperaceæ*.
6. *Carex Magellanica*.
7. *Equisetum limosum*.
8. " *sylvaticum*.
9. *Fucus digitatus*, N. sp.
10. *Oryzopsis asperifolia*.
11. *Populus grandidentata*.
12. *Potamogeton pectinatus*.
13. " *rutilans*.
14. *Potentilla Anserina*.

From similar nodules found in the clays at Besserer's wharf, along the Ottawa River, below the mouth of Green's creek, the following have been obtained :

1. *Betula lutea*.
2. *Cyperaceæ*.
3. *Fucus digitatus*.
4. *Hypnum fluitans*.
5. *Populus balsamifera*.
6. " *grandidentata*.
7. *Potamogeton perfoliatus*.
8. " *pusillus*.
9. " *rutilans*.
10. *Potentilla Anserina*.
11. *Vallisneria*, sp.
12. *Typha latifolia* (?).

From nodules found at Green's creek by John Stewart, 1893.

1. *Macoma fragilis*, Fabricius. (= *M. Balthica*, L.)
2. *Saxicava rugosa*, Linn.
3. *Leda (Portlundica) arctica*, Gray.

4. *Cylichna alba* or *C. minuta*.
5. *Balanus crenatus*, Bruguière.
6. *Mallotus villosus*, Cuvier.
7. *Cottus uncinatus*, Reinhardt.

From creek near the bridge at Cyrville, county of Carleton, Ont.
Collected by John Stewart, 1893. (H. M. A. coll.)

1. *Saxicava rugosa*, Linn.
2. *Leda (Portlandia) arctica*, Gray.
3. *Balanus crenatus*, Bruguière.
4. *Mallotus villosus*, Cuvier.

From Graham's brickyard, Ottawa East. Collected by H. M. Ami.

1. *Macoma Balthica*, Linnæus.
2. *Macoma calcarea*, Chemnitz.
3. *Leda (Portlandia) arctica*, Gray.
4. *Cylichna alba*, Brown.
5. *Balanus crenatus*, Bruguière.
6. *Natica affinis*, Gmelin.

From right bank of the Rideau river, near Manotick road. Collected by R. H. Campbell, Esq., 1891-92.

1. *Macoma Balthica*, Linnæus.
2. *Saxicava rugosa*, Linn.
3. *Mytilus edulis*, Linn.
4. *Balanus porcatus*, De Costa.

From Gatineau Valley railway, half mile north of Chelsea station.
Collected by W. J. Wilson, H. Nelson and H. M. A., 1894-1898.

1. *Macoma Balthica*, Linnæus.
2. *Saxicava rugosa*, Linn.
3. *Balanus crenatus*, Bruguière.
4. *Leda (Portlandia) arctica*, Gray.

From Odell's brickyard, Ottawa East. Collected by Messrs. Walter and Mortimer Odell, R. L. Burland Harold Nelson, and H. M. Ami, 1889-1896.

1. *Thuja occidentalis*, well preserved branches.
2. *Polystomella crispa*, var.

3. *Quinqueloculina seminulum*.
4. *Nonionina*, sp. cf. *N. scapha*.
5. *Polymorphina lactea*.
6. *Craniella Logani*, Dawson.
7. *Eschara elegantula*, d'Orbigny.
8. *Leda (Portlandia) arctica*, Gray.
9. *Saxicava rugosa*, Linn.
10. *Macoma Balthica*, Linn.
11. *Nucula tenuis* (Montagu).
12. *Natica affinis*, Gmelin.
13. *Velutina (Limneria) undata*, Brown.
14. *Chrysodomus despectus*, Linn.
15. *Phoca*, sp.

In addition to the above there were collected by Sir William Dawson and members of the staff of the Geological Survey, and described in *Geology of Canada*, 1863, pp. 916-917, from Green's creek along the Ottawa River.

1. *Cyclopterus lumpus*.
2. *Cottus*, sp.
3. *Tellina Groenlandica (Macoma Balthica)*.
4. *Saxicava rugosa*.
5. *Drosera rotundifolia*.
6. *Trifolium repens*.
7. *Potentilla Norvegica*.
8. " *tridentata*.
9. " *Canadensis*.
10. *Arctostaphylos uva-ursi*.
11. *Populus balsamifera*.
12. *Potamogeton perfoliatus*.
13. " *natans*.
14. *Mallotus villosus*.
15. *Gasterosteus*, sp. indt.

From Wright's brickyard, north of Tétreauville, Hull, Que.

1. *Saxicava rugosa*, Linnæus.
2. *Phoca* sp. probably young of *P. vitulina*.

From Green's creek and adjacent shores of the Ottawa, in clay nodules, there were obtained by Sir William Dawson and H. M. Ami, the following remains of fossil insects described by Prof. Scudder.

1. *Tenebrio calculensis*, Scudder.
2. *Byrrhus Ottawaensis*, Scudder.

3. *Fornax ledensis*, Scudder.
4. *Phryganea ejecta*, Scudder.

The following species of Pleistocene plants are recorded by Prof. D. P. Penhallow, of McGill University, in his recent paper on "The Pleistocene Flora of the Don Valley" embodied in the Report of the committee of the British Association for the Advancement of Science appointed to report upon the "Canadian Pleistocene Fauna and Flora," published in report of the British Association for the Advancement of Science for the 1900 (Bradford meeting), pp. 328-339. Most of the forms recorded were collected by the writer and were kindly determined by Prof. Penhallow himself, who generously undertook the task of naming the species present.

From Besserer's Springs, Gloucester, Ont.

1. *Betula lutea*.
2. *Cyperaceæ*.
3. *Elodea Canadensis*.
4. *Encyonema prostratum*.
5. *Fucus digitatus*.
6. *Hypnum fluitans*.
7. *Populus balsamifera*.
8. *Potamogeton pectinatus*.
9. " *perfoliatus*.
10. " *pusillus*.
11. " *rutilans*.
12. *Potentilla Anserina*.
13. *Typha latifolia*.
14. *Vallisneria spiralis*.

From Green's Creek, Gloucester, Ont.

1. *Acer saccharinum*.
2. *Algæ*—*sp.*
3. *Alnus*—*sp.*
4. *Brasenia peltata*.
5. *Bromus ciliatus*.
6. *Carex Magellanica*.
7. *Cyperaceæ*—*sp.*
8. *Drosera rotundifolia*.
9. *Elodea Canadensis*.
10. *Encyonema prostratum*.
11. *Equisetum limosum*.

12. *Equisetum scirpoides*.
13. " *sylvaticum*.
14. *Fontinalis*—*sp.*
15. *Potamogeton digitatus*.
16. *Caylusaia*,—*sp.*
17. *Graminea resinosa*.
18. *Oryzopsis asperifolia*.
19. *Populus balsamifera*.
20. " *grandidentata*.
21. " *perfoliatus*.
22. " *pusillus*.
23. " *rubilans*.
24. *Potentilla Anserina*.
25. *Vallisneria spiralis*.

FRESH WATER DEPOSITS.

From the shell-marl deposit of Hemlock lake, New Edinburgh, the following species were obtained by H. M. Ami in 1882 :—

1. *Valvata tricarinata*.
2. *Amnicola porata*.
3. *Physa heterostropha*.
4. *Planorbis campanulatus*.
5. " *bicarinatus*.
6. " *parvus*.
7. *Limnea galbana*, Binney, an extinct species.
8. " *stagnalis*.
9. " *desidiosa*.
10. *Mesodon albolabris*.
11. " " var. *dentifera*.
12. " *Sayi*.
13. *Patula alternata*.
14. *Hyalina indentata*.
15. " *arborea*.
16. *Conulus fulvus*.
17. *Pisidium abditum*.

PALÆOZOIC ERA.

ORDOVICIAN SYSTEM.

LORRAINE FORMATION.

From a low cutting on the Canada Atlantic railway, about two and one quarter miles East of Ottawa city. Rocks : buff-weathering earthy shales and mudstones. Collected by H. M. Ami, 1884.

1. *Monticuliporoidæ*, branching forms.
2. *Orthis (Dinorthis) pectinella*, Emmons.
3. *Orthis (Dalmanella) testudinaria*, Dalman.
4. *Rafinesquina alternata*, Conrad.
5. *Strophomena Trentonensis*, Winchell and Schuchert.
6. *Leptaena (Plectambonites) sericea*, Sowerby.
7. *Zygospira Heardi*, Billings.
8. *Cyrtolites ornatus*, Conrad.
9. *Bellerophon bilobatus*, Sowerby.
10. *Murchisonia subconica*, Hall or n. sp.
11. " *gracilis*, Hall.
12. *Modiolopsis modiolaris*, Conrad.
13. " *pholadiformis*, Hall.
14. *Byssonychia radiata*, Hall.
15. *Pterinea demissa*, Hall.
16. *Asaphus*, sp.
17. *Calymene senaria*, Conrad.
18. *Crinoidal* fragments.

From an outcrop on the Russell Road, township of Gloucester, lot 4, range VI., County of Carleton, Ont. Collected by R. W. Ells and N. J. Giroux, 1894.

1. *Bythotrephes*, sp.
2. *Crinoidal* fragments.
3. *Conchicolites*, sp. cf. *C. flexuosus* or possibly n. sp.
4. *Plectambonites sericea*, small form, Sowerby.
5. " " very large oblong form.
6. *Orthis (Dalmanella) testudinaria*, Dalman.
7. " (*Dalmanella*) *emacerata*, Hall.
8. *Modiolopsis rhomboideus*, Hall.
9. *Clidophorus planulatus*.
10. *Byssonychia radiata*, Hall.
11. *Calymene senaria*, Conrad.

UTICA FORMATION.

From lot 17, Junction gore, near Rideau river. Collected by James Richardson, 1853.

1. *Lingula curta*, Hall,
2. " *Daphne*, Billings.
3. " *Progne*, Billings.
4. *Dalmanella testudinaria* or closely related species.
5. *Trocholites ammonius*, Emmons.
6. *Orthoceras lamellosum*, Hall.
7. *Asaphus latimarginatus*, Hall. (= *Asaphus Canadensis*, Chapman.)

From Mackay street, New Edinburgh, H. M. Ami, 1891.

1. *Intricaria* (*Subretopora*) sp. parasitic on body chamber of *Endoceras proteiforme*, Hall.
2. *Monticuliporoid* (? *Batostomella erratica*, Ulrich).
3. *Arthronema*, sp.
4. *Leptobolus insignis*, Hall.
5. *Dalmanella testudinaria*, Dalman.
6. *Schizocrania filosa*, Hall.
7. *Plectambonites sericea*, Sowerby.
8. *Lyrodesma pulchellum*, Emmons.
9. *Cyclonema*, sp. cf. *C. bilix*, Hall.
10. *Murchisonis*, sp.
11. *Metoptoma*, n. sp. (*Metoptoma rara*, MS.).
12. *Trocholites ammonius*, Conrad.
13. *Conularia Trentonensis*, Hall.
14. *Endoceras proteiforme*, Hall.
15. *Orthoceras cancellatum*, Walcott.
16. *Triarthrus Becki*, Green.
17. *Asaphus latimarginatus*, Hall.
18. *Calymene senaria*, Conrad.
19. *Primitia Ulrichi*, Jones.

From Cummings's Bridge, south side of Rideau river, township of Gloucester, county of Carleton, Ont. Collected by H. M. Ami, 1885.

1. *Orthograptus quadrimucronatus*, Hall.
2. *Leptograptus flaccidus*, Hall.

3. *Leptograptus annectans*, Walcott.
4. *Diplograptus truncatus*, Lapworth.
5. *Leptobolus insignis*, Hall.
6. *Schizocrania filosa*, Hall.
7. *Zygospira modesta*, Say.
8. *Pterinea Trentonensis*, Conrad.
9. " *insueta*, Conrad.
10. *Mediolopsis*, sp. indt.
11. *Orthoceras lamellosum*, Hall.
12. *Triarthrus spinosus*, Billings.
13. " *Becki*, Green.

From the corner of O'Connor and Queen streets, Ottawa City. Collected by H. M. Ami, 1888.

1. *Lingula Progne*, Billings.
2. *Dalmanella testudinaria*, Dalman.
3. *Plectambonites sericea*, Sowerby.
4. *Endoceras proteiforme*, Hall.
5. *Triarthrus Becki*, Green.
6. *Asaphus latimarginatus*, Hall.

From Porter's Island, Rideau River, Ottawa City, from collections made by J. C. Reichenbach, N. J. Giroux and H. M. Ami in 1894.

1. *Stephanella sancta*, Hinde.
2. *Leptograptus flaccidus*, Hall.
3. *Diplograptus amplexicaulis*, Hall or closely allied species.
4. *Leptobolus insignis*, Hall.
5. *Pterinea Trentonensis*, Conrad.
6. *Trocholites ammonius*, Emmons, very large form.
7. *Orthoceras lamellosum*, Hall.
8. *Triarthrus Becki*, Green.
9. " *spinosus*, Billings.
10. Conodont (*Prionodus*), n. sp., shewing six minute rounded pointed teeth, imbedded at their base in narrow and delicate ramus. Indications of longitudinal striations faintly seen on the teeth, smaller ones appear to be intercalated between the larger ones in a couple of instances. The fragment as preserved measures 3.5 millimetres. (*Prionodus desideratus* is suggested as a designation for this species.)

From New Edinburgh, near entrance to Rideau Hall, on Mackay street. H. M. Ami, 1894.

1. *Arthronema*, sp. probably new.
2. ? *Sagenella ambigua*, Walcott.
3. *Pholidops subtruncatus*, Hall, or n. sp.
4. *Lingula Progne*, Billings.
5. *Dalmanella testudinaria*, Dalman.
6. *Rafinesquina alternata*, Emmons.
7. *Plectambonites sericea*, Sowerby.
8. *Lyrodesma pulchellum*, Emmons.
9. *Modiolopsis anodontoides*, Conrad.
10. *Pleurotomaria subconica*, Hall.
11. *Conularia Trentonensis*, Hall.
12. *Trocholites ammonius*, Emmons.
13. *Orthoceras lamellosum*, Hall.
14. *Asaphus latimarginatus*, Hall.
15. *Triarthrus Becki*, Green.
16. *Calymene senaria*, Conrad.
17. *Primitia*, sp.

Zone of *Schizambon Canadensis*, Ami.

From the band of impure bituminous limestone holding *Schizambon Canadensis*, at Sparks's Rapids on the east shore of the Rideau River in Gloucester, opposite the old Rideau Rifle Range—the following species of Utica fossils were obtained by the writer:—

1. *Batostomella erratica*, Ulrich.
2. *Lingula curta*, Hall.
3. " *elongata*, Hall.
4. " *quadrata*, Eichwald (cf. *Lingula Elderi*, W. & S.)
5. *Leptaena (Plectambonites) sericea*, Sowerby.
6. *Strophomena (Rafinesquina) alternata*, Conrad (Emmons).
7. *Orthis (Dalmanella) testudinaria*, Dalman.
8. *Zygospira Headi*, Billings.
9. " *modesta*, Say.
10. " sp. probably new species.
11. *Conularia Trentonensis*, Hall.
12. *Turrilepas Canadensis*, Henry Woodward.
13. *Asaphus latimarginatus*, Hall.
(= *Asaphus Canadensis*, Chapman.)
14. *Asaphus*, sp. cf. *platycephalus*, Stokes.
15. *Calymene senaria*, Conrad.
16. *Beyrichia oculifera*, Hall or allied form.

17. *Leperditia cylindrica*, Hall.
18. *Primitia*, sp. nov.

TRENTON FORMATION.

From south shore of the Ottawa, Nepean point, between Parliament hill and the steamboat landing. H. M. Ami.

1. *Palæophycus obscurus*, Billings.
2. *Licrophycus gracilis*, Hall.
3. *Stenaster Salteri*, Billings.
4. *Agelacrinites Chapmani*, Billings.
5. *Glyptocrinus ramulosus*, Billings.
6. *Rhodocrinus* (*Archæocrinus*) *pyriformis*, Billings.
7. *Prasopora lycoperdon*, Vanuxem. (= *P. Selwyni*, Nich.)
8. *Monotrypella Trentonensis*, Nicholson.
9. *Protarea vetusta*, Hall.
10. *Streptelasma corniculum*, Hall.
11. *Diplograptus*, sp.
12. *Rafinesquina alternata*, Conrad (Emmons).
13. " *deltoidea*, Conrad.
14. *Strophomena incurvata*, Shepard.
15. *Dalmanella testudinaria*, Dalman.
16. *Hebertella insculpta*, Hall.
17. *Plectambonites sericea*, Sowerby.
18. *Platy-trophia biforata*, Schlotheim, var. *lynx*, Eichwald.
19. *Trochonema umbilicatum*, Hall.
20. *Murchisonia* (*Hormotoma*) *bellicincta*, Hall.
21. " " *gracilis*, Hall.
22. *Raphistoma lenticulare*, Hall.
23. *Ambonychia amygdalina*, Billings.
24. *Calymene senaria*, Conrad.
25. *Asaphus platycephalus*, Stokes.

From Nepean point, collected by R. H. Campbell, H. D. Herdt and H. M. Ami, 1890.

1. *Licrophycus*, sp.
2. *Bythotrephes succulens*, Billings.
3. *Rhodocrinus* (*Archæocrinus*) *pyriformis*, Billings.
4. *Prasopora lycoperdon*, Vanuxem,
5. *Pachydictya acuta*, Hall.
6. *Dalmanella testudinaria*, Dalman.

7. *Rafinesquina alternata*, Conrad (Emmons).
8. *Plectambonites sericea*, Sowerby.
9. *Platystrophia biforata*, var. *lynx*, Eichwald.
10. *Zygospira recurvirostra*, Hall.
11. *Bellerophon bilobatus*, Sowerby.
12. *Pleurotomaria Daphne*, Billings.

From Brigham's quarry, Hull. Collected by H. M. Ami and T. M. Hardie, 1883.

1. *Periglyptocrinus Billingsi*, W. & S.
2. *Glyptocrinus ramulosus*, Billings.
3. *Archæocrinus pyriformis*, Billings.
4. *Dendrocrinus congregatus*, Billings.
5. " *acutidactylus*, Billings.
6. *Solenopora compacta*, Billings.
7. *Ptilodictya falciformis*, Nicholson.
8. *Rhinidictya paupera*, Nicholson.
9. *Graptodictya*, sp.
10. *Arthroclema pulchellum*, Billings.
11. *Prasopora lycoperdon*, Vanuxem.
12. *Monotrypella Trentonensis*, Nicholson.
13. *Batostoma Ottawaënse*, Foord.
14. *Pachydictya acuta*, Hall.
15. *Monticulipora Billingsi*, Foord.
16. *Spatiopora areolata*, Foord.
17. *Ptilodictya maculata*, Ulrich.
18. *Lingula Philomela*, Billings.
19. " *elongata*, Hall.
20. *Dalmanella testudinaria*, Dalman.
21. *Rafinesquina alternata*, Conrad (Emmons).
22. *Plectambonites sericea*, Sowerby.
23. *Skenidium Merope*, Billings.
24. *Rhynchonella (Rhynchotrema) inæquivalvis*, Castelnau.
25. *Serpulites dissolutus*, Billings.
26. *Murchisonia (Hormotoma) gracilis*, Hall.
27. *Asaphus platycephalus*, Stokes.
28. *Calymene senaria*, Conrad.

From Hull quarries. Collected by John Stewart, 1885-93.

1. *Archæocrinus microbasalus*, Billings.
2. *Dendrocrinus acutidactylus*, Billings.
3. *Dendrocrinus conjugans*, Billings.

4. *Glyptocrinus*, sp.
5. *Periglyptocrinus Billingsi*, Wach. & Spr.
6. *Archæocrinus desideratus*, W. R. Billings.
7. “ *pyriformis*, Billings.
8. *Cleioocrinus grandis*, Billings.

From Beaver meadow, Hull. H. M. Ami, 1891.

1. *Pachydictya acuta*, Hall.
2. *Prasopora lycoperdon*, Vanuxem.
3. *Dalmanella testudinaria*, Dalman.
4. *Rafinesquina alternata*, Conrad.
5. *Plectambonites sericea*, Sowerby.
6. *Platystrophia biforata*, Schlotheim, v. lynx, Eichwald.
7. *Conularia Trentonensis*, Hall.
8. *Bellerophon bilobatus*, Sowerby.
9. *Zygospira recurvirostra*, Hall.
10. *Orthis (Hebertella) occidentalis*, Hall.
11. *Asaphus platycephalus*, Stokes.
12. *Calymene senaria*, Conrad.
13. *Dalmanites Bebryx*, Billings.

From Majors Hill Park, near rustic house overlooking cliff facing the Chaudière falls. H. M. A., 1890.

1. *Streptelasma corniculum*, Hall.
2. *Amplexopora discoidea*, James.
3. *Dalmanella testudinaria*, Dalman.
4. *Plectorthis plicatella*, Hall.
5. *Platystrophia biforata*, v. lynx, Eichwald.
6. *Rafinesquina alternata*, Conrad.
7. “ *deltoidea*, Conrad.
8. *Plectambonites sericea*, Sowerby.
9. *Murchisonia (Hormotoma) bellicincta*, Hall.
10. *Trochonema umbilicatum*, Hall.
11. *Illænus Americanus*, Billings.

From quarry near Rockcliffe, New Edinburgh. H. M. Ami.

1. *Solenopora compacta*, Billings.
2. *Prasopora Selwyni*, Nicholson.
3. *Rafinesquina alternata*, Conrad (Emmons).
4. *Strophomena incurvata*, Shepard.

From Wright's new quarries, Hull, H. M. Ami, 1889.

1. *Brachiospongia digitata*, Owen.
2. *Solenopora compacta*, Billings.
3. *Arthroclema pulchellum*, Billings.
4. *Monticulipora* ? *mammillata*, d'Orbigny.
5. *Prasopora lycoperdon*, Nicholson.
6. *Asteroporites Ottawaensis*, Lambe.
7. *Pachydictya acuta*, Hall.
8. *Amplexopora* or *Batostoma*, sp.
9. *Glyptocrinus* stems.
10. *Lingula*, sp.
11. *Trematis Ottawaensis*, Billings.
12. *Dalmanella testudinaria*, Dalman.
13. *Orthis*, sp. indt.
14. *Rafinesquina alternata*, Conrad, (Emmons).
15. *Zygospira*, sp., cf. *Z. recurvirostra*, Hall.
16. *Conularia*, sp. probably n. sp.
17. *Cyclonema bilix*, Hall.
18. *Lichas Trentonensis*, Hall.
19. " sp. indt.
20. *Asaphus platycephalus*, Stokes.
21. *Illænus Trentonensis*, Billings.
22. " sp. with very narrow pygidium.

From Sussex street, below Hamilton Brothers' office.

1. *Heterocrinus simplex*, Hall, var. *Canadensis*, Billings.
2. *Zygospira recurvirostra*, Hall very abundant.

From shore of Ottawa river at Queen's or steamboat wharf, Ottawa city. H. M. Ami, 1884.

1. *Bythotrephes flexuosus*, Emmons, or *B. succulens*, Billings.
2. *Pasceolus globosus*, Billings.
3. *Pachydictya acuta*, Hall.
4. *Monticuliporidae*, several species.
5. *Plectambonites sericea*, Sowerby.
6. *Rafinesquina alternata*, Conrad (Emmons).
7. *Strophonema incurvata*, Shepard.
8. *Orthis* (*Dalmanella*) *testudinaria*, Dalman.
9. " " *occidentalis*, Hall.
10. *Rhynchotrema inæquivalvis*, Castelnau.
11. *Asaphus platycephalus*, Stokes.
12. *Proetus parviusculus*, Hall.

From Rideau Hall grounds, New Edinburgh. Collected by T. M. Hardie and H. M. A., 1883..

1. *Streptelasma corniculum*, Hall.
2. *Solenopora compacta*, Billings.
3. *Lichenocrinus crateriformis*. Hall.
4. *Iocrinus subcrassus*, Meek and Worthen.
5. *Serpulites dissolutus*, Billings.
6. (?) *Amplexopora Canadensis*, Foord.
7. *Monticuliporidae* not described.
8. *Discina Circe*, Billings (*Orbiculoidea lamellosa*), Hall.
9. *Dalmanella testudinaria*, Dalman.
10. *Orthis* (*Skenidium*) *Merope*, Billings.
11. *Platystrophia biforata*, Schlotheim.
12. *Rafinesquina alternata* Conrad (Emmons).
13. *Plectambonites sericea*, Sowerby.
14. *Rhynchotrema inaequivalvis*, Castelnau.
15. *Zygospira recurvirostra*, Hall.
16. *Trochonema umbilicatum*, Hall.
17. *Murchisonia* (*Hormotoma*) *bellicincta*, Hall.
18. " *gracilis* Hall.
19. " *perangulata*, Hall.
20. *Asaphus platycephalus*, Stokes.
21. *Calymene senaria*, Conrad.

From Rideau Hall grounds, additional. Collected by Lords Kerry and Charles, and Mr. A. J. Galpin of Government House, 1885.

1. *Cystidean* plates, sp. indt.
2. *Crinoidal* fragments.
3. *Pachydictya acuta*, Hall.
4. *Amplexopora discoidea*, James.
5. *Solenopora compacta*, Rillings.
6. *Prasopora lycoperdon*, Vanuxem
7. " *oculata*, Foord.
8. *Orthis* (*Plectorthis*) *Laurentina*, Billings.
9. " (*Hebertella*) *occidentalis*, Hall.
10. " (*Dinorthis*) *pectinella*, Emmons.
11. *Strophomena incurvata*, Shepard.
12. *Murchisonia Milleri*, Hall.
13. *Pleurotomaria subconica*, Hall.
14. *Fusispira subfusiformis*, Hall.
15. *Endoceras proteiforme*, Hall.
16. *Gonioceras anceps*, Hall. (locality doubtful, H.M.A.)

17. *Asaphus megistos*, (?) Locke.
18. *Ceraurus*, sp.
19. *Illaenus*, sp.

From Governor General's bay. Collectors, H. M. Ami and Prof. J. Fowler, 1889.

1. *Amplexopera Canadensis* (?) Foord.
2. *Prasopora lycoperdon*, Vanuxem (*P. Selwyni*) Nicholson.
3. *Pachydictya acuta*, Hall.
4. *Homotrypa* (?) sp. indt.
5. *Amplexopora discoidea*, James.
6. *Solenopora compacta*, Billings.
7. *Arthronema*, sp.
8. *Rhinidictya paupera*, Nicholson.
9. ? *Helopora*, sp.
10. *Batostoma Ottawaensis*, Foord.
11. *Monotrypella Trentonensis*, Nicholson.
12. *Parastrophia hemiplicata*, Hall.
13. *Pholidops subtruncatus*, Hall.
14. *Trematis*, sp.
15. *Rafinesquina alternata*, Conrad (Emmons).
16. *Dalmanella testudinaria*, Dalman.
17. *Plectambonites sericea*, Sowerby.
18. *Orthis plicatella*, Hall.
19. *Anastrophia*, sp.
20. *Zygospira recurvirostra*, Hall.
21. *Orthis* (*Hebertella*) *insculpta*, Hall.
22. *Platystrophia bifurcata*, var. *lynx* Eichwald.
23. *Murchisonia* (*Hormotoma*) *gracilis*, Hall.
24. " " *bellicincta*, Hall.
25. *Remopleurides affinis*, Billings, or allied species.
26. *Encrinurus vigilans*, Hall.
27. *Calymene senaria*, Conrad.
28. *Asaphus platycephalus*, Stokes.
29. *Lichas Trentonensis*, Hall.
30. *Ceraurus pleurexanthemus*, Green.
31. *Dalmanites callicephalus*, Green.
32. *Beyrichia*, sp.

The shaly and calcareous strata of the Trenton of Governor's Bay, New Edinburgh, Ottawa, and of the first cutting on the Pontiac and Pacific Railway west of the C. P. R. crossing at Hull on the way

to Aylmer, belong to one and the same geological horizon. The following table of the occurrence of species from "The Heap" at Hull, (which material was derived from the above mentioned cutting) and from the Trenton of Governor's Bay, will serve to indicate the association of species at both localities.

LIST of Fossils from the Trenton of Governor's Bay, Ottawa, Ontario,
and from "The Heap," Hull, Quebec.

rr—rather rare; r—rare; c—common; rc—rather common; a—abundant.

Genera and Species.	Author.	Governor's Bay, Ottawa	"The Heap," Hull, Que.	Prevalence.
<i>Heterocrinus simplex</i>	Billings	*	*	rr
<i>Crinoidal fragments</i> .....	.....	*	*	c
<i>Amplexopora discoidea</i>	James	*	*	rc
<i>Prasopora Selwyni</i>	Nicholson	*	*	a
<i>Monotrypella Trentonensis</i>	"	*	*	rc
<i>Pachydictya acuta</i>	Hall	*	*	rc
<i>Stylodictya</i> , n. sp. ....	.....	*	*	r
<i>Pachydictya</i> , sp. ....	.....	*	*	r
<i>Pholidops subtruncatus</i>	Hall	*	*	rc
<i>Plectambonites sericea</i>	Sowerby	*	*	a
<i>Rafinesquina alternata</i>	Conrad	*	*	a
<i>Strophomena incurvata</i>	Shepard	*	*	ra
<i>Dalmanella testudinaria</i>	Dalman	*	*	a
<i>Dinorthis pectinella</i>	Emmons	*	*	rc
<i>Plectorthis</i> , sp. cf., <i>P. Whitfieldi</i>	Winchell	*	*	rc
<i>Hebertella occidentalis</i>	Hall	*	*	rr
<i>Platystrophia biforata</i>	Schlottheim	*	*	rc
<i>Rhynchotrema inaequivalvis</i>	Castelnau	*	*	c
<i>Parastrophia hemiplicata</i>	Hall	*	*	c
<i>Cyclospira bisulcata</i>	Emmons	*	*	rr
<i>Zygospira recurvirostra</i>	Hall	*	*	a
<i>Tetranota</i> , sp. ....	.....	*	*	r
<i>Bellerophon bilobatus</i>	Sowerby	*	*	c
<i>Conularia Trentonensis</i>	Hall	*	*	rr
<i>Trochonema umbilicatum</i>	"	*	*	rc
<i>Hormotoma gracilis</i>	"	*	*	r
<i>Lophospira perangulata</i>	"	*	*	r
<i>Whitella</i> , sp. indt. ....	.....	*	*	r
" <i>subcarinata</i> ?	Billings	*	*	r
<i>Plourotomaria</i> , sp. ....	.....	*	*	r
<i>Orthoceras</i> , sp. ....	.....	*	*	r
<i>Turrilepas Ottawaensis</i> (nobis) .....	.....	*	*	r
<i>Calymene senaria</i>	Conrad	*	*	rc
<i>Remopleurides affinis</i> , var.	Billings	*	*	r
<i>Ceravrus pleurexanthemus</i>	Green	*	*	r
<i>Pterygomelopus callicephalus</i>	Hall	*	*	rc
" sp. ....	.....	*	*	r
" <i>intermedius</i>	Walcott	*	*	r
<i>Asaphus platycephalus</i>	Stokes	*	*	rc
<i>Beyrichia</i> , n. sp. ....	.....	*	*	rr
<i>Isachilina</i> , n. sp. ....	.....	*	*	rr

From foot of cliff, Ottawa river, between Queen's wharf and Nepean point. H. M. Ami, 1899.

1. *Bythotrephis succulens*, Hall.
2. *Bythotrephis*, n. sp.
3. *Crinoidal* columns, not determined.
4. *Prasopora lycoperdon*, (*P. Selwyni*, Nicholson).
5. *Plectambonites sericea*, Sowerby.
6. *Rafinesquina alternata*, Conrad. (Emmons.)
7. *Orthis* (*Dalmanella*) *testudinaria*, Dalman.
8. *Rhynchotrema inaequivalvis*, Castelnau.
9. *Zygospira recurvirostra*, Hall.
10. *Orthis* (*Dinorthis*) *plicatella*, Hall.
11. *Rafinesquina deltoidea*, Conrad.
12. *Strophomena incurvata*, Shepard.
13. *Murchisonia* (*Hormotoma*) *Augustina*, var. *Ottawaënsis*. n. var.
14. *Trochonema umbilicatum*, Hall.
15. *Calymene senaria*, Conrad.
16. *Encrinurus*, sp.
17. *Pterygometopus callicephalus*, Green.
18. *Asaphus*, sp. indt.

From vacant lot, corner Rideau and Sussex streets. H. M. Ami, 1894.

1. *Crinoidal* fragments.
2. *Leptæna* (*Plectambonites*) *sericea*, Sowerby.
3. *Strophomena* (*Rafinesquina*) *alternata*, Conrad. (Emmons).
4. *Murchisonia* (*Hormotoma*) *gracilis*, Hall.
5. " " *bellicincta*, Hall.

From Brigham's creek, back of Hull. R. W. Ells and N. J. Giroux, 1894.

1. *Crinoidal* fragments.
2. *Pachydictya*, sp.
3. *Monticuliporoidea*.
4. *Strophomena incurvata*, Shepard.
5. *Rafinesquina alternata*, Conrad. (Emmons.)
6. *Parastrophia hemiplicata*, Hall.
7. *Cyrtodonta Canadensis*? Billings.
8. *Asaphus*, sp.
9. *Dalmanites callicephalus*, Green.
10. *Bathyrurus extans*, Hall.
11. *Illænus*, sp.
12. *Murchisonia Milleri*, Hall.

TRENTON AND BLACK RIVER.

From lots 22-23, ranges II-III Nepean, near Fallowfield, Ont. Collected by R. W. Ells and N. J. Giroux, 1894.

1. *Tetradium fibratum*, Safford.
2. *Pachydictya*, sp.
3. *Glyptocrinus* stems.
4. *Orthis*, sp.
5. *Skenidium Merope*, Billings.
6. *Dalmanella testudinaria*, Dalman.
7. *Rhynchonella*, sp.
8. *Orthis* (*Plectorthis*) *plicatella*, Hall.
9. " *tricenaria*, Conrad.
10. *Rafinesquina alternata*, Conrad.
11. *Strophomena incurvata*, Shepard.
12. *Murchisonia* (*Hormotoma*) *gracilis*, Hall.
13. *Cyclonema*, sp.
14. *Murchisonia* (*Hormotoma*) *gracilis*, Hall.
15. *Asaphus*, sp. (*A. platycephalus*), Stokes.

THE BLACK RIVER FORMATION.

From Keefer's bluff, near the entrance to Beechwood Cemetery, township of Gloucester. H. M. Ami.

1. *Tetradium fibratum*, Safford.
2. *Columnaria Halli*, Nicholson.
3. *Orthis tricenaria*, Conrad.
4. *Cyrtodonta*, sp. cf. *C. Huronensis*, Billings.
5. *Murchisonia* (*Hormotoma*) *gracilis*, Hall.
6. *Trochonema umbilicatum*, Hall.
7. *Helicotoma planulata*, Salter.
8. *Actinoceras Bigsbyi*, Stokes.
9. *Asaphus*, sp. indt.
10. *Bathyurus*, cf. *B. extans*, Hall.
11. *Isochilina*, sp.
12. *Ostracoda* (*Leperditia* and *Beyrichia*) several forms.

From the western portions of lots 3-4, range III, River front, Gloucester, Carleton county. W. R. Billings, 1884. Listed in the Transactions of the Ottawa Field-Naturalists' Club, vol. II, No. 6, pp. 259-260; 1884, by Walter R. Billings, Esq.

1. *Stromatocerium rugosum*, Hall.
2. *Tetradium fibratum*, Safford.

3. *Pachydictya acuta*, Hall.
4. *Orthis tricenaria*, Conrad.
5. *Rhynchotrema inæquivalvis*, Castelnau.
6. *Strophonema Trentonensis*, Winchell & Schuchert.
7. *Bucania expansa*, Hall.
8. " *punctifrons*, Emmons.
9. " *bidorsata*, Hall.
10. *Ophileta Ottawaënsis*, Billings.
11. *Ecculiomphalus Trentonensis*, Hall.
12. *Helicotoma planulata*, Salter.
13. *Raphistoma Progne*, Billings.
14. *Pleurotomaria subconica*, Hall.
15. *Subulites (Fusispira) subfusiformis*, Hall.
16. " " *elongata*, Hall.
17. *Cyclonema Hallianum*, Salter.
18. *Murchisonia Milleri*, Hall.
19. " " var. *perangulata*, Hall.
20. " (*Lophospira*) *helicteres*, Salter.
21. *Endoceras annulatum*, Hall.
22. *Orthoceras bilineatum*, Hall.
23. " *multicameratum*, Hall.
24. " *amplicameratum*, Hall.
25. *Lituities convolans* (= *L. Americanus*, d'Orbigny).
26. *Cyrtodonta Canadensis*, Billings.
27. " *obtusa*, Billings.
28. " *Huronensis*, Billings.
29. " *subtruncata*, Hall.
30. " *subcarinata*, Billings.
31. *Ambonychia orbicularis*, Emmons.
32. *Modiolopsis Trentonensis*, Hall.
33. " *modiolaris*, Conrad.
34. " *Meyeri*, Billings.
35. " *Gesneri*, Billings.
36. *Iliaenus ovatus*, Billings.
37. " *Milleri*, Hall.
38. *Bathyrurus extans*, Hall.
39. *Ceraurus pleurexanthemus*, Green.

From the ridge north of Aylmer, Hull township, Quebec. Collected by T. W. E. Sowter, 1883.

1. *Bythotrephis (Chondrites)*, sp.
2. *Stromatocerium rugosum*, Hall.

3. *Tetradium fibratum*, Safford.
4. *Solenopora compacta*, Billings.
5. *Amplexopora discoidea*, James.
6. *Pachydictya acuta*, Hall.
7. *Ptilodictya maculata*, Ulrich.
8. *Rafinesquina alternata*, Conrad, (Emmons).
9. *Strophonema incurvata*, Shepard.
10. *Plectambonites sericea*, Sowerby.
11. *Zygospira recurvirostra*, Hall.
12. *Murchisonia perangulata*, Hall.
13. *Cyrtodonta Huronensis* (?) Billings.
14. *Cyrtoceras anceps*, Hall.
15. *Actinoceras Bigsbyi*, Stokes.
16. *Endoceras multitubulatum* ? Hall.
17. *Gonioceras anceps*, Hall.
18. *Asaphus platycephalus*, Stokes.
19. *Isocbilina*, sp.

From Little Chaudière, Ottawa river, Mechanicsville. Collector,
E. Billings.

1. *Calapœcia Canadensis*, Billings.
2. *Streptelasma corniculatum*, Hall.
3. *Rhynchotrema inaequalis*, Castelnau.
4. *Strophomena incurvata*, Shepard.
5. *Cyrtodonta subtruncata*, Hall sp.
6. *Pleurotomaria subconica*, Hall.
7. *Actinoceras Bigsbyi*, Stokes,
8. *Orthoceras bilineatum*, Hall.
9. " *decrescens*, Billings.
10. *Oncoceras constrictum*, Hall.
11. *Cyrtoceras*, sp. large form, indt.
12. " *sinuatum*, Billings.
13. *Gonioceras anceps*, Hall.
14. *Cyroceras vagrans*, Billings
15. *Illænus Trentonensis*, Billings.
16. " *ovatus*, Billings.
17. " *Conradi*, Billings.

From Hog's Back, Rideau river, south side, R. W. Ells and N. J,
Giroux, 1894.

1. *Crinoidal* columns.
2. *Glyptocrinus*, large stems, cf. *G. priscus*, Billings.

3. *Monticuliporidae*, branching forms, cf. *Batostoma* &c.
4. *Strophonema*, sp. indt.
5. *Rhynchotrema inaequalis*, Castelnau.
6. *Vanuxemia Montrealensis*, Billings.
7. *Cyrtodonta Huronensis*, Billings.
8. *Pleurotomaria subconica*, (?) Hall.
9. *Cyrtoceras*, sp.
10. *Strophomena incurvata*, Shepard.
11. *Bellerophon bilobatus*, Sowerby.
12. *Dalmanites*, sp.
13. *Illænus globosus* ? Billings.
14. " *Bayfieldi*, Billings.
15. *Asaphus*, sp.
16. " cf. *A. platycephalus*, Stokes.
17. *Ceraurus pleurexanthemus*, Green.

From lots 24-28, range V, Nepean, R. W. Ells and N. G. Giroux, 1894.

1. (?) *Phytopsis tubulosum*, Hall. (Probably a *Bythotrephis*).
2. *Solenopora compacta*, Billings.
3. *Tetradium fibratum*, Safford.
4. *Monticuliporidae*, branching forms.
5. *Streptelasma*, sp.
6. *Helicotoma*, sp.
7. *Trochonema umbilicatum*, Hall.
8. " *pauperum*, Hall.
9. *Murchisonia* (*Hormotoma*) *gracilis*, Hall.
10. " *perangulata*, Hall.

From bluff, one quarter of a mile south of City View post-office, township of Nepean, collected by H. M. Ami and R. W. Ells 1899.

1. *Bythotrephis*, sp.
2. *Phytopsis tubulosum*, Hall.
3. *Stromatocerium rugosum*, Hall.
4. *Tetradium fibratum*, Safford.
5. *Columnaria Halli*, Nicholson.
6. *Streptelasma profundum*, Hall.
7. *Crinoid stems*.
8. *Monticuliporidae*, two species.
9. *Orthis tricenaria*, Conrad.
10. *Dalmanella testudinaria*, Dalman.

11. *Rafinesquina alternata*, Conrad, (Emmons).
12. *Strophonema incurvata*, Shepard.
13. *Rhynchotrema inæquivalvis*, Castelnau.
14. *Ctenodonta nasuta*, Hall.
15. *Trochonema umbilicatum*, Hall.
16. *Murchisonia*, cf. *M. perangulata*, Hall.
17. *Maclurea*, sp. indt.
18. *Orthoceras* (*Actinoceras*) *Bigsbyi*, Stokes.
19. " *annellum*, Hall.
20. *Cyrtoceras*, sp. indt.
21. *Conioceras anceps*, Hall.
22. *Asaphus*, sp. large form.

From a low escarpment near City View corner, on Mr. J. R. Booth's property County of Carleton, Ont.

1. *Phytopsis*, large radiating form.
2. *Monticuliporidae*, several forms.
3. *Strophomena incurvata*, Shepard.
4. *Rafinesquina alternata*, Emmons, Conrad.
5. *Dalmanites testudinaria*, Dalman.
6. *Rhynchotrema inæquivalvis*, Castelnau.
7. *Trochonema umbilicatum*, Hall.
8. *Subulites* (*Fusispira*) *Canadensis*, Ulrich.
9. *Actinoceras Bigsbyi*, Stokes.
10. *Asaphus*, very large form.

THE CHAZY FÖRMATION.

From north side of Ottawa river, shore at Deschênes Mills. Collected by H. M. Ami, 1884.

1. *Rhynchonella orientalis*, Billings.
2. *Monticuliporidae*, sp. indt.
3. *Orthis* (*Hebertella*) *imperator*, (?), Billings.
4. *Orthis* (*Hebertella*) *borealis*, Billings.
5. *Pleurotomaria*, sp. or *Raphistoma*, sp.

From Aylmer, Que., collected by T. W. E. Sowter, 1885.

1. *Rhynchonella*, sp., cf. *Rhynchonella* (*Camaratœchia*) *plena*, Hall.
2. " *orientalis*, Billings.
3. *Orthis* (*Hebertella*) *borealis*, Billings.

From Hog's Back, Rideau river, township of Nepean, H. M. Ami, 1890.

1. *Columnaria incerta*, (?), Billings.
2. *Lingula Belli*, Billings.
3. " cf. *L. Mantelli*, Billings.
4. *Pleurotomaria* (*Scalites*) *calyx*, Billings.
5. " (?) sp. indt.
6. *Cyrtodonta*, sp. cf. *C. breviscula*, Billings.
7. *Bathyurus Angelini*, Billings.
8. *Isochilina Ottawa*, Jones.
9. *Ostracoda*. Several forms sent to Prof. T. Rupert Jones for identification.

From lot 8, range IV, Hull township, in a brook near Wright's brickyard, R. W. Ells and N. J. Giroux.

1. *Cyrtodonta*, sp., probably a new species.

Hog's Back, Nepean Township, County of Carleton, Ont. From collections made by Dr. Whiteaves, Dr. Ells, Messrs. Giroux Herdt, McConnell, McInnes, Lambé, Moore, Wait and H. M. A

Plantæ.

1. *Palæophycus* ? sp., probably an undescribed form.

Brachiopoda.

2. *Lingula Belli*, Billings.
3. " *Huroneusis*, Billings.
4. " *Mantelli*, Billings, or a very closely related species.
5. *Rhynchonella* (*Camarotoechia*) *plena*, Hall.

Vermes.

6. *Serpulites*, n. sp. A form distinct from *Serpulites splendens*, Billings, and *S. dissolutus*, Billings. Probably an undescribed species.

Pelecypoda.

7. *Ctenodonta breviscula*, Billings.
8. *Ctenodonta*, sp.
9. *Modiolopsis parviscula*, Billings.

Gasteropoda.

10. *Pleurotomaria (Scalites) calyx*, Billings.
11. *Trochonema pauperum*, Hall (sp.).
12. *Murchisonia*, sp., indt.
13. *Cyclonema*, sp.

Cephalopoda.

14. *Orthoceras*, sp. cf., *Orthoceras Allumettense*, Billings.
15. *Orthoceras*, sp., a form with rather distant septa and gradually tapering shell.

Trilobita.

16. *Bathyrurus*, sp., cf., *Bathyrurus caudatus*, Billings.
17. *Bathyrurus*, sp. cf., *Bathyrurus Angelini*, Billings.
18. *Asaphus canalis*, Conrad.
19. ?*Bolbocephalus*, sp.

Ostracoda.

20. *Isochilina Amiana*, Ulrich (= *Isochilina Ottawa*, var. *intermedia*, Jones.)
21. *Primitia*, sp.

Burrows or Tracks and trails of organisms.

22. *Scolithus prolificus*, MS.
23. *Protichnites* (?) *sparcus*, MS.

THE CALCIFEROUS FORMATION.

On lot 19, Con. VIII, of the township of Marlborough, in the County of Carleton, Ont., the following species of characteristic fossils were obtained in 1899 by Dr. R. W. Ells and the writer, and determined by the latter :—

1. *Ophileta complanata*, Vanuxem. (= *Ophileta compacta*, Salter).
2. *Ophileta disjuncta*, Billings.
3. *Pleurotomaria Canadensis*, Billings.
4. " *calcifera*, Billings.
5. *Orthoceras Lamarcki*, Billings.
6. *Ribeiria calcifera*, Billings.

From the magnesian and semicrystalline limestones of the Black Rapids, nine miles above Ottawa City, on the Rideau River, *Ophileta complanata*, Vanuxem was obtained by the writer in 1881. Its presence is sufficient to predicate the occurrence of strata belonging to the Calciferous formation.

THE POTSDAM FORMATION.

From the nearest outcrops of the Potsdam formation to Ottawa City, no organic remains have as yet been detected. Footprints, or tracks and trails, of marine organisms have however been recorded by Sir William Logan and Sir Richard Owen from the eastern and western extension of the same geological horizon about Ottawa.

1. *Perth, Ont.*—In the vicinity of Perth, the late Dr. Wilson discovered tracks of organisms in the sandstones of this formation, which were subsequently described under the name of *Climactichnites Wilsoni*, by Sir William Logan himself. A large slab from the Perth quarries, illustrating the type of this species is now on exhibition in the palæontological division of the National Museum.

2. *Beverley and South Crosby, Ont.*—At Beverley and in South Crosby outcrops of a sandstone referred to the Potsdam formation by Sir Wm. Logan are known to yield abundance of the following species.

1. *Palæophycus Beverleyensis*, Billings.
2. *Lingulepis acuminata*, Conrad.
3. *Scolithus Canadensis*, Billings.

3. *Nepean or Bishop's Quarries.*—Although these quarries from which the bulk of the material with which the Parliament Buildings were constructed, were examined carefully for organic remains, none have as yet been detected. From the relative position of these sandstones, to the magnesian limestones of the Calciferous adjoining, there is no doubt that they belong to the Potsdam formation.

4. *Buckingham, Que.*—From the bluff at the foot of the falls and rapids below the bridge along the line of the Canadian Pacific Railway, west of Buckingham Station and Basin specimens of *Scolithus Canadensis*, Billings, were found by the writer in a band about eighteen feet above low water mark on the Du Lièvre River.

5. *Rockland, Ont.*—No organic remains were obtained from the outcrops of the Potsdam formation at the Rockland Mills, nor near the residence of Mr. W. C. Edwards, M.P.

6. *Monte Bello, Que.*—Between Papineauville, and the “Manoir de Monte Bello” and on the Presqu’île and Squirrel Island interesting outcrops of the Potsdam sandstone occur with many of their surfaces showing ripple-marks and other phenomena of wind and wave action, besides several tracks and trails of marine organisms similar to those described by Sir Richard Owen from the Potsdam of Beauharnois on the St. Lawrence, were observed by Sir William Dawson and the writer during field-days of the Natural History Society of Montreal and the Ottawa Field-Naturalists’ Club. These include at least two species, viz. :—

1. *Protichnites septem-notatus*, Owen.
 2. *Protichnites lineatus*, Owen.
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