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THE DEVONIAN OF SOUTHWESTERN ONTARIO

BY

CLINTON R. STAUFFER

GEOLOGICAL SURVEY

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PREFACE.

While identifying the fossils in connexion with the preparation of this report, quite a number of specimens were submitted to Dr. Stuart Weller of the University of Chicago, and one or two others to Dr. R. S. Bassler of the Smithsonian Institution, for confirmation of identification. To both of these gentlemen the Geological Survey is, therefore, indebted for their kindness.

The Devonian of Southwestern Ontario.

CHAPTER I.

DISTRIBUTION AND DIVISIONS OF THE ONTARIO DEVONIAN.

EXTENT OF DEVONIAN ROCKS IN ONTARIO.

Rocks of Devonian age cover considerable portions of two rather widely separated areas in Ontario. The larger and more northerly of these lies in the vicinity of James bay. Thus far no thorough study of the Devonian formations in that northern region has been made, but the various geologists who have made exploration trips for economic purposes have brought back with them small collections of Devonian fossils. Although Dr. Robert Bell and others have recorded such forms, it is chiefly to Dr. W. A. Parks that we are indebted for our knowledge of the Devonian fauna[1] of that region. A small but more recent collection was made by Prof. M. B. Baker during the summer of 1910.[2] It is quite evident that our knowledge of the stratigraphy of northern Ontario is still very fragmentary; but the limited available information is sufficient to demonstrate the presence of the Onondaga fauna with an indication that a portion of the Hamilton occurs above it.

The other area covered by Devonian rocks lies in southwestern Ontario. Of this Sir William Logan says "the region occupied by the Corniferous formation (Onondaga limestone) in western Ontario may be defined as the whole of that portion of the province (of Ontario) lying to the south and west of a curved line running from the outlet of Lake Erie, and passing through Stratford, to a point on Lake Huron near the mouth of the Saugeen river. The shales of the Hamilton formation, and

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[1] Parks, W. A.; Rept. Ont. Bur. Mines, 1904, pt. 1, pp. 180–191, pls. 1–8.
[2] Baker, M. B.; Rept. Ont. Bur. Mines, vol. XX, pt. 1, 1911, pp. 227, 228.

those of the Portage and Chemung group, cover this limestone over a very small area, but by far the greater part is only overlaid by the superficial clays and sands."[1] This approximately defines the portion of southwestern Ontario covered by Devonian rocks, for the Oriskany sandstone, the basal Devonian formation of the province, spreads out beyond the Onondaga (Corniferous) limestone scarcely as much as a mile, and along a very small fraction of that line. However, there is an outcrop of the Detroit River series extending along the shore of Lake Huron from Baie du Doré to some point to the south of Goderich and several very important inliers of the same age which apparently were not recognized in 1863. The Detroit River series has usually been considered to belong in the Silurian, but at the present time its correlation is more or less in dispute. The Hamilton formations also cover a much larger area than the above statement would seem to indicate (see the accompanying map).

CLASSIFICATION.

Some of the names now applied to the Canadian Devonian had been used by Alexander Murray[2] as early as 1848, but apparently they did not come into general use until after the publication of Logan's Geology of Canada, in which he grouped together these Ontario formations in the following manner.[3]

Devonian {
Chemung and Portage group.
Hamilton formation.
Corniferous formation.
Oriskany formation.

These subdivisions were adopted from the New York State classification, but in so doing Logan took over the names rather than the formational units. He considered the Esopus and Schoharie grits of New York as local phases of the Oriskany sandstone which could not be distinguished from the latter in Ontario.

[1] Logan, Sir William; Geology of Canada, 1863, p. 787.

[2] Geol. Surv., Can., Rept. Prog. for 1848(1849), p. 24. Also idem. for 1850–51, p. 29.

[3] Op. cit. pp. 20, 932.

The Corniferous formation (Onondaga limestone) he expanded so as to include not only the Corniferous limestone, as then recognized in New York, but the underlying Onondaga limestone as well. This union of formations, it will be recalled, was made by the geologists of New York state at a somewhat later date, but the compound formation was there termed the Onondaga limestone and the word "Corniferous" disappeared from official geological literature. Since "Corniferous," which refers to the cherty character of the rock, is even less suited to the formation as it appears in Ontario than it was to the same deposit in New York, and since it does not conform to the usual rule in naming a formation, the term has been dropped from the Canadian list of formations also and the name Onondaga limestone substituted; but care must be taken to distinguish between this term and the old name "Onondaga Salt group" formerly used for the Salina beds of the Silurian.

Under the name Hamilton formation Logan included all of the strata found in Ontario between the Corniferous formation (Onondaga limestone) and the black shale of the upper Devonian. The remaining Devonian beds were united to form the Portage-Chemung group, which was treated as one subdivision and included the shale usually referred to as the Genesee in the eastern states.

The succeeding reports by Dr. T. Sterry Hunt[1] have adopted approximately the same classification as that introduced by Logan. Nicholson, however, regarded the black shale at Kettle point as probably equivalent in age to the Genesee shale of New York,[2] while he thought the sandstone of North Cayuga and Oneida townships possibly of Schoharie, or even Corniferous (Onondaga) age.[3] Dawson and later Brumell adopted essentially the Logan classification,[4] as have most other workers in

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[1] Geol. Surv., Canada, Rept. Prog. for 1863–1866, pp. 234, 238–250. Also idem for 1866–1869 (1870), pp. 216–218.

[2] Nicholson, H. A.; Palæontology of the Province of Ontario, 187[illegible], p. 10.

[3] Loc. cit., pp. 8, 9.

[4] Dawson, Sir J. William; Handbook of Canadian Geology, 1889, p. 175. Also Brumell, H. P. H.; Geol. Surv., Canada, Ann. Rept., vol. V, pt. Q. 1891, p. 5.

that field since. The Devonian deposits of Ontario are, however, more complex than this simple statement would lead one to expect. This was, at least in part, recognized by most of the geologists who did the pioneer work. Hunt, for example, refers to "the insignificant representative of the Marcellus shale"[1] at the base of the Hamilton beds, while Logan[2] and Nicholson[3] make very similar statements. Well drillers at Petrolia and Oil Springs recognize five rather persistent divisions of the Hamilton,[4] and in the township of Moore the records of deep wells suggest that even the Portage and Chemung[5] might possibly be separated.

A classification, therefore, which gives a measurable amount of information with regard to the deposits indicated, must diverge somewhat from those which have usually appeared. Moreover, such a classification is not easily found, for it means the introduction of subdivisional names other than those now extant. The chief purpose of the name of a deposit is its usefulness, and the aim in a grouping of formations is to show their relationships. Hence there can be no real objection to new names, provided those now in existence are not serviceable for a more detailed study. Such are the conditions which have called forth the following modifications to the classification as used by Logan:

Devonian	Upper ..	Port Lambton beds (probably Portage and Chemung).	
		Huron shale (probably Genesee shale).	
	Middle..	Hamilton formation.	Ipperwash limestone.
			Petrolia shale.
			Widder beds.
			Olentangy shale.
		Delaware limestone.	
		Onondaga limestone	Onondaga limestone.
			Springvale sandstone (local facies.)
	Lower...	Oriskany sandstone.	
		Helderbergian (wanting or possibly represented, in part, by the Detroit River series).	

[1] Hunt, T. Sterry; Geol. Surv., Canada, Rept. Prog. 1866–1869 (1870), p. 216.

[2] Geology of Canada, 1863, p. 385.

[3] Palæontology of Ontario, 1874, p. 9

[4] Brumell, H. P. H.; Geol. Surv., Canada, Ann. Rept., vol. V, pt. Q, 1891, pp. 61, 62, etc.

[5] Brumell, H. P. H.; Loc. cit. p. 67.

DISCUSSION OF FORMATIONAL DIVISIONS.

The lowest formations of the system are generally wanting over the Devonian covered area of southwestern Ontario. There is a possibility, however, that certain of the upper Monroe beds, or the Detroit River series, although differing widely from the typical Helderbergian, may represent deposits contemporaneous with the lowest Devonian of the east. This is suggested chiefly by the similarity of much of the Detroit River fauna to the fossil forms found in the Onondaga limestone, but thus far the relationship has not been sufficiently demonstrated to warrant placing those beds in the classification of Devonian deposits. These Detroit River beds will receive more detailed attention in a supplemental report following the present one.

The Oriskany sandstone, the lowest certain Devonian formation in Ontario, was named by James Hall[1] in 1839 from Oriskany Falls, Oneida county, New York, where it is typically developed. The Oriskany of Ontario does not differ essentially from the same deposit as it extends eastward into New York state. It is usually a massive, coarse-grained, friable, white to yellowish sandstone in which the individual grains sometimes attain an eighth of an inch in diameter. This sandstone lies unconformably on the Silurian dolomites and the lowest layer is often made up in part of dolomite pebbles embedded in a matrix of sand. It is usually rich in the characteristic, large, coarsely marked fossils, although small forms are also found in some abundance. Occasionally there is a bed of chert at the horizon where one would naturally expect to find the sandstone. This chert is commonly without fossils, but Logan apparently considered it of Oriskany age.[2] The presence of sand, of probable Oriskany origin, penetrating the joint cracks in the rocks below the chert seems to indicate that the chert itself may be younger than the earliest Oriskany. The Oriskany sandstone is found in isolated and patchy outcrops from Fort Erie westward to the vicinity of DeCewville and Nelles Corners. These sandstone outcrops often occur as outliers beyond the margin of the main

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[1] Geol. Surv. New York, 3rd Ann. Rept., 1839, pp. 308, 309.

[2] Geology of Canada, 1863, p. 360.

body of Devonian deposits, but when this is the case they are never large. The most important outcropping area of this formation covers considerable portions of several square miles lying in North Cayuga and Oneida townships of Haldimand county. There the formation attains a thickness which varies between 1 and slightly more than 20 feet, and rests on an old erosion surface which is rather uneven.

The Onondaga limestone, which is probably the most important Devonian formation in Ontario, was also named by James Hall[1] in 1839. The type locality is Onondaga county, New York. In Canada the Onondaga limestone rests unconformably on the beds below and usually contains fragments of those rocks embedded in its lowest layers. Where the Oriskany sandstone is wanting, as is usually the case, these underlying beds are of Silurian age. Lithologically the Onondaga limestone is a most variable formation as it is traced westward across the province. Near Fort Erie and Port Colborne the lower portion is a compact, cherty, grey limestone containing a fauna composed, for the most part, of brachiopods. These beds pass upward into an argillaceous, brownish limestone in which the fossils occur chiefly in semi-crystalline streaks. This portion is gradually succeeded by a highly calcareous, semi-crystalline, grey limestone in massive beds which are separated by thin partings of a greenish shale. Corals and large crinoid stems are abundant and often make up a very considerable portion of the rock. Petroleum is not uncommon in the cavities of the fossils and sometimes oozes out of the pores in sufficient quantities to stain the rock face. These beds are overlaid, at places unconformably, by cherty, bluish black, compact limestone containing numerous corals, although many other forms are commonly associated with them. These beds in turn pass upward into very cherty, grey limestone, with a meagre fauna, constituting the uppermost portion of the Onondaga in the vicinity of Windmill point. As the formation is traced westward the lower and upper portions either thin out entirely or become more like the middle part and are thus inseparable from it. Moreover the different litho-

[1] Geol. Surv. New York, 3rd Ann. Rept., 1839, pp. 309, 310.

logical subdivisions above referred to are not mutually independent but often grade into each other and carry what may be considered a common fauna. At Springvale the bottom layers of the Onondaga contain such quantities of coarse sand that they resemble very closely the true Oriskany sandstone except that they contain the Onondaga fauna. The supply of sand for these beds undoubtedly came from a nearby deposit of the Oriskany which was worked over by the advancing Onondaga sea and the resulting material incorporated into the basal layers of the deposit from that sea. This local facies of the Onondaga limestone is here referred to as the Springvale sandstone in order to distinguish it from the older or Oriskany deposit. The Springvale sandstone has a thickness of about 8 or 10 feet and is found outcropping along the edge of the Devonian westward from Hagersville for a distance of nearly 6 miles. The thickness of the whole Onondaga cannot be satisfactorily determined from outcrops, except at Goderich where the thickness is reduced to about 32 feet, for at no other place is the entire formation exposed. Well records generally give a thickness of about 150 feet, and some even more, of limestone which is usually considered as Onondaga.

The name Hamilton beds or group was introduced by Lardner Vanuxem,[1] in 1840, to designate the beds of shale and sandstone which are typically developed at West Hamilton, Madison county, New York. These beds lie between the Marcellus shale and the Tully limestone. As used in Canada and elsewhere, however, this term has been somewhat enlarged so as to include all the rocks between the top of the Onondaga limestone and the base of the black shale, usually thought to be of Genesee age. At the present time it is customary to limit the usage more nearly to its original application. The Hamilton beds, as that term has been used in Ontario, usually succeed the Onondaga limestone with little or no appreciable break. But near Selkirk there are occasional developments of the Marcellus shale which intervene between the Onondaga and the usual basal limestone of the Hamilton. This calcareous, brown, shaly mass is often

[1] Geol. Surv. New York, 4th Ann. Rept., 1840, p. 380.

thin and soon gives place to limestone, but it carries such characteristic Marcellus fossils as *Styliolina fissurella* (Hall) and *Tenaculites gracillistriatus* Hall which render its Marcellus age rather certain. In the vicinity of Port Burwell and to the westward it lies immediately under the drift and consists of 10 to 30 feet of black shale overlying the Onondaga limestone. In the high drift banks bordering the lake at Port Stanley there occur well preserved fragments of black shale which evidently came from the bed-rock to the north and east. These shale boulders contain an abundance of Marcellus fossils which seem to prove the age of the black shale deposits struck in the gas wells of that vicinity. Usually the shale of this horizon grades into the overlying limestone or is interbedded with it. In such cases it becomes impossible to separate the two. In addition to the Marcellus forms included in this brown shale and associated brown to bluish limestone, there are numerous others which are identical with, or near relatives to, certain Onondaga fossil forms of the same locality. It is evident that conditions similar to those which obtained during the deposition of the Onondaga limestone were restored after the first invasion of the Marcellus had subsided, and that many of the Onondaga forms which had withstood the interruption resumed their old habitats with few, if any, important anatomical changes. This has often led to an error in the classification of these beds whereby they were confused with the Onondaga, just as it led to the confusion in regard to the same or similar deposits in Ohio. The introduction of new forms, wholly foreign to the Onondaga and identical with those occurring in the Marcellus and Hamilton deposits of other regions, is the important event and the one that should be regarded as determining the age. The residue of the Onondaga fauna is a diminishing quantity as the later and later Marcellus and eventually the Hamilton beds have been deposited, and thus it is clear that the history of the fauna as a unit had terminated with the change incident to the beginning of the Marcellus.

This "bottom limestone" of the Hamilton is thus certainly distinct from the Onondaga and measurably so from the Hamilton. It is identical, both lithologically and faunally, with the Delaware limestone of Ohio and may thus be designated by the same name. The best outcrops occur along the Thames river and in the quarries at St. Marys. The thickness of the Delaware limestone in the province is difficult to determine, because the full amount of it is nowhere exposed; and also because in well sections it is often impossible to separate it from the underlying Onondaga limestone. It is quite probable that it does not lack much of 50 feet, while at Petrolia and vicinity the interpretation of well records has assigned 70 feet more to it.

Above the Delaware limestone lies a soft, blue shale with occasional thin lenses of limestone interbedded. This marks the true beginning of the Hamilton beds. Much of this shale is almost destitute of fossils, but the lenses of limestone are often crowded with various remains of animal life. This is the "lower soapstone" of well drillers. In Ohio it is encountered in the deep wells south and east of Sandusky and forms a few meagre outcrops in that vicinity. In central Ohio it often outcrops along the Olentangy river and hence is known as the Olentangy shale. The most extensive outcrops of this member of the Hamilton are in the vicinity of Arkona and Marsh's mill along the Ausable river and its tributaries, although it also outcrops in the old brick-yard at Thedford. The total outcrop of this portion at the mill measures 27 feet, although still lower beds are shown up stream from that point. At Sarnia well records indicate between 60 and 70 feet belonging to the Olentangy shale, although it is quite possible that some of this belongs in the succeeding subdivision which also includes much shale.

Above the Olentangy shale comes a deposit of bluish limestones alternating with grey shales. The limestone varies from semi-crystalline to argillaceous layers which are little more than consolidated calcareous mud beds. The shale, which forms rather more than half of the subdivision, often contains small flattened concretions and is slightly more indurated than the shale of the division below. Fossils are more or less abundant throughout and in some layers are fairly crowded together. This is the division which has furnished the major part of the excellent Ontario Hamilton fossils so widely known. Some layers contain faunules differing slightly from those contained in other beds of the division, but there are enough common species to bind the whole into a unit distinctly set off from the beds below. Some of these faunal zones have received distinct names, such as the Encrinal limestone,[1] which forms the basal layer of this division, the Coral zone, etc. These beds will receive more attention in connexion with the sections in which they are exposed. The best outcrops of this portion of the Hamilton are to be found at Rock Glen (Jones' mill) and in the glen at No. 4 hill (Austin's mill). It is better known, however, from the Grand Trunk Railway cutting at the overhead bridge 1 mile east of Thedford and 1¼ miles north of the old village of Widder. It forms more or less of a ridge from Widder northward for nearly a mile beyond the railway and in this distance it is several times exposed, while its limestones are sometimes quarried for local use. It seems proper, therefore, to refer to this member as the Widder beds. The upper portion of the Widder beds consists of 8 to 10 feet of limestone which is doubtless the "middle limestone" of well drillers to the south and west. The total thickness of this division of the Hamilton is about 50 feet. In the northern portion of the southwestern Devonian covered area, in the vicinity of Wingham and Formosa, there is a remarkable deposit of massive, grey limestone which is made up largely of stromatoporoids. This mass has usually been identified with the Onondaga limestone, but recent detailed study has shown it to be the equivalent of the middle Hamilton limestone at Alpena, Michigan. The association of species which lived in and about a stromatoporoid reef was doubtless not identical with that which lived in other parts of the sea at the same time, and this was the case in the reefs of the Alpena limestone. No other such fauna is known in Ontario, although, of course, many of the same species are found elsewhere in the province, for it is distinctly an assemblage of Hamilton forms. But it is thus impossible to determine definitely whether the stromatoporoid reefs at Formosa and vicinity are the exact equivalent of any part of the Widder beds or not, although the horizon which it occupies in Michigan is suggestive of such an interpretation.

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[1] Shimer, H. W., and A. W. Grabau; Bull. Geol. Soc. Am., vol. XIII, 1902, p. 150.

Above the Widder beds lies a very considerable thickness of soft blue shale which well drillers refer to as the "upper soapstone." This shale is not well exposed anywhere within the province. Very poor outcrops of a soft blue shale, which is probably it, may be seen in the shallow waters of Lake Huron at Stony point and along the Sydenham river some distance above Shetland. In the wells at Petrolia it ranges in thickness from 100 to 130 feet, while at Sarnia even greater thicknesses of it are recorded.[1] This deposit may be called the Petrolia shale, since at that place it has been penetrated by hundreds of wells and its thickness and physical characters pretty definitely determined.

The top division of the Hamilton is a grey limestone with a small amount of bluish shale. Its upper part may be seen outcropping along the shore of Lake Huron between Kettle point and Ipperwash beach. A better outcrop of somewhat lower beds is to be found at Stony point to the east of the beach, and again at Smith falls on the Sydenham river. The outcrops of this member are not very satisfactory at any point, but since those on either side of Ipperwash beach are the better and more extensive, it may be called the Ipperwash limestone. Great masses of this rock have been brought up from the bottom of Lake Huron and now lie along the water's edge at Blue point north of Camlachie. The oil wells at Petrolia show a thickness of about 40 feet for this division.

The total thickness of the Hamilton formations in Ontario is thus between 280 and 550 feet, but, as shown by certain well records, it sometines exceeds that amount.

Overlying the Hamilton beds there is a black shale which has been variously classed as Genesee and Portage-Chemung. In Michigan this shale and the associated deposits above it are united under the name Antrim shale,[2] but it appears that name also includes beds of somewhat later age. The best outcrop of this shale is to be found at Kettle point on Lake Huron where

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[1] Brumell, H. P. H.; Rept. Geol. Surv., Canada, vol. V, pt. Q, 1892, pp. 61–69.

[2] Lane, Alfred C.; Jour. Geol., vol. XVIII, 1910, p. 417.

only about 12 to 18 feet are exposed. It is there seen to be a rather thin-bedded, black shale containing large spheroidal concretions similar to those found in the black shales along the Huron, Olentangy, and Scioto rivers in Ohio. Fragmentary fish remains and certain fossil plants occur rather abundantly in it. *Lingula ligea* Hall and *Lingula spatulata* Vanuxem are also somewhat common as are various Conodonts. These furnish the chief reasons for considering the lower portion of this shale Genesee[1] in age, although, of course, its stratigraphic position suggests the same thing. The total thickness of these upper Devonian beds of Ontario exceeds 200 feet; but it is scarcely probable that more than 50 to 100 feet belong to the horizon of the Genesee shale. Since the Genesee age of this deposit is not established, it has seemed better to follow Dr. Kindle's suggestion and call the black shale immediately succeeding the Hamilton in Ontario the Huron shale.[2]

"Overlying the black fissile slate, ... we find, at Kettle point, alternations of a peculiar, somewhat arenaceous, green and black shale which were recognized by him (James Hall) as the lower beds of the Portage group. In the same way at Kingstone's Mills, the upper beds, which are compact, thick-bedded, scarcely slaty, and dark olive or greenish-black in color, are by Prof. Hall referred to the Portage group, of which they were found by him to contain the characteristic fish-remains."[3] The wells in Moore township show the presence of these greenish shales associated with greenish sandstones in the uppermost Devonian. These beds lie under 120 feet of drift so that nothing very definite can be said regarding them; but it seems that they also belong in the horizon of the Portage and Chemung of the eastern states. These green shales with the associated green sandstones are suggestive of the Chagrin formation[4] of northern

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[1] See also Hunt, T. Sterry, Geol. Surv., Canada, Rept. Prog. 1863–1866, p. 242.

[2] Kindle, Edward M., Summary Rept. for 1912, Geol. Surv., Can., 1914, pp. 287-288.

[3] Hunt, T. Sterry; Geol. Surv., Canada, Rept. Prog. 1863-1866, p. 242.

[4] Prosser, Charles S.; Geol. Surv. Ohio, 4th ser. Bull. No. 15, 1912, pp. 182, 183, 510, 511.

Ohio, in which a Chemung fauna occurs. Since these beds are distinctly different from the highly bituminous black shale which underlies them, they are here named the Port Lambton beds, from their occurrence in the wells at that place.

CHAPTER II.

DETAILS OF STRATIGRAPHY.

GENERAL STATEMENT.

Beginning at Niagara river, the first outcrop of Devonian deposits in Ontario is located just above the ferry landing at Fort Erie, that is, at the steel tower supporting the electric power transmission lines where they cross the river. From that place south and westward along the north shore of Lake Erie, rocks of Devonian age outcrop at frequent intervals for a distance of nearly 50 miles. The majority of the points of land projecting into the lake are protected against wave action by outcrops of Onondaga limestone, and even where the beach is sandy, rock is usually only a short distance below. The sand dunes south of Sherks are heaped up on a bed of solid rock and the same is repeated again and again to the westward. The landward border of the Devonian deposits is back 1 to 4 miles from the lake until the Grand river is reached and from thence westward the distance gradually increases.

The Devonian deposits represented near Niagara river are the Onondaga limestone with meagre remnants of the Oriskany sandstone. Where this latter formation is not represented, portions of its arenaceous material are incorporated into the basal layers of the next younger deposit and may be of sufficient quantity to produce a sandstone. The Devonian rests unconformably on beds ranging in age from Salina (Bertie waterlime) to Cobleskill and, towards the north and west, perhaps even on younger beds. Some of these lower rocks also outcrop at Fort Erie and at various places to the west. They often show the effects of the period of weathering and erosion which intervened between the deposition of these and the oldest Devonian of the region. The drift is thin over the Devonian covered area, so thin in fact that the rock is frequently uncovered in making roads, or even in cultivating the fields. Scores of quarries have been opened in it and others might be located at many places. Of the Hamilton shales showing along the shore to the south of Buffalo none occur on the Canadian side until the vicinity of Selkirk is reached where slight indications of the Marcellus shale first appear. It is evident that these soft shales have suffered much more from glacial and other erosion than have the more resistant limestones and that the basin of Lake Erie owes its existence largely to this fact.

WELLAND COUNTY SECTIONS.

FORT ERIE.

The outcrop of Onondaga limestone at Fort Erie consists of about 6 feet of the rough, dark bluish black, cherty layers with a rather limited fauna. Bryozoa and corals are most numerous, although a few brachiopods were also found. A small amount of sand occurs in the upper part of the Silurian rocks at Victoria, a short distance to the northwest of Fort Erie; but the first probable remnant of Oriskany sandstone occurs along Frenchmans creek, somewhat less than 3 miles to the west of Niagara river, on land owned by a Mr. Spears. This remnant consists of 3½ feet of unfossiliferous, coarse, white sandstone, the basal part of which contains angular fragments of the Cobleskill dolomite on which it rests unconformably. The Oriskany sandstone is not known to cover more than a very small area here, nor does it appear that other remnants of any considerable size occur in the same vicinity.

On lot 6, concession V, township of Bertie, there is an outcrop of 5 feet of the cherty basal layers of the Onondaga. Mr. George Woehl, who owns the lot, had recently quarried out a small amount of rock here and collecting was then (1910) fairly good. The following species were obtained here.

Anthozoa

Zaphrentis sp.

Bryozoa

Cystodictya gilberti (Meek).
Polypora mutabilis (Hall).

Brachiopoda

Anoplia nucleata Hall.
Anoplotheca camilla (Hall).
Atrypa reticularis (Linnaeus).
Centronella glansfagea Hall.
Chonetes acutiradiatus Hall.
Chonetes hemisphericus Hall.
Chonetes mucronatus Hall.
Eunella lincklaeni Hall.
Leptaena rhomboidalis (Wilckens).
Meristella clusia (?) (Billings).
Meristella doris Hall.
Metaplasia disparilis (Hall).
Nucleospira concinna Hall.
Rhipidomella vanuxemi Hall.
Schellwienella pandora (Billings).
Spirifer duodenarius (Hall).
Spirifer macrus Hall.
Stropheodonta demissa (Conrad).
Stropheodonta inequistriata (Conrad).
Stropheodonta perplana (Conrad).

Pelecypoda

Conocardium cuneus (Conrad).
Cypricardinia indenta Conrad.

Gastropoda

Diaphorostoma lineatum (Conrad).
Igoceras conicum (Hall).
Platyceras carinatum Hall.
Platyceras dentalium Hall.

Pteropoda

Tentaculites scalariformis Hall.

Trilobita

Hausmania phacoptyx Hall and Clarke.
Phacops cristata Hall.
Proetus rowi (Green).

The fauna of the above outcrop, as will be observed on comparing it with those obtained at Windmill point, Port Colborne, Selkirk, Hagersville, etc., is remarkable for the abundance of brachiopods and the scarcity of corals. This is still more strikingly illustrated by the collection obtained from the Bertie Township quarry where the same horizon is again exposed.

RIDGEMOUNT.

About a half mile to the south of the hotel at Ridgemount is the Bertie Township quarry, on lot 7, concession VIII. At this place the basal layers of the Devonian are exposed and a considerable excavation into the Silurian has been made. The following section may be seen near the highway.

Section of the Bertie Township Quarry at Ridgemount.

	Feet	Inches
5. Soil and drift	0	6
Onondaga limestone		
4. A very cherty, fairly compact, grey limestone in rather thin, even beds, This rock contains an abundant Onondaga fauna which is remarkable for the few corals it carries	7	10
3. A thin layer of grey shale overlying the irregular surface of the Silurian dolomites	0	2
Cobleskill dolomite		
2. Thin, even bedded, mottled grey to drab dolomite. It contains a few fossils such as *Leperditia alta*, *Schuchertella hydraulica* (?), etc. For some distance below the Silurian-Devonian contact, the cracks and crevices often contain much coarse sand; but the Oriskany sandstone itself is wanting	7	8

	Feet	Inches
Salina beds (Bertie waterlime) ?		
1. A drab to dark bluish, compact dolomite containing a few fossils similar to those in the beds just above. Fragments of this rock emit somewhat of a clinking sound when struck together......................	2	6

The following is a list of the species of fossils found in the Devonian part of this section.

Anthozoa

Cladopora cryptodens (Billings).
Zaphrentis sp.

Bryozoa

Cystodictya gilberti (Meek).
Monotrypa tenuis (Hall).
Polypora celsipora (Hall).
Polypora granilinea (Hall).

Brachiopoda

Amphigenia elongata (Vanuxem).
Anoplia nucleata Hall.
Anoplotheca camilla (Hall).
Atrypa reticularis (Linnaeus).
Camarotoechia carolina Hall.
Camarotoechia tethys (Billings).
Centronella glansfagea Hall.
Chonetes hemisphericus Hall.
Chonetes mucronatus Hall.
Chonostrophia reversa (Whitfield).
Cyrtina hamiltonensis Hall.
Leptaena rhomboidalis (Wilckens).
Meristella nasuta (Conrad).
Metaplasia disparilis (Hall).
Nucleospira concinna Hall.
Orbiculoidea sp.
Pholidops patina Hall and Clarke.
Pholidostrophia iowaensis (Owen).
Reticularia fimbriata (Conrad).
Rhipidomella vanuxemi Hall.
Schellwienella pandora (Billings).
Spirifer divaricatus Hall.
Spirifer duodenarius (Hall).

Spirifer macrothyris Hall.
Spirifer manni Hall.
Spirifer macrus Hall.
Stropheodonta callosa Hall.
Stropheodonta concava Hall.
Stropheodonta demissa (Conrad).
Stropheodonta hemispherica Hall.
Stropheodonta inequistriata (Conrad).
Stropheodonta parva (?) Hall.
Stropheodonta patersoni Hall.
Stropheodonta perplana (Conrad).
Strophonella ampla Hall.

Pelecypoda

Aviculopecten sp.
Conocardium cuneus (Conrad).
Cypricardinia indenta Conrad.
Megambonia cardiiformis Hall.

Gastropoda

Diaphorostoma lineatum (Conrad).
Igoceras conicum (Hall).
Platyceras carinatum Hall.
Platyceras concavum Hall.
Platyceras dentalium Hall.
Platyceras dumosum Conrad.
Platyceras erectum Hall.
Platyceras rictum Hall.

Pteropoda

Tentaculites scalariformis Hall.

Trilobita

Chasmops anchiops (Green).
Hausmania phacoptyx Hall and Clarke.
Odontocephalus selenurus (Eaton).
Phacops cristata Hall.
Proetus rowi (Green).

As has been observed this fauna is markedly different from that of the usual outcrops of the Onondaga limestone in Ontario. A few of its forms have not been found, while others are rare, at higher horizons. Among those especially characteristic of the lowest portion of the formation are: *Amphigenia elongata*, *Anoplia nucleata*, *Anoplotheca camilla*, *Centronella glansfagea*, *Chonetes hemisphericus, Cypricardinia indenta, Platyceras dentalium,* and many others, some of which are common at higher horizons also. It is distinctly the fauna of the lower 15 or 20 feet of the Onondaga limestone. Although often admitting other forms not found at the Bertie Township quarry and losing others, it retains its identity as far north as Pinkerton, Bruce county, at which place the eastern margin of the Devonian is lost under a heavy coating of drift, only to reappear with the same fauna on the shore of Lake Huron south of Port Elgin.

At the Bertie Township quarry bed-rock is practically at the surface and lies weathering out over portions of the adjoining fields. The quarry is located just back from the edge of a ridge or cliff which is part Silurian and part Devonian rock. The angling road to the southwestward follows this cliff nearly to Ridgeway and the Onondaga is often at the surface either in the roadway or in the fields slightly back from it. At a few places there are remnants of the Oriskany sandstone, although no fossils were found in it. On lots 5 and 6 of concession IX, in the township of Bertie, the sandstone is 8 inches to a foot in thickness and consists of the same coarse material as is usually to be found in the Oriskany. Sometimes a foot or more of the underlying rock is involved in a more or less mixed up mass of sandstone and dolomite. This latter is either brecciated or is cracked and the spaces thus formed filled with sand. Usually, however, the Onondaga rests directly on the Silurian as at the Bertie Township quarry.

About 1½ miles to the south of Ridgemount, on lot 4, concession VIII, is the location of the Baxter quarry and limekiln. No lime has been produced there for a number of years and the place is more or less in ruins; but there are two important quarry pits where good sections may be seen. One is in the high grade limestone which was used in burning for lime and the other, which is somewhat separated, is in the dark, cherty portion. The following is a combined section of the rocks exposed there, all of which are Onondaga limestone.

Section of the Baxter Quarry 1½ Miles to the South of Ridgemount.

		Feet	Inches
3.	Dark bluish black, rough, cherty limestone....	8	6
2.	Covered interval..........................	2	0
1.	Semi-crystalline, massive, grey limestone containing an abundance of corals and large crinoid stems..........................	8	0

The following very small collection of fossils was made at the Baxter quarry.

	Horizon	
Anthozoa	1	3
Alveolites squamosus Billings..............................	x	..
Amplexus yandelli Milne-Edwards and Haime...............	x	..
Cladopora cryptodens (Billings).........................	x	..
Cladopora labiosa (Billings).............................	x	x
Cladopora pulchra Rominger............................	x	..
Cystiphyllum vesiculosum Goldfuss......................	x	x
Favosites basalticus Goldfuss............................	x	x
Favosites canadensis Billings............................	..	x
Favosites cervicornis Milne-Edwards and Haime............	x	..
Favosites emmonsi Rominger............................	x	..
Favosites hemisphericus (Troost)........................	x	x
Favosites turbinatus Billings............................	x	x
Heliophyllum exiguum Billings...........................	x	..
Heliophyllum halli Milne-Edwards and Haime...............	x	x
Synaptophyllum simcoense (Billings).....................	x	x
Syringopora perelegans Billings..........................	x	x
Zaphrentis gigantea Lesueur.............................	x	x
Vermipora fasciculata (?) Rominger......................	x	..
Brachiopoda		
Stropheodonta demissa (Conrad).........................	..	x

Several wells have been bored, with a diamond drill, in the bottom of this quarry, and the cores may be found lying around the buildings near the kiln; but a satisfactory record was not obtainable. Apparently the Oriskany sandstone is either wanting or very poorly developed, as no evidence of it was found in the cores.

WINDMILL POINT.

Formerly the Onondaga limestone was quarried on a rather large scale near this place and there are a number of old abandoned pits in that vicinity. Most of them are now nearly filled with water and much of the section is thus rendered inaccessible. Perhaps the best section of rock is to be found in the Buel quarries located on lot 12, Bertie township, a short distance to the north-east of the Grand Trunk Railway station. At that place the following section may be seen.

Section of the Buel Quarries, Windmill Point.

	Feet	Inches
6. Soil and drift	2	0
Onondaga limestone.		
5. Thin-bedded and massive, compact, cherty, grey to drab limestone in which fossils are generally rare	26	0
4. Covered interval between the south and the north quarry pits	1	0
3. A very compact, grey to drab limestone with a great quantity of grey to white chert mixed through the limestone	4	4
2. Very rough, hard, blue to black limestone containing much black chert. The roughness of the weathered surface is greatly increased by the presence of the chert. The uneven bedding planes are usually more or less shaly and in this material Bryozoa are often abundant.	8	6
1. Massive, semicrystalline, crinoidal, grey, limestone to the level of the water in the bottom of the south quarry pit	8	4

The north pit of the Buel quarry has sometimes been called the "flint quarry" because of the abundance of that material in the rock. It is in striking contrast to the limestone of the south pit both because of the lithological peculiarities and the rarity of fossils. Along the joint cracks the calcareous material has weathered out and the rough vesicular chert, which probably makes up more than half of the rock, is left. The dip of these rocks averages nearly 15 degrees to the northeast and this accounts for the relatively large section exposed.

The following species were collected from the rocks in the Buel quarries.

	Horizons			
Anthozoa	1	2	3	5
Aulopora cornuta Billings	..	x	..	..
Aulopora tubaeformis (?) Goldfuss	..	x	..	..
Cladopora cryptodens (Billings)	x	x	..	..
Cladopora expatiata Rominger	..	x	..	..
Cladopora imbricata Rominger	..	x	..	..
Cladopora labiosa Billings	x	x	..	x
Cladopora pulchra Rominger	..	x	..	..
Cladopora rimosa Rominger	..	x	..	..
Cyathophyllum coalitum Rominger	x	..	..	..
Cystiphyllum vesiculosum Goldfuss	x	x	..	..
Diphyphyllum strictum Milne-Edwards and Haime	..	x	..	..
Diphyphyllum arundinaceum (Billings)	..	x	..	..
Favosites basalticus Goldfuss	x	x	..	..
Favosites canadensis Billings	x	x	..	x
Favosites emmonsi Rominger	x	x	..	..
Favosites hemisphericus Milne-Edwards and Haime	x	x	..	..
Favosites turbinatus Billings	..	x	..	x
Heliophyllum halli Milne-Edwards and Haime	..	x	..	x
Ptychophyllum knappi Hall	..	..	..	x
Synaptophyllum simcoense (Billings)	..	x	..	..
Syringopora perelegans Billings	..	x	..	..
Zaphrentis gigantea Lesueur	x	x	..	x
Hydrozoa				
Syringostroma densa (?) Nicholson	x	x	..	..

Bryozoa	Horizons 1	2	3	5
Cystodictya gilberti (Meek)	..	x	..	..
Fenestella sp.	x	x	..	..
Isotrypa conjunctiva (Hall)	..	x	..	..
Polypora celsipora (Hall)	..	x	..	..
Polypora robusta (Hall)	..	x	..	..
Brachiopoda				
Amphigenia elongata (Vanuxem)	..	..	..	x
Atrypa reticularis (Linnaeus)	..	x	..	x
Camarotoechia tethys (Billings)	..	x	..	..
Chonetes hemisphericus Hall	..	..	..	x
Chonetes mucronatus Hall	..	x	..	..
Meristella nasuta (Conrad)	..	x	..	..
Orthis (?) eryna Hall	..	x	..	..
Pentamerella arata (Conrad)	..	..	..	x
Reticularia fimbriata (Conrad)	..	x	..	..
Rhipidomella vanuxemi Hall	..	x	..	..
Schellwienella pandora (Billings)	..	..	..	x
Spirifer duodenarius (Hall)	..	x	..	x
Spirifer macrus (?) Hall	..	x	..	..
Stropheodonta demissa (Conrad)	..	x	..	..
Stropheodonta hemispherica Hall	..	x	..	x
Stropheodonta inequiradiata Hall	..	x	..	..
Stropheodonta inequistriata (Conrad)	..	x	..	..
Gastropoda				
Diaphorostoma lineatum (Conrad)	..	x	..	..

Along the Lake Erie shore near by there is a low outcrop of Onondaga limestone. To the south of Ridgeway this consists of the usual cherty, black limestone with a great many fossil corals. Over this outcrop, at a short distance back from the water's edge, is usually a coating of wind-blown sand which is sometimes heaped into dunes.

SHERKS.

Near the lake, to the south of Sherks, Humberstone township, the Empire Limestone company has a large quarry in the Onondaga limestone. The following section includes the rocks of the immediate vicinity as well as those of the quarry.

Section of the Rocks Exposed at the Empire Limestone Company's Quarry.

	Feet	Inches
5. Wind-blown sand........................	6	0
Onondaga limestone ·		
4. Compact, bluish drab, limestone filled with grey chert, and containing very few fossils ..	3	6
3. Somewhat crystalline, dark blue limestone containing much black chert and quite fossiliferous................................	8	4
2. Massive, semi-crystalline, grey limestone containing much grey to bluish chert which usually runs in streaks. Corals and crinoid segments are rather abundant in these layers...	18	6
1. Massive, semi-crystalline, grey limestone showing partings of a greenish shale. Large compound corals are often abundant and the cavities of these are sometimes filled with petroleum. These beds extended to the lowest part of the quarry in 1910..........	10	0

Although the rock here is very fossiliferous, the freshly quarried material was not found adapted to collecting and only the following small list of species was obtained.

Anthozoa	Horizons 1	2	3	4
Cladopora labiosa (Billings)	..	x	..	x
Cystiphyllum vesiculosum Goldfuss	x	x	x	..
Diphyphyllum sp.	x	..	x	..
Favosites basalticus Goldfuss	..	..	..	x
Favosites cervicornis Milne-Edwards and Haime	x	..	..	..
Favosites emmonsi Rominger	x	..	..	..
Favosites hemisphericus (Troost)	x	x	x	..
Favosites turbinatus Billings	x	x	x	..
Heliophyllum halli Milne-Edwards and Haime	x	..	..	..
Syringopora hisingeri Billings	..	..	..	x
Zaphrentis gigantea Lesueur	x	..	..	x
Hydrozoa				
Syringostroma densa Nicholson	..	x	..	..
Brachiopoda				
Atrypa reticularis (Linnaeus)	..	x	..	..
Camarotoechia sp.	..	..	x	..
Leptaena rhomboidalis (Wilckens)	..	..	x	..
Pentamerella arata (Conrad)	..	..	x	..
Reticularia fimbriata (Conrad)	..	x	..	..
Spirifer duodenarius (Hall)	..	..	x	x
Stropheodonta hemispherica Hall	..	..	x	..

The upper or cherty drab layers of this section form a low, partly covered, cliff-like outcrop a short distance to the east of the Empire quarry and from thence strike diagonally southwestward to the lake. The presence of the chert gives this rock a mottled appearance so that on first sight it resembles the Cobleskill dolomite. A closer examination soon dispels the allusion. Along the lake shore the dark bluish to black, cherty limestone is the surface rock, although it shows little more than a foot or two and that is chiefly covered by drifting sand.

PORT COLBORNE.

In the construction of the Welland canal, at the Lake Erie end of which Port Colborne stands, it was necessary to make an extensive cut through the Devonian and Silurian rocks, and great quantities of this material were then removed. The drift covering often does not exceed a few inches over much of the surrounding region and the fossils, many of which are silicified, have weathered out of the Onondaga limestone in great numbers. During the stripping, preparatory to quarrying out the rock for the canal, many of these were recovered and have found their way into the museums over a considerable part of the continent. One of the most noted localities was Herbert S. Ramey's farm (lot 27, concession II, township of Humberstone). There is no section exposed at that place, but over the fields and along the canal much weathered out material may be found. The following is a list of the species obtained.

List of Fossils from Ramey's Farm, Port Colborne.

Anthozoa

Cladopora cryptodens (Billings).
Cladopora labiosa (Billings).
Cyathophyllum zenkeri Billings.
Cystiphyllum sulcatum Billings.
Cystiphyllum vesiculosum Goldfuss.
Favosites basalticus Goldfuss.
Favosites emmonsi Rominger.
Favosites hemisphericus (Troost).
Favosites turbinatus Billings.
Heliophyllum corniculum (Lesueur).
Heliophyllum exiguum Billings.
Michelinia convexa (d'Orbigny).
Phillipsastrea billingsi Calvin.
Striatopora cavernosa Rominger.
Synaptophyllum simcoense (Billings).
Syringopora maclurei Billings.
Zaphrentis gigantea Lesueur.
Zaphrentis prolifica Billings.

Bryozoa

Cystodictya gilberti (Meek).
Fenestella sp.

Brachiopoda

Amphigenia elongata (Vanuxem).
Atrypa reticularis (Linnaeus).
Centronella glansfagea Hall.
Chonetes hemisphericus Hall.
Chonetes mucronatus Hall.
Leptaena rhomboidalis (Wilckens).
Meristella nasuta (Conrad).
Pentamerella arata (Conrad).
Pholidostrophia iowaensis (Owen).
Spirifer duodenarius (Hall).
Stropheodonta demissa (Conrad).
Stropheodonta inequiradiata Hall.
Stropheodonta perplana (Conrad).
Strophonella ampla Hall.

Pelecypoda

Conocardium cuneus (Conrad).

Gastropoda

Diaphorostoma lineatum (Conrad).

Pteropoda

Coleolus sp.

Trilobita

Hausmania phacoptyx Hall and Clarke
Phacops cristata Hall.
Proetus rowi (Green).

The Hogan quarry, which is located within the limits of Port Colborne at the crossing of the Niagara, St. Catharines, and Toronto Electric railway and the Grand Trunk switch, furnishes an important exposure of the Onondaga limestone.

This quarry, now under the control of the Canadian Portland Cement company, has been worked but little and not at all in the last few years. But when last worked a considerable surface was stripped of drift and a deep hole quarried out so that the character of the rock is well shown.

Section of the Hogan Quarry, Port Colborne.

	Feet	Inches
6. Soil and drift or lake deposit................	1	0
Onondaga limestone		
5. Hard, bluish limestone with rough, black chert which stands out in relief on the weathered surfaces..............................	1	6
4. Dark, bluish, cherty limestone with an abundance of silicified compound corals studding the surface of the upper layer.............	1	6
3. Blue limestone with very little chert. The lower half is filled with corals, chiefly of the branching type	3	0
2. Blue limestone with some black chert and often with shaly bedding planes. Sometimes the bedding planes are rough and uneven, chiefly because of the presence of large compound corals. Crinoid stems of large size are also conspicuous, but identifiable specimens were not found. These beds are shown chiefly in the water hole.........................	5	10
1. Rather compact blue limestone with little or no chert and fossils less abundant. This portion extends to the level of the water in the lowest portion of the quarry.............	5	0

The following is a list of the fossil species obtained in the limestone at the Hogan quarry.

Anthozoa	Horizons 1	2	3	4	5
Alveolites confertus Nicholson	..	..	x	..	..
Alveolites distans Nicholson	..	..	x	..	..
Aulopora cornuta Billings	..	..	x	..	..
Bothrophyllum decorticatum Billings	..	x	x	x	x
Cladopora criptodens (Billings)	..	..	x	..	..
Cystiphyllum vesiculosum Goldfuss	x	x	x	x	x
Favosites basalticus Goldfuss	..	x	x	x	x
Favosites canadensis (Billings)	..	x	x	x	x
Favosites cervicornis Milne-Edwards and Haime	..	..	x	..	..
Favosites emmonsi Rominger	x	x	x	x	x
Favosites epidermatus Rominger	..	..	x	x	x
Favosites limitaris Rominger	..	x	x	x	x
Favosites radiciformis Rominger	..	x	..	..	..
Favosites turbinatus Billings	x	x	x	x	..
Heliophyllum corniculum (Lesueur)	..	..	x	..	..
Heliophyllum halli Milne-Edwards and Haime	x	x	x	..	x
Michelinia convexa d'Orbigny	..	..	x	..	..
Michelinia favositoides Billings	..	..	..	x	..
Synaptophyllum simcoense (Billings)	x	x	x	..	x
Syringopora hisingeri Billings	..	..	..	..	x
Syringopora nobilis Billings	..	..	x	..	..
Syringopora perelegans Billings	..	x	x	x	x
Zaphrentis gigantea Lesueur	x	x	x	x	x
Hydrozoa					
Clathrodictyon cellulosum Nicholson and Murie	..	..	..	x	..
Stromatoporella granulata Nicholson	..	x	x	x	..
Stromatoporella (?) tuberculata Nicholson	..	..	x	..	..
Syringostroma nodulata Nicholson	..	..	x	x	..
Bryozoa					
Fenestella parallela Hall	..	..	x	..	..
Fistulipora subcava (Hall)	..	..	x	..	..
Unitrypa pernodosa (Hall)	..	x	..	..	..

Brachiopoda	Horizons 1	2	3	4	5
Atrypa reticularis (Linnaeus)	..	..	x	..	x
Camarotoechia tethys (Billings)	..	..	x	..	..
Centronella glansfagea Hall	..	..	x	..	..
Chonetes mucronatus Hall	..	..	..	..	x
Cyrtina hamiltonensis Hall	..	..	x	..	..
Delthyris raricosta Conrad	..	..	x	..	..
Eunella linckleani Hall	..	..	x	..	..
Meristella nasuta (Conrad)	x	x	x	..	x
Metaplasia disparilis (Hall)	..	..	x	..	..
Pentamerella arata (Conrad)	...	x	x	..	x
Rhipidomella vanuxemi Hall	..	..	x	..	..
Schellwienella pandora (Billings)	..	..	x	..	..
Spirifer duodenarius (Hall)	..	..	x	..	x
Stropheodonta demissa (Conrad)	..	..	x	..	..
Stropheodonta hemispherica Hall	..	x	..	..	x
Stropheodonta inequistriata (Conrad)	..	..	x	..	..
Strophonella ampla Hall	x	x	..	..	..
Pelecypoda					
Conocardium cuneus (Conrad)	..	x	..	..	..
Gastropoda					
Diaphorostoma lineatum (Conrad)	..	x	x	x	x
Diaphorostoma turbinatum (Hall)	..	..	x	..	..
Platyceras carinatum Hall	..	..	..	..	x
Platyceras erectum (Hall)	..	x	x	..	..
Platyceras thetis Hall	..	..	x	..	..
Trilobita					
Phacops rana (Green)	..	..	x	..	..
Proetus rowi (Green)	..	..	x	..	..

About one mile to the west of Port Colborne, along the Grand Trunk railway, the Canadian Portland Cement company has an active plant and a quarry in the Onondaga limestone. The pit is opened on a low anticlinal fold with axis running a little to the north of east. In the quarry proper the beds dip a little more sharply to the north-northwest bringing in the higher beds in that portion of the pit. The greater part of the rock is of the high grade limestone; but other beds are also exposed, as shown by the following section.

Section of the Canadian Portland Cement Company's Quarry at Port Colborne.

	Feet	Inches
6. Soil and drift	3	0
Onondaga limestone.		
5. Dark bluish limestone containing much black chert. These beds weather rough and uneven, and are sometimes separated from the underlying beds by several inches of shale.	4	6
4. Somewhat massive, semi-crystalline, blue limestone with a small amount of chert and corals rather abundant	3	6
3. An impure, blue limestone with little or no chert and a great many corals scattered through it. Bedding planes rough and irregular, often shaly, and containing much carbonaceous matter	2	8
2. A rather massive, semi-crystalline, bluish grey limestone with partings of a greenish shale. The bedding of this mass is often rough and irregular. Corals are abundant and well preserved in it	18	6
1. Massive, grey limestone passing downward into a brownish impure limestone. These beds are streaked with semi-crystalline bands in which fossils are more abundant than in the remainder of it. This portion extends to the bottom of the water-hole at the west side of the quarry	10	0

The following fossils were found in the rocks exposed at the Canadian Portland Cement Company's quarry.

Spongia	Horizons 1	2	3	4	5
Hindia fibrosa (?) Roemer	..	..	x	..	..
Anthozoa					
Alveolites confertus Nicholson	..	..	..	..	x
Alveolites distans Nicholson	..	..	..	..	x
Alveolites ramulosus Nicholson	..	..	..	..	x
Aulopora cornuta Billings	..	..	..	..	x
Aulopora tubiformis (?) Goldfuss	..	..	..	..	x
Bothrophyllum decoricatum Billings	..	..	..	..	x
Chonostegites clappi Milne-Edwards and Haime	..	x	..	..	..
Cladopora cryptodens (Billings)	..	..	..	..	x
Cladopora imbricata Rominger	..	..	..	..	x
Cladopora labiosa (Billings)	x	x	x	..	x
Cladopora pinguis (?) Rominger	..	..	..	..	x
Cladopora pulchra Rominger	..	..	..	..	x
Cystiphyllum vesiculosum Goldfuss	x	x	x	x	x
Diplophyllum arundinaceum (Billings)	..	..	..	..	x
Eridophyllum verneuilianum Milne-Edwards and Haime	..	x	..	..	..
Favosites basalticus Goldfuss	x	..	..	x	x
Favosites canadensis (Billings)	..	x	..	x	x
Favosites emmonsi Rominger	x	x	x	x	x
Favosites epidermatus Rominger	..	..	..	..	x
Favosites limitaris Rominger	..	x	..	..	x
Favosites radiciformis Rominger	..	x	..	..	x
Favosites turbinatus Billings	x	x	..	x	x
Favosites winchelli Rominger	x	x	..	..	..
Heliophyllum corniculum (Lesueur)	..	..	..	x	..
Heliophyllum exiguum Billings	..	..	..	..	x
Heliophyllum halli Milne-Edwards and Haime	x	x	..	..	x
Michelinia convexa (d'Orbigny)	x	x	..	..	..
Michelinia favositoides Billings	x	x	..	..	..
Romingeria umbellifera (Billings)	..	x	..	..	..
Synaptophyllum simcoense (Billings)	..	x	x	x	x
Synaptophyllum straminium (Billings)	..	x	..	..	..
Syringopora hisingeri Billings	x	x	..	x	x
Syringopora maclurei Billings	..	..	..	..	x
Syringopora perelegans Billings	x	x	..	x	x
Zaphrentis gigantea Lesueur	x	x	x	x	x
Zaphrentis prolifica Billings	..	..	..	..	x

Bryozoa	Horizons 1	2	3	4	5
Coscinium striatum (?) Hall and Simpson....	..	..	..	..	x
Fenestella sp..............................	..	..	x	x	x
Reteporidra perundata (Hall)...............	..	..	..	..	x
Brachiopoda					
Amphigenia elongata (Vanuxem)............	x	..	..	..	..
Atrypa reticularis (Linnaeus)................	x	x	..	..	x
Camarotoechia billingsi Hall...............	..	..	..	x	..
Chonetes mucronatus Hall..................	..	..	..	..	x
Cyrtina hamiltonensis Hall.................	..	..	..	..	x
Leptaena rhomboidalis (Wilckens)...........	..	..	..	..	x
Meristella doris Hall.......................	..	..	..	..	x
Meristella nasuta (Conrad)................	x	x	..	..	x
Metaplasia disparilis (Hall)................	..	..	..	x	x
Parazyga hirsuta Hall......................	..	..	..	..	x
Pentamerella arata (Conrad)...............	x	..	..	..	x
Reticularia fimbriata (Conrad).............	..	..	..	..	x
Rhipidomella cleobis (?) Hall..............	..	..	..	..	x
Rhipidomella livia (Billings)...............	x	..	..	..	..
Rhipidomella vanuxemi Hall................	..	..	..	..	x
Schellwienella pandora (Billings)	x	x	..	..	x
Schizophoria propinque Hall...............	..	..	..	..	x
Spirifer duodenarius (Hall)................	..	..	..	x	x
Spirifer varicosus Hall.....................	..	..	..	..	x
Stropheodonta demissa (Conrad)...........	..	x	..	..	x
Stropheodonta hemispherica Hall...........	..	..	..	..	x
Stropheodonta inequistriata (Conrad)	..	x	..	..	x
Strophonella ampla Hall...................	x	x	x	..	..
Trematospira gibbosa (?) Hall.............	..	..	..	..	x
Pelecypoda					
Conocardium cuneus (Conrad).............	..	..	..	..	x
Gastropoda					
Diaphorostoma lineatum (Conrad)..........	x	x	..	x	x
Diaphorostoma turbinatum (Hall)..........	..	..	..	..	x
Diaphorostoma turbinatum cochleatum (Hall)	..	..	..	..	x
Loxonema pexatum Hall....................	..	..	..	..	x

Gastropoda—*Contd.*	Horizons 1	2	3	4	5
Platyceras carinatum Hall	..	..	..	..	x
Platyceras conicum (?) Hall	..	..	..	..	x
Platyceras erectum (Hall)	x	x	..	..	..
Platyceras rictum Hall	..	..	..	..	x
Strophostylas varians Hall	..	..	..	..	x
Turbinopsis schumardi (de Verneuil)	..	x	..	..	..
Crinoidea					
Megistocrinus sp	..	..	..	..	x
Trilobita					
Phacops cristata Hall	..	..	..	..	x

Along the Grand Trunk railway about 3 miles west of Port Colborne there is another interesting series of outcrops of Onondaga limestone. The quarry of the Welland County Lime Works (also known as John Reeb's quarry) is located here and furnishes the following section.

Section of the Welland County Lime Works' Quarry.

	Feet	Inches
3. Soil and drift	1	6
Onondaga limestone.		
2. Bluish, semi-crystalline limestone with very little chert, except at the top	5	6
1. Massive, bluish grey crystalline limestone	6	0

The following is a list of the species of fossils obtained from the quarry of the Welland County Lime Works.

Anthozoa	Horizons 1	Horizons 2
Acervularia rugosa Milne-Edwards and Haime	..	x
Bothrophyllum decorticatum Billings	x	x
Cladopora labiosa (Billings)	x	x
Cystiphyllum vesiculosum Goldfuss	x	x
Diphyphyllum strictum Milne-Edwards and Haime	..	x
Eridophyllum verneuilianum Milne-Edwards and Haime	x	..
Favosites basalticus Goldfuss	x	x
Favosites canadensis (Billings)	x	x
Favosites cervicornis Milne-Edwards and Haime	x	..
Favosites emmonsi Rominger	x	x
Favosites epidermatus Rominger	..	x
Favosites hemisphericus (Troost)	x	..
Favosites limitaris Rominger	x	x
Favosites turbinatus Billings	x	..
Heliophyllum halli Milne-Edwards and Haime	x	x
Michelinia favositoides Billings	x	..
Synaptophyllum simcoense Billings	x	..
Syringopora hisingeri Billings	x	x
Syringopora maclurei Billings	..	x
Syringopora perelegans Billings	..	x
Zaphrentis gigantea Lesueur	x	x
Zaphrentis prolifica Billings	..	x
Hydrozoa		
Syringopora densa Nicholson	..	x

Southward, across the Grand Trunk tracks, from the lime-kiln of the Welland County Lime Works Company, the massive, semi-crystalline layers of the Onondaga come to the surface and have been quarried to some extent. These layers contain an abundance of corals and the characteristic large crinoid stems; but brachiopods are scarce. The surface of the limestone is well polished and shows both grooves and striæ extending S. 20° W. The points of land projecting into the lake near Burnaby, south of Wainfleet, are protected by outcrops of several feet of the cherty part of the Onondaga. Both the dark, cherty layers with an abundance of corals and the compact, drab to grey cherty limestone with few corals are in outcrop, and the latter may be seen definitely overlying the former.

HALDIMAND COUNTY SECTIONS.

PORT MAITLAND.

Along the lake shore to the west of Port Colborne there are numerous outcrops of the Onondaga limestone, in addition to those near Burnaby; but few of them rise more than 4 or 5 feet above the water level until Port Maitland, Dunn township, is reached, where the following section begins.

Section Along the Shore of Lake Erie Beginning at Port Maitland and Extending Westward 3 Miles.

Onondaga limestone	Feet	Inches
3. Dark bluish to grey limestone containing much black chert	8	0
2. Bluish to grey semi-crystalline limestone containing a less amount of black chert and an abundance of corals	16	0
1. A very cherty, bluish limestone poor in fossils	12	0

Fossils found in the preceding section.

	Horizons	
Anthozoa	2	3
Acervularia rugosa Milne-Edwards and Haime	x	..
Aulopora cornuta Billings	x	x
Cladopora labiosa (Billings)	x	x
Cystiphyllum vesiculosum Goldfuss	x	x
Favosites cervicornis Milne-Edwards and Haime	x	x
Favosites emmonsi Rominger	x	x
Favosites turbinatus Billings	x	x
Heliophyllum corniculum (Lesueur)	x	..
Heliophyllum halli Milne-Edwards and Haime	x	x
Synaptophyllum simcoense Billings	x	..
Syringopora hisingeri Billings	..	x
Syringopora maclurei Billings	x	..
Syringopora perelegans Billings	x	x
Zaphrentis gigantea Lesueur	x	x
Hydrozoa		
Syringostroma densa Nicholson	x	..
Bryozoa		
Fenestella sp	x	..
Brachiopoda		
Atrypa reticularis (Linnaeus)	..	x
Camarotoechia billingsi Hall	..	x
Centronella glansfagea Hall	x	..
Meristella nasuta (Conrad)	..	x
Rhipidomella vanuxemi Hall	..	x
Schellwienella pandora (Billings)	..	x
Spirifer sp	..	x
Stropheodonta demissa (Conrad)	..	x
Stropheodonta hemispherica Hall	x	..
Pelecypoda		
Conocardium cuneus (Conrad)	..	x
Trilobita		
Phacops cristata Hall	..	x

Along the side of the highway, about 2½ miles to the north of Port Maitland, near the westward turn at the Grand river, there is an outcrop of the lower portion of the Devonian which shows the following section.

Section Along the Highway 2½ Miles North of Port Maitland.

	Feet	Inches
6. Soil and drift	1	0
Onondaga limestone		
5. A cherty, grey limestone containing some sand	2	0
4. A grey to white chert with some thin irregular shaly layers which are bituminous	2	0
Oriskany sandstone?		
3. A hard, cherty, grey sandstone which is almost a quartzite. These layers contain some dolomitic limestone pebbles	1	0
2. A very coarse, grey sandstone containing pebbles of the underlying dolomitic limestone. Many of these have dissolved out leaving numerous holes in the sandstone	1	0
Rondout waterlime?		
1. A compact, banded, drab, dolomitic limestone weathering to a buff or ash colour	2	0

Only a few fragmentary fossils were found in these beds; but they were sufficient to establish the Devonian age of all but the lowest division, which is undoubtedly Silurian, and to make the above reference to formations probable. Eastward, just across the river at Stromness post-office, a similar section is exposed in the bed of the canal.

BYNG.

South of the Grand river from Dunnville, Mr. Weber has opened a quarry at the edge of the village of Byng. The pit is entirely in the Silurian dolomitic limestone, some layers of which are so finely grained and compact that they have been tried as a lithographic stone, although apparently without very marked success. In the hill above the quarry to the southwest the Devonian beds come in and the total section is as follows.

Section of the Weber Quarry and the Hill Above.

Onondaga limestone	Feet	Inches
6. Very cherty, grey limestone with a small amount of shale, and passing downward into arenaceous layers	6	0
Oriskany sandstone ?		
5. Coarse sandstone in which no fossils were found, but closely resembling the Oriskany	1	0
4. Covered interval	4	0
Rondout waterlime		
3. Very compact, grey to buff, banded dolomitic limestone	9	0
Cobleskill dolomite		
2. Mottled grey to yellowish grey dolomitic limestone	10	0
Salina beds (Bertie waterlime)		
1. Drab to bluish, compact, banded dolomite to the bottom of the Weber quarry	6	0

The following list of species includes only those fossils found in the Onondaga limestone (No. 6) of this section.

Anthozoa

Chonostegites clappi Milne-Edwards and Haime.
Cladopora cryptodens (Billings).
Cladopora labiosa (Billings).
Cystiphyllum vesiculosum Goldfuss.
Favosites emmonsi Rominger.
Favosites turbinatus Billings.
Heliophyllum corniculum (Lesueur).

Anthozoa—*Contd.*

Heliophyllum exiguum Billings.
Synaptophyllum simcoense Billings.
Zaphrentis gigantea Lesueur.
Zaphrentis prolifica Billings.

Bryozoa

Cystodictya gilberti (Meek).
Fenestella sp.

Brachiopoda

Atrypa reticularis (Linnaeus).
Camarotoechia sp.
Centronella glansfagea Hall.
Chonetes hemisphericus Hall.
Chonetes mucronatus Hall.
Leptaena rhomboidalis (Wilckens).
Meristella nasuta (Conrad).
Pentamerella arata (Conrad).
Rhipidomella vanuxemi Hall.
Spirifer divaricatus Hall.
Spirifer duodenarius (Hall).
Stropheodonta demissa (Conrad).
Strophonella ampla Hall.

Gastropoda

Diaphorostoma lineatum (Conrad).
Platyceras attenuatum Hall.
Platyceras dentalium Hall.
Platyceras dumosum (?) Conrad.

Trilobita

Hausmania phacoptyx Hall and Clarke.
Proetus rowi (Green).

Westward from Byng there are several other sandstone remnants in Dunn township; but they are small and of little importance. In South Cayuga township the Onondaga limestone is often at the surface. At Bingham Road ridges of this formation control the topography and the fields are strewn with fragments of limestone. Although the rock is frequently to be seen through the thin coating of drift, no very important sections are exposed. In Rainham, North Cayuga, Oneida, and Walpole townships of Haldimand county, Devonian outcrops are to be counted by the score. In Townsend and Woodhouse townships of Norfolk county there are also a number of outcrops. Only the more important sections, however, can be discussed within the limits of this report.

SELKIRK.

Among the outcrops in the vicinity of this town, in the south-eastern part of Walpole township, that to be found along Stony creek from the village to the lake is perhaps the most important. The following is a section of the rocks exposed along that stream.

Section Along Stony Creek at Selkirk.

	Feet	Inches
5. Soil and drift	4	0
Onondaga limestone		
4. A rather compact, bluish grey limestone alternating with layers of grayish white chert	5	4
3. Semi-crystalline, bluish grey limestone with chert more or less in layers but not very abundant	2	8
2. Dark blue limestone with some chert. The limestone is uneven-bedded like that below, but is inclined to be shaly. The large compound corals project from the surface of these beds in great numbers	7	0
1. Cherty, uneven-bedded, crinoidal, bluish limestone, with many corals, extending to the level of Lake Erie	6	6

The following is a list of the species of which fossils were found in the rocks of this section.

	Horizons			
Anthozoa	1	2	3	4
Cladopora labiosa (Billings)	x	x	..	x
Cystiphyllum vesiculosum Goldfuss	x	x	..	..
Eridophyllum vernuillianum Milne-Edwards and Haime	x	x	..	x
Favosites cervicornis Milne-Edwards and Haime	x	x	..	..
Favosites emmonsi Rominger	x	x	x	x
Favosites turbinatus Billings	..	x	x	..
Heliophyllum corniculum (Lesueur)	x	..	x	..
Heliophyllum halli Milne-Edwards and Haime	x	x	x	x
Synaptophyllum simcoense Billings	..	x	..	..
Syringopora maclurei Billings	x	x	x	..
Syringopora perelegans Billings	x	x	x	..
Zaphrentis gigantea Lesueur	x	x	x	..
Hydrozoa				
Syringostroma densa Nicholson	x	..	..	..
Brachiopoda				
Amphigenia elongata (Vanuxem)	..	..	x	..
Atrypa reticularis (Linnaeus)	..	..	x	..
Chonetes mucronatus Hall	..	..	x	..
Leptaena rhomboidalis (Wilckens)	..	..	x	..
Meristella nasuta (Conrad)	..	..	x	..
Rhipidomella vanuxemi Hall	..	..	x	x
Spirifer sp.	..	..	x	..
Stropheodonta demissa (Conrad)	..	..	..	x
Stropheodonta inequistriata Hall	..	..	..	x
Pelecypoda				
Conocardium cuneus (Conrad)	..	..	x	..
Trilobita				
Hausmania phacoptyx Hall and Clarke	..	..	x	..

A small outcrop of much importance occurs on lot 23, concession I, township of Walpole. This is at the lake shore on the next lot to the west of the mouth of Stony creek and the following is a section of the rocks there exposed.

Section at the Lake Erie Shore on Lot 23, Concession I, Township of Walpole.

	Feet	Inches
5. Soil and drift	6	0
Delaware limestone		
4. Compact, dark blue limestone with an abundance of chert in it	3	0
3. Covered interval. The last rock exposed is dipping to the southwest, under a small angle, as is also the first seen 100 yards to the west where No. 4 was measured	2	0
2. Compact, blue limestone with chert in thin layers, chiefly along the bedding planes	4	8
1. Thin, compact, calcareous, brown shale or shaly limestone, weathering to bluish, and containing thin bands of chert. These beds extend to the level of Lake Erie	2	2

The following fauna was obtained at this place.

	Horizons			
Anthozoa	1	2	3	4
Favosites turbinatus Billings	..	..	..	x
Synaptophyllum simcoense (?) Billings	..	..	..	x
Syringopora sp	..	x	..	x
Brachiopoda				
Atrypa reticularis (Linnaeus)	..	x	..	x
Camarotoechia sp	..	..	..	x
Cryptonella planirostris Hall	x	..	..	..
Lingula sp	x	..	..	..
Meristella nasuta (?) (Conrad)	..	..	..	x
Productella sp	x	..	..	..
Rhipidomella cyclas Hall	x	..	..	..
Spirifer sp	x	..	..	..
Strophonella ampla Hall	..	..	..	x
Pteropoda				
Styliolina fissurella (Hall)	x	..	..	..
Tentaculites gracillistriatus Hall	x	..	..	..
Trilobita				
Phacops rana Green	..	..	..	x

This outcrop is interesting chiefly because of the bed of brown shale at the base in which two rather characteristic Marcellus shale fossils occur. It is remarkable that just a few feet above this shaly zone should be found such forms as *Meristella nasuta* and *Strophonella ampla,* both of which are not commonly found above the base of the Marcellus shale. This same relation occurs at several other places in this vicinity and there can be no doubt that the above is the true position of the beds even though a covered interval is introduced into the section. The fossil forms above referred to are apparently typical of the species to which they have been referred, although *Pentamerella arata* of this horizon may be a variety.

Selkirk is in the midst of the gas producing territory and the country rock round about has been perforated by numerous holes in the exploitation of that field. Almost any one of these wells furnishes a good section of the rock down to the Medina and, since essentially the whole of the Onondaga limestone is present here, gives some idea of the thickness of that Devonian formation. The following is a record of a gas well on Mr. George W. Hedges' lot at Selkirk.

Record of the George W. Hedges' Gas Well at Selkirk.

		Depth in Feet
9.	Soil and drift	8
8.	Cherty limestone (Onondaga)	135
7.	Dolomitic limestones and shales (Salina, Cobleskill, etc.)	320
6.	Limestone and dolomite (Lockport and Guelph)	282
5.	Shale (Rochester)	45
4.	Shale and limestone yielding a little gas (Clinton beds)	27
3.	Red shale yielding gas 15 feet below the top (Medina)	31
2.	Grey shale (Medina)	60
1.	White sandstone, the chief gas horizon (Medina)	17

This well is said to have attained a total depth of 990 feet; but the record did not show the nature of the beds below the white Medina, or chief gas bearing horizon.

At Helkie's lime-kiln, on lot 3, concession II, along Stony creek about one mile to the northeast of Selkirk, 7 feet of the Onondaga are exposed and carry the usual abundance of corals. Along the same creek on the next two concessions to the north good outcrops of somewhat higher beds of the Onondaga occur, while the Delaware limestone is exposed on the higher ground on either side of the creek. This latter as exposed here is usually a dark bluish limestone, with a decided shaly tendency, and in the upper part contains a few thin bands or layers of dark coloured chert. When freshly broken, the limestone has a brown colour and usually a strong petroleum odour. Fossils are not abundant and in most outcrops corals are nearly absent. On lot 3, concession III, township of Rainham, the Delaware limestone has been opened for quarrying to a depth of 8 feet and at that place the following fossils were found.

Anthozoa

Zaphrentis sp.

Brachiopoda

Atrypa reticularis (Linnaeus).
Chonetes mucronatus Hall.
Leiorhynchus limitare (?) (Vanuxem).
Leptaena rhomboidalis (Wilckens).
Lingula desiderata Hall.
Meristella nasuta (Conrad).
Productella spinulicosta Hall.
Schellwienella sp.
Spirifer macrus (?) Hall.
Strophalosia truncata (Hall).
Stropheodonta demissa (Conrad).
Strophonella ampla Hall.

Pelecypoda

Conocardium cuneus (Conrad).
Modiomorpha concentrica (Conrad).
Paracyclas elliptica (?) Hall.

Gastropoda

Loxonema sp.

Trilobita

Phacops rana (?) (Green).

CHEAPSIDE.

This is a small village on the line between concessions II and III, Walpole township, and about 3 miles to the northwest of Selkirk. The outcrop at that place is along Dry creek and is most interesting to the northward from the village, where the following section is exposed.

Section Along Dry Creek, Beginning About Three-quarters of a Mile North of Cheapside on Lot 19, Concession III, Extending up Stream, and Ending on Lot 18, Concession IV.

	Feet	Inches
11. Soil and drift	6	0
Delaware limestone		
10. A very cherty, bluish grey to dark blue or brown, compact limestone in rather massive beds, but weathering into thin irregular layers	7	6
9. Layers of compact hard, blue limestone, some of which are separated by brown bituminous shale and all show more or less of a tendency to weather shaly. These beds contain some black chert, a part of which is in distinct layers	6	6
8. A fine-grained, hard and brittle, blue limestone in uneven layers and alternating with beds of grey chert	7	6
7. A rough, uneven, bituminous, shaly mass, blue to brown in colour and with much black chert intermixed	0	6
6. A hard, blue limestone containing iron pyrite and some crystals of calcite	0	6
5. A brown shale with thin bands of black chert. It also includes several thin hard limestones and has a strong odour of petroleum. This shale contains an abundance of *Styliolina fissurella* and *Tentaculites gracillistriatus*, both of which, especially when associated, are rather characteristic of the Marcellus shale and probably do not occur below that horizon	4	2
Onondaga limestone		
4. A compact, cherty, blue limestone, somewhat crinoidal and quite fossiliferous	0	6
3. Covered interval	4	0
2. A compact, drab to grey limestone containing quite a little chert and few fossils	2	6

	Feet	Inches
1. Massive, coraline, blue to grey limestone which is almost a perfect mat of corals. These layers extend to creek level at the last outcrop above the village........................	2	0

The following table gives a list of the fossils found in this section and also the horizons at which they occur.

	Horizons									
Anthozoa	1	2	3	4	5	6	7	8	9	10
Acervularia rugosa Milne-Edwards and Haime....................	x	...	...	...	...	...	...	...	...	...
Bothrophyllum decorticatum Billings	x	...	...	...	...	...	...	...	...	...
Cladopora labiosa (Billings)..........	x	x	...	...	...	...	...	x	...	...
Cyathophyllum anna Whitfield......	x	...	...	...	...	...	...	...	...	...
Cystiphyllum vesiculosum Goldfuss.	x	...	...	x	...	...	...	...	...	...
Diphyphyllum strictum (?) Milne-Edwards and Haime............	x	...	...	...	...	...	...	...	...	...
Diphyphyllum sp..................	x	...	...	x	...	...	...	x	...	...
Favosites basalticus Goldfuss........	x	...	...	...	...	...	...	...	...	...
Favosites emmonsi Rominger........	x	...	...	...	...	...	...	...	...	...
Favosites turbinatus Billings........	x	...	...	x	...	...	...	...	...	...
Favosites sp......................	x	...	...	...	...	...	...	x	...	x
Heliophyllum halli Milne-Edwards and Haime....................	x	...	...	x	...	...	...	x	...	...
Michelinia convexa (d'Orbigny)......	x	...	...	...	...	...	...	...	...	...
Synaptophyllum simcoense Billings..	x	...	...	...	...	...	...	...	...	...
Syringopora hisingeri Billings........	x	...	...	...	...	...	...	...	...	...
Syringopora maclurei Billings........	x	...	...	...	...	...	...	...	...	...
Syringopora perelegans Billings......	x	...	...	...	...	...	...	...	...	...
Zaphrentis gigantea Lesueur.........	x	...	...	x	...	...	...	...	...	...
Zaphrentis prolifica Billings.........	x	...	...	...	...	...	...	...	...	x
Zaphrentis sp.....................	x	...	...	...	...	...	...	...	...	...
Hydrozoa										
Stromatoporella sp..................	...	...	...	...	...	...	x	...	...	...
Bryozoa										
Fenestella sp......................	...	x	...	x	...	...	x	x	...	...

Brachiopoda	Horizons 1	2	3	4	5	6	7	8	9	10
Atrypa reticularis (Linnaeus)	...	x	...	...	...	...	...	x	x	x
Camarotoechia sp.	...	...	...	...	...	...	...	...	...	x
Chonetes mucronatus Hall	...	x	...	...	...	x	...	...	x	x
Cyrtina hamiltonensis Hall	...	...	...	...	...	...	...	...	...	x
Leptaena rhomboidalis (Wilckens)	...	...	...	...	...	...	...	...	...	x
Meristella barrisi Hall	...	...	...	...	...	...	...	...	...	x
Meristella nasuta (Conrad)	...	...	...	...	...	...	...	x	x	x
Nucleospira concinna Hall	...	...	...	...	...	...	...	...	...	x
Pentamerella arata (?) (Conrad)	...	...	...	...	...	...	...	x	...	...
Rhipidomella vanuxemi Hall	...	...	...	...	...	...	...	x	x	...
Spirifer sp.	...	...	...	...	...	...	x	x	x	...
Strophalosia truncata Hall	...	...	...	...	x	...	...	...	...	...
Stropheodonta concava (?) Hall	...	...	...	x	...	...	...	...	...	...
Stropheodonta demissa (Conrad)	...	...	...	...	...	...	x	...	...	...
Stropheodonta patersoni Hall var	...	...	...	...	...	...	...	...	...	x
Stropheodonta perplana (Conrad)	...	...	...	...	...	...	...	x	...	x
Strophonella ampla Hall	...	...	...	x	...	...	...	x	...	x
Pelecypoda										
Conocardium cuneus (Conrad)	...	...	...	x	...	...	...	...	...	...
Goniophora hamiltonensis Hall	...	...	...	...	...	...	...	...	...	x
Lunulicardium ornatum Hall	...	...	...	...	...	...	...	...	...	x
Modiomorpha mytiloides Hall	...	...	...	...	...	...	...	...	...	x
Paracyclas ohioensis (Meek)	...	...	...	...	...	...	...	...	...	x
Gastropoda										
Loxonema hamiltoniae Hall	...	...	...	...	...	...	...	...	...	x
Euryzone itys (Hall)	...	...	...	...	...	...	...	...	...	x
Pteropoda										
Coleolus sp.	...	...	...	...	x	...	...	...	x	...
Styliolina fissurella Hall	...	...	...	...	x	...	...	...	...	x
Tentaculites gracillistriatus Hall	...	...	...	...	x	...	...	...	...	...
Trilobita										
Phacops rana Green	...	...	...	...	...	...	...	x	...	x
Proetus sp.	...	...	...	...	...	...	...	...	...	x

As indicated in the above section the bed of cherty, brown shale observed along the lake shore appears here also and contains the same Marcellus shale fossils in abundance. In the limestone above occur again several of the species which have been so intimately associated with the Onondaga and lower horizons that it seems hard to believe that the beds in which they are here found belong above the base of the Marcellus shale, and yet there seems to be no escape from that conclusion. However, good evidence has made it necessary to consider other equally good Onondaga forms as passing above the same boundary line in the case of the Delaware limestone of Ohio where geologists have been as reluctant to accept the evidence found in the rocks, and it seems there can be no better reason for disregarding that here observed. Possibly when an abundance of these Onondaga forms have been collected they may be found to be varieties of the species with which they are here identified. Various collectors report having found *Martinia maia*, a typical Delaware limestone fossil, in the upper limestone near Selkirk. In view of these occurrences the bed of brown shale bearing the Marcellus forms is considered to be the basal portion of the Delaware limestone.

HAGGERTY FALLS.

Along Sandusk creek about 3½ miles to the northwest of Cheapside is a beautiful waterfall known as Haggerty falls. This is on lot 13, concession IV, township of Walpole, and scarcely a quarter of a mile to the south of the little village of Sandusk. Haggerty falls furnishes one of the best natural sections of the Onondaga limestone in this part of Ontario, as well as a region of considerable scenic beauty (see Plate II). The following is a section of the rocks exposed at that place.

Section Exposed at Haggerty Falls.

	Feet	Inches
6. Soil and drift	0	6
Onondaga limestone		
5. Bluish grey, semi-crystalline limestone in which there is little or no chert and fossils are not quite so abundant as in the layers below	2	8

	Feet	Inches
4. Very massive, rough, bluish grey limestone containing some chert and quite full of corals and other fossils	8	0
3. An irregular layer of massive, bluish grey limestone containing numerous corals	2	6
2. Grey to bluish, crystalline limestone in irregular beds alternating with grey to white chert	4	0
1. Sub-crystalline, grey to bluish grey limestone with irregular masses of chert and abundantly fossiliferous. This portion extends to the lowest level of Sandusk creek below the falls	3	6

The following fossils were found in the rocks at Haggerty falls.

Anthozoa	Horizons				
	1	2	3	4	5
Bothrophyllum decorticatum Billings	..	..	..	x	..
Chonostegites clappi Milne-Edwards and Haime	..	..	..	x	..
Cladopora cryptodens (Billings)	..	..	..	x	..
Cladopora labiosa (Billings)	..	..	x	x	..
Cladopora pulchra Rominger	..	..	..	x	..
Cladopora sp.	..	x	x	x	x
Cystiphyllum vesiculosum Goldfuss	x	..	x	x	x
Diphyphyllum sp.	x	x	..	x	x
Eridophyllum vernuillianum Milne-Edwards and Haime	..	..	..	..	x
Favosites basalticus Goldfuss	x	x	x	x	x
Favosites canadensis (Billings)	..	..	x	x	..
Favosites cervicornis Milne-Edwards and Haime	..	..	x	x	x
Favosites emmonsi Rominger	x	..	x	x	x
Favosites limitaris Rominger	..	..	..	x	..
Favosites turbinatus Billings	x	..	..	x	..
Heliophyllum halli Milne-Edwards and Haime	x	x	x	x	x
Michelinia convexa (d'Orbigny)	x	..	x	..	x
Striatopora cavernosa Rominger	..	..	..	x	..
Synaptophyllum simcoense Billings	..	..	..	x	..

Anthozoa—*Contd*	Horizons 1	2	3	4	5
Syringopora hisingeri Billings	..	..	x	x	..
Syringopora perelegans Billings	..	..	..	x	..
Zaphrentis gigantea Lesueur	x	x	x	x	x
Zaphrentis sp	x	..	..	..	x
Hydrozoa					
Stromatoporella sp	..	..	x	.	x
Bryozoa					
Fenestella sp	x	..	..	..	..
Brachiopoda					
Atrypa reticularis (Linnaeus)	x	..	..	x	x
Meristella nasuta (Conrad)	..	..	..	..	x
Rhipidomella vanuxemi Hall	..	..	..	..	x
Spirifer sp	x	..	..	..	..
Stropheodonta demissa (Conrad)	..	..	..	..	x
Stropheodonta patersoni Hall	..	..	..	..	x
Pelecypoda					
Conocardium cuneus (Conrad)	..	..	..	..	x
Gastropoda					
Platyceras sp	..	x	..	..	..
Cephalopoda					
Orthoceras thoas Hall	..	..	..	x	..

About 2 miles up the Sandusk from Haggerty falls, on lot 9, concession V, township of Walpole, somewhat higher beds of the Onondaga limestone appear as follows.

Section on Sandusk Creek Above Haggerty Falls.

	Feet	Inches
3. Drift	3	0
Onondaga limestone		
2. Compact, bluish grey limestone alternating with layers of greyish white chert	2	0
1. Compact bluish grey semi-crystalline limestone with trails of lighter colour, showing especially on the weathered surface. These beds extend to the level of Sandusk creek	1	6

The following fossils were found in the above section.

	Horizons	
	1	2
Anthozoa		
Cystiphyllum vesiculosum Goldfuss	x	..
Heliophyllum halli Milne-Edwards and Haime	x	..
Zaphrentis sp.	x	..
Bryozoa		
Fenestella sp.	x	x
Brachiopoda		
Atrypa reticularis (Linnaeus)	..	x
Camarotoechia sp.	..	x
Delthyris raricosta Conrad	x	..
Leptaena rhomboidalis (Wilckens)	..	x
Meristella nasuta (Conrad)	..	x
Stropheodonta patersoni Hall	x	x
Strophonella ampla Hall	x	..
Gastropoda		
Platyceras sp.	x	..
Cephalopoda		
Orthoceras nuntium Hall	x	..
Trilobita		
Hausmania phacoptyx Hall and Clarke	x	..
Phacops sp.	x	..

Towards the lake there are other fair outcrops along Sandusk creek. Probably the most important of these are to be found on lots 16, 17, and 18, concession I, Walpole township, where 8 to 10 feet of the cherty, compact, bluish brown limestone occurs. These beds are usually irregular and often more or less shaly. The fossils are not very characteristic, but they apparently indicate beds of the same general age as those found along Dry creek above Cheapside. The banks of Nanticoke creek also show several meagre outcrops of limestone. The upper portion of the beds exposed just above the village of Nanticoke is probably Delaware limestone.

FISHERVILLE.

In the vicinity of this little village, located in Rainham township, about 5 miles north of Lake Erie, the Onondaga limestone lies very near the surface and frequently outcrops along the small runs that traverse the country. The thickness of rock exposed is seldom important in that vicinity. On lot 5, concession V, about three-quarters of a mile to the west of the village, there is a small waterfall and an 8-foot outcrop of rock on a branch of Stony creek. Along the same little stream, at the next road crossing it to the north, 4 or 5 feet of cherty, grey limestone may be seen. At this latter place the usual Onondaga corals are abundant; but all fossils are rather rare at the former. On another small eastward branch of Stony creek, 1½ miles to the southeast of Fisherville, several outcrops occur. The better of these is located on lot 10, concession IV, where the following section is exposed.

Section on Lot 10, Concession IV, Rainham Township, 1½ Miles Southeast of Fisherville.

	Feet	Inches
3. Soil and drift	5	0
Onondaga limestone		
2. Very cherty, bluish grey limestone containing very few fossils	6	0
1. Massive, cherty, dark bluish limestone extending to the creek level	3	6

The following fauna was collected from the preceding section.

Anthozoa	Horizons 1	Horizons 2
Bothrophyllum decorticatum Billings	x	..
Cladopora labiosa (Billings)	x	x
Cladopora sp	x	..
Cystiphyllum vesiculosum Goldfuss	x	..
Diphyphyllum sp	x	..
Favosites basalticus Goldfuss	x	..
Favosites canadensis (Billings)	x	..
Favosites emmonsi Rominger	x	..
Favosites turbinatus Billings	x	..
Heliophyllum halli Milne-Edwards and Haime	x	..
Syringopora hisingeri Billings	x	x
Syringopora perelegans Billings	x	..
Zaphrentis gigantea Lesueur	x	x
Zaphrentis sp	x	..

DECEWVILLE.

This village, located in North Cayuga township about 3 miles to the west of Cayuga and the Grand river, is on the edge of the Devonian deposits. In fact there are Silurian and basal Devonian outcrops along the Grand Trunk railway less than a half mile distant from the depot on either side. The following section occurs a short distance to the west of DeCewville, on lot 45, concession I, north of the Talbot road.

Section on Lot 45, Concession I, North of the Talbot Road, North Cayuga Township, Near the Village of DeCewville.

	Feet	Inches
6. Soil and drift	2	0
Onondaga limestone		
5. Cherty, grey limestone, mostly covered	3	0
4. A very cherty, grey limestone carrying an abundance of the usual Onondaga fossils	5	0

	Feet	Inches
3. Mostly chert but with some limestone which carries a quantity of sand grains. Fossils are rare in these beds....................	1	6
Oriskany sandstone		
2. A true sandstone carrying fragments of the underlying beds..........................	0	4
Cobleskill (?) dolomite		
1. A compact, drab to ash coloured dolomite in even beds. (This rock is certainly Silurian but its exact age was not determined.)	6	0

The following fauna is chiefly from beds Nos. 4 and 5 of the above section, although a considerable portion of it was collected from loose material which apparently came from the same horizon.

Anthozoa

Cladopora labiosa (Billings).
Cystiphyllum vesiculosum Goldfuss.
Favosites basalticus Goldfuss.
Favosites emmonsi Rominger.
Favosites sp.
Heliophyllum exiguum Billings.
Heliophyllum halli Milne-Edwards and Haime.
Zaphrentis sp.

Bryozoa

Cystodictya gilberti (Meek).
Fenestella sp.

Brachiopoda

Amphigenia elongata (Vanuxem).
Anoplia nucleata Hall.
Anoplotheca camilla (Hall).
Athyris sp.
Atrypa reticularis (Linnaeus).
Camarotoechia tethys (Billings).
Centronella glansfagea Hall.
Leptaena rhomboidalis (Wilckens).

Brachiopoda—*Contd.*

Meristella clusia (Conrad).
Meristella walcotti (?) Hall and Clarke.
Metaplasia disparilis (Hall).
Nucleospira concinna Hall.
Parazyga hirsuta Hall.
Pentamerella arata (Conrad).
Pholidops patina Hall and Clarke.
Reticularia fimbriata (Conrad).
Rhipidomella livia (Billings).
Rhipidomella vanuxemi Hall.
Schellwienella pandora (Billings).
Spirifer divaricatus Hall.
Spirifer duodenarius (Hall).
Spirifer arenosus unicus Hall.
Stropheodonta concava Hall.
Stropheodonta demissa (Conrad).
Stropheodonta hemispherica Hall.
Stropheodonta inequistriata (Conrad).
Stropheodonta perplana (Conrad).
Strophonella ampla Hall.

Pelecypoda

Conocardium cuneus (Conrad).
Cypricardinia indenta Conrad.

Gastropoda

Euryzone lucina (Hall).
Igoceras conicum (Hall).
Platyceras dentalium Hall.
Platyceras erectum Hall.

Pteropoda

Tentaculites scalariformis Hall.

Trilobita

Chasmops anchiops (Green).
Coronura diurus (Green).
Phacops cristata Hall.
Phacops rana (Green).
Proetus rowi (Green).

While there is apparently a thin representative of the Oriskany sandstone present in this outcrop, no fossils were found in place in it. However, in the north end of the same lot and over the four or five lots immediately to the west, as well as those of corresponding position in the next concession to the north, typical Oriskany sandstone with its usual fauna is well developed. Outcrops are rather abundant, as the sandstone lies near the surface and has been quarried at more than a dozen localities. This formation is exceedingly variable in thickness, as it lies on an uneven surface (see Plate V), and is in turn succeeded unconformably by the Onondaga limestone. The break between the Oriskany sandstone and the Silurian was a long one. During this interval land conditions prevailed over much, if not all, of southwestern Ontario and erosion left its marks over the region then exposed.[1] The latest Silurian and the earliest Devonian, if the latter were ever deposited, disappeared during this period of weathering and erosion, while the joints in the underlying beds were widened by solution. Into the crevices thus formed the sand of the Oriskany penetrated and now forms seams of that material often extending 4 or 5 feet below the actual contact. This condition is traceable far beyond the present distribution of the arenaceous formation and has sometimes been taken as sufficient justification for including the Oriskany as one of the local formations in regions where it has long since ceased to exist. Such sandy material in the crevices of the top layers of the Silurian and mingled with Silurian pebbles in the basal Devonian are to be found even at Goderich and Amherstburg. The lowest layers of the Oriskany sandstone include angular fragments of the Silurian dolomitic limestones and sometimes portions of the residual clays formed by its disintegration. This latter material, however, more often forms the base on which the sandstone rests. In comparatively recent time the irregularity of the contact has been somewhat increased by the solvent action of water. At some places it is possible for a man to crawl in between the two formations, while at others the sandstone has sunken and is again in contact with the Silurian.

[1]See Kindle, E. M., Geol. Surv., Canada, Summary Rept. for 1912 (1914), pp. 286, 287.

Near the north end of lot 46, concession I, north of the Talbot road, North Cayuga township, there is a rather large opening in the Oriskany sandstone on property owned by Mr. Jacob McClung. In this quarry the rock is a coarse, even-grained, white sandstone in which fossils are exceedingly rare. There is a thickness of nearly 6 feet exposed without reaching the bottom of the sandstone. On top of the Oriskany occurs a 4 to 6-inch layer of conglomerate in which the pebbles are of sandstone, but mingled with them are balls of calcareous mud. The matrix of this deposit is chiefly sand; but, owing to the admixture of a large quantity of limestone mud, it may take on the appearance of mortar (see Plate III). The sandstone pebbles were found to contain specimens of *Spirifer arenosus*. The calcareous mud balls are also fossiliferous; but the remains are usually too fragmentary for positive identification. Mingled with this mass are various Onondaga corals, brachiopods, trilobites, fish plates and teeth, etc. This is, in fact, the lowest portion of the Onondaga limestone and shows the nature of the contact between it and the Oriskany sandstone. It is evident that the present fragmentary state of the Oriskany is due to the period of erosion which followedso on after its deposition, and that the arenaceous condition of much of the basal portion of the Onondaga is due to the destruction of a part of the sandstone formation by the advancing Onondaga sea and the incorporation of the material thus obtained into the deposit then forming.

Neighbouring lots to the westward contain good deposits of the Oriskany sandstone and on nearly every one some quarrying has been done. The largest and most important of these openings is to be found on lots 48 and 49 (concession II, north of the Talbot road), where the Oneida Lime and Sand Company has a large crushing plant for this friable sandstone formation. Fossils are also very much more abundant there, especially in the wood-lot just beyond, and extending westward into lot 50. On the Oneida Lime and Sand Company's property there occurs an outcrop of Onondaga limestone, the sandstone quarries, a Silurian dolomitic limestone quarry, and a gypsum prospect shaft. This shaft starts in the Onondaga limestone and ends in the Salina formation. Where it passes through the Oriskany that formation is only 18 inches thick, while in the sandstone quarry, less than 100 yards distant, it is nearly 20 feet thick (see Plate IV). The following is a combined section of the outcrop, the quarry, and the shaft, although the measurements for the latter are only approximately correct.

Section of the Oneida Lime and Sand Company's Quarries and Shaft.

	Feet	Inches
15. Soil and drift	0	6
Onondaga limestone		
14. A very cherty, bluish grey limestone in which fossils are abundant	3	8
13. Cherty, calcareous layers with an abundance of coarse sand	0	8
Oriskany sandstone		
12. Coarse-grained, friable, white to yellowish sandstone. At places, especially in the upper part, this sandstone contains occasional concretion-like masses resembling true quartzite. The sand grains vary in size up to an eighth of an inch in diameter and are usually well rounded. The lower portion contains sub-angular fragments of the underlying dolomitic limestones. The thickness of this sandstone varies much from place to place, chiefly because of the uneven surface on which it lies, but also because of the unconformity between it and the succeeding formation. These beds are often well filled with characteristic Oriskany fossils	19	6
Cobleskill (?) dolomite		
11. Weathered buff to yellowish brown, somewhat porous magnesian limestone. These beds contain a few fossils and vary much in thickness at different places	2	6
Salina beds		
10. Compact, banded drab dolomitic limestone	3	6

	Feet	Inches
9. Compact, banded, brown dolomitic limestone	10	0
8. A compact, drab dolomite banded with dark blue	5	0
7. Compact drab dolomite	5	0
6. Hard drab to brown dolomite splitting into thin layers	8	0
5. Fine-grained, blue shale	24	0
4. A compact, drab, calcareous rock containing thin films of carbonaceous matter	5	0
3. A compact, drab, calcareous rock containing numerous pores or small cavities	1	6
2. Blue, shaly rock containing masses of celestite	3	6
1. An incoherent, blue shale containing crystals of gypsum. Bottom of shaft	8	0

The following fauna was collected from the Devonian rocks on the Oneida Lime and Sand Company's property and the Oriskany sandstone of the adjacent lot to the west.

Anthozoa	Horizons 12	13	14
Acrophyllum oneidaensis Billings	..	..	x
Amplexus yandelli Milne-Edwards and Haime	..	x	x
Bothrophyllum decorticatum Billings	..	x	x
Chonostegites clappi Mine-Edwards and Haime	..	..	x
Cladopora cryptodens (Billings)	..	x	x
Cladopora labiosa (Billings)	..	x	x
Cystiphyllum sulcatum Billings	..	..	x
Cystiphyllum vesiculosum Goldfuss	..	x	x
Eridophyllum vernuillianum Milne-Edwards and Haime	..	..	x
Favosites basalticus Goldfuss	..	..	x
Favosites clausus Rominger	..	..	x
Favosites conicus (?) Hall	x	..	..
Favosites emmonsi Rominger	..	..	x
Favosites epidermatus Rominger	..	..	x
Favosites helderbergiae Hall	x	..	..
Favosites limitaris Rominger	..	..	x
Favosites turbinatus Billings	..	x	x

Anthozoa—*Contd.*	Horizons 12	13	14
Heliophyllum corniculum (Lesueur)	..	..	x
Heliophyllum exiguum Billings	..	..	x
Heliophyllum halli Milne-Edwards and Haime	..	..	x
Michelinia convexa d'Orbigny	..	x	x
Michelinia favositoidea Billings	..	..	x
Phillipsastrea gigas Owen	..	..	x
Synaptophyllum simcoense (Billings)	..	..	x
Syringopora hisingeri Billings	..	..	x
Syringopora maclurei Billings	..	..	x
Syringopora perelegans Billings	..	x	x
Zaphrentis gigantea Lesueur	..	x	x
Zaphrentis nodulosa Rominger	..	..	x
Zaphrentis prolifica Billings	..	..	x
Zaphrentis roemeri Hall	x	..	..
Hydrozoa			
Stromatoporella granulata Nicholson	..	..	x
Bryozoa			
Cystodictya gilberti (Meek)	..	x	x
Fenestella biseriata (?) Hall	x	..	..
Hederella magna (?) Clarke	x	..	..
Monotrypella sp	x	..	..
Polypora hexagonalis (?) (Hall)	x	..	..
Polypora robusta Hall	..	x	x
Brachiopoda			
Amphigenia elongata (Vanuxem)	x	x	x
Anoplia nucleata Hall	?	..	x
Anoplotheca camilla (Hall)	..	x	x
Anoplotheca flabellites (Conrad)	x	..	..
Atrypa reticularis (Linnaeus)	x	x	x
Beachia suessana Hall	x	..	..
Brachyprion schuchertanum (?) Clarke	x	..	..
Camarotoechia barrandei Hall	x	..	..
Camarotoechia billingsi Hall	..	..	x
Camarotoechia dryope Billings	x	..	..
Camarotoechia tethys (Billings)	..	..	x
Centronella glansfagea Hall	..	x	x

Brachiopoda—*Contd.*	Horizons 12	13	14
Centronella tumida Billings	x	..	..
Chonetes hemisphericus Hall	..	..	x
Chonetes hudsonicus Clarke	x	..	..
Chonetes mucronatus Hall	?	x	x
Chonostrophia complanata Hall	x	..	..
Crania pulchella Hall and Clarke	x	..	..
Cryptonella fausta (?) Clarke	x	..	..
Cyrtina hamiltonensis Hall	..	x	x
Cyrtina rostrata Hall	x	..	..
Cyrtina varia Clarke	x	..	..
Delthyris raricosta Conrad	..	..	x
Eatonia peculiaris (Conrad)	x	..	..
Eatonia sinuata (?) Hall	x	..	..
Eunella harmonica Hall	..	..	x
Hipparionyx proximus Vanuxem	x	..	..
Leptaena rhomboidalis (Wilckens)	x	x	x
Leptaena rhomboidalis ventricosa Hall	x	..	..
Leptostrophia oriskania Clarke	x	..	..
Megalanteris ovalis Hall	x	..	..
Meristella lata Hall	x	..	..
Meristella lentiformis Clarke	x	..	..
Meristella nasuta Conrad	..	x	x
Meristella walcotti Hall and Clarke	x	..	..
Metaplasia pyxidata Hall	x	..	..
Nucleospira concinna Hall	..	x	x
Nucleospira ventricosa Hall	x	..	..
Orbiculoidea ampla Hall	x	..	..
Oriskania navicella Hall and Clarke	x	..	..
Pentamerella arata (Conrad)	..	x	x
Pholidops arenaria Hall	x	..	..
Pholidops terminalis Hall	x	..	..
Pholidostrophia iowaensis (Owen)	..	..	x
Rensselaeria cayuga Hall and Clarke	x	..	..
Rensselaeria ovoidea (Eaton)	x	..	..
Rensselaeria ovulum Hall and Clarke	x	..	..
Rensselaeria sp.	x	..	..
Recticularia fimbriata (Conrad)	x	..	x
Rhipidomella livia (Billings)	..	..	x
Rhipidomella musculosa Hall	x	..	..
Rhipidomella oblata Hall	x	..	..
Rhipidomella vanuxemi Hall	..	x	x

	Horizons		
Brachiopoda—*Contd.*	12	13	14
Schellwienella deformis Hall	x	..	..
Schellwienella pandora (Billings)	..	x	x
Spirifer arenosus (Conrad)	x	..	..
Spirifer duodenarius (Hall)	..	x	x
Spirifer murchisoni Castelnau	x	..	..
Spirifer plicatus (Weller)	x	..	..
Spirifer saffordi Hall	x	..	..
Spirifer tribulis Hall	x	..	..
Spirifer varicosus Hall	..	..	x
Stropheodonta callosa (?) Hall	x	..	..
Stropheodonta demissa (Conrad)	..	x	x
Stropheodonta hemispherica Hall	..	..	x
Stropheodonta inequiradiata Hall	..	x	..
Stropheodonta inequistriata (Conrad)	..	..	x
Stropheodonta lincklaeni Hall	x	..	..
Stropheodonta magnifica Hall	x	..	..
Stropheodonta magniventer Hall	x	..	..
Stropheodonta patersoni Hall	..	x	..
Stropheodonta perplana Hall	..	..	x
Stropheodonta vascularia Hall	x	..	..
Strophonella ampla Hall	x	x	x
Uncinulus mutabilis Hall	x	..	..
Pelecypoda			
Actinopteria pumillus Clarke	x	..	..
Actinopteria textilis arenaria (Hall)	x	..	..
Conocardium cuneus (Conrad)	x	..	..
Cypricardinia indenta Conrad	..	x	x
Cypricardinia lamellosa Hall	x	..	..
Goniophora cerusus (?) Clarke	x	..	..
Megambonia lamellosa Hall	x	..	..
Pterinopecten plumilus Clarke	x	..	..
Gastropoda			
Cyrtolites expansus Hall	x	..	..
Diaphorostoma desmatum Clarke	x	..	..
Diaphorostoma lineatum (Conrad)	..	x	x
Diaphorostoma turbinatum (Hall)	..	..	x
Diaphorostoma unisulcatum (Conrad)	..	..	x

Gastropoda—*Contd.*	Horizons 12	13	14
Diaphorostoma ventricosum (Conrad)	x	..	..
Igoceras conicum (Hall)	..	..	x
Platyceras carinatum Hall	..	x	..
Platyceras dentalium Hall	..	..	x
Platyceras nodosum Conrad	x	..	..
Pleurotomaria delicatula Hall	..	..	x
Straporollus clymenoides (Hall)	..	..	x
Strophostylus matheri Hall	x	..	..
Pteropoda			
Tentaculites elongatus Hall	x	..	..
Ostracoda			
Beyrichia sp.	x	..	..
Trilobita			
Chasmops anchiops (Green)	x	..	x
Hausmania phacoptyx Hall and Clarke	x	x	x
Hausmania pleuroptyx (Green)	x	..	..
Phacops correlator Clarke	x	..	..
Phacops cristata Hall	..	x	x
Phacops logani Hall	x	..	..
Phacops rana (Green)	..	..	x
Proetus conradi Hall	x	..	..
Proetus crassimarginatus Hall	..	..	x
Proetus rowi (Green)	..	..	x
Synphoria stemmatus Clarke	x	..	..
Vermes			
Autodetus beecheri Clarke	x	..	..

From the above list of species it is quite evident that there has not been a mingling of the Oriskany and Onondaga faunas in Ontario as has been supposed.[1] Indeed the two deposits are not

[1] Nicholson, H. A., Report on the Palæontology of the Province of Ontario, Toronto, 1874, pp. 7-8.

exactly consecutive, as they are separated by an interval during which the Oriskany was sufficiently consolidated to allow the formation of pebbles when the Onondaga sea later advanced over it and formed the mortar-like beds above referred to. At some places this basal deposit of the Onondaga was supplied with a sufficient quantity of sand to make a true sandstone. The material of this latter deposit is a coarse, white to yellowish sand, and the beds themselves are lithologically similar in every way to those of the true Oriskany sandstone below. This basal deposit (the Springvale sandstone) of the Onondaga, however, carries the usual fauna of that formation entirely free from characteristic representatives of the older sandstone fauna. It was undoubtedly due to the lithological similarity that a confusion of collections from these two different horizons occurred and which led to this erroneous idea of a mingling of the two faunas in Ontario.[1]

HAGERSVILLE.

This is the centre of the most active quarrying operations in the county and second only to St. Marys as a producer of limestone from the Devonian formations. It is located at the crossing of the Grand Trunk and Michigan Central railways and is thus provided with the shipping facilities which are likely to encourage greater development in the future.

At the overhead bridge along the Michigan Central railway, $1\frac{1}{2}$ miles east of town, there is a rock cut in which about 8 feet of the compact, banded, drab to buff Silurian dolomites are exposed. On the top of these, to the east of the bridge, there rests unconformably, 3 feet of nearly barren, grey chert. This is probably the chert which Logan regarded as Oriskany in age. The chert is often somewhat arenaceous; but the fragments of fossils found in it seem to indicate that it belongs to the Onondaga horizon. To the west of the bridge there are remnants of very coarse, pebbly sandstone cemented to the top of the Silurian dolomite and the same kind of sand fills the cracks in

[1] For an earlier discussion of this point see Bull. Geol. Soc. Am., vol. XXII, 1912, pp. 371-376.

the underlying rocks. These remnants apparently lie below the chert, above mentioned, and seem to represent the true Oriskany sandstone, although no fossils were found to prove it.

One mile to the west of the overhead bridge, or within one mile of town, Mr. Robert Hamilton has recently opened a quarry in the lower part of the Onondaga limestone. During the summer of 1912 this showed a 6-foot face of rock and a like amount is exposed along the rock cut of the Michigan Central railway near by. Weathering out over the fields to the north are still lower layers of the same formation. The following fossils were found in the rocks of the railway cut at Hamilton's quarry.

Anthozoa

Bothrophyllum decorticatum Billings.
Chonostegites clappi Milne-Edwards and Haime.
Cladopora cryptodens (Billings).
Cyathophyllum coalitum Rominger.
Cystiphyllum vesiculosum Goldfuss.
Eridophyllum colligatum (Billings).
Favosites canadensis (Billings).
Favosites emmonsi Rominger.
Favosites limitaris Rominger.
Favosites turbinatus Billings.
Favosites winchelli Rominger.
Heliophyllum corniculum (Lesueur).
Heliophyllum exiguum Billings.
Heliophyllum halli Milne-Edwards and Haime.
Michelinia convexa (d'Orbigny).
Syringopora hisingeri Billings.
Syringopora perelegans Billings.
Zaphrentis gigantea Lesueur.
Zaphrentis nodulosa Rominger.

Brachiopoda

Amphigenia elongata (Vanuxem).
Anoplotheca camilla (Hall).
Atrypa reticularis (Linnaeus).
Centronella glansfagea Hall.
Chonetes mucronatus Hall.
Cryptonella iphis Hall.

Brachiopoda—*Contd.*

Cyrtina hamiltonensis Hall.
Leptaena rhomboidalis (Wilckens).
Meristella nasuta (Conrad).
Rhipidomella vanuxemi Hall.
Schellwienella pandora (Billings).
Spirifer divaricatus Hall.
Spirifer duodenarius (Hall).
Stropheodonta demissa (Conrad).
Stropheodonta hemispherica Hall.
Stropheodonta inequistriata (Conrad).
Stropheodonta perplana (Conrad).
Strophonella ampla Hall.

Pelecypoda

Conocardium cuneus (Conrad).

Gastropoda

Diaphorostoma lineatum (Conrad).
Diaphorostoma turbinatum (Hall).

Trilobita

Calymene platys Green.
Phacops rana (Green).

And from the loose blocks, of a lower horizon of the Onondaga limestone weathering out in the fields to the north, the following forms were obtained.

Anthozoa

Bothrophyllum decorticatum Billings.
Cystiphyllum vesiculosum Goldfuss.
Eridophyllum colligatum (Billings).
Favosites basalticus Goldfuss.
Favosites limitaris Rominger.
Favosites turbinatus Billings.
Heliophyllum exiguum Billings.
Heliophyllum halli Milne-Edwards and Haime.
Zaphrentis gigantea Lesueur.

Brachiopoda

Amphigenia elongata (Vanuxem).
Anoplia nucleata Hall.
Anoplotheca camilla (Hall).
Atrypa reticularis (Linnaeus).
Camarotoechia billingsi Hall.
Centronella glansfagea Hall.
Cyrtina crassa Hall.
Cyrtina hamiltonensis Hall.
Meristella nasuta (Conrad).
Reticularia fimbriata (Conrad).
Rhipidomella livia (Billings).
Schellwienella pandora (Billings).
Spirifer duodenarius (Hall).
Stropheodonta hemispherica Hall.
Stropheodonta perplana (Conrad).

Pelecypoda

Conocardium cuneus (Conrad).
Modiomorpha concentrica (Conrad).

Gastropoda

Diaphorostoma lineatum (Conrad).
Pleuronotus sp.

Trilobita

Phacops cristata Hall.
Proetus crassimarginatus Hall.

This is the fauna usually found in the lower portion of the Onondaga limestone and the same that was collected at Ridgemount and various other places where that part of the formation is exposed. Along the side of the street, near the schoolhouse in the northern part of Hagersville, there is an outcrop of the Springvale sandstone, which carries the basal Onondaga fauna. This outcrop is very poor; but of interest, because it lies comparatively near to the real Oriskany sandstone with which it has so often been confused.

At present the best rock sections exposed in the vicinity of Hagersville are located on the west side of town. About one-half mile from the depot, on the north side of the Michigan Central Railway tracks, Mr. J. C. Ingles has a large quarry and crushing plant in the Onondaga, where the following section occurs.

Section of the J. C. Ingles' Quarry at Hagersville.

	Feet	Inches
6. Soil and drift	1	0
Onondaga limestone		
5. A grey to bluish brown, semi-crystalline limestone containing much dark bluish chert (see Plate VI). When freshly quarried these layers are quite massive, but when weathered they split into thin, uneven shaly layers. Corals and crinoid fragments are abundant	9	6
4. A shaly parting not always conspicuous	0	1
3. Bluish grey, semi-crystalline limestone containing a relatively small amount of grey to white chert. The whole mass is abundantly fossiliferous and sometimes even matted with corals	4	8
2. A dark bluish grey, fine-grained limestone almost free from chert, and fossils much less abundant than in the layers above. The upper 4 or 5 inches are often shaly and sometimes shaly partings occur between beds in the upper portion	6	10
1. A rough, cherty, bluish limestone extending to the level of water in the lowest part of the quarry	6	3

The following fauna was collected from the rock exposed in this quarry.

	Horizons			
Anthozoa	1	2	3	5
Bothrophyllum decorticatum Billings	..	x	..	x
Cladopora labiosa Billings	..	..	x	..
Cayugaea whiteavesiana Lambe	..	..	..	x
Cystiphyllum vesiculosum Goldfuss	..	x	..	..
Favosites basalticus Goldfuss	..	..	..	x
Favosities canadensis (Billings)	..	..	..	x
Favosites cervicornis Milne-Edwards and Haime	x	..	..	x
Favosites emmonsi Rominger	x	x	x	x
Favosites epidermatus Rominger	..	..	..	x
Favosites limitaris Rominger	x	..	..	x
Favosites turbinatus Billings	..	x	x	x
Favosites winchelli Rominger	..	x	..	..
Heliophyllum corniculum (Lesueur)	..	..	x	x
Heliophyllum halli Milne-Edwards and Haime	..	x	x	x
Michelinia convexa (d'Orbigny)	..	x	x	..
Synaptophyllum simcoense (Billings)	..	..	x	x
Syringopora hisingeri Billings	x	x	x	..
Syringopora perelegans Billings	x	..	x	x
Syringopora tabulata Milne-Edwards and Haime	..	x	..	..
Zaphrentis gigantea Lesueur	x	x	x	x
Hydrozoa				
Stromatoporella granulata Nicholson	..	x	..	..
Stromatoporella (?) tuberculata Nicholson	..	..	..	x
Bryozoa				
Fenestella (?) erectipora Hall	..	x	..	x
Fenestella sp	x	..	..	..
Pinnatopora tenuistriata (Hall)	..	x	..	..
Polypora hexagonalis (Hall)	..	x	..	..
Brachiopoda				
Amphigenia elongata (Vanuxem)	..	x	..	..
Anoplotheca camilla (Hall)	..	x	..	..
Atrypa reticularis (Linnaeus)	x	x	x	x
Chonetes mucronatus Hall	..	..	..	x

Brachiopoda—*Contd.*	Horizons 1	2	3	4
Cyrtina hamiltonensis Hall	..	x	..	..
Meristella nasuta (Conrad)	..	x	x	..
Metaplasia disparilis (Hall)	..	x	..	..
Pentamerella arata (Conrad)	..	..	..	x
Productella spinulicosta Hall	..	..	..	x
Reticularia fimbriata (Conrad)	..	..	..	x
Rhipidomella vanuxemi Hall	..	..	..	x
Schuchertella pandora (Billings)	x	..	..	..
Spirifer divaricatus Hall	..	..	..	x
Spirifer duodenarius (Hall)	..	x	..	x
Spirifer gregarius (Clapp)	..	..	x	..
Spirifer macrus Hall	..	x	..	..
Stropheodonta demissa (Conrad)	..	x	..	x
Stropheodonta hemispherica Hall	..	x	..	x
Stropheodonta patersoni Hall	..	..	..	x
Strophonella ampla Hall	..	x	..	..
Pelecypoda				
Conocardium cuneus (Conrad)	..	x	..	..
Gastropoda				
Platyceras sp	..	x	..	..
Trilobita				
Hausmania phacoptyx Hall and Clarke	..	x	..	..
Phacops cristata Hall	x	..	..	x
Phacops rana (Green)	..	x	..	..

Just across the railway, to the south from this plant, is a large quarry belonging to the Michigan Central Railway Company. The following is a section of the rocks exposed at that place.

Section of the Michigan Central Quarry at Hagersville.

	Feet	Inches
6. Soil and drift	0	6
Onondaga limestone		
5. Cherty, bluish grey limestone which is quite fossiliferous	8	0
4. Shaly parting	0	3
3. A grey to bluish, semi-crystalline limestone with very little chert. Corals rather abundant	4	5
2. A rather soft, dark blue limestone in which fossils are not abundant. The upper part is usually somewhat shaly and contains *Hindia fibrosa*	7	2
1. A dark blue limestone containing a large amount of dark blue chert. Fossils are not abundant in these beds	2	9

The following fauna was collected from the rocks exposed in the Michigan Central quarry.

	Horizons				
Spongia	1	2	3	4	5
Hindia fibrosa Roemer	..	x	..	..	..
Anthozoa					
Bothrophyllum decorticatum Billings	..	..	..	..	x
Cladopora labiosa (Billings)	..	..	..	..	x
Cladopora sp	..	..	x	..	x
Cystiphyllum vesiculosum Goldfuss	..	x	x	..	x
Diphyphyllum sp	..	..	x	..	x
Diplophyllum arundinaceum (Billings)	..	..	x	..	..
Favosites basalticus Goldfuss	..	x	x	..	x
Favosites canadensis (Billings)	..	..	..	..	x
Favosites cervicornis Milne-Edwards and Haime	..	..	x	..	x
Favosites emmonsi Rominger	x	x	..	x	x
Favosites turbinatus Billings	..	x	..	..	..

	Horizons				
Anthozoa—*Contd.*	1	2	3	4	5
Favosites winchelli Rominger................	x	x	..	x	..
Heliophyllum halli Milne-Edwards and Haime	x	x	x	x	x
Michelinia convexa (d'Orbigny).............	..	x	x	..	..
Synaptophyllum simcoense (Billings)	..	..	..	..	x
Syringopora hisingeri Billings................	..	..	x	..	x
Syringopora maclurei Billings...............	..	x	..	..	x
Syringopora perelegans Billings Lesueur......	..	x	x	..	x
Zaphrentis gigantea Lesueur................	..	x	x	x	x
Zaphrentis prolifica Billings.................	..	x	x	..	x
Bryozoa					
Cystodictya gilberti (Meek).................	x	..	..	..	..
Fenestella sp............................	..	x	..	..	x
Brachiopoda					
Atrypa reticularis (Linnaeus)................	x	..	..	..	x
Cyrtina hamiltonensis Hall..................	..	..	x	..	..
Meristella nasuta (Conrad).................	..	x	x	..	x
Rhipidomella vanuxemi Hall.................	..	x	..	..	x
Spirifer duodenarius (Hall)..................	..	..	..	..	x
Stropheodonta demissa (Conrad)............	..	x	..	x	x
Stropheodonta patersoni Hall...............	..	..	..	..	x
Strophonella ampla Hall....................	..	..	..	..	x
Gastropoda					
Diaphorostoma lineatum (Conrad)...........	..	..	..	..	x
Trilobita					
Hausmania phacoptyx Hall and Clarke.......	..	x	..	..	..
Phacops cristata Hall......................	..	..	x	..	..

Several tests for gas have been made in Hagersville. These seem to indicate 75 to 100 feet of Onondaga limestone not removed by erosion. From these tests one of the best records obtainable is that of the well located at the high school and known as No. 2 of the Hagersville Light and Fuel Company Limited, The following is an interpretation of the record and samples. both of which were faithfully kept and preserved by Mr. Howard.

The Hagersville Light and Fuel Company's Well, No. 2.

	Thickness	Total
7. Soil and drift........................	3 Feet	3 Feet.
6. Onondaga Limestone. A hard, cherty, grey limestone passing into bluish limestone and shale........................	97 "	100 "
5. Salina beds. Compact, dark bluish dolomite and grey shale.............	340 "	440 "
4. Niagara limestone (Lockport and Guelph). Partly crystalline, grey dolomitic limestone.............................	230 "	670 "
3. Rochester shale. Dark bluish grey, earthy shale.............................	42 "	712 "
2. Clinton beds. A light grey semi-crystalline limestone passing into bluish shale at the bottom.......................	26 "	738 "
1. Medina sandstone and shale. Arenaceous, grey and red shales with a 15-foot stratum of white sandstone near the centre.............................	172 "	910 "

This well was finished in April 1905 and proved a poor producer. One of the most interesting things regarding the above record, so far as the present interests are concerned, is the utter lack of the Oriskany sandstone or even of the sandy material in the base of the Onondaga. If the drill passed through any such deposit, no record of it was made nor were such samples preserved. This is all the more remarkable from the fact that the Springvale sandstone (basal Onondaga) outcrops in the north-eastern part of town. Other wells to the southwest of Hagersville sometimes record such a sandstone deposit at the base of the

Devonian. This seems to indicate that the Oriskany sandstone is patchy within as well as at the margin of the Devonian covered area.

SPRINGVALE.

This little village is located 4 miles west of Hagersville and on the line between concessions XIV and XV, of Walpole township. The Springvale sandstone is typically exposed here and is in outcrop at numerous places along the margin of a rock terrace extending from the north part of Hagersville to the northwestward beyond Springvale. An interesting section of this sandstone, showing its relation to the upper and lower deposits, is to be found on lot 9, concession XIII, owned by Mr. William Shoap.

Section on William Shoap's Farm, Northwest of Hagersville.

	Feet	Inches
5. Soil and drift	4	0
Onondaga limestone		
4. A very cherty, blue to grey limestone which is quite fossiliferous	5	6
(Springvale sandstone)		
3. Coarse white to yellowish sandstone. The lower part is rather massive while the upper layers are somewhat irregular and seem to contain more fossils	8	0
2. Arenaceous blue shale	0	7
Basal Devonian chert (Oriskany) ?		
1. Irregular beds of bluish grey chert with a few thin calcareous layers	3	2

The following fossils were found in the sandstone and cherty limestone of this outcrop.

	Horizons 3	Horizons 4
Anthozoa		
Bothrophyllum decorticatum Billings	..	x
Chonostegites clappi Milne-Edwards and Haime	..	x
Cladopora labiosa (Billings)	..	x
Cystiphyllum vesiculosum Goldfuss	..	x
Favosites basalticus Goldfuss	..	x
Favosites emmonsi Rominger	x	x
Favosites limitaris Rominger	..	x
Favosites turbinatus Billings	..	x
Heliophyllum exiguum Billings	..	x
Heliophyllum halli Milne-Edwards and Haime	..	x
Michelinia convexa (d'Orbigny)	..	x
Michelinia favositoidea Billings	..	x
Phillipsastrea gigas Owen	..	x
Synaptophyllum simcoense (Billings)	..	x
Syringopora perelegans Billings	..	x
Zaphrentis gigantea Lesueur	x	x
Zaphrentis prolifica Billings	x	x
Bryozoa		
Cystodictya gilberti (Meek)	x	..
Brachiopoda		
Amphigenia elongata (Vanuxem)	x	x
Anoplotheca camilla (Hall)	..	x
Atrypa reticularis (Linnaeus)	x	x
Camarotoechia billingsi Hall	x	x
Chonetes hemisphericus Hall	..	x
Crania sp	x	..
Leptaena rhomboidalis (Wilckens)	x	x
Meristella nasuta (Conrad)	x	x
Orbiculoidea sp	x	..
Pentamerella arata (Conrad)	x	..
Reticularia fimbriata (Conrad)	..	x
Rhipidomella cleobis Hall	?	x
Schellwienella pandora (Billings)	x	x
Spirifer divaricatus Hall	x	..

Brachiopoda—*Contd.*	Horizons 3	4
Spirifer duodenarius (Hall)	x	x
Spirifer macrothyris Hall	x	..
Stropheodonta demissa (Conrad)	..	x
Stropheodonta hemispherica Hall	x	x
Stropheodonta inequiradiata Hall	x	..
Stropheodonta perplana (Conrad)	..	x
Strophonella ampla Hall	x	x
Pelecypoda		
Conocardium cuneus (Conrad)	..	x
Gastropoda		
Diaphorostoma lineatum (Conrad)	..	x
Trilobita		
Hausmania phacoptyx Hall and Clarke	x	x
Phacops cristata Hall	..	x
Proetus rowi (Green)	x	..

On lot 6 of the same concession, just beyond the crossroad to the westward from the above locality, there is another interesting section of this same horizon in what appears to be a continuation of the same terrace-like rock ledge. The section begins in a small quarry to the south of the highway, but is chiefly along the roadway and shows the following section.

Section on Mr. Gray's Farm, One Mile South of Springvale, Lot 6, Concession XIII, Walpole Township.

	Feet	Inches
7. Soil and drift	1	0
Onondaga limestone		
6. Cherty, argillaceous, blue limestone weathering rapidly to a soft blue clay	4	0

	Feet	Inches
5. Grey chert and cherty limestone, all very fossiliferous	6	8
4. Covered interval along the highway. This is probably grey chert and cherty limestone	4	0
3. Arenaceous chert grading into arenaceous limestone and all containing an abundant fauna	0	6
(Springvale sandstone)		
2. Rather coarse, grey to white sandstone containing hard white masses which are cemented nearly as hard as quartzite	3	8
1. Coarse, grey to white sandstone which is somewhat more massive than that above	2	9

The following fauna was collected from the above section.

	Horizons				
Spongia	1	2	3	5	6
Hindia fibrosa Roemer	..	..	..	..	x
Anthozoa					
Acervularia rugosa Milne-Edwards and Haime	..	..	..	..	x
Bothrophyllum decorticatum Billings	..	x	..	x	x
Cladopora labiosa (Billings)	..	..	..	x	..
Cystiphyllum vesiculosum Goldfuss	..	..	..	x	..
Favosites basalticus Goldfuss	..	..	..	x	..
Favosites canadensis (Billings)	..	..	..	x	..
Favosites cervicornis Milne-Edwards and Haime	..	..	..	x	..
Favosites clausus Rominger	..	..	..	x	..
Favosites emmonsi Rominger	..	..	..	x	x
Favosites epidermatus Rominger	..	..	..	x	..
Favosites turbinatus Billings	..	x	x	x	..
Favosites sp	..	..	x	..	x
Heliophyllum corniculum (Lesueur)	..	..	..	x	..
Heliophyllum halli Milne-Edwards and Haime	..	..	..	x	..
Michelinia convexa (d'Orbigny)	..	..	..	x	x
Phillipsastrea gigas Owen	..	..	..	x	..
Phillipsastrea verrilli Meek	..	..	..	x	..

	Horizons				
Anthozoa—*Contd.*	1	2	3	5	6
Synaptophyllum simcoense (Billings)	..	..	..	x	..
Syringopora perelegans Billings	..	..	..	x	..
Zaphrentis gigantea Lesueur	..	x	x	x	x
Zaphrentis sp	x	..	..	..	..
Blastoidea					
Codaster pyramidatus Shumard	..	..	..	..	x
Bryozoa					
Cystodictya gilberti (Meek)	..	..	x	..	..
Brachiopoda					
Amphigenia elongata (Vanuxem)	..	x	x	x	x
Atrypa reticularis (Linnaeus)	x	x	..	x	x
Atrypa reticularis impressa (?) Hall	..	..	..	..	x
Camarotoechia billingsi Hall	..	x	..	..	..
Chonetes hemisphericus Hall	..	x	..	x	..
Chonetes mucronatus Hall	..	..	x	..	..
Crania crenistriata Hall	..	..	x	..	..
Leptaena rhomboidalis (Wilckens)	x	x	..	x	..
Meristella lenta Hall	..	x	..	..	..
Meristella nasuta (Conrad)	..	x	x	..	..
Meristella sp	..	x	..	..	..
Nucleospira concinna Hall	..	x	..	..	..
Pentamerella arata (Conrad)	..	x	x	..	x
Pholidostrophia iowaensis (Owen)	..	x	..	..	..
Rhipidomella cleobis Hall	..	..	..	..	x
Rhipidomella semele Hall	..	x	..	..	..
Rhipidomella vanuxemi Hall	..	x	..	x	..
Schizophoria propinque Hall	..	x	..	..	..
Schellwienella pandora (Billings)	x	x	x	x	..
Spirifer divaricatus Hall	..	x	..	..	..
Spirifer duodenarius (Hall)	..	x	x	..	..
Spirifer macrus Hall	..	x	..	..	..
Spirifer sp	..	x	..	x	..
Stropheodonta demissa (Conrad)	..	..	x	..	..
Stropheodonta hemispherica Hall	..	x	..	..	..
Stropheodonta perplana (Conrad)	..	x	x	x	..
Strophonella ampla Hall	..	x	..	..	..

Pelecypoda	Horizons 1	2	3	5	6
Conocardium cuneus (Conrad)	..	x	..	x	x
Gastropoda					
Diaphorostoma lineatum (Conrad)	..	x	..	x	x
Platyceras attenuatum Hall	..	x	x	..	..
Platyceras sp	..	x	..	..	..
Pteropoda					
Tentaculites scalariformis Hall	..	x	..	..	..
Trilobita					
Chasmops anchiops (Green)	..	x	..	..	..
Coronura myrmecophorus (Green)	..	x	..	..	..
Hausmania phacoptyx Hall and Clarke	..	x	x	..	..
Phacops cristata Hall	..	..	..	x	..
Phacops cristata pipa Hall and Clarke	..	x	..	..	..
Proetus crassimarginatus Hall	..	x	..	..	..
Proetus rowi (Green)	..	..	..	..	x

Just south of Springvale, on lot 6, concession XIV, Mr. S. W. Winger has occasionally quarried out some of the sandstone and a very good section on the lower Onondaga is now partly exposed, while the Springvale sandstone is well shown in several places.

Section on Mr. S. W. Winger's Farm, Lot 6, Concession XIV, Township of Walpole.

	Feet	Inches
6. Soil and drift	0	6
Onondaga limestone		
5. Cherty, compact, grey limestone. These beds are to be seen weathering out over the fields above the old quarry	10	0

	Feet	Inches
4. Arenaceous chert and calcareous sandstone with an abundant fauna..................	0	6
3. Arenaceous limestone or calcareous sandstone with an abundance of fossils..............	2	0
(Springvale sandstone)		
2. A coarse, white to yellowish sandstone with hard, white masses of sand cemented by silica....................................	2	0
1. A more or less massive, coarse, white to yellowish sandstone.........................	5	3

The lowest of these beds extend to the bottom of the quarry and are said to rest on a light coloured chert, which in turn rests on the drab dolomites exposed in the old quarry at the lime-kiln in the village of Springvale. Some of the chert may be found in the pasture field below the sandstone quarry of which the above is a section. The following is a list of the fossils found in the section on Mr. S. W. Winger's place.

Anthozoa	Horizons				
	1	2	3	4	5
Acervularia rugosa Milne-Edwards and Haime	..	..	..	..	x
Acrophyllum oneidaensis (Billings)...........	..	..	..	x	..
Amplexus yandelli Milne-Edwards and Haime.	..	..	..	..	x
Aulocophyllum sulcatum (d'Orbigny).........	..	x	..	..	..
Aulopora conferta Winchell.................	..	..	..	x	..
Bothrophyllum decorticatum Billings.........	..	..	x	x	x
Cladopora labiosa (Billings)................	..	..	..	..	x
Cladopora pulchra Rominger................	..	x	..	..	..
Cladopora robusta Rominger................	..	..	..	..	x
Cyathophyllum validum Hall................	..	..	x	..	..
Cystiphyllum vesiculosum Goldfuss..........	..	x	..	x	..
Diphyphyllum gracile (?) (McCoy)..........	..	..	..	..	x
Eridophyllum vernuillianum Milne-Edwards and Haime............................	..	..	..	..	x
Favosites basalticus Goldfuss................	..	..	..	x	..
Favosites canadensis (Billings)..............	..	..	..	..	x
Favosites clausus Rominger.................	..	..	..	..	x
Favosites emmonsi Rominger................	..	..	x	x	x

Anthozoa—*Contd.*	Horizons 1	2	3	4	5
Favosites limitaris Rominger	..	..	..	x	x
Favosites turbinatus Billings	..	x	x	x	x
Heliophyllum corniculum (Lesueur)	..	x	x	x	x
Heliophyllum exiguum Billings	..	x	x	x	x
Heliophyllum halli Milne-Edwards and Haime	..	..	x	x	x
Michelinia convexa (d'Orbigny)	..	x	x	x	x
Phillipsastrea gigas Owen	..	..	..	..	x
Phillipsastrea verrilli Meek	..	..	x	..	x
Synaptophyllum simcoense (Billings)	..	..	..	..	x
Syringopora hisingeri Billings	..	..	..	..	x
Syringopora perelegans Billings	..	..	..	..	x
Syringopora sp	..	..	..	x	..
Zaphrentis gigantea Lesueur	..	x	x	x	x
Zaphrentis nodulosa Rominger	..	..	..	..	x
Zaphrentis prolifica Billings	..	x	x	x	x
Zaphrentis sp	..	x	..	..	x
Bryozoa					
Cystodictya crescens (Hall)	..	..	..	..	x
Cystodictya gilberti (Meek)	..	x	x	x	x
Fenestella parallela Hall	..	..	..	x	x
Fenestella sp	..	x	..	x	x
Hederella sp	..	..	..	x	..
Loculipora circumstata (Hall and Simpson)	..	..	..	x	..
Monotrypa tenuis (Hall)	..	..	x	..	x
Polypora celsipora (Hall)	..	..	..	..	x
Polypora porosa (Hall)	..	..	..	..	x
Polypora robusta (Hall)	..	..	..	..	x
Stictopora (? ?) fruticosa Hall	..	..	..	..	x
Unitrypa pernodosa (Hall)	..	..	x	..	..
Brachiopoda					
Amphigenia elongata (Vanuxem)	x	x	x	x	x
Anoplia nucleata Hall	..	..	..	x	x
Anoplotheca camilla (Hall)	..	..	x	x	x
Athyris vittata indianaensis Stauffer	..	..	..	..	x
Atrypa reticularis (Linnaeus)	x	x	x	x	x
Camarotoechia billingsi Hall	..	..	..	x	x
Camarotoechia carolina Hall	..	x	..	x	x
Camarotoechia tethys (Billings)	..	x	..	..	x

Brachiopoda—*Contd.*	Horizons 1	2	3	4	5
Camarotoechia sp	..	..	..	x	x
Centronella glansfagea Hall	x	x	x	x	x
Chonetes hemisphericus Hall	..	x	x	x	x
Chonetes sp	..	x	..	..	..
Chonostrophia reversa (Whitfield)	x	x	..	x	x
Cyrtina biplicata Hall	..	..	..	x	x
Cyrtina hamiltonensis Hall	..	..	..	x	x
Dalmanella lenticularis (Vanuxem)	..	x	..	..	..
Delthyris raricosta Conrad	..	..	..	..	x
Eunella harmonica Hall	..	..	..	..	x
Eunella sullivanti Hall	..	..	..	..	x
Leptaena rhomboidalis (Wilckens)	x	x	x	x	x
Lingula sp	x	..	..	..	..
Meristella clusia (Billings)	..	..	x	x	..
Meristella doris Hall	..	..	..	x	..
Meristella nasuta (Conrad)	x	x	x	x	..
Meristella sp	x	x	..	..	..
Nucleospira concinna Hall	x	..	..	x	x
Parazyga hirsuta Hall	..	..	..	..	x
Pentamerella arata (Conrad)	x	x	x	x	x
Pholidops patina Hall and Clarke	..	..	x	..	..
Pholidostrophia iowaensis (Owen)	x	..	..	..	x
Rhipidomella cleobis Hall	..	..	..	..	x
Rhipidomella livia (Billings)	..	x	x	..	x
Rhipidomella semele Hall	..	x	..	..	..
Rhipidomella vanuxemi Hall	x	x	x	x	x
Schellwienella pandora (Billings)	x	x	x	x	x
Schizophoria propinque Hall	..	x	..	..	..
Spirifer acuminatus (Conrad)	..	..	x	x	..
Spirifer divaricatus Hall	x	x	x	x	..
Spirifer duodenarius (Hall)	x	x	x	x	x
Spirifer macrothyris Hall	x	x	x	..	..
Spirifer macrus Hall	x	..	..	..	..
Spirifer varicosus Hall	..	..	..	..	x
Spirifer sp	..	..	x	..	..
Stropheodonta demissa (Conrad)	..	..	x	x	x
Stropheodonta hemispherica Hall	..	x	x	..	x
Stropheodonta inequiradiata Hall	..	..	..	..	x
Stropheodonta inequistriata (Conrad)	..	..	x	x	x
Stropheodonta perplana (Conrad)	x	x	x	x	x
Strophonella ampla Hall	..	x	x	..	x

	Horizons				
Pelecypoda	1	2	3	4	5
~~Actinopteria~~ boydi (Conrad)	..	..	..	..	x
Aviculopecten princeps (Conrad)	..	..	..	..	x
Conocardium cuneus (Conrad)	..	x	x	x	x
Cypricardinia indenta Conrad	..	..	..	..	x
Pterinea flabellum (Conrad)	..	..	..	..	x
Gastropoda					
Callonema bellatulum (Hall)	..	..	..	..	x
Diaphorostoma lineatum (Conrad)	x	..	x	x	x
Diaphorostoma turbinatum (Hall)	..	..	..	..	x
Igoceras conicum (Hall)	..	..	x	..	..
Macrocheilus sp	..	..	..	..	x
Platyceras attenuatum Hall	x	..	x	..	x
Platyceras carinatum Hall	..	..	..	..	x
Platyceras dentalium Hall	..	..	x	x	x
Platyceras dumosum Conrad	..	..	x	..	x
Platyceras erectum Hall	..	x	x	x	..
Platyceras sp	x	..	..	..	..
Straparollus clymenioides Hall	..	..	..	..	x
Pteropoda					
Tentaculites scalariformis Hall	x	x	x	x	x
Ostracoda					
Kloedenia manliensis (?) (Weller)	..	..	..	..	x
Trilobita					
Chasmops anchiops (Green)	..	x	x	x	x
Coronura myrmecophorus (Green)	..	x	..	..	..
Hausmania concinna serrulus (Hall and Clarke)	..	..	..	..	x
Hausmania phacoptyx Hall and Clarke	x	x	x	..	..
Odontocephalus selenurus (Eaton)	..	..	x	..	..
Phacops cristata Hall	..	x	x	x	x
Phacops cristata pipa Hall and Clarke	..	..	..	x	x
Proetus crassimarginatus Hall	..	x	x	x	x
Proetus rowi (Green)	..	x	..	x	x
Pisces					
Macropetalichthys rapheidolabis (?) (Norwood and Owen)	..	..	x	..	..

That the Springvale sandstone is but a local facies of the lower part of the Onondaga limestone, is quite evident from the fauna which it contains. A mere casual comparison of this fauna with that of the Oriskany brings out the most marked differences. As already pointed out, the cause of confusion between this deposit and the Oriskany must have been the marked similarity of the two sandstones and their corresponding horizons; while the supposed mingling of the Oriskany and Onondaga faunas must have resulted from a lack of proper care in collecting. This may have happened by relying too much on the work of the amateur collector. At any rate it is certain that rarely does one find a greater difference between the life of two ages, relatively near together, than that which exists between the faunas of the Oriskany and the Springvale sandstones. This is still more clearly brought out by the fauna of the beds exposed on Mr. John Winger's farm, which is located about one-half mile to the west of the village of Springvale and is on lot 5, concession XIV, township of Walpole. The following is a section of the outcrop and small quarry at that locality.

Section of John Winger's Quarry and the Hill-slope Above.

Onondaga limestone	Feet	Inches
4. Cherts and cherty, grey limestone weathering out over the hill-side. The upper part contains an abundance of corals which are chiefly of the compound type.............	15	0
3. Arenaceous cherts weathering out in the field above the quarry........................	0	6
2. Arenaceous, grey limestone which becomes chiefly sand in the lower part.............	1	6
(Springvale sandstone)		
1. Yellowish to white, coarse sandstone containing hard masses resembling quartzite. These layers are best exposed in the quarry face located along the terrace-like ledge near the north end of the lot......................	5	6

The following are the more common fossils found in the rocks exposed on the John Winger place.

Anthozoa	Horizons 1	2	3	4
Acrophyllum oneidaense (Billings)	..	..	..	x
Bothrophyllum decorticatum Billings	x	..	x	x
Chonostegites clappi Milne-Edwards and Haime	..	..	..	x
Cladopora cryptodens (Billings)	..	..	..	x
Cladopora expatiata Rominger	..	..	..	x
Cladopora francisci Davis	..	..	..	x
Cladopora labiosa (Billings)	..	..	..	x
Cladopora pinguis Rominger	..	..	..	x
Cladopora robusta Rominger	..	..	..	x
Cladopora turgida Rominger	..	..	..	x
Cystiphyllum aggregatum Billings	..	..	..	x
Cystiphyllum sulcatum Billings	x	..	..	..
Cystiphyllum vesiculosum Goldfuss	x	..	x	x
Eridophyllum collegatum (Billings)	..	..	..	x
Eridophyllum vernuillianum Milne-Edwards and Haime	..	..	..	x
Favosites basalticus Goldfuss	..	..	..	x
Favosites canadensis (Billings)	..	..	..	x
Favosites emmonsi Rominger	x	..	x	x
Favosites epidermatus Rominger	..	..	..	x
Favosites goodwini Davis	..	..	..	x
Favosites limitaris Rominger	x	..	..	x
Favosites tuberosus Rominger	..	..	..	x
Favosites turbinatus Billings	x	x	x	x
Favosites winchelli Rominger	..	..	..	x
Heliophyllum corniculum (Lesueur)	x	..	..	x
Heliophyllum exiguum Billings	x	x	..	x
Heliophyllum halli Milne-Edwards and Haime	x	..	x	x
Michelinia convexa (d'Orbigny)	x	x	..	x
Michelinia favositoidea Billings	..	..	..	x
Phillipsastrea gigas Owen	..	..	..	x
Phillipsastrea verrilli Meek	..	..	..	x
Pleurodictyum problematicum (?) Goldfuss	x	..	..	..
Synaptophyllum simcoense (Billings)	x	..	..	x
Syringopora hisingeri Billings	x	x	..	x
Syringopora perelegans Billings	..	..	..	x
Zaphrentis gigantea Lesueur	x	x	x	x
Zaphrentis nodulosa Rominger	..	..	..	x
Zaphrentis prolifica Billings	x	x	..	x

	Horizons			
Hydrozoa	1	2	3	4
Stromatoporella granulata Nicholson	x	..	..	..
Bryozoa				
Cystodictya gilberti (Meek)	x	..	..	..
Hederella canadensis (Nicholson)	..	..	..	x
Isotrypa conjunctiva (Hall)	..	..	..	x
Monotrypa tenuis (Hall)	..	x	..	..
Polypora robusta (Hall)	..	..	..	x
Brachiopoda				
Amphigenia elongata (Vanuxem)	x	x	x	x
Anoplia nucleata Hall	x	..	..	..
Anoplotheca camilla (Hall)	..	..	..	x
Atrypa reticularis (Linnaeus)	x	x	..	x
Camarotoechia billingsi Hall	..	..	..	x
Camarotoechia carolina Hall	x	..	..	x
Camarotoechia tethys (Billings)	..	..	?	x
Camarotoechia sp	..	..	..	x
Centronella glansfagea Hall	x	..	x	x
Chonetes hemisphericus Hall	x	x	x	x
Chonetes mucronatus Hall	..	..	..	x
Chonostrophia reversa (Whitfield)	..	..	..	x
Cyrtina biplicata Hall	..	..	..	x
Cyrtina hamiltonensis Hall	..	..	..	x
Dalmanella lenticularis (Vanuxem)	x	..	..	..
Eunella lincklaeni Hall	..	..	..	x
Leptaena rhomboidalis (Wilckens)	x	x	..	x
Meristella nasuta (Conrad)	x	x	..	x
Nucleospira concinna Hall	..	..	..	x
Pentamerella arata (Conrad)	x	x	x	x
Pholidops patina Hall and Clarke	..	..	..	x
Pholidostrophia iowaensis (Owen)	x	..	..	x
Reticularia fimbriata (Conrad)	x	..	..	x
Rhipidomella cleobis Hall	..	..	x	..
Rhipidomella livia (Billings)	x	..	..	..
Rhipidomella penelope (?) Hall	..	..	..	x
Rhipidomella semele Hall	..	..	..	x
Rhipidomella vanuxemi Hall	x	x	x	x
Schellwienella pandora (Billings)	x	x	x	x

Brachiopoda—*Contd.*	Horizons 1	2	3	4
Schizophoria propinqua Hall	x	..	..	..
Spirifer acuminatus (Conrad)	..	..	x	..
Spirifer divaricatus Hall	x	x	x	x
Spirifer duodenarius (Hall)	x	x	?	x
Spirifer macrothyris Hall	x	x	..	..
Spirifer arenosus unicus Hall	..	x	..	..
Stropheodonta concava Hall	..	..	..	x
Stropheodonta demissa (Conrad)	x	x	x	x
Stropheodonta hemispherica Hall	x	x	x	x
Stropheodonta inequiradiata Hall	..	..	..	x
Stropheodonta inequistriata (Conrad)	..	..	..	x
Stropheodonta perplana (Conrad)	x	..	x	x
Strophonella ampla Hall	x	x	x	x
Pelecypoda				
Aviculopecten princeps (?) (Conrad)	..	..	..	x
Conocardium cuneus (Conrad)	x	x	x	x
Gastropoda				
Callonema lichas (?) Hall	..	..	..	x
Diaphorostoma lineatum (Conrad)	x	x	..	x
Euryzone lucina (Hall)	..	..	..	x
Igoceras conicum (Hall)	x	..	..	x
Loxonema pexatum Hall	..	..	..	x
Platyceras attenuatum Hall	x	x	..	x
Platyceras bucculentum Hall	x	..	..	..
Platyceras carinatum Hall	..	..	..	x
Platyceras concavum Hall	..	..	..	x
Platyceras dentalium Hall	x	x	..	..
Platyceras dumosum Conrad	x	..	..	..
Platyceras undatum Hall	..	x	..	..
Pteropoda				
Tentaculites scalariformis Hall	x	x	..	x
Cephalopoda				
Orthoceras sp	x	..	..	x
Potericeras eximium Hall	x	..	..	..

Trilobita	Horizons 1	2	3	4
Chasmops anchiops (Green)	x	x	..	x
Coronura diurus (Green)	..	..	..	x
Hausmania phacoptyx Hall and Clarke	x	x	..	x
Phacops cristata Hall	x	x	x	x
Proetus crassimarginatus Hall	x	..	x	x
Proetus rowi (Green)	x	..	..	x

Across the highway to the north, on lot 5, concession XV, the top Silurian layers, showing joint cracks filled with the coarse Oriskany sands, occur just below the surface and are uncovered in excavations for the basements of farm buildings. A great many blocks of this rock have been removed from the cultivated fields and heaped into piles along the fences and lanes; but no fossils have been found in them.

The last outcrop of the Silurian-Devonian contact, in this region, is shown along the line between Norfolk and Haldimand counties, on lot 24, concession VI, Townsend township. At that place the basal Devonian consists of a single 18-inch layer of coarse white sandstone which includes numerous fragments of the Silurian dolomites. No fossils were found; but the layer probably represents the Oriskany sandstone.

Teitz's quarry is located on lot 1, concession XIV, near the west line of Walpole township. The ridge of limestone in which it has been opened extends in a nearly north and south direction for a distance of several miles and its fossiliferous layers are frequently to be seen weathering out over the fields. As the fauna shows, the horizon of the Teitz quarry is just above the highest layers exposed near Springvale and may be considered as a continuation of the section on Mr. John Winger's place.

Section of the Teitz Quarry.

Onondaga limestone	Feet	Inches
4. Weathered, cherty limestone which may have been slightly moved....................	0	6
3. A semi-crystalline, grey limestone filled with the smooth variety of *Synaptophyllum simcoense*, and having a few thin layers of chert in it...................................	3	6
2. Semi-crystalline, grey limestone alternating with beds of soft, calcareous, blue shale. The limestone layers are usually very crinoidal and contain numerous corals, while the shaly layers contain the small sponge *Hindia fibrosa*...................................	2	6
1. Four to 6-inch layers of blue to bluish grey semi-crystalline limestone in which fossils are not abundant. These layers extend to the bottom of the quarry.................	2	0

The following is a list of the more common species found fossil in the rocks exposed in the Teitz quarry.

	Horizons		
Spongia	1	2	3
Hindia fibrosa Roemer................................	..	x	..
Anthozoa			
Bothrophyllum decorticatum Billings..................	..	..	x
Chonophyllum magnificum Billings.....................	..	x	..
Cladopora labiosa Billings...........................	?	..	x
Clisiophyllum conigerum Rominger......................	..	..	x
Cyathophyllum anna (Whitfield).......................	..	x	..
Cystiphyllum vesiculosum Goldfuss....................	x	x	x
Eridophyllum colligatum (Billings)...................	..	x	x
Favosites basalticus Goldfuss........................	x	x	x
Favosites canadensis (Billings)......................	..	x	x

Anthozoa—*Contd.*	Horizons 1	2	3
Favosites cervicornis Milne-Edwards and Haime	..	..	x
Favosites clausus Rominger	..	x	..
Favosites emmonsi Rominger	x	x	x
Favosites epidermatus Rominger	..	x	x
Favosites limitaris Rominger	..	..	x
Favosites radiciformis Rominger	..	x	..
Favosites turbinatus Billings	x	x	x
Favosites winchelli Rominger	x	x	..
Heliophyllum corniculum (Lesueur)	..	..	x
Heliophyllum fecundum Hall	..	x	..
Heliophyllum halli Milne-Edwards and Haime	x	x	x
Michelinia convexa (d'Orbigny)	x	x	..
Phillipsastrea gigas Owen	..	x	..
Synaptophyllum simcoense (Billings)	..	x	..
Syringopora his ingeri Billings	x	x	..
Syringopora maclurei Billings	x	x	x
Syringopora perelegans Billings	x	x	x
Zaphrentis davisana Miller	..	..	x
Zaphrentis gigantea Lesueur	..	x	..
Zaphrentis prolifica Billings	?	x	x
Hydrozoa			
Stromatoporella granulata Nicholson	x	x	..
Stromatoporella tuberculata Nicholson	x	x	..
Bryozoa			
Polypora robusta (?) (Hall)	..	..	x
Brachiopoda			
Amphigenia elongata (Vanuxem)	..	x	..
Atrypa reticularis (Linnaeus)	..	x	..
Meristella nasuta (Conrad)	x	x	x
Rhipidomella livia (Billings)	..	x	..
Rhipidomella vanuxemi Hall	..	x	..
Schellwienella pandora (Billings)	..	x	..
Spirifer macrus (?) Hall	..	x	..
Stropheodonta demissa (Conrad)	x	x	..
Strophonella ampla Hall	x	x	..

Pelecypoda	Horizons 1	2	3
Conocardium (Conrad)	..	x	..
Gastropoda			
Diaphorostoma lineatum (Conrad)	x	x	..
Platyceras ammon Hall	..	x	..
Platyceras concavum Hall	..	x	..
Platyceras dumosum Conrad	?	x	..
Platyceras erectum Hall	..	x	..
Platyceras rictum Hall	..	x	..
Cephalopoda			
Gyroceras sp	x	x	..
Orthoceras sp	..	x	..
Trilobita			
Phacops cristata Hall	x	..	..
Phacops rana (Green)	..	x	..

This is the locality from which the small sponge was first collected. *Hindia fibrosa* is really a Silurian sponge and the form here identified as that species may, after a more thorough study of the specimens, prove to be a variety or even a new species. The identification, with some such provisional statement as just given, was made by Dr. R. S. Bassler of the United States National Museum to whom a number of the specimens were submitted.

NORFOLK COUNTY SECTIONS.

VILLANOVA.

Several small outcrops occur at Villanova, on the Michigan Central railway, 5 miles east of Waterford, in Townsend township. A little quarrying has been done on Mr. John McLaren's farm, lot 18, concession VIII, and the following is a combined section of the rocks outcropping along the banks of Nanticoke creek and exposed in the quarries on that farm.

Section on Mr. John McLaren's Farm at Villanova.

Onondaga limestone	Feet	Inches
5. Dark bluish, cherty, fossiliferous limestone....	3	0
4. Mottled, grey chert, with some limestone, poor in fossils....................................	4	0
3. Cherty limestone partly covered.............	3	0
2. Mottled, cherty, bluish limestone inclined to be shaly and with numerous silicified corals....	2	6
1. Rather compact, semi-crystalline, blue limestone containing very little chert, but with numerous silicified corals. These beds extend to creek level at the little quarry in the field....................................	6	4

The following fossils were collected from the above section.

Anthozoa	Horizons 1	2	3	4	5
Acervularia rugosa Milne-Edwards and Haime	x	..	..	..	..
Amplexus yandelli Milne-Edwards and Haime	x	..	..	..	x
Bothrophyllum decorticatum Billings.........	x	..	..	..	x
Bothrophyllum promissum Hall.............	..	..	..	..	x
Cladopora expatiata Rominger.............	..	..	..	..	x
Cladopora labiosa (Billings)................	x	x	x	..	x
Cladopora pulchra Rominger...............	x	..	..	..	x
Cystiphyllum vesiculosum Goldfuss..........	x	x	..	..	x
Eridophyllum sp..........................	..	x	x	x	..
Favosites basalticus Goldfuss...............	x	..	..	..	x

Anthozoa—*Contd.*	Horizons 1	2	3	4	5
Favosites canadensis (Billings)	x	x	..	..	x
Favosites cervicornis Milne-Edwards and Haime	x	..	..	..	x
Favosites clausus Rominger	x	..	..	..	x
Favosites emmonsi Rominger	x	x	..	..	x
Favosites epidermatus Rominger	x	..	..	..	x
Favosites limitaris Rominger	x	..	..	..	x
Favosites tuberosus Rominger	..	..	..	..	x
Favosites turbinatus Billings	x	..	..	..	x
Heliophyllum corniculum (Lesueur)	..	x	x	..	..
Heliophyllum halli Milne-Edwards and Haime	x	x	..	..	x
Michelinia convexa (d'Orbigny)	..	..	..	..	x
Pleurodictyum problematicum (?) Goldfuss	..	..	..	..	x
Romingeria umbellifera (Billings)	x	..	..	..	..
Synaptophyllum simcoense (Billings)	x	x	..	..	x
Syringopora hisingeri Billings	x	..	x	..	x
Syringopora maclurei Billings	..	..	..	..	x
Syringopora nobilis Billings	x	..	..	..	x
Syringopora perelegans Billings	x	x	..	..	x
Zaphrentis gigantea Lesueur	x	x	..	..	x
Hydrozoa					
Stromatoporella tuberculata Nicholson	..	..	..	..	x
Bryozoa					
Fenestella sp	..	x	..	..	..
Brachiopoda					
Atrypa reticularis (Linnaeus)	..	..	..	x	..
Meristella nasuta (Conrad)	x	..	..	..	x
Pentamerella arata (Conrad)	..	..	..	..	x
Spirifer sp	..	..	..	x	..
Stropheodonta demissa (Conrad)	..	x	..	..	..
Pelecypoda					
Conocardium cuneus (Conrad)	..	..	..	x	..
Gastropoda					
Diaphorostoma lineatum (Conrad)	..	..	..	..	x

ROCKFORD.

On lot 21, concession X, Townsend township, about 2½ miles to the southeast of Villanova, there is a small waterfall in Nanticoke creek where a very good section of Onondaga limestone outcrops. By the mill at Rockford there is quite a large surface of this limestone exposed and the following is a section measured at that place.

Section Exposed by the Grist Mill at Rockford.

	Feet	Inches
4. Soil and drift	3	0
Onondaga limestone		
3. Uneven-bedded, bluish grey, limestone with a considerable amount of grey chert	9	6
2. Semi-crystalline, bluish grey limestone with very little chert and full of corals. Along the west side of the outcrop these beds seem to pinch out and allow beds No. 3 to rest on beds No. 1	6	0
1. Dark bluish layers of limestone which are fully half chert. These beds present a rough appearance and extend to the bottom of the outcrop in Nanticoke creek	2	0

The fauna of the Onondaga limestone at this place is chiefly of the corals. The following is a list of the species found.

Anthozoa	Horizons 1	2	3
Aulopora cornuta Billings	..	x	..
Cayugaea whiteavesiana Lambe	..	x	..
Cladopora cryptodens (Billings)	..	x	x
Cladopora labiosa (Billings)	..	x	x
Cladopora pulchra Rominger	..	x	..
Cystiphyllum vesiculosum Goldfuss	x	x	x
Diplophyllum arundinaceum (Billings)	..	x	..
Favosites basalticus Goldfuss	x	..	x

Anthozoa—*Contd.*	Horizons 1	2	3
Favosites canadensis (Billings)	..	x	..
Favosites cervicornis Milne-Edwards and Haime	x	x	x
Favosites emmonsi Rominger	x	x	x
Favosites epidermatus Rominger	..	..	x
Favosites limitaris Rominger	..	x	..
Favosites radiciformis Rominger	..	x	..
Favosites turbinatus Billings	x	x	x
Heliophyllum annulatum Hall	..	x	..
Heliophyllum halli Milne-Edwards and Haime	x	x	x
Synaptophyllum simcoense (Billings)	x	x	x
Synaptophyllum stramineum (Billings)	..	x	..
Syringopora perelegans Billings	x	..	x
Zaphrentis gigantea Lesueur	x	..	x
Zaphrentis prolifica Billings	..	..	x
Hydrozoa			
Stromatoporella tuberculata Nicholson	..	..	x
Brachiopoda			
Meristella nasuta (Conrad)	..	x	x
Spirifer sp	..	..	x
Stropheodonta demissa (Conrad)	..	..	x
Strophonella ampla Hall	..	..	x
Gastropoda			
Platyceras erectum Hall	..	..	x

On Mr. Howard's land (lot 23, concession XI), along the highway to the southeast of the village, the creek again cascades over a 6-foot outcrop of the fossiliferous, cherty, blue Onondaga limestone. Then on Mr. McPherson's land, at the south end of the same lot, a similar ledge of this limestone appears in the creek and a portion of it has been quarried along the banks where the following section is exposed.

Section of the Old Quarry on Mr. McPherson's Land.

	Feet	Inches
3. Soil and drift	0	6
Onondaga limestone		
2. Grey to bluish limestone containing mottled grey chert	1	6
1. A rough, cherty, somewhat shaly, grey to blue limestone extending to the level of Nanticoke creek	5	10

In these beds a fauna similar to that at the village of Rockford occurs. In fact it is very probable that the horizon is essentially the same in the two cases. The following is a list of the species found in the rocks exposed on Mr. McPherson's land.

	Horizons	
Anthozoa	1	2
Cladopora cryptodens (Billings)	..	x
Cladopora labiosa (Billings)	..	x
Cystiphyllum vesiculosum Goldfuss	x	x
Favosites basalticus Goldfuss	..	x
Favosites cervicornis Milne-Edwards and Haime	..	x
Favosites emmonsi Rominger	x	x
Heliophyllum halli Milne-Edwards and Haime	x	x
Synaptophyllum simcoense (Billings)	..	x
Syringopora nobilis Billings	..	x
Syringopora perelegans Billings	x	x
Zaphrentis gigantea Lesueur	..	x
Zaphrentis sp	..	x
Bryozoa		
Fenestella sp	..	x
Brachiopoda		
Rhipidomella vanuxemi Hall	x	..

About 3 miles down the creek from Rockford, on lot 24, concession XIII, there is a very good outcrop of the Onondaga limestone. This is within 2½ miles of the town of Jarvis. The following is a section of the rocks exposed at that point.

Section of the Rocks Exposed Along Nanticoke Creek, 3 Miles Below Rockford.

	Feet	Inches
5. Soil and drift	1	6
Onondaga limestone		
4. Bluish grey, semi-crystalline limestone with much grey chert, the lower layers partly covered	8	0
3. Compact, cherty, grey to bluish grey limestone weathering into thin irregular beds	3	9
2. A rather compact, bluish grey limestone containing a considerable quantity of grey chert	1	8
1. Very cherty, grey limestone to the level of Nanticoke creek	6	4

The fauna of these beds shows them to belong in the middle portion of the formation where the abundance of corals is characteristic. The following is a list of the fossils found in the above section.

Anthozoa	Horizons 1	2	3	4
Bothrophyllum decorticatum Billings	..	x	..	..
Cladopora francisci Davis	..	..	..	x
Cladopora labiosa (Billings)	x	x	x	x
Cystiphyllum vesiculosum Goldfuss	x	x	x	x
Favosites basalticus Goldfuss	..	x	..	x
Favosites canadensis (Billings)	..	x	..	..
Favosites cervicornis Milne-Edwards and Haime	x	x	..	..
Favosites emmonsi Rominger	x	x	..	..
Favosites turbinatus Billings	..	..	..	x
Heliophyllum halli Milne-Edwards and Haime	x	x	x	x
Michelinia convexa (d'Orbigny)	..	..	..	x
Synaptophyllum simcoense (Billings)	x	x	..	x
Syringopora hisingeri Billings	..	..	..	x
Syringopora perelegans Billings	..	x	..	..
Zaphrentis gigantea Lesueur	..	x	..	x

	Horizons			
	1	2	3	4
Hydrozoa				
Stromatoporella sp.	..	..	..	x
Bryozoa				
Fenestella sp.	..	..	x	..
Brachiopoda				
Atrypa reticularis (Linnaeus)	..	..	..	x
Schellwienella pandora (Billings)	..	..	x	..

PORT DOVER.

Along the shore of Lake Erie rock frequently outcrops to within half a mile of Port Dover and, although the section is usually small, a very interesting one may be found on lot 20, concession I, township of Woodhouse. This place is about 3½ miles to the east of town and shows the following section.

Section Along the Lake Erie Shore 3½ Miles to the East of Port Dover.

	Feet	Inches
4. Soil and drift	40	0
Onondaga limestone		
3. Grey limestone alternating with beds of grey chert	1	6
2. Grey chert and limestone with a pronounced gastropod fauna	0	8
1. Bluish grey limestone with alternating layers of grey chert and also pockets of chert. These layers extend to the level of Lake Erie	5	4

The fauna found in these limestones and cherts included the following forms.

Anthozoa	Horizons 1	2	3
Favosites emmonsi Rominger	x	..	x
Favosites turbinatus Billings	x	..	..
Romingeria umbellifera (Billings)	x	x	..
Zaphrentis gigantea Lesueur	x	..	..
Zaphrentis sp	x	..	..
Bryozoa			
Isotrypa consimilis Hall	x	x	..
Monotrypa tenuis Hall	x	..	..
Polypora hexagonalis (Hall)	..	x	..
Polypora sp	x	x	..
Ptiloporina disparilis (Hall and Simpson)	x	x	..
Brachiopoda			
Anoplotheca camilla (Hall)	..	x	..
Athyris vittata indianaensis Stauffer	..	x	..
Atrypa reticularis (Linnaeus)	x	x	x
Atrypa spinosa Hall	..	x	..
Camarotoechia billingsi Hall	x	..	..
Camarotoechia tethys (Billings)	x	..	..
Chonetes mucronatus Hall	x	x	..
Cyrtina hamiltonensis Hall	x	..	..
Delthyris raricosta Conrad	x	x	..
Eunella lincklaeni Hall	..	x	..
Leptaena rhomboidalis (Wilckens)	x	x	..
Meristella nasuta (Conrad)	..	x	..
Nucleospira concinna Hall	x	x	..
Pentamerella arata (Conrad)	x	x	x
Pholidostrophia iowaensis (Owen)	..	x	..
Reticularia fimbriata (Conrad)	x	x	x
Rhipidomella livia (Billings)	..	x	..
Rhipidomella vanuxemi Hall	x	x	..
Schellwienella pandora (Billings)	..	x	x
Schizophoria propinqua Hall	x	x	x
Spirifer varicosus Hall	x	x	x
Stropheodonta concava Hall	..	x	..
Stropheodonta demissa (Conrad)	x	x	..
Stropheodonta hemispherica Hall	x	x	x
Stropheodonta inequiradiata Hall	x	..	..

Brachiopoda—*Contd.*	Horizons 1	2	3
Stropheodonta patersoni Hall	x	x	..
Stropheodonta perplana (Conrad)	..	x	..
Strophonella ampla Hall	x	x	x
Pelecypoda			
Actinopteria boydi (Conrad)	..	x	..
Conocardium cuneus (Conrad)	x	x	..
Microdon sp	..	x	..
Modiomorpha concentrica (Conrad)	..	x	..
Mytilarca percarinata Whitfield	..	x	..
Pterinea flabellum (Conrad)	..	x	..
Gastropoda			
Bellerophon newberryi Meek	..	x	..
Bellerophon pelops Hall	..	x	..
Bellerophon propinquus Meek	..	x	..
Callonema bellatulum (Hall)	..	x	..
Cyclonema crenulatum Meek	..	x	..
Dentalium martini Whitfield	..	x	..
Euryzone dublinensis Stauffer	..	x	..
Euryzone hyphantes (Meek)	..	x	..
Euryzone lucina (Hall)	..	x	..
Hormotoma desiderata Hall	..	x	..
Hormotoma maia (Hall)	..	x	..
Lophospira adjutor (Hall)	..	x	..
Loxonema laeviusculum Hall	..	x	..
Loxonema pexatum Hall	..	x	..
Loxonema pexatum obsoletum Hall	..	x	..
Macrocheilus hebe (Hall)	..	x	..
Naticopsis aequistriata Meek	..	x	..
Naticopsis laevis Meek	..	x	..
Platyceras dumosum Conrad	x	x	..
Pleuronotus decewi (Billings)	..	x	..
Pleurotomaria insolita Hall	..	x	..
Solenospira quadricarinatus Stauffer	..	x	..
Straparollus clymenioides Hall	..	x	..
Straparollus corrugatus Stauffer	..	x	..
Pteropoda			
Coleolus crenatocinctus Hall	..	x	..

	Horizons		
	1	2	3
Cephalopoda			
Orthoceras sp	..	x	..
Poterioceras sp	..	x	..
Trilobita			
Dalmanites erina Hall	..	x	..
Phacops cristata Hall	x	x	..

This is a representative of the remarkable gastropod fauna of a thin cherty zone in the Onondaga (Columbus) limestone of central Ohio, and especially well developed along Eversole Run[1] in Delaware county. There, as here near Port Dover, the specimens are mostly silicified and, as the chert in which they occur weathers to a chalky crumbly mass, the fossils may be obtained with the external surface well preserved.

At the grist mill on the River Lynn, 1 mile to the north-west of Port Dover (lot 10, concession II, township of Wood-house), 4 or 5 feet of grey to bluish limestone outcrops. This exposure is chiefly in the bed of the stream and not easily collected from, but the following terms were found.

Brachiopoda

Atrypa reticularis (Linnaeus).
Chonetes mucronatus Hall.
Delthyris raricosta Conrad.
Leptaena rhomboidalis (Wilckens).
Pentagonia unisulcata (Conrad).
Pholidops patina Hall and Clarke.
Reticularia fimbriata (Conrad).
Rhipidomella vanuxemi Hall.
Schizophoria propinqua Hall.
Stropheodonta demissa (Conrad).
Strophonella ampla Hall.

[1] Geol. Surv. of Ohio, 4th ser. Bull. 10, 1909, pp. 66-71.

Pelecypoda

Conocardium cuneus (Conrad).

Cephalopoda

Orthoceras sp.

Trilobita

Phacops cristata Hall

Westward from the eastern part of Norfolk county the drift thickens along the north shore of Lake Erie and our knowledge of the bed-rock in that direction is limited chiefly to such information as may be derived from well records. In exploring that region for gas, numerous holes have punctured the bed-rock; but the records are seldom kept in detail and are often of little scientific value.

PORT ROWAN.

This town is located on the inner bay of Long point, and in a region where the drift is very thick. Although the bed-rock is thus too far below the surface to outcrop, a number of wells have recently penetrated it to a very considerable depth and brought to us a considerable amount of information in regard to it. The following is a record of a gas well drilled on Mr. J. L. Buck's lot.

Record of Mr. J. L. Buck's Well on College Avenue.

	Thickness	Total
7. Surface deposits. These are reported to be, in part, soft blue clay.........	303 Ft.	303 Ft.
6. Delaware and Onondaga limestones. Cherty limestone..................	257 "	560 "
5. Oriskany ? sandstone. A sharp, white sand............................	2 "	562 "
4. Cayugan series and Niagara limestone. Limestone and dolomite............	588 "	1,150 "
3. Rochester shale. Dark shale.........	100 "	1,250 "
2. Clinton beds.......................	68 "	1,318 "

	Thickness	Total
1. Medina formation. Red and grey shales with interbedded white sandstone	132 Ft.	1,450 Ft.

In this well a strong flow of water was encountered in the Niagara, and gas in paying quantity was found in the Clinton and red Medina, but the thin stratum of white sandstone in the Medina was barren.

LYNEDOCH.

In March 1910 a well was drilled in the valley of Big creek about 4 miles to the south of Delhi. This well, of which the record is here given, reached a depth of over 1,400 feet and was located within the village of Lynedoch.

Record of a Well at Lynedoch, Drilled in March 1910.

	Thickness	Total
12. Drift and surface material	195 Ft.	195 Ft.
Delaware limestone		
11. Black shale	10 "	205 "
Onondaga limestone		
10. Limestone	60 "	265 "
9. Shale and shaly limestone	140 "	405 "
Onondaga limestone, including a portion of the Cayugan series.		
8. Limestone	225 "	630 "
Cayugan series		
7. Shale and limestone	390 "	1,020 "
Niagara (Lockport and Guelph) dolomitic limestone.		
6. Dolomite or dolomitic limestone	240 "	1,260 "
Rochester shale		
5. Dark shale	55 "	1,315 "
Clinton beds		
4. Shaly limestone	21 "	1,336 "
Medina formation		
3. Red shale	35 "	1,371 "
2. Blue shale	60 "	1,431 "
1. Red shale	10 "	1,441 "

In this well the Clinton yields gas, but the white sandstone of the Medina, which is usually productive, is absent. Regarding the portion of the record which is referred to the Onondaga, there may be some doubt as to the proper interpretation. The section seems to be rather unique in some respects, and yet the details are not definite enough to make a trustworthy interpretation possible. It is to be noted that the distance between the black shale and the top of the Medina, which is a red shale and easily recognizable, in this well is 1,131 feet and that the same interval in the Port Burwell record is 1,126 feet. This certainly suggests that there was probably not much difference in the conditions of sedimentation at these two localities, although the record of the Lynedock well shows a great mass of shale introduced where only limestone is expected. On the basis of this well alone, the interpretation might have been very different from that which is suggested above.

The basal Devonian, which lies at the surface in the eastern part of Norfolk county, lies under 500 feet of other rock at Lynedoch, 20 miles distant. The westward dip of the rock is, therefore, approximately 25 feet per mile, since the surface elevation is relatively constant.

ELGIN COUNTY SECTIONS.

PORT BURWELL.

A number of wells have been drilled in and about Port Burwell, which is located on the shore of Lake Erie near the southeastern corner of the county. The following is the record of one which Mr. A. R. Crays drilled, during 1911, on Mr. Weaver's farm along the lake shore one mile west of town.

Record of the Well on Mr. Weaver's Farm, 1 mile West of Port Burwell.

	Thickness	Total
8. Drift and surface material. The lower 35 feet is reported to be clay	287 Ft.	287 Ft.
Delaware limestone		
7. Black shale	30 "	317 "

	Thickness	Total
Onondaga limestone and probably a portion of the Cayugan series.		
6. Cherty limestone, reported as flint.......	280 Ft.	597 Ft.
Cayugan series		
5. Limestone and shale....................	490 "	1,087 "
Niagara limestone		
4. Limestone...........................	270 "	1,357 "
Rochester shale		
3. Dark shale...........................	60 "	1,417 "
Clinton beds		
2. Shale and limestone....................	26 "	1,443 "
Medina beds		
1. Red and blue arenaceous shales including also a thin layer of white sandstone....	112 "	1,555 "

At Vienna, just a few miles to the north of Port Burwell, a limestone is encountered under 240 feet of drift[1]. This is considered to be, and probably is, the Onondaga limestone. Recent gas wells near Vienna have been heavy producers.

PORT STANLEY.

Along the lake at Port Stanley the high bluffs contain glaciated fragments of a fossiliferous black shale. The source of these drift boulders of shale was doubtless the bed-rock to the northeast and the presence of the following fauna indicates that the age is Marcellus, and hence a part of the Delaware limestone.

Flora and Fauna of the Shale Fragments at Port Stanley.

Sporansites bilobatus ? Dawson (a).
Leiorhynchus laura ? (Billings) (a).
Leiorhynchus limitare (Vanuxem) (a).
Lingula ligea Hall (c).
Martinia subumbona (Hall) (c).
Orbiculoidea lodiensis (Vanuxem) (a).
Orbiculoidea minuta Hall (c).
Styliolina fissulella (Hall) (a).
Prioniodus armatus Hinde (r).

[1] Hunt, T. Sterry, Geol. Surv., Canada, Rept. Prog. from 1863–1866, p. 250.

A comparatively shallow well, drilled at this town a number of years ago, has the following record.[1]

Record of Well Drilled at Port Stanley.

		Thickness	Total
4.	Drift	172 Ft.	172 Ft.
3.	Black and brown shale	30 "	202 "
2.	Light coloured shale	16 "	218 "
1.	Limestone	80 "	298 "

It is probable that the limestone at the bottom of this well is the Onondaga, but that the shales above belong in the Delaware. This black shale extends northward to London, Middlesex county, where some wells indicate its presence,[2] while in others the Onondaga limestone appears to lie immediately beneath the drift.

OXFORD COUNTY SECTIONS.

TILLSONBURG.

Considerable drilling has been done in the vicinity of Tillsonburg, but the records preserved are very poor. Dr. Hunt mentions 160 feet[3] of limestone, which is probably the Onondaga, lying under only 36 feet of drift. Along Big Otter creek, to the southwest of the city, the Onondaga is said to be overlain by 11 feet of soft Hamilton shale. This doubtless means that the basal Hamilton (Erian) or Delaware limestone, is also present and has been included with the Onondaga by the driller.

WOODSTOCK.

There are several small quarries and a few outcrops, exposing rocks belonging to the Onondaga limestone, along the south branch of the Thames river near Woodstock. Of these

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[1] Brumell, H. P. H., Geol. Surv., Canada, Ann. Rept., vol. V, 1892, p. 49 Q.
[2] Hunt, T. S., Op. cit., p. 249.
[3] Hunt, T. Sterry, Geol. Surv., Canada, Rept. of Prog. from 1863–1866, p. 250.

Mr. Wier's quarry on the west bank of the river, just opposite the Canadian Pacific Railway depot, is the most accessible and at the same time the most interesting. The following is a section of the Wier quarry.

Section of the Wier Quarry.

	Feet	Inches
4. Soil and drift	4	0
Onondaga limestone		
3. Partly weathered, semi-crystalline, bluish grey limestone	0	8
2. Irregularly stratified, bluish grey limestone with bituminous films	2	0
1. Very cherty, bluish grey to brown limestone extending to the river level	2	2

The rock at this place is quite fossiliferous; but the small amount of it exposed has made it impossible to obtain a very extensive fauna. The following is a list of the species found in the Wier quarry.

	Horizons		
Anthozoa	1	2	3
Cladopora labiosa (Billings)	x	x	x
Cystiphyllum vesiculosum Goldfuss	x	x	x
Favosites basalticus Goldfuss	..	..	x
Favosites emmonsi Rominger	..	x	x
Favosites polymorpha (Billings)	x	..	..
Favosites turbinatus Billings	..	x	..
Heliophyllum halli Milne-Edwards and Haime	x	..	x
Synaptophyllum simcoense (Billings)	x	..	x
Syringopora hisingeri Billings	x	x	..
Syringopora perelegans Billings	x	..	x
Zaphrentis gigantea Lesueur	x	x	x
Hydrozoa			
Stromatoporella tuberculata Nicholson	..	x	x
Bryozoa			
Fenestella sp	x	x	..

Brachiopoda	Horizons 1	2	3
Amphigenia elongata (Vanuxem)	x	..	..
Atrypa reticularis (Linnaeus)	x	x	x
Camarotoechia sp	x	..	..
Meristella nasuta (Conrad)	x	..	..
Reticularia fimbriata (Conrad)	..	..	x
Rhipidomella vanuxemi Hall	x	..	x
Spirifer sp	x	..	x
Stropheodonta demissa (Conrad)	..	x	..
Stropheodonta hemispherica Hall	x	..	..
Pelecypoda			
Conocardium cuneus (Conrad)	..	..	x
Trilobita			
Phacops cristata Hall	..	..	x

Under the Grand Trunk bridge at the western limits of Woodstock the Onondaga limestone is represented by a small outcrop of dark bluish to brown limestone which contains much bituminous matter. The following species were found at that place.

Anthozoa

Cladopora labiosa (Billings).
Cystiphyllum vesiculosum Goldfuss.
Eridophyllum vernuillianum Milne-Edwards and Haime.
Favosites emmonsi Rominger.
Favosites polymorpha (Billings).
Favosites turbinatus Billings.
Synaptophyllum simcoense (Billings).
Syringopora hisingeri Billings.
Zaphrentis gigantea Lesueur.

Hydrozoa

Stromatoporella tuberculata Nicholson.
Stromatoporella sp.

Brachiopoda

Atrypa reticularis (Linnaeus).
Spirifer sp.
Stropheodonta demissa (Conrad).
Stropheodonta inequistriata (Conrad).
Strophonella ampla Hall.

At the Rapson quarry, on the east bank of the river about a quarter of a mile below the Grand Trunk bridge, nearly 3 feet of cherty, bluish grey limestone is exposed above the river level, while about 5 or 6 feet more are usually covered by water. A small amount of collecting yielded the following fossils.

Anthozoa

Acervularia rugosa Milne-Edwards and Haime.
Cladopora labiosa (Billings).
Cystiphyllum vesiculosum Goldfuss.
Eridophyllum vernuillianum Milne-Edwards and Haime.
Favosites basalticus Goldfuss.
Favosites emmonsi Rominger.
Favosites turbinatus Billings.
Synaptophyllum simcoense (Billings).
Syringopora hisingeri Billings.
Syringopora perelegans Billings.
Zaphrentis gigantea Lesueur.

Hydrozoa

Stromatoporella sp.

Byrozoa

Fenestella sp.

Brachiopoda

Atrypa reticularis (Linnaeus).
Pentamerella arata (Conrad).
Reticularia fimbriata (Conrad).
Spirifer sp.
Stropheodonta hemispherica Hall.

Pelecypoda

Conocardium cuneus (Conrad).

Gastropoda

Diaphorostoma lineatum (Conrad).

The quarries at Beachville, a few miles down the river from Woodstock, are in the Detroit River series which there form an inlier within the area covered by the Onondaga limestone.

PERTH COUNTY SECTION.

ST. MARYS.

Several large quarries are located in and near St. Marys, while the Devonian limestones outcrop along the Thames river, which flows through the city, for some distance both up and down stream. The quarries of the Standard White Lime Company, in the eastern part of St. Marys, are in Silurian rock which seems to form an inlier within the Devonian. The large quarries in the western and southwestern parts of the city, however, are in the Devonian. This proximity of quarries in rocks of such widely differing ages is the more remarkable when it is pointed out that the Silurian quarries are located on somewhat higher ground than that occupied by those in rocks of the middle Devonian. The explanation of this unusual occurrence is to be found in the rock structure. Running nearly north and south through the city there is a rather pronounced anticlinal or monoclinal fold (see Plate VII) which brings up the Silurian to the east and drops the Devonian to the west. The Thames river cuts into the side of this fold so that at the dam near the Queens Street bridge the dip is up stream, while a quarter of a mile below the bridge the dip is down stream. The excellent artesian wells, which supply St. Marys with such a quantity of good water, may depend on this same structure.

One of the important Devonian sections at St. Marys is to be found at the Horseshoe quarry in the southwestern part of the city. The rocks exposed at that place dip strongly to the westward and at the east end of the pit they turn up sharply and then become nearly horizontal (see Plates VII and VIII).

Section of the Rocks Exposed in the Horseshoe Quarry, St. Marys.

		Feet	Inches
10.	Soil and drift	4	0
	Delaware limestone		
9.	A blue to brownish limestone with many fossils	7	0
8.	A bluish brown limestone alternating with bands of compact, brown, shaly limestone, which is crowded with fossils	5	10
7.	Bluish, compact limestone like that below but with shaly partings	4	8
6.	A persistent parting of brown shale	0	½
5	A very compact, bluish limestone which passes downward into a semi-crystalline, bluish grey limestone. Beds from 8 to 14 inches in thickness	10	0
4.	Rather massive beds of blue to bluish grey limestone with bituminous contacts	2	6
	Onondaga limestone		
3.	A bluish grey, semi-crystalline limestone containing carbonaceous films	2	6
2.	Rather massive layers of semi-crystalline, grey limestone full of fossils. A little below the middle of these beds is a conspicuous coral horizon in which petroleum is frequently encountered	3	6
1.	Massive beds of grey limestone brought up at the east end of the quarry by the monoclinal fold. These beds often appear more or less leached and furnish a constant supply of running water	6	10

The fauna collected from these rocks includes the following species.

	Horizons								
Rhizopoda	1	2	3	4	5	6	7	8	9
Calcisphaera robusta Williamson	...	x	...	...	...	...	...	...	...
Anthozoa									
Cystiphyllum vesiculosum Goldfuss	x	x	...	...	...	...	...	...	...
Favosites turbinatus Billings	...	...	x	...	...	...	...	...	...
Heliophyllum corniculum (Lesueur)	...	...	x	...	...	...	...	...	...
Heliophyllum halli Milne-Edwards and Haime	x	x	x	...	x	...	...	...	...
Hydrozoa									
Stromatoporella granulata Nicholson	...	x	...	...	...	...	...	...	...
Bryozoa									
Cystodictya gilberti (Meek)	...	x	...	...	...	...	...	...	...
Cystodictya hamiltonense Ulrich	...	...	...	...	...	...	...	...	x
Fenestella sp	...	...	...	...	...	...	...	...	x
Fistulipora sp	...	...	...	...	...	x	...	...	...
Brachiopoda									
Ambocoelia umbonata (Conrad)	...	...	...	...	...	...	x	x	...
Athyris vittata Hall	...	...	...	...	...	x	...	...	x
Atrypa reticularis (Linnaeus)	x	x	x	...	...	...	...	...	...
Atrypa spinosa Hall	...	...	...	...	...	...	...	...	x
Camarotoechia carolina Hall	x	x	...	...	...	...	...	...	...
Camarotoechia tethys (Billings)	x	...	...	...	...	...	...	...	...
Chonetes deflectus Hall	...	...	...	...	...	...	x	x	x
Chonetes lepidus Hall	...	...	...	...	...	...	...	...	x
Chonetes mucronatus Hall	...	x	...	...	x	...	...	...	...
Chonostrophia reversa (Whitfield)	x	x	x	...	...	...	...	x	...
Cyrtina hamiltonensis Hall	x	...	...	...	...	...	x	...	x
Delthyris consobrina (d'Orbigny)	...	...	...	x	...	...	...	x	...
Leptaena rhomboidalis (Wilckens)	x	x	x	...	...	...	...	...	x
Martinia maia (Billings)	...	...	...	...	...	...	x	x	x
Martinia subumbona (Hall)	...	...	...	...	...	...	...	...	x
Pentamerella arata (Conrad)	...	x	...	...	...	...	...	...	...
Pholidops patina Hall and Clarke	...	x	...	...	...	...	...	...	...
Pholidostrophia iowaensis (Owen)	x	x	...	x	x	...	...	...	x

	Horizons								
Brachiopoda—*Contd.*	1	2	3	4	5	6	7	8	9
Productella spinulicosta Hall	...	x	...	...	...	...	...	x	x
Rhipidomella vanuxemi Hall	x	x	...	...	...	...	...	...	...
Schellwienella pandora (Billings)	...	..	x	...	...	...	...	...	...
Schizophoria propinqua Hall	...	x	...	..	...	...	...	...	...
Spirifer duodenarius (Hall)	x	...	...	...	...	...	...	...	...
Spirifer macrus Hall	x	. x	x	...	x	...	...	x	
Spirifer varicosus Hall	x	...	...	...	...	...	...	...	...
Spirifer sp	x	x	...	...	x	...	...	x	x
Stropheodonta demissa (Conrad)	x	x	x	x	x	...	...	x	x
Stropheodonta hemispherica Hall	...	x	x	...	...	...	...	...	...
Stropheodonta perplana (Conrad)	...	x	...	...	...	...	...	...	x
Pelecypoda									
Actinopteria boydi (Conrad)	...	...	...	...	...	...	...	x	...
Conocardium cuneus (Conrad)	...	x	x	...	...	...	...	...	...
Paracyclas elliptica Hall	...	...	x	...	x	...	...	...	...
Paracyclas lirata (Conrad)	...	...	...	...	...	...	...	x	...
Gastropoda									
Platyceras dumosum Conrad	x	...	...	...	...	...	...	...	...
Platyceras erectum Hall	...	...	...	x	x	...	...	...	...
Pleuronotus decewi (Billings)	...	x	...	x	...	...	...	...	...
Pleurotomaria sp	x	...	...	...	...	...	...	...	...
Pteropoda									
Tentaculites scalariformis Hall	x	x	...	...	...	...	...	...	...
Cephalopoda									
Gigantoceras inelegans (Meek)	...	...	...	x	...	...	...	...	...
Trilobita									
Phacops cristata Hall	x	...	x	...	...	...	...	...	...
Proetus rowi (Green)	...	x	...	...	...	...	...	...	...

Another important opening in the Devonian at St. Marys is known as the Thames quarry (see Plate IX). It is located along the Canadian Pacific railway near the southeast bank of the river and has exposed the following section.

Section of the Thames Quarry at St. Marys.

	Feet	Inches
10. Soil and drift	10	0
Delaware limestone		
9. Bluish brown limestone with layers more or less shaly and separated by soft shaly partings	8	6
8. A thin but persistent shaly layer	0	1
7. Hard layers of blue limestone with some shaly partings	2	7
6. A parting of brown shale, rather persistent	0	½
5. Rather compact, semi-crystalline, blue limestone becoming a very compact, bluish drab limestone at the top. Beds 8 to 14 inches in thickness but often breaking into 3 to 6 inch irregular layers	9	10
4. A blue limestone, hard, compact, and brittle. It is semi-crystalline, has bituminous contacts, and is quite fossiliferous	2	6
Onondaga limestone		
3. A semi-crystalline, blue limestone with a dark blue to almost black carbonaceous material at the contacts	2	6
2. Bluish grey, semi-crystalline limestone with several species of corals abundant near the bottom. This rock is very fossiliferous and petroleum occurs abundantly in the cavities of the fossils	3	6
1. Grey limestone, inclined to be massive, usually covered by water and forming the deepest part of the quarry at the pumps	6	0

The following fossils were found in the rocks at the Thames quarry, St. Marys.

	Horizons								
Anthozoa	1	2	3	4	5	6	7	8	9
Cystiphyllum vesiculosum Goldfuss	...	x	...	...	...	...	...	...	...
Heliophyllum corniculum (Lesueur)	...	x	...	...	...	...	...	...	...
Heliophyllum halli Milne-Edwards and Haime	...	...	x	...	...	...	...	...	...
Zaphrentis sp.	...	...	...	x	...	...	...	...	...
Bryozoa									
Cystodictya hamiltonense Ulrich	...	...	...	...	...	x	...	...	..
Fenestella sp	...	x	...	...	...	...	...	...	x
Brachiopoda									
Ambocoelia umbonata (Conrad)	...	...	...	...	...	...	x	...	x
Anoplotheca cautiplicata (?) (Conrad)	...	...	...	...	x	...	...	...	...
Athyris vittata (Hall)	...	...	...	...	...	...	...	x	x
Atrypa reticularis (Linnaeus)	...	x	x	x	x	...	...	...	...
Atrypa spinosa Hall	...	...	...	...	...	...	...	...	x
Camarotoechia tethys (Billings)	...	...	...	...	x	...	...	...	x
Chonetes deflectus Hall	...	...	...	...	...	...	...	...	x
Chonetes mucronatus Hall	...	x	x	x	x	...	x	x	x
Cyrtina hamiltonensis Hall	...	...	...	...	...	...	...	...	x
Cyrtina umbonata alpenaensis Hall and Clarke	...	...	...	...	...	...	...	...	x
Leptaena rhomboidalis (Wilckens)	...	x	x	x	x	...	...	...	x
Lingula ligea Hall	...	...	...	x	...	...	...	x	...
Martinia maia (Billings)	...	...	...	...	...	...	x	x	x
Martinia subumbona (Hall)	...	...	...	...	...	...	...	...	x
Pentamerella arata (Conrad)	...	...	...	x	...	...	...	...	...
Pholidostrophia iowaensis (Owen)	...	...	x	x	x	...	x	...	x
Productella spinulicosta Hall	...	...	...	...	x	...	...	...	x
Rhipidomella vanuxemi Hall	...	x	x	...	...	...	...	...	x
Spirifer macrus Hall	...	...	x	x	x	...	x	x	x
Spirifer mucronatus (Conrad)	...	...	...	...	...	...	...	...	x
Spirifer sp	...	...	x	...	...	...	...	x	...
Strophalosia truncata (Hall)	...	...	...	x	...	...	...	...	...
Stropheodonta concava Hall	...	...	...	...	...	...	...	...	x
Stropheodonta demissa (Conrad)	...	...	x	x	x	...	...	...	x
Stropheodonta hemispherica Hall	...	x	...	...	...	...	...	...	...
Stropheodonta perplana (Conrad)	...	...	...	...	...	...	...	...	x

Pelecypoda	Horizons 1	2	3	4	5	6	7	8	9
Aviculopecten sp	...	...	...	...	...	...	...	...	x
Conocardium cuneus (Conrad)	...	x	...	...	...	...	...	...	...
Grammysia bisulcata (Conrad)	...	...	...	...	...	...	...	...	x
Nyassa arguta Hall	...	...	...	...	...	...	...	...	x
Paracyclas elliptica Hall	...	x	...	x	x	...	...	...	...
Paracyclas lirata (Conrad)	...	...	...	...	x	...	...	...	...
Pterinea flabellum (Conrad)	...	...	...	...	...	...	...	...	x
Sphenotus cuneatus (Conrad)	...	...	...	...	...	...	...	...	x
Tellinopsis subemarginata (Conrad)	...	...	...	...	...	...	...	...	x
Gastropoda									
Platyceras erectum Hall	...	...	x	x	...	...	...	...	...
Pleuronotus decewi (Billings)	...	...	x	...	...	...	...	...	...
Pleurotomaria sp	...	...	...	...	...	...	...	...	x
Cephalopoda									
Centroceras ohioense (Meek)	...	...	...	x	...	...	...	...	...
Gigantoceras inelegans (Meek)	...	...	...	x	...	...	...	...	...
Nephriticeras bucinum (Hall)	...	...	...	...	...	...	...	...	x
Orthoceras constrictum (?) Vanuxem	...	...	...	...	...	...	...	...	x
Orthoceras sp	...	...	...	...	...	...	...	...	x
Protokionoceras marcellense (Vanuxem)	...	...	...	...	...	...	...	...	x
Trilobita									
Phacops sp	x	...	...	...	...	...	...	...	...

St. Marys is the best Ontario locality for observing the Delaware limestone. While it is often exposed elsewhere to the north and occasionally to the south, at no other place is its character better shown than in the quarries near the western limits of this city. It is separated from the underlying Onondaga with difficulty, although at most other places where it outcrops this contact is quite sharp. The outcrop at St. Marys has usually been classed with the Onondaga limestone, but the upper layers contain a preponderance of species which belong to a later formation. These latter show them to be of the same age as those beds from which the Marcellus shale fossils have been collected and make it impossible to class them as Onondaga.

HURON COUNTY SECTIONS.

CRANBROOK.

This is a small village lying off the railway 2½ miles to the southwest of Ethel, and 5½ miles east-southeast of Brussels, Gray township. The south branch of Maitland river runs past Cranbrook and it is in the bed and along the banks of that stream that the interesting rock outcrops occur. Mr. Valentine Grahmn has done some quarrying and burned lime on lot 14, concession XI, near the northwestern edge of the village, and there the following section is exposed.

Section at Mr. Valentine Grahamn's Lime-kiln, Cranbrook.

	Feet	Inches
3. Soil and drift	1	10
Delaware limestone		
2. Compact, often semi-crystalline, brittle, bluish grey limestone in 6 to 18-inch beds. Fossils are abundant in most of these layers	5	4
Onondaga limestone		
1. A grey to brown, more or less massive limestone which breaks up into thinner beds. Crinoid stems quite abundant and conspicuous because of their white colour. The contact of these beds with those overlying is rough and uneven. River level	2	6

The following fauna was found in the rocks of this section.

Anthozoa	Horizons 1	Horizons 2
Cladopora labiosa (Billings)	x	..
Cystiphyllum vesiculosum Goldfuss	..	x
Diphyphyllum sp	..	x

	Horizons 1	2
Bryozoa		
Cystodictya gilberti (Meek)	x	..
Cystodictya hamiltonense Ulrich	..	x
Fenestella sp	x	..
Brachiopoda		
Atrypa reticularis (Linnaeus)	x	x
Camarotoechia carolina Hall	x	..
Chonetes deflectus Hall	..	x
Craniella hamiltoniae (Hall)	..	x
Cyrtina hamiltonensis Hall	..	x
Martinia maia (Billings)	..	x
Martinia subumbona (Hall)	..	x
Pholidostrophia iowaensis (Owen)	x	x
Productella spinulicosta Hall	..	x
Rhipidomella vanuxemi Hall	x	..
Spirifer macrus Hall	..	x
Stropheodonta demissa (Conrad)	..	x
Stropheodonta hemispherica Hall	x	..
Stropheodonta perplana (Conrad)	x	x
Pelecypoda		
Concardium cuneus (Conrad)	x	..
Grammysia sp	..	x
Paracyclas lirata (Conrad)	..	x
Paracyclas ohioensis Meek	..	x
Gastropoda		
Platyceras carinatum Hall	x	..
Platyceras cymbium Hall	x	..
Platyceras dumosum Conrad	x	..
Platyceras erectum Hall	x	x
Cephalopoda		
Protokionoceras marcellense (Vanuxem)	..	x

Nearly 3 miles farther west, along the river towards Brussels, a somewhat similar but more extensive outcrop of these beds occurs. On Mr. Robert Miller's farm, lot 5, concession XII, a small amount of quarrying has been done and the following section exposed.

Section of the Rocks Exposed in Robert Miller's Quarry.

	Feet	Inches
3. Soil and drift	3	0
Delaware limestone		
2. Compact, semi-crystalline, blue limestone with some thin shaly partings; layers usually very fossiliferous	8	6
Onondaga limestone		
1. Crinoidal, grey limestone, rather more crystalline than the beds above. Upper surface of this rock rough and the contact with the Delaware limestone uneven	4	4

The fauna collected from these beds was as follows.

	Horizons	
Brachiopoda	1	2
Ambocoelia umbonata (Conrad)	..	x
Atrypa reticularis (Linnaeus)	x	x
Chonetes deflectus Hall	..	x
Cyrtina hamiltonensis Hall	..	x
Cyrtina umbonata alpinensis Hall and Clarke	..	x
Leptaena rhomboidalis (Wilckens)	..	x
Martinia maia (Billings)	..	x
Martinia subumbona (Hall)	..	x
Pholidostrophia iowaensis (Owen)	..	x
Productella spinulicosta Hall	..	x
Rhipidomella vanuxemi Hall	..	x
Spirifer macrus Hall	..	x
Stropheodonta demissa (Conrad)	x	x
Pelecypoda		
Aviculopecten princeps (Conrad)	..	x
Paracyclas elliptica Hall	..	x
Paracyclas ohioensis Meek	..	x

	Horizons	
Gastropoda	1	2
Platyceras carinatum Hall	x	x
Platyceras rarispinosum Hall	..	x
Pteropoda		
Coleolus tenuicinctus Hall	..	x

As the fauna in division 2 of the above section distinctly shows, it is the same as that which occurs in the same division of the preceding section and in the upper portion of the outcrop at St. Marys.

FORDWICH.

This village is on the north branch of Maitland river near the central part of Howick township. At the highway bridge over the river, just west of town, lot 18, of concessions VI and VII, there is an outcrop of a few feet of Onondaga limestone in the bed of the stream. Several old lime-kilns are located there and formerly a little quarrying was done, but the pits have long since caved in and are now completely overgrown with vegetation. The rock is a grey to brownish limestone which usually contains chert. The following fossils are rather common.

Anthozoa

Eridophyllum vernuillianum Milne-Edwards and Haime.
Favosites cervicornis Milne-Edwards and Haime.
Favosites turbinatus Billings.
Favosites winchelli Rominger.
Heliophyllum exiguum Billings.
Synaptophyllum simcoense (Billings).
Syringopora hisingeri Billings.
Syringopora perelegans Billings.
Zaphrentis gigantea Lesueur.

Hydrozoa

Stromatoporella sp.

Bryozoa

Fenestella sp.

Brachiopoda

Meristella nasuta (Conrad).
Rhipidomella vanuxemi Hall.
Stropheodonta concava Hall.
Stropheodonta demissa (Conrad).
Stropheodonta hemispherica Hall.
Stropheodonta perplana (Conrad).

Pelecypoda

Conocardium cuneus (Conrad).

Trilobita

Coronura diurus (Green).

These rocks dip to the westward and, if this is not reversed, should lie below the fossiliferous beds found at W. G. Hamilton's quarry a few miles to the west. As will be seen, however, there is no evidence of these beds in that quarry and it seems hardly probable that they lie below the lowest rocks there exposed.

GORRIE.

There are several important outcrops near the town of Gorrie, which is also located along the north branch of the Maitland river in Howick township. Three miles to the southeast Mr. W. G. Hamilton has burned lime and quarried a little from the steep bank of the river. The section exposed at that place is as follows.

Section of W. G. Hamilton's Quarry.

	Feet	Inches
4. Soil and drift	6	0
Onondaga limestone		
3. Irregularly bedded, compact, earthy, brown limestone with a little shale and some chert. Cavities resulting from the solution of fossils are partly filled with calcite and rather abundant	8	0
2. Massive, somewhat banded, brown limestone	3	0
1. Covered to level of Maitland river	9	0

The rocks in this quarry are not very fossiliferous, but the following species may be found.

	Horizons 2	Horizons 3
Anthozoa		
Aulopora cornuta (?) Billings	..	x
Romingeria umbellifera (Billings)	..	x
Syringopora hisingeri Billings	x	..
Zaphrentis gigantea (?) Lesueur	x	..
Bryozoa		
Cystodictya gilberti (Meek)	..	x
Cystodictya sp	..	x
Fenestella tuberculata (?) Hall and Simpson	..	x
Isotrypa conjunctiva (Hall)	..	x
Prismopora triquetra Hall	..	x
Brachiopoda		
Atrypa reticularis (Linnaeus)	..	x
Camarotoechia tethys (Billings)	..	x
Crania crenistriata Hall	..	x
Eunella sp	..	x
Meristella nasuta (Conrad)	..	x
Productella spinulicosta Hall	..	x
Rhipidomella livia (Billings)	..	x
Stropheodonta inequistriata (?) (Conrad)	..	x
Pelecypoda		
Goniophora perangulata Hall	..	x
Modiomorpha sp	..	x
Cephalopoda		
Gomphoceras sp	..	x
Ryticeras citum Hall	..	x

A very similar outcrop of these same beds occurs at Robert Ashton's quarry on lot 17, concession VIII, 1½ miles east of

Gorrie. Considerable limestone has been taken out of that quarry, chiefly to supply a local lime-kiln, and the following section has been exposed.

Section of Robert Ashton's Quarry.

	Feet	Inches
4. Soil and drift	4	0
Onondaga limestone		
3. Irregular, hard, brittle, grey to drab limestone in thin beds. The upper few feet of this mass is almost a shale and bituminous films are common throughout. These beds also contain a little chert	8	6
2. Irregularly banded, massive, brown limestone with indications of fossils, but none identifiable, and all rare	4	2
1. Covered to level of Maitland river	5	8

The following fauna was collected entirely from beds No. 3.

Anthozoa

Aulopora cornuta Billings.
Cladopora labiosa (Billings).
Cystiphyllum vesiculosum Goldfuss.
Eridophyllum vernuillianum Milne-Edwards and Haime.
Favosites basalticus Goldfuss.
Favosites clausus Rominger.
Favosites emmonsi Rominger.
Favosites limitaris Rominger.
Favosites radiciformis Rominger.
Favosites turbinatus Billings.
Heliophyllum halli Milne-Edwards and Haime.
Romingeria umbellifera (Billings).
Synaptophyllum simcoense (Billings).
Syringopora hisingeri Billings.
Zaphrentis gigantea Lesueur.

Hydrozoa

Stromatoporella granulata Nicholson.
Stromatoporella tuberculata Nicholson.
Syringostroma densa Nicholson.

Blastoidea

Codaster pyramidatus Shumard.

Bryozoa

Cystodictya gilberti (Meek).
Cystodictya sp.
Fistulipora (?) permarginata (Hall).
Hederella cirrhosa Hall.
Isotrypa consimilis Hall.
Loculipora circumstata (Hall and Simpson).
Polypora brevisulcata (Hall).
Polypora hexagonalis (Hall).

Brachiopoda

Athyris sp.
Atrypa reticularis (Linnaeus).
Camarotoechia carolina (?) Hall.
Chonetes hemisphericus Hall.
Delthyris raricosta Conrad.
Leiorhynchus sp.
Meristella nasuta (Conrad).
Pentamerella arata (Conrad).
Rhipidomella vanuxemi Hall.
Schellwienella pandora (Billings).
Schizophoria propinqua Hall.
Spirifer varicosus Hall.
Stropheodonta demissa (Conrad).
Stropheodonta perplana (Conrad).
Strophonella ampla Hall.

Pelecypoda

Aviculopecten sp.
Conocardium cuneus (Conrad).
Modiomorpha sp.
Mytilarca percarinata Whitfield.

Gastropoda

Cyclonema crenulatum Meek.
Euryzone lucina (Hall).
Hormotoma maia (Hall).
Loxonema pexatum Hall.
Loxonèma robustum Hall.
Pleurotomaria sp.

Cephalopoda

Gomphoceras n. sp.
Gomphoceras conradi (?) Hall.
Gomphoceras illaenus (?) Hall.
Ryticeras citum Hall.
Spyroceras thoas (Hall).

Trilobita

Proetus rowi (Green).

The impurities in the limestone, the bituminous films, and the irregular deposition of the rock at this and the preceding place, give abundant evidence of deposition near shore. A very short distance to the west the bed-rock is Silurian in age. Its surface is often very much eroded and, where the Devonian is found lapping up on the edges of the old land mass, the unconformity is marked. Fairly good examples of this condition may be found in Culross township half a mile below the falls of the Teeswater, where variation in the Silurian surface sometimes exceeds 30 feet within short distances. It seems that the region extending from some point near Sunshine, Morris township, northward beyond Riversdale, Greenock township, must have been land, probably an island, during the time that the adjacent areas were covered by the Devonian sea; and that this land was furnishing a small amount of sediment which at times polluted the waters in which limestone was being deposited.

BENMILLER.

This is a small village located 5 miles up the Maitland river from Lake Huron, and at the point where Sharp creek joins the main stream. One mile west of the village the river falls or cascades over about 5 feet of the Onondaga limestone, while a portion of the lower Erian or Delaware limestone is shown in the adjacent bank. Numerous pot-holes are developed here in the lower beds, but none are of very great size. A much better section of these same layers occurs at the bridge south of the village post-office, where the following section may be seen.

Section Exposed at the Highway Bridge Near Benmiller Post-office.

	Feet	Inches
5. Soil and drift	6	0
Delaware limestone		
4. Compact, drab limestone with some grey to buff layers near the top where leaching has modified them. These beds are quite fossiliferous and are separated from those below by a stylolitic surface	8	8
Onondaga limestone		
3. Massive, semi-crystalline, grey to brown limestone in which fossils are comparatively rare	4	8
2. Grey to brown limestone with irregular masses of soft, cherty nodules rather common	1	6
1. Grey to brown fossiliferous limestone to the level of Maitland river	3	0

The following fauna was collected from the rocks of this section.

	Horizons	
Anthozoa	1 to 3	4
Heliophyllum halli Milne-Edwards and Haime	..	x
Zaphrentis prolifica Billings	..	x
Hydrozoa		
Stromatoporella sp	..	x
Bryozoa		
Fenestella sp	x	..
Brachiopoda		
Athyris vittata Hall	..	x
Atrypa reticularis (Linnaeus)	x	x
Atrypa spinosa Hall	..	x
Chonetes mucronatus Hall	x	x
Cranaena romingeri Hall	..	x
Cyrtina hamiltonensis Hall	x	x

	Horizons	
Brachiopoda—*Contd.*	1 to 3	4
Cyrtina umbonata alpenaensis Hall and Clarke	..	x
Delthyris consobrina (d'Orbigny)	..	x
Eunella lincklaeni Hall	..	x
Leiorhynchus limitare (Vanuxem)	..	x
Leptaena rhomboidalis (Wilckens)	..	x
Lingula ligea Hall	..	x
Pentamerella arata (Conrad)	..	x
Pholidops patina Hall and Clarke	x	..
Pholidostrophia iowaensis (Owen)	..	x
Productella exanthemata Hall	..	x
Productella spinulicosta Hall	..	x
Rhipidomella vanuxemi Hall	..	x
Schizophoria striatula (Schlotheim)	..	x
Spirifer lucasensis Stauffer	..	x
Spirifer macrus Hall	..	x
Strophalosia truncata (Hall)	..	x
Stropheodonta demissa (Conrad)	x	x
Stropheodonta hemispherica Hall	x	..
Stropheodonta perplana (Conrad)	x	x
Pelecypoda		
Actinopteria boydi (Conrad)	..	x
Aviculopecten bellus (Conrad)	..	x
Conocardium cuneus (Conrad)	x	..
Conocardium normale Hall	..	x
Paracyclas elliptica Hall	..	x
Schizodus appressus (Conrad)	..	x
Gastropoda		
Euomphalus sp	..	x
Platyceras erectum Hall	..	x
Pleurotomaria sp	..	x
Pteropoda		
Tentaculites scalariformis Hall	..	x
Cephalopoda		
Centroceras ohioense (Meek)	..	x
Gigantoceras inelegans (Meek)	..	x
Trilobita		
Proetus sp	..	x

About 4 miles east of Benmiller the river cuts through somewhat higher beds on Mr. Holliday's land. Below the highway bridge on the line between concessions II and III, Colborne township, a small amount of quarrying has been done and the following section is exposed.

Section on Mr. Holliday's Land, 4 Miles East of Benmiller.

	Feet	Inches
4. Soil and drift	6	0
Delaware limestone		
3. A hard, massive layer of fossiliferous blue to drab limestone	1	6
2. Hard, blue to drab fossiliferous limestone	2	6
1. Rough, blue to grey crinoidal limestone to the level of Maitland river	1	8

The following fauna was collected from the rocks of this section.

	Horizons	
Anthozoa	1	2 and 3
Cystiphyllum vesiculosum Goldfuss	..	x
Brachiopoda		
Athyris vittata Hall	..	x
Atrypa reticularis (Linnæus)	..	x
Atrypa spinosa Hall	..	x
Camarotoechia dotis Hall	..	x
Camarotoechia prolifica Hall	..	x
Chonetes deflectus Hall	..	x
Craniella hamiltoniae Hall	..	x
Delthyris consobrina (d'Orbigny)	..	x
Pholidostrophia iowaensis (Owen)	..	x
Productella spinulicosta Hall	..	x
Rhipidomella vanuxemi Hall	x	x
Schizophoria striatula (Schlotheim)	..	x
Spirifer macrus Hall	..	x
Spirifer sp	..	x
Stropheodonta demissa (Conrad)	x	x
Stropheodonta perplana (Conrad)	..	x

Pelecypoda	Horizons 1	Horizons 2 and 3
Grammysia arcuata (Conrad)	..	x
Nyassa recta (?) Hall	..	x
Panenka alternata Hall var	..	x
Paracyclas elliptica Hall	..	x
Paracyclas ohioensis Meek	..	x
Gastropoda		
Bembexia planidorsalis Hall	..	x
Platyceras erectum Hall	x	..
Pleurotomaria sp	..	x

GODERICH.

The largest and most important outcrops along the Maitland river are located at Goderich. About half a mile above the Grand Trunk depot the river has made a considerable cut through the heavy drift covering and into the bed-rock. Nearly vertical cliffs of limestone are thus exposed and form a section unexcelled in the county.

Section Along the Maitland River One-half Mile Above the Grand Trunk Depot at Goderich.

	Feet	Inches
9. Soil and drift	30	0
Delaware limestone		
8. A very compact, fossiliferous, grey to drab limestone separated from that below by a rough contact	9	6
Onondaga limestone		
7. Massive, grey to brown, semi-crystalline limestone	10	0
6. A layer of brown limestone in which corals are rather abundant	1	4

	Feet	Inches
5. Grey to brown, semi-crystalline and earthy limestones inclined to be massive. Some layers show a wavy banding due to the presence of bituminous films. Rough, bituminous bedding planes are common and an occasional dolomitic pebble may be found as much as 3 feet above the bottom..........	19	6
4. Semi-crystalline, grey limestone with pebbles of the underlying dolomites, and some quartz sand, mingled with Onondaga fossils.......	0	6
Detroit River series		
3. Thin-bedded to shaly, compact, drab limestone or dolomite with much bituminous matter in the form of films between the layers........	2	6
2. A variable amount of buff to ash-coloured, compact dolomite which is slightly banded.....	2	10
1. Soft, mottled, yellow, and porous, drab dolomites. One or two layers have a conglomeratic phase in places. The upper layer is invariably uneven and a compact yellowish rock. Some layers are banded with bituminous matter. Level of Maitland river..................	5	6

This section is especially important because it shows both boundaries of the Onondaga limestone and the unconformity at the base (see Plate X). It is also remarkable for the slight thickness of the Onondaga limestone, which is here reduced to less than 32 feet. No attempt has been made to divide the Onondaga into faunal zones, although in the field some indication of such a possibility was found. The following fauna was collected from the section above given.

	Horizons	
Anthozoa	4 to 7	8
Acervularia rugosa Milne-Edwards and Haime	x	..
Cystiphyllum vesiculosum Goldfuss	..	x
Favosites emmonsi Rominger	x	..
Favosites turbinatus Billings	x	..
Heliophyllum halli Milne-Edwards and Haime	x	..
Zaphrentis gigantea Lesueur	x	..
Zaphrentis sp	x	..
Bryozoa		
Cystodictya gilberti (Meek)	x	..
Fenestella parallela Hall	x	..
Fenestella sp	x	..
Fistulipora subcava (Hall)	x	..
Monotrypa tenuis (Hall)	x	..
Brachiopoda		
Athyris vittata Hall	?	x
Atrypa reticularis (Linnaeus)	x	x
Atrypa spinosa Hall	..	x
Camarotoechia billingsi (?) Hall	..	x
Camarotoechia prolifica Hall	..	x
Chonetes deflectus Hall	..	x
Chonetes lineatus Conrad	x	..
Chonetes mucronatus Hall	x	x
Crania crenistriata Hall	..	x
Cyrtina hamiltonensis Hall	x	x
Cyrtina umbonata alpenaensis Hall and Clarke	..	x
Eunella harmonica Hall	..	x
Eunella lincklaeni Hall	..	x
Leptaena rhomboidalis (Wilckens)	..	x
Lingula delia Hall	..	x
Pholidostrophia iowaensis (Owen)	x	x
Productella spinulicosta Hall	x	..
Rhipidomella vanuxemi Hall	x	x
Schizophoria propinqua Hall	x	..
Schizophoria striatula (Schlotheim)	..	x
Spirifer divaricatus Hall	..	x
Spirifer lucasensis Stauffer	..	x
Spirifer macrus Hall	x	x

	Horizons	
	4 to 7	8
Brachiopoda—*Contd.*		
Spirifer manni Hall	x	..
Strophalosia truncata (Hall)	..	x
Stropheodonta concava Hall	x	x
Stropheodonta demissa (Conrad)	x	x
Stropheodonta hemispherica (Hall)	x	..
Stropheodonta patersoni Hall	x	..
Stropheodonta perplana (Conrad)	x	x
Pelecypoda		
Actinopteria boydi (Conrad)	..	x
Aviculopecten bellus (Conrad)	..	x
Conocardium normale Hall	..	x
Nyassa recta Hall	..	x
Paracyclas elliptica Hall	x	x
Paracyclas lirata (Conrad)	..	x
Gastropoda		
Euomphalus sp	..	x
Platyceras carinatum Hall	x	..
Platyceras erectum Hall	..	x
Platyceras sp	x	..
Pleoronotus decewi (Billings)	x	..
Pteropoda		
Tentaculites scalariformis Hall	x	..
Cephalopoda		
Gigantoceras inelegans (Meek)	..	x
Trilobita		
Coronura diurus (Green)	x	..
Proetus crassimarginatus Hall	x	..
Proetus welleri (?) Stauffer	x	..
Proetus sp	..	x

PORT ALBERT.

This is a small village located in Ashfield township about 8 miles to the north of Goderich. At that point the Lucknow river empties into Lake Huron, and the falls of the Lucknow are located at the mill in the village about a mile up from the lake. The following is a section of the rocks exposed at the falls.

Section at the Falls of the Lucknow River at Port Albert.

	Feet	Inches
5. Soil and drift	1	0
Delaware limestone		
4. Compact, blue to grey limestone	1	8
Onondaga limestone		
3. Grey to brown limestone	1	0
2. Covered interval	4	0
1. Massive, grey to brown, semi-crystalline limestone with considerable bituminous matter occurring in streaks. These beds extend to the level of the Lucknow river below the falls	10	0

The following fauna was found in the rocks exposed at the falls of the Lucknow.

	Horizons	
Anthozoa	1	4
Cystiphyllum vesiculosum Goldfuss	x	x
Zaphrentis sp	x	..
Brachiopoda		
Athyris vittata Hall	..	x
Atrypa reticularis (Linnaeus)	x	x
Chonetes deflectus Hall	..	x
Chonetes mucronatus Hall	x	..
Cyrtina hamiltonensis Hall	..	x
Cyrtina umbonata alpenaensis Hall and Clarke	..	x
Delthyris consobrina (d'Orbigny)	..	x
Eunella lincklaeni Hall	..	x
Leptaena rhomboidalis (Wilckens)	..	x
Pholidostrophia iowaensis (Owen)	..	x
Rhipidomella vanuxemi Hall	x	x
Schizophoria striatula (Schlotheim)	..	x
Spirifer sp	x	x
Stropheodonta concava Hall	..	x
Stropheodonta demissa (Conrad)	x	x
Stropheodonta hemispherica Hall	x	..
Stropheodonta perplana (Conrad)	x	x
Pelecypoda		
Actinopteria boydi (Conrad)	..	x

This small collection of species does not adequately represent the fauna which these rocks evidently contain. This is chiefly because the more fossiliferous portions are but poorly exposed. The list is extensive enough, however, to make the reference of these beds to the horizons here given certain. This is, in fact, an outcrop of the same beds that occur in outcrop near Brussels and Cranbrook, and which are so well developed in Colborne township to the southward.

Fish teeth and fragments of spines are rather abundant in the Delaware limestone in the vicinity of Goderich, but no identifiable remains were found. It is evident from much of the fauna that this formation was, in part at least, contemporaneous with the Marcellus beds of New York. In fact at some places, as has been pointed out on a previous page, the real Marcellus black shale is developed in Ontario. But as a whole it is hardly possible to correlate these beds directly with those of New York, chiefly because the Ontario fauna often bears a stronger relationship to the Onondaga than does that of the Marcellus beds. The change to western conditions is apparently indicated in the Marcellus beds of western New York where "the basal shale becomes more calcareous, and in Erie county the Agoniatite layer and the strata below it have become so far assimilated with the Onondaga limestone as not to be readily distinguished from it."[1] In Ohio the Delaware limestone with which these Ontario deposits are identified, is now usually considered as belonging in the Hamilton[2], but it is rather the Hamilton group, or the older usage of that name, which is there adhered to. The term Erian has now largely replaced the Hamilton in that sense and the older is used in a much more limited way. The basal portion of the Delaware of Ohio is often composed of a brown shale which carries fossils nearly as distinctive of the Marcellus as are those of the deposits referred to as occurring near Selkirk. It seems evident, therefore, that all of these beds are of relatively the same age and that they begin at essentially the same horizon. They are more or less transitional between the Onondaga and

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[1] Hartnagel, C. A.; N.Y. State Museum, Handbook 19, 1912, pp. 64, 65.
[2] Geol. Surv. of Ohio, Bull. 10, 1909, pp. 19, 20, 176, 177.

the true Hamilton beds and it is hardly probable that they terminated at the same time in these rather distant portions of the old middle Devonian sea. The more comprehensive fauna found in these beds in Ontario is evidence which seems to bear out this statement.

WINGHAM.

This town is located at the junction of the north and south branches of the Maitland river and only about 4 miles from the north line of Huron county. It is on the eastern border of the Detroit River series inlier or island already mentioned and apparently is underlaid by rocks of that age.

Beginning a short distance to the east of Wingham and extending northward to some point about halfway between the villages of Greenock and Chepstowe, is a mass of rock which differs radically from anything else belonging to the Devonian of southwestern Ontario. It is a massive, rough, semi-crystalline, grey limestone which seems to show no bedding. It is cracked and checked like newly burned lime, and does not seem to be uniformly soluble as is suggested by the holes and cavities appearing on the weathered surface. The fauna of this limestone isquite varied, but a close examination of the face of a cliff in a favourable locality, such as Formosa, soon reveals the fact that it is almost a solid mass of stromatoporoids and the fragments that have wasted from the reefs built by these organisms. Dwelling in among the hydrozoans were occasional corals and the numerous other forms of life, such as crustaceans, mollusks, brachiopods, etcetera, which are usually attracted to places of abundant food supply. The thickness of this mass of rock is not definitely known, but as much as 40 feet occurs in the cliffs below the falls of the Teeswater river and it probably does not greatly exceed that amount. The width of the area covered by this deposit is also more or less obscure, but it seems to be much less than its length, thus giving the whole an elongate elliptical form. Just west of the area covered by this mass of rocks, drift boulders derived from it are scattered over the surface in abundance. At some places one could walk over several acres of land by stepping from one boulder to another.

The southernmost known outcrop of this massive Devonian limestone is to be found on lot 20, concession VIII, township of Turnberry, where it rises 5½ feet above the north branch of the Maitland river. Here it shows the usual rough, massive, grey limestone with no real bedding visible and cut by irregular joints. The following are the abundant fossil forms occurring in it.

Anthozoa

Cladopora labiosa (Billings).
Cystiphyllum vesiculosum Goldfuss.
Diphyphyllum sp.
Favosites alpenaensis Winchell.
Favosites billingsi Rominger.
Favosites limitaris (?) Rominger.
Favosites turbinatus Billings.
Heliophyllum halli Milne-Edwards and Haime.
Syringopora intermedia (?) Nicholson.
Zaphrentis prolifica Billings.

Hydrozoa

Stromatopora monticulifera Winchell.
Stromatopora pustulifera Winchell.
Stromatoporella granulata Nicholson.

Bryozoa

Polypora hexagonalis (?) (Hall).

Brachiopoda

Atrypa reticularis (Linnaeus).
Camarotoechia prolifica Hall.
Camarotoechia sappho Hall.
Camarotoechia sp.
Craniella hamiltoniae Hall.
Meristella barrisi Hall
Pentamerella arata (?) Hall
Rhipidomella vanuxemi Hall.
Spirifer divaricatus Hall.
Spirifer macrus Hall.
Spirifer sp.
Stropheodonta inaequistriata (Conrad).
Stropheodonta perplana (Conrad).

Pelecypoda

Aviculopecten pecteniformis (Conrad).
Conocardium normale Hall.
Grammysia sp.
Modiomorphia sp.
Mytalarca sp.
Nucula sp.
Pterinea flabellum (Conrad).

Gastropoda

Bellerophon sp.
Euomphalus planodiscus Hall.
Hormotoma maia (?) Hall.
Loxonema sp.
Pleurotomaria plena Hall.
Strophostylas varians (?) Hall.

Cephalopoda

Cyclostomiceras metula (?) (Hall).
Poterioceras clavatum (?) (Hall).
Poterioceras sp.
Ryticeras sp.
Spyroceras nuntium (Hall).
Spyroceras thoas (?) (Hall).

Trilobita

Proetus crassimarginatus (?) Hall.
Proetus microgemma (?) Hall.

As will be seen from the above list, this fauna resembles the Onondaga in some respects. Those doubtfully referred to forms belonging in that formation, however, probably are new species. The state of preservation of much of the material collected made it uncertain whether such forms were distinct or not.

BRUCE COUNTY SECTIONS.

BELMORE.

Along the Teeswater river in southeastern Culross and southwestern Carrick townships, about 2 miles to the north and northwest of the village of Belmore, there are some good outcrops of this very massive limestone. At the old sawmill and the lime-kilns on the township line to north, the limestone stands in cliffs 30 to 40 feet high, while on lot 4, concession III, Culross township, the river drops over a ledge of this rock producing what is known as the falls of the Teeswater. In the sides of the more or less rock bound valley below there are very good outcrops showing nearly 40 feet of the Devonian, and in a rough pasture field on the next lot below that on which the falls occur, the underlying dolomites are occasionally shown. These are sometimes at an elevation of as much as 30 feet above nearby outcrops of Hamilton rocks and thus indicate the extent of the uneveness of the pre-Hamilton surface. On lot 5, concession IV, an old rock gorge occurs where steep cliffs of Devonian limestone outcrop. In all of these places the rock is the same massive, grey limestone which was described for the locality near Wingham. The whole area covered by it is, in fact, one great stromatoporoid reef with little or no division into faunal zones. Owing to the massiveness of the rock and the poor preservation of the fossils obtainable, its study is attended with considerable difficulty. The following is a list of the forms collected at the falls of the Teeswater.

Anthozoa

Cystiphyllum vesiculosum Goldfuss.
Favosites alpenaensis Winchell.
Favosites billingsi Rominger.
Favosites clausus Rominger.
Favosites limitaris (?) Rominger.
Favosites radiatus Rominger.
Favosites turbinatus Billings.
Heliophyllum halli Milne-Edwards and Haime.
Zaphrentis prolifica Billings.

Hydrozoa

Stromatoporella monticulifera Winchell.

Bryozoa.

Polypora sp.

Brachiopoda.

Atrypa reticularis (Linnaeus).
Cyrptonella planirostris Hall.
Cyrtina biplicata (?) Hall.
Cyrtina hamiltonensis Hall.
Nucleospira concinna Hall.
Pentamerella arata (?) Hall.
Reticularia fimbriata (Conrad).
Rhipidomella vanuxemi Hall.
Schizophoria striatula (Schlotheim).
Schellwienella perversus (Hall).
Spirifer divaricatus Hall.
Spirifer macrus Hall.
Spirifer sp.
Stropheodonta concava Hall.
Stropheodonta inaequistriata (Conrad).

Pelecypoda

Aviculopecten sp.
Conocardium normale Hall.
Conocardium ohioensis (Conrad).
Pterinea flabellum (Conrad).

Gastropoda

Bellerophon sp.
Lophospira adjutor (Hall).
Loxonema sp.
Pleurotomaria sp.

Cephalopoda

Clostomiceras metula (?) (Hall).
Poterioceras raphanus (Hall).
Poterioceras sp.
Spyroceras nuntium (Hall).
Spyroceras thoas (?) (Hall).

Trilobita

Phacops sp.
Proetus crassimarginatus (?) Hall.
Proetus microgemma (?) Hall.

FORMOSA.

This village is located on the line between Carrick and Culross townships, about 8 miles to the north of Belmore. It is in a rather deep valley excavated by a tributary to the Teeswater river and an excellent outcrop of the massive Devonian limestone occurs within the village. Although there is a total of not more than 27 feet of this rock exposed at Formosa, it is undoubtedly the best of all the outcrops of this phase of the Devonian. The reef structure is shown to good advantage and the fossils are somewhat more accessible than at many of the other outcrops. While the fauna of this limestone is hardly to be considered a diminutive one, it is a noticeable fact that the specimens of Brachiopoda and Mollusca most frequently found are much under the usual adult size. Many of the fossils are merely cavities, more or less altered by solution or partly filled by crystals of calcite. Nevertheless, some very fine specimens may be obtained and in the fresher parts of the rock many of them are well preserved, but often difficult to obtain. The following fauna was collected at Formosa.

Anthozoa

Cladopora roemeri (Billings).
Cystiphyllum vesiculosum Goldfuss.
Diphyphyllum sp.
Favosites alpenaensis Winchell.
Favosites billingsi Rominger.
Favosites clausus Rominger.
Favosites limitaris (?) Rominger.
Favosites radiatus Rominger.
Favosites radiciformis Rominger.
Heliophyllum halli Milne-Edwards and Haime.
Syringopora crassata (?) Winchell.
Zaphrentis prolifica Billings.

Hydrozoa

Stromatopora monticulifera Winchell.
Stromatopora pustulifera Winchell.
Stromatoporella granulata Nicholson.
Stylodictyon columnare Nicholson.

Vermes

Spirorbis omphalodes Goldfuss.

Byrozoa

Cystodictya hamiltonensis Ulrich.
Cystodictya incisurata (Hall).
Fenestella sp.
Hederella filiformis (Billings).
Polypora celsipora (?) Hall.
Polypora hexagonalis (?) Hall.
Streblotrypa hamiltonensis (Nicholson).

Brachiopoda

Ambocoelia umbonata (Conrad).
Athyris cora Hall.
Athyris vittata Hall.
Atrypa reticularis (Linnaeus).
Camarotoechia prolifica Hall.
Camarotoechia sappho Hall.
Camarotoechia tethys (Billings).
Craniella hamiltoniae Hall.
Cryptonella planirostris Hall.
Cyrtina hamiltonensis Hall.
Eunella linckleani Hall.
Gypidula comis (?) (Owen).
Gypidula romingeria (?) Hall and Clarke.
Leiorhynchus laura (Billings).
Leiorhynchus mysia (?) Hall.
Leiorhynchus sp.
Meristella barrisi Hall.
Nucleospira concinna Hall.
Pentamerella arata (?) (Conrad).
Pentamerella pavillionensis Hall.
Productella spinulicosta Hall.
Reticularia fimbriata (Conrad).
Rhipidomella cyclas (?) Hall.
Schizophoria striatula (Schlotheim).
Spirifer divaricatus Hall.
Spirifer macrus Hall.
Spirifer sp.
Stropheodonta inaequistriata (Conrad).
Stropheodonta patersoni Hall var.
Stropheodonta perplana (Conrad).

Pelecypoda

Actinopteria boydi (Conrad).
Aviculopecten sp.
Conocardium cuneus (?) (Conrad).
Conocardium normale Hall.
Goniophora hamiltonensis Hall.
Grammysia cuneata (?) Hall.
Macrodon hamiltoniae Hall.
Mytalarca sp.
Nyassa recta Hall.
Pterinea flabellum (Conrad).
Pterinopecten intermedius (?) Hall.

Gastropoda

Bellerophon sp.
Bembexia sulcomarginata (Conrad).
Callonema sp.
Cyclonema hamiltoniae Hall.
Euomphalus planodiscus Hall.
Hormotoma maia (?) Hall.
Hormotoma micula Hall.
Loxonema delficola Hall.
Loxonema laeviusculum Hall.
Platyceras carinatum Hall.
Platyceras erectum Hall.
Pleurotomaria rotalia Hall.
Pleurotomaria sp.
Straparollus sp.

Pteropoda

Hyolithes aclis Hall.

Cephalopoda

Poterioceras sp.
Ryticeras citum (?) (Hall).
Ryticeras cf. trivolve (Conrad).
Spyroceras crotalum (Hall).
Spyroceras nuntium (Hall.)
Spyroceras thoas (?) (Hall).
Tornoceras uniangulare (Conrad).
Trochoceras sp.

Ostracoda

Leperditia (?) subrotunda Ulrich.

Trilobita

Phaethonides varicella Hall var.
Proetus crassimarginatus (?) Hall.
Proetus microgemma (?) Hall.
Proetus rowi (Green).

In the highway between concessions X and XI, about 2½ miles to the southwest of the village, there is an outcrop of the same thickness of this limestone where essentially the same fauna may be found. Another even more important outcrop occurs at Bruder's lime-kiln where Beaver creek crosses the township line 2½ miles north of Formosa. A great mass of the rock stands in the highway and large blocks of it have slipped part way down the slopes making a most picturesque and striking appearance (see Plate XI). The contact of this limestone with the underlying Detroit River dolomite is also well shown at Bruder's lime-kiln (see Plate XII).

Section at Bruder's Lime-kiln, 2½ Miles North of Formosa.

	Feet	Inches
Hamilton beds (Alpena limestone)		
4. Massive, rough, semi-crystalline, grey limestone with an abundant fauna in which stromatoporoids are dominant. These beds lie unconformably on the uneven surface of the Silurian	32	0
Detroit River series		
3. Buff to ash coloured dolomitic limestone which is quite soft and somewhat irregularly bedded. These beds are also quite fossiliferous	2	6
2. Massive, brown dolomitic limestone	5	4
1. Covered interval to the level of Beaver creek	18	6

The following fauna was collected from the Devonian portion of the above section.

Anthozoa

Cystiphyllum vesiculosum Goldfuss.
Diphyphyllum sp.
Favosites billingsi Rominger.
Favosites limitaris (?) Rominger.
Favosites radiatus Rominger.
Favosites turbinatus Billings.
Heliophyllum halli Milne-Edwards and Haime.
Michelinia sp.
Syringopora crassata (?) Winchell.
Syringopora intermedia Nicholson.
Zaphrentis prolifica Billings.

Hydrozoa

Stromatopora monticulifera Winchell.
Stromatopora pustulifera Winchell.
Stromatoporella granulata Nicholson.

Bryozoa

Cystodictya hamiltonensis Ulrich.
Fenestella sp.

Brachiopoda

Athyris vittata Hall.
Athyris sp.
Atrypa reticularis (Linnaeus).
Camarotoechia tethys (Billings).
Eunella lincklaeni Hall.
Gypidula romingeria (?) Hall and Clarke.
Leiorhynchus sp.
Leptaena rhomboidalis (Wilckens).
Meristella barrisi Hall.
Pentamerella arata (?) (Conrad).
Pentamerella pavillionensis Hall.
Productella spinulicosta Hall.
Rhipidomella cyclas (?) Hall.
Schellwienella perversus (Hall).
Schizophoria striatula (Schlotheim).
Spirifer sp.
Stropheodonta inaequistriata (Conrad).
Stropheodonta perplana (Conrad).
Stropheodonta sp.

Pelecypoda

Conocardium normale Hall.

Gastropoda

Callonema sp.
Euomphalus planodiscus Hall.
Loxonema delphicola Hall.
Macrochilina hebe Hall.
Platyceras carinatum Hall.
Pleurotomaria filitexta Hall.
Pleurotomaria sp.
Trepospira rotalia Hall.

Cephalopoda

Poterioceras conradi (?) (Hall).
Poterioceras sp.
Spyroceras nuntium (Hall).
Spyroceras thoas (?) (Hall).

Trilobita

Phaethonides varicella Hall var.
Proetus crassimarginatus (?) Hall.
Proetus microgemma (?) Hall.
Preotus rowi (Green).

As has been indicated, this mass of limestone is, in every respect, unique among the outcropping formations of Ontario. Certain aspects of its fauna bear a marked resemblance to that of the purer portion of the Onondaga limestone. Sir William Logan evidently considered it as Onondaga, for he says that "escarpments of twenty to thirty feet of the (Corniferous) limestone, run through the west half of Carrick, and are said to extend southward into Howick."[1] A careful study of this limestone and its fauna, however, reveals a preponderance of Hamilton forms and makes even the identification of those referred to Onondaga species seem less certain. A failure to find similar deposits elsewhere within the province led to an investigation of the Devonian rocks across the lake at Alpena, Michigan, and

[1] Logan, Sir William, Geology of Canada, 1863, p. 371.

there in the middle of the Hamilton beds (Traverse group) the same massive, grey limestone, often in great stromatoporoid reefs, occurs with essentially the same fauna. This is that portion of the Traverse group of Michigan which Dr. Grabau has called the Alpena limestone.[1] It undoubtedly covered a large area in Bruce and Huron counties at some former time and represents a period of eastward spreading of the sea which occupied the Michigan basin,[2] for during the earlier Devonian, and at some places even well into the Hamilton, this region was certainly land. It is a noticeable fact that whenever the Hamilton is represented by limestone, there its fauna resembles more nearly the older Onondaga fauna, as if there were a tendency to revert to those ancestral forms.

Northward from Formosa the middle Hamilton limestone soon disappears, but the Devonian is there represented by the Onondaga limestone, which was either never deposited in the Formosa region or was removed by the pre-Alpena limestone erosion period.

CARGILL.

This town is located on the Teeswater river on the line between Greenock and Brant townships. On lot 25, concession A, Greenock township, and northward even as far as Pinkerton, there are good outcrops of the Onondaga limestone. At the first named locality the following section occurs.

Section Along the Teeswater at Cargill.

	Feet	Inches
4. Soil and drift	4	0
Onondaga limestone		
3. Grey to brown, bituminous limestone with an abundance of grey to white chert in alternate beds. The bedding is irregular and rather thin	20	6

[1] Grabau, A. W., Ann. Rept. Geol. Surv. Mich. for 1901 (1902), pp. 175, etc.

[2] Stauffer, C. R., Geol. Surv. of Ohio, 4th ser. Bull. 10, 1909, pp. 184, 185, pls. XIV and XV.

		Feet	Inches
2.	Covered with talus from the overhanging beds of the preceding zone....................	3	0
1.	Grey to brown limestone with some chert, to the level of the Teeswater river...........	1	0

From the Cargill section the following fauna was collected.

	Horizons	
Anthozoa	1	3
Bothrophyllum decorticatum Billings	..	x
Cladopora cryptodens (Billings)	..	x
Cladopora turgida Rominger	..	x
Cystiphyllum vesiculosum Goldfuss	..	x
Diphyphyllum sp.	x	..
Eridophyllum vernuillianum Milne-Edwards and Haime	..	x
Favosites basalticus Goldfuss	..	x
Favosites emmonsi Rominger	..	x
Favosites limitaris Rominger	..	x
Favosites winchelli Rominger	..	x
Favosites sp.	x	..
Heliophyllum corniculum (Lesueur)	..	x
Heliophyllum exiguum Billings	..	x
Michelinia convexa (d'Orbigny)	..	x
Pleurodictyum problematicum Goldfuss	..	x
Syringopora hisingeri Billings	..	x
Zaphrentis gigantea Lesueur	..	x
Zaphrentis prolifica Billings	..	x
Zaphrentis sp.	x	x
Bryozoa		
Semicoscinium hindei (?) (Nicholson)	..	x
Fenestella sp.	..	x
Brachiopoda		
Amphigenia elongata (Vanuxem)	x	x
Atrypa reticularis (Linnaeus)	x	x
Camarotoechia billingsi Hall	x	x
Camarotoechia carolina Hall	..	x
Camarotoechia tethys (Billings)	..	x
Centronella glansfagea Hall	..	x

	Horizons 1	3
Brachiopoda—*Contd.*		
Chonetes hemisphericus Hall	..	x
Chonetes lineatus (Conrad)	..	x
Chonetes mucronatus Hall	..	x
Leptaena rhomboidalis (Wilckens)	..	x
Meristella nasuta (Conrad)	..	x
Pentamerella arata (Conrad)	x	x
Rhipidomella vanuxemi Hall	x	x
Schellwienella pandora (Conrad)	..	x
Spirifer divaricatus Hall	..	x
Spirifer duodenarius (Hall)	..	x
Stropheodonta demissa (Conrad)	..	x
Stropheodonta hemispherica Hall	..	x
Stropheodonta perplana (Conrad)	x	..
Strophonella ampla Hall	..	x
Pelecypoda		
Concardium cuneus (Conrad)	..	x
Modiomorpha concentrica (Conrad)	..	x
Paracyclas elliptica Hall	..	x
Plethomytilus ponderosus Hall	..	x
Pterinea flabellum (Conrad)	..	x
Gastropoda		
Bellerophon pelops Hall	..	x
Callonema lichas Hall	..	x
Diaphorostoma lineatum (Conrad)	x	x
Euryzone hyphantes (Meek)	..	x
Hormotoma maia (Hall)	..	x
Loxonema pexatum Hall	..	x
Pteropoda		
Coleolus crenatocinctus Hall	..	x
Cephalopoda		
Orthoceras pelops Hall	..	x
Orthoceras sp.	..	x
Ostracoda		
Bythocypris sp.	..	x

Trilobita	Horizons 1	3
Chasmops anchiops (Green)	..	x
Lichas hylaeus (?) Hall and Clarke	..	x
Phacops cristata Hall	..	x
Phacops rana (Green)	..	x
Proetus rowi (Green)	x	x
Pisces		
Macropetalichthys rapheidolabis Norwood and Owen	..	x

This fauna will be readily recognized as that of the basal portion of the Onondaga limestone and essentially the same as that found in the vicinity of Hagersville and Ridgemount.

PORT ELGIN.

About 6 miles to the southwest of Port Elgin along the Lake Huron shore, on concession II, Saugeen township, there is a low outcrop of cherty, grey to brownish limestone carrying the Onondaga fauna. These beds extend out under the lake forming the rock bottom to a considerable expanse of shallow water, and indications are that these same beds continue southward along the shore for a distance of 3 or 4 miles. Even at Baie du Doré loose blocks of Onondaga limestone occur along the shore and formerly supplied the rock for a small lime-kiln. Perhaps the submerged rock ledges at that point contain beds of the same age.

From the submerged layers on concession II, Saugeen township, the following fauna was collected.

Anthozoa

Favosites basalticus Goldfuss.
Favosites emmonsi Rominger.
Heliophyllum halli Milne-Edwards and Haime.
Syringopora hisingeri Billings.
Zaphrentis gigantea Lesueur.

Bryozoa

Cystodictya gilberti (Meek).
Fenestella parallela Hall.

Brachiopoda

Amphigenia elongata (Vanuxem).
Anoplia nucleata Hall.
Atrypa reticularis (Linnaeus).
Camarotoechia tethys (Billings).
Centronella glansfagea Hall.
Chonetes mucronatus Hall.
Delthyris raricosta Conrad.
Leptaena rhomboidalis (Wilckens).
Meristella nasuta (Conrad).
Nucleospira concinna Hall.
Pholidostrophia iowaensis (Owen).
Rhipidomella vanuxemi Hall.
Schellwienella pandora (Billings).
Spirifer duodenarius (Hall).
Stropheodonta demissa (Conrad).
Stropheodonta hemispherica Hall.

Pelecypoda

Conocardium cuneus (Conrad).
Paracyclas elliptica Hall.

Gastropoda

Diaphorostoma lineatum (Conrad).
Platyceras sp.

Trilobita

Phacops cristata Hall.
Proetus rowi (Green).

The rocks outcropping at this place are very fossiliferous; but the limit to the number of species obtained was determined by the difficulties of collecting from solid bed-rock under 2 feet of water. From the higher layers on the shore, now apparently covered, Logan obtained a few additional species. A sufficient fauna was obtained, however, to prove the horizon to be identical with that at Cargill and elsewhere to the southwest, viz., the lower part of the Onondaga limestone.

Somewhat higher beds are to be found about a mile inland from the lake, especially on concessions I of Saugeen and XIV of Bruce townships where the Onondaga limestone forms a flat surface outcrop over a very considerable area, although it is generally covered by a thin sod. Just south of the line between the above named townships, the following fauna was found.

Anthozoa

Bothrophyllum decorticatum Billings.
Eridophyllum vernuillianum Milne-Edwards and Haime.
Favosites emmonsi Rominger.
Favosites hemisphericus (Troost).
Favosites limitaris Rominger.
Favosites winchelli Rominger.
Heliophyllum halli Milne-Edwards and Haime.
Michelinia convexa (d'Orbigny).
Phillipsastrea gigas Owen.
Phillipsastrea verrilli Meek.
Synaptophyllum simcoense (Billings).
Syringopora hisingeri Billings.
Zaphrentis gigantea Lesueur.
Zaphrentis nodulosa Rominger.

Bryozoa

Cystodictya gilberti (Meek).
Semicoscinium hindei (?) (Nicholson).

Brachiopoda

Amphigenia elongata (Vanuxem).
Anoplia nucleata Hall.
Atrypa reticularis (Linnaeus).
Meristella nasuta (Conrad).
Meristella rostrata (?) Hall.
Rhipidomella vanuxemi Hall.
Schellwienella pandora (Billings).
Spirifer duodenarius (Hall).
Stropheodonta hemispherica Hall.

Pelecypoda

Conocardium cuneus (Conrad).

The lime-kilns at McRae point are located "about half a mile" to the south of "Little Pine Brook" where Logan found "fossiliferous cherty beds" which he considered to be "similar to those on the other side of Point Douglas."[1] With the pos-

[1] Logan, Sir William, Geology of Canada, 1863, pp. 273, 274.

sible exception of the rough massive non-fossiliferous beds at the top, the rocks outcropping there unquestionably belong in the Detroit River series. The fossiliferous rocks outcropping along the Penetangore river, just east of Kincardine,[1] are also of Detroit River age, although they have frequently been referred to as Onondaga limestone.

MIDDLESEX COUNTY SECTIONS.

LONDON.

The drift at London has a thickness running from 70 to as much as 130 feet. The wells on the western side of the city show the lesser thickness of drift and 30 feet or more of younger rock than is found in the wells of the eastern part of the city. No very good record of these wells is available. The following is a record of the well at the Insane Asylum as it was furnished by Mr. W. Harris of Petrolia, to Mr. H. P. H. Brumell.[2]

Record of the Well at the Insane Asylum, London.

		Thickness	Total
9.	Drift and surface material	130 Ft.	130 Ft.
8.	Onondaga limestone, a hard rock	200 "	330 "
7.	Soft limestone	270 "	600 "
6.	Hard limestone	100 "	700 "
5.	Limestone	600 "	1,300 "
4.	Salt and shale	100 "	1,400 "
3.	Clinton beds, a black shale	200 "	1,600 "
2.	Medina formation, a red shale	500 "	2,100 "
1.	Richmond or Lorraine beds, limestone and shale	150 "	2,250 "

In the above section, numbers 4 to 7 inclusive are given as the Salina "with Guelph and Niagara, if present."

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[1] Loc. cit. pp. 274, 275, 522.

[2] Brumell, H. P. H., Geol. Surv., Canada, Ann. Rept. Vol. V, pt. Q, 1892, p. 49.

STRATHROY.

The upper layers of the Widder beds lie under a very thin covering of drift near Strathroy, Adelaide township. Fifty years ago this rock was quarried and burnt for lime on lot 17, concession II, south of the Egremont road, but even the old kiln is no longer to be seen. On lots 16, of concessions II and III, this limestone has been quarried for local foundations at a comparatively recent date. It is said that the limestone does not run very deep and that it is underlain by soft, blue shale. There is no important outcrop of rock here, although only a foot or so of soil covers it on parts of three or four lots. Hamilton fossils are more or less common in this limestone, and the following are among those that may be found.

Chonetes deflectus Hall.
Spirifer mucronatus (Conrad).
Stropheodonta demissa (Conrad).
Strophedonta perplana (Conrad).
Paracyclas lirata (Conrad).

MARSH'S (MARSHALL'S) MILL.

At Marsh's mill, 2½ miles east of Arkona, the Ausable river cuts through the Hamilton shales exposing a fine section of the Olentangy shale and a portion of the Widder beds (see Plate XIII). The following measurements were made near the highway bridge at Marsh's mill, West Williams township.

Section Along the Ausable River at Marsh's Mill.

	Feet	Inches
7. Soil and drift	8	0
Widder beds		
6. Soft, blue shale containing several harder layers of impure, blue limestone which are full of *Spirifer mucronatus*	7	10
5. Soft, argillaceous, blue limestone containing a rather limited fauna, but *Leiorhynchus laura* and *Spirifer mucronatus* common at the top	1	3
4. Coral zone. A soft, shaly, grey limestone filled with various corals and other fossils	3	6
3. Encrinal limestone. A blue to grey, hard, pyritiferous granular limestone with numerous crinoid fragments. From the bottom up, this bed consists of 5 inches of limestone showing large trail or stem-like markings in relief on the lower side, 5 inches of brown shale, 5 inches of blue limestone with a shaly parting, and then the real encrinal limestone 14 inches in thickness	2	5
Olentangy shale		
2. Soft, gritless, blue shale containing ostracods, and a few crinoid stems, but fossils in general not abundant	19	0
1. Soft, blue shale with a few flattened calcareous concretions, some of which contain fossils, and thin lenses of limestone. These limestone lenses are simply a mass of fossils, among which *Spirifer mucronatus arkonense*, or the variety with a very much extended hinge-line, and *Tentaculites attenuatus* are most abundant. These beds extend to the level of the Ausable river	7	0

The following fauna was collected from the rocks of this section.

	Horizons					
Anthozoa	1	2	3	4	5	6
Alveolites goldfussi Billings	...	...	...	x	...	...
Aulopora serpens Rominger	...	...	x	...	...	...
Ceratopora dichotoma Grabau	...	...	...	x	...	...
Cladopora fisheri (Billings)	...	...	...	x	...	...
Cladopora frondosa (Nicholson)	...	...	...	x	...	...
Cladopora labiosa (Billings)	...	...	...	x	...	...
Cladopora roemeri (Billings)	...	...	...	x	...	...
Cystiphyllum vesiculosum Goldfuss	...	...	...	x	...	...
Favosites alpenaensis Winchell	...	...	...	x	...	...
Favosites billingsi Rominger	...	...	...	x	...	...
Favosites canadensis (Billings)	...	...	...	x	...	...
Favosites clausus Rominger	...	...	...	x	...	...
Favosites digitatus Rominger	...	...	...	x	...	...
Favosites placentus Rominger	...	...	...	x	...	...
Favosites turbinatus Billings	...	...	x	x	...	...
Heliophyllum confluens Hall	...	...	x	...	...	...
Heliophyllum halli Milne-Edwards and Haime	...	...	x	x	...	...
Heliophyllum juvene (Rominger)	...	...	...	x	...	...
Michelinia insignis Rominger	...	...	...	x	...	...
Microcyclas discus Meek and Worthen	...	x	...	...	...	...
Syringopora intermedia Nicholson	...	...	...	x	...	...
Syringopora perelegans (?) Billings	...	...	x	...	...	...
rachypora elegantula Billings	...	...	...	x	...	...
Zaphrentis prolifica Billings	...	...	...	x	...	...
Hydrozoa						
Stromatoporella mammillata Nicholson	...	...	...	x	...	...
Crinoidea						
Anthracantha punctobranchiata Williams	x	...	...	...	...	...
Gennaeocrinus arkonensis Whiteaves	x	...	...	...	...	...
Asteroidea						
Palaestar eucharis Hall	x	...	...	...	...	...
Vermes						
Ortonia intermedia Nicholson	...	...	...	x	...	...

Vermes—*Contd.*	Horizons 1	2	3	4	5	6
Spirorbis angulatus Hall	...	...	...	x	...	...
Spirorbis arkonensis Nicholson	...	...	...	x	...	...
Spirorbis omphalodes Goldfuss	x	...	...	x	...	...
Spirorbis spinuliferus Nicholson	...	...	...	x	...	...
Bryozoa						
Botryllopora socialis Nicholson	...	...	...	x	...	...
Cystodictya hamiltonensis Ulrich	...	...	...	x	...	...
Cystodictya incisurata (Hall)	x	...	x	x	...	...
Fenestella emaciata Hall	...	...	...	x	...	...
Fenestella magnifica (?) Nicholson	...	...	...	x	...	...
Fenestrapora biperforata Hall	...	...	...	x	...	...
Fistulipora huronensis (Nicholson)	...	...	...	x	...	...
Fistulipora incrassata (Nicholson)	...	...	...	x	...	...
Hederella canadensis (Nicholson)	x	...	...	...	...	...
Hederella cirrhosa (Hall)	x	...	...	x	...	...
Hederella filiformis (Billings)	x	...	...	x	...	...
Lioclema minutissimum (Nicholson)	...	...	...	x	...	...
Loculipora perforata (Hall)	...	...	...	x	...	...
Paleschara (?) reticulata Hall	...	...	...	x	...	...
Pinacotrypa stellata (Hall)	...	...	...	x	...	...
Pinacotrypa variapara (Hall)	x	...	...	...	...	...
Polypora arkonensis Miller	...	...	...	x	...	...
Polypora multiplex (Hall)	...	...	...	x	...	...
Polypora mutabilis (?) (Hall)	...	...	...	x	...	...
Reteporidra perundata (Hall)	...	...	...	x	...	...
Reteporina striata (Hall)	...	...	...	x	...	...
Semicoscinium davidsoni (Nicholson)	...	...	...	x	...	...
Semipora bistigmata Hall	...	...	...	x	...	...
Streblotrypa hamiltonensis (Nicholson)	...	...	x	...	...	...
Taeniopora exigua Nicholson	...	...	...	x	...	...
Taeniopora subcarinata (Hall)	...	...	...	x	...	...
Brachiopoda						
Ambocoelia umbonata (Conrad)	...	...	...	...	x	x
Athyris vittata Hall	x	...	...	...	...	...
Atrypa reticularis (Linnaeus)	...	...	x	x	...	...
Camarotoechia sappho Hall	x	...	...	...	...	...
Camarotoechia thedfordensis Whiteaves	...	...	...	x	...	...
Chonetes coronatus Conrad	...	...	x	x	...	...

	Horizons					
Brachiopoda—*Contd.*	1	2	3	4	5	6
Chonetes deflectus Hall	x	...	...	...	x	x
Chonetes lepidus Hall	x	...	...	x	x	x
Chonetes scitulus Hall	x	...	...	x	x	...
Crania crenistriata Hall	...	...	...	x	...	...
Crania favincola Hall and Clarke	...	...	...	x	...	...
Craniella hamiltonensis Hall	...	...	...	x	x	...
Cyclorhina nobilis Hall	...	...	...	x	...	x
Cyrtina hamiltonensis Hall	x	...	...	x	x	...
Delthyris consobrina (d'Orbigny)	...	...	...	x	...	...
Delthyris sculptilis Hall	...	...	x	...	...	...
Eunella harmonica Hall	...	...	...	x	...	...
Eunella sp.	...	...	...	x	...	...
Leiorhynchus laura (Billings)	...	...	x	x	x	x
Lingula ligea Hall	...	...	...	...	...	x
Parazyga hirsuta Hall	x	...	...	x	...	...
Pentagonia unisulcata (Conrad)	...	...	x	...	...	...
Pholidostrophia iowaensis (Owen)	...	...	...	x	...	...
Productella spinulicosta Hall	x	...	...	...	...	...
Reticularia fimbriata (Conrad)	...	...	x	...	...	...
Rhipidomella penelope Hall	...	...	x	x	...	...
Rhipidomella vanuxemi Hall	...	...	x	x	...	...
Schellwienella perversus (Hall)	x	...	x	...	...	x
Spirifer mucronatus (Conrad)	x	x	x	x	x	x
Spirifer mucronatus thedfordense Shimer and Grabau	...	...	...	...	...	x
Stropheodonta concava Hall	...	...	x	x	...	...
Stropheodonta demissa (Conrad)	...	...	...	x	...	...
Streopheodonta inequiradiata Hall	...	...	...	x	...	...
Stropheodonta inequistriata (Conrad)	...	...	...	x	...	...
Stropheodonta perplana (Conrad)	...	...	x	x	x	...
Terebratula ontario Hall	...	...	...	x	...	...
Tropidoleptus carinatus Hall	...	...	x	...	...	...
Pelecypoda						
Actinopteria boydi (Conrad)	x	...	...	x	...	...
Aviculopecten sp.	x	...	...	...	...	...
Aviculopecten princeps (Conrad)	...	...	x	...	...	...
Glyptodesma erectum (Conrad)	x	...	...	...	...	...
Leda rostellata (Conrad)	x	...	...	...	...	...
Nucula lirata (Conrad)	x	...	...	...	...	...
Nucula sp.	x	...	...	...	...	...

Pelecypoda—*Contd.*	Horizons 1	2	3	4	5	6
Nuculites triqueter Conrad	x	...	...	...	...	...
Paleoneilo emarginata (Conrad)	x	...	...	...	...	...
Paracyclas lirata (Conrad)	x	...	...	...	...	...
Pterinea flabellum (Conrad)	...	...	x	...	x	...
Sphenotus solenoides Hall	x	...	...	...	...	...
Gastropoda						
Bellerophon triliratus (?) Hall	x	...	...	...	...	...
Diaphorostoma lineatum (Conrad)	...	...	...	x	...	...
Igoceras conicum (Hall)	...	...	...	x	...	...
Platyceras carinatum Hall	...	...	x	...	...	...
Platyceras erectum Hall	...	...	...	x	...	...
Platyceras rarispinosum Hall	x	...	...	x	...	...
Cephalopoda						
Bactrites arkonensis Whiteaves	x	...	...	...	...	...
Orthoceras lambtonensis Whiteaves	...	...	x	...	...	...
Orthoceras subulatum Hall	x	...	...	...	...	...
Tornoceras uniangulare (Conrad)	x	...	...	...	...	...
Ostracoda						
Primitiopsis punctulifera (Hall)	x	x	...	...	x	x
Trilobita						
Cryphaeus boothi Green	...	...	...	x	x	x
Phacops rana Green	x	...	x	x	...	x

A short distance up the Ausable river from the last section (Marsh's mill) still lower beds appear. Ten feet or more of soft, blue shale, with thin lenses of limestone, occur at several localities within a distance of 2 miles. In these beds the following fauna was found.

Anthozoa

Aulopora serpens Rominger.

Crinoidea

Arthracantha punctobranchiata Williams.

Bryozoa

Ascodictyon fusiforme Nicholson and Etheridge.
Ascodictyon stellatum Nicholson and Etheridge.
Eridotrypa (?) obliqua (Ulrich).
Fistulipora spinulifera Rominger.
Hederella canadensis (Nicholson).
Hederella filiformis (Billings).
Leptotrypa (?) quadrangularis (Nicholson).
Vinella devonica Cleland.

Brachiopoda

Chonetes coronatus Conrad.
Chonetes scitulus Hall.
Craniella hamiltoniae Hall.
Cyrtina hamiltonensis Hall.
Orbiculoidea lodiensis media Hall.
Schellwienella perversus (Hall).
Spirifer mucronatus arkonense Shimer and Grabau.
Stropheodonta demissa (Conrad).

Pelecypoda

Paracyclas lirata (Conrad).

Gastropoda

Platyceras erectum Hall.
Platyceras rarispinosum Hall.

Pteropoda

Tentaculites attenuatus Hall.

Cephalopoda

Orthoceras sp.

Trilobita

Phacops rana Green.

LAMBTON COUNTY SECTIONS.

ARKONA.

This town is located in the southeastern part of Bosanquet township, near the point where the Ausable river turns sharply from a westerly to a northerly direction. It is about 6 miles south of Thedford. The sections exposed near Arkona are the best outcrops of Hamilton rocks in Ontario. Rock Glen creek flows through the town and as it approaches the Ausable river it plunges over a ledge of limestone in the upper part of the Widder beds (see Plates XIV and XV) into a deep valley. The following is a section of the rocks exposed in Rock glen.

Section at Rock Glen, Arkona.

	Feet	Inches
11. Soil and drift	15	0
Widder beds		
10. Massive, argillaceous, blue limestone alternating with blue shale and all quite fossiliferous. These beds form the top of the falls by the old mill	10	8
9. Rather soft, blue shale with calcareous nodules or concretions. *Spirifer mucronatus* is a conspicuous and abundant fossil in the lower layers	8	4
8. Argillaceous, blue limestone with few fossils	1	6
7. Soft, blue shale with several layers that are a little more massive than the others. Fossils rather abundant and in several of the layers they are crowded together	17	4
6. Rather massive shale and several layers of shaly blue limestone in the lower part	7	0
5. *Coral zone.* A decomposed blue to grey shale or impure shaly limestone filled with corals	3	6

	Feet	Inches
4. *Encrinal limestone.* A hard, pyritiferous, bluish grey limestone which is a mass of crinoidal segments, coral fragments, and other fossils. It includes some brown shale near the base............................	2	4
Olentangy shale		
3. A soft, gritless, blue shale in which fossils are rather rare...........................	19	0
2. A soft, blue shale with a few thin lenses of crinoidal limestone and an occasional flat calcareous concretion. Fossils are fairly abundant in these beds and especially in the lenses of limestone.....................	10	0
1. Covered interval to the level of Ausable river.	10	0

The following fossils were collected from the beds exposed in Rock glen.

Anthozoa	Horizons								
	2	3	4	5	6	7	8	9	10
Alveolites goldfussi Billings............	...	...	...	x	...	...	...	...	...
Aulopora serpens Rominger............	...	...	x	x	...	...	...	...	x
Aulopora sp.........................	...	...	x	...	...	...	...	...	...
Ceratopora dichotoma Grabau..........	...	...	x	...	...	...	...	...	...
Cladopora alpenensis Rominger.........	...	...	...	x	...	...	...	...	...
Cladopora cryptodens (?) (Billings)......	...	...	...	x	...	...	...	...	...
Cladopora fisheri (Billings)............	...	...	...	x	...	...	...	...	...
Cladopora frondosa (Nicholson).........	...	...	...	x	...	...	...	...	...
Cladopora labiosa (Billings)............	...	...	...	x	...	...	...	...	...
Cladopora roemeri (Billings)...........	...	...	...	x	...	...	...	...	...
Craspedophyllum archiaci (Billings).....	...	...	x	...	...	...	...	...	...
Craspedophyllum subcaespitosum (Nicholson)	...	...	...	x	...	...	...	...	...
Cystiphyllum vesiculosum Goldfuss.....	...	...	x	x	...	...	...	...	...
Cystiphyllum sp.......................	...	...	...	x	...	...	...	...	...
Favosites billingsi Rominger...........	...	...	...	x	...	...	...	...	...
Favosites canadensis (Billings).........	...	...	...	x	...	...	...	...	...
Favosites clausus Rominger............	...	...	...	x	...	...	...	...	...
Favosites digitatus Rominger...........	...	...	...	x	...	...	...	...	...
Favosites hamiltoniae Hall.............	...	...	...	x	...	...	...	...	...

	Horizons								
Anthozoa—*Contd.*	2	3	4	5	6	7	8	9	10
Favosites placentus Rominger..........	...	...	...	x	...	...	...	...	...
Favosites turbinatus Billings...........	...	...	x	x	...	...	...	...	...
Heliophyllum halli Milne-Edwards and Haime..........................	...	...	x	x	...	...	...	...	...
Heliophyllum tenuiceptatum (Billings)..	...	...	...	x	...	...	...	...	...
Michelinia insignis Rominger..........	...	...	...	x	...	...	...	...	...
Microcyclas discus Meek and Worthen...	...	x	...	x	...	...	...	...	...
Syringopora intermedia Nicholson.......	...	...	x	...	...	...	...	...	...
Syringopora nobilis Billings............	...	...	x	...	...	...	...	...	...
Trachypora elegantula Billings.........	...	...	x	x	...	...	...	...	...
Zaphrentis prolifica Billings...........	...	...	x	x	...	...	...	...	...
Crinoidea									
Arthracantha punctobranchiata Williams	...	x	...	...	...	...	...	...	...
Dolatocrinus liratus Hall..............	...	...	x	...	...	...	...	...	...
Dolatocrinus sp.......................	...	...	...	x	...	...	...	...	...
Gennaeocrinus arkonensis Whiteaves.....	x	...	...	...	...	...	...	...	...
Poteriocrinus sp......................	...	x	...	...	...	...	...	...	...
Vermes									
Autodetus lindstroemi Clarke..........	...	...	...	x	...	...	...	...	...
Ortonia intermedia Nicholson..........	...	...	...	x	...	...	...	...	...
Spirorbis angulatus Hall...............	...	...	...	x	...	...	...	...	...
Spirorbas arkonensis Nicholson.........	...	...	...	x	...	...	...	...	...
Spirorbis omphalodes Goldfuss.........	...	...	...	x	...	...	...	...	...
Spirorbis spinuliferus Nicholson........	...	...	...	x	...	...	...	...	...
Bryozoa									
Botryllopora socialis Nicholson.........	...	...	...	x	...	...	...	...	...
Cystodictya hamiltonensis Ulrich........	...	...	...	x	...	...	...	...	...
Coscinium striatum Hall and Simspon...	...	...	...	x	...	...	...	...	...
Fenestella emaciata Hall..............	...	...	...	x	...	...	...	...	...
Fenestella nicholsoni Whiteaves........	...	...	...	x	...	...	...	...	...
Fistulipora huronensis (Nicholson).......	...	...	...	x	...	...	...	...	...
Fistulipora incrassata (Nicholson).......	...	...	...	x	...	...	...	...	...
Hederella canadensis (Nicholson)........	...	...	...	x	...	...	...	...	...
Hederella cirrhosa (Hall)..............	...	...	...	x	x	x	...	...	...
Hederella filiformis (Billings)...........	...	...	x	x	...	...	...	...	...

Bryozoa—*Contd.*	Horizons 2	3	4	5	6	7	8	9	10
Hemitrypa cribrosa (Hall)	...	...	...	x	...	...	...	...	...
Heterotrypa (?) moniliformis (Nicholson)	...	...	...	x	...	...	...	...	...
Leptotrypa (?) quadrangularis (Nicholson)	x	...	...	...	...	...	...	...	x
Loculipora perforata (Hall)	...	...	...	x	...	...	...	...	...
Orthopora carinata (Hall and Simpson)	...	...	...	x	...	...	...	...	...
Paleschara (?) reticulata Hall	...	...	...	x	x	...	...	...	...
Pinacotrypa stellata (Hall)	...	...	...	x	...	...	...	...	...
Pinacotrypa variapora (Hall)	...	...	...	x	...	...	...	...	x
Polypora arkonensis Miller	...	...	...	x	...	...	...	...	...
Polypora multiplex (Hall)	...	...	...	x	...	...	...	...	...
Polypora robusta (?) (Hall)	...	...	...	x	...	...	...	...	...
Polypora sp.	...	...	...	x	...	...	...	...	x
Ptilopora striata Hall	...	...	...	x	...	...	...	...	...
Reteporidra perundata (Hall)	...	...	...	x	...	...	...	...	...
Rhombopora subannulata Ulrich	...	...	...	x	...	...	...	...	...
Stictopora (??) incrassata (Hall)	...	...	...	...	...	...	...	...	x
Streblotrypa hamiltonensis (Nicholson)	x	...	x	x	...	...	...	...	...
Teaniopora exigua Nicholson	...	...	x	x	...	...	...	...	...
Taeniopora subcarinata (Hall)	...	...	...	x	...	...	...	...	...
Vinella devonica Cleland	...	...	...	x	...	...	...	...	...
Brachiopoda									
Ambocoelia umbonata (Conrad)	...	...	x	x	x	...	...	x	...
Athyris spiriferoides Eaton	...	...	...	x	...	...	...	...	...
Athyris vittata Hall	...	...	...	x	...	...	...	x	x
Atrypa reticularis (Linnaeus)	...	...	x	x	...	...	...	x	x
Camarotoechia thedfordensis Whiteaves	...	...	...	x	...	...	...	...	...
Chonetes coronatus Conrad	...	...	x	...	...	...	...	...	...
Chonetes deflectus Hall	x	...	...	...	...	x	...	...	...
Chonetes lepidus Hall	x	x	x	x	x	x	x	x	x
Chonetes mucronatus Hall	...	...	...	x	...	...	...	...	...
Chonetes scitulus Hall	x	...	...	x	x	x	...	...	...
Cyclorhina nobilis Hall	...	...	...	x	...	...	...	...	...
Cyrtina hamiltonensis Hall	x	...	...	x	x	x	x	x	x
Delthyris sculptilis Hall	...	...	x	...	...	...	...	...	...
Eunella lincklaeni Hall	...	...	...	x	...	...	...	...	...
Leiorhynchus laura (Billings)	x	...	x	x	x	x	...	...	x
Lingula ligea Hall	...	...	...	x	...	...	...	...	...
Parazyga hirsuta Hall	...	...	...	x	...	...	...	...	...

Brachiopoda—*Contd.*	Horizons 2	3	4	5	6	7	8	9	10
Pholidops hamiltoniae Hall	...	...	x	...	...	...	...	...	...
Pholidostrophia iowaensis (Owen)	...	...	x	x	...	...	...	...	x
Productella productoides (Murchison)	...	...	x	...	...	...	...	...	...
Productella spinulicosta Hall	...	...	...	x	...	...	...	...	...
Reticularia fimbriata (Conrad)	...	...	...	x	...	...	...	...	...
Rhipidomella penelope Hall	...	...	x	x	...	...	...	...	...
Rhipidomella vanuxemi Hall	...	...	x	x	...	...	...	...	...
Schelliwenella perversus (Hall)	x	...	x	...	...	x	...	...	...
Spirifer divaricatus Hall	...	...	x	...	...	...	...	...	...
Spirifer mucronatus (Conrad)	x	...	x	x	x	x	...	x	x
Spirifer mucronatus arkonense Shimer and Grabau	x	...	...	...	...	...	...	...	...
Spirifer mucronatus thedfordense Shimer and Grabau	...	...	...	x	...	x	x	x	x
Stropheodonta concava Hall	...	...	x	x	...	x	...	...	...
Stropheodonta demissa (Conrad)	...	...	x	...	...	x	...	...	x
Stropheodonta inequistriata Hall	...	...	...	...	...	...	x	...	...
Stropheodonta perplana (Conrad)	...	...	x	x	...	...	...	...	x
Pelecypoda									
Actinopteria boydi (Conrad)	...	...	...	...	...	...	...	...	x
Aviculopecten bellus (Conrad)	...	...	...	...	...	x	...	x	x
Cypricardella bellistriatus (?) Conrad	...	...	...	...	...	...	...	...	x
Cypricardinia indenta (Conrad)	...	...	...	x	...	...	...	...	...
Elymella nuculoides Hall	...	...	...	...	x	x	...	...	...
Glyptodesma erectum (Conrad)	x	...	...	...	...	...	...	...	...
Grammysia (?) lirata (Conrad)	...	...	...	...	x	...	...	...	...
Nucula sp.	x	...	...	...	...	...	...	...	...
Paracyclas lirata (Conrad)	x	...	...	...	...	...	...	...	...
Pterinea flabellum (Conrad)	...	...	x	...	x	...	...	...	x
Tellinopsis subemarginata (Conrad)	...	...	...	...	x	...	...	...	...
Gastropoda									
Bellerophon cf. triliratus Hall	x	...	...	...	...	...	...	...	...
Diaphorostoma lineatum (Conrad)	...	...	...	x	...	...	...	...	...
Gyroma capillaria (Conrad)	...	...	...	...	...	x	...	...	...
Phanerotinus laxus Hall	...	...	...	...	...	...	...	...	x
Platyceras carinatum Hall	...	...	...	x	...	...	...	...	...
Platyceras erectum Hall	x	...	x	...	...	...	...	...	x

Gastropoda—*Contd.*	Horizons								
	2	3	4	5	6	7	8	9	10
Platyceras rarispinosum Hall	x	...	...	x	...	...	...	...	...
Platyceras subspinosum Hall	x	...	...	x	...	...	...	...	...
Platyceras sp.	...	...	x	...	...	...	...	...	...
Pleurotomaria delicatula (?) Hall	x	...	...	...	...	...	...	...	...
Pteropoda									
Styliolina fissurella (Hall)	x	...	...	x	x	...	...	...	...
Tentaculites attenuatus Hall	x	...	...	...	...	...	...	...	...
Tentaculites bellulus Hall	x	...	x	...	...	...	...	...	...
Cephalopoda									
Bactrites arkonensis Whiteaves	x	...	...	...	...	...	...	...	...
Nautilus sp.	...	...	...	...	...	...	...	...	x
Nephriticeras bucinum (Hall)	...	...	...	...	...	...	...	...	x
Orthoceras exile Hall	...	...	...	x	...	...	...	...	...
Orthoceras lambtonensis Whiteaves	...	...	...	...	...	...	...	x	x
Orthoceras sp.	x	...	...	...	...	...	...	...	...
Parodiceras discoideum (Hall)	...	...	...	x	x	...	...	x	...
Tornoceras uniangulare (Conrad)	x	...	...	x	...	x	x	...	...
Ostracoda									
Primitiopsis punctulifera (Hall)	x	...	...	x	x	x	...	...	...
Trilobita									
Cryphaeus boothi Green	...	...	...	...	x	x	...	x	x
Phacops rana Green	x	...	x	x	x	x	...	x	x

A very similar section is exposed at No. 4 hill, 2 miles north of Arkona. This is at the former site of Jones' mill and is on lot 4, concession I, where a small tributary to Ausable river has cut the following section.

Section at No. 4 Hill (Jones' Mill).

	Feet	Inches
12. Soil and drift	5	0
Widder beds		
11. Shaly, blue limestone containing harder nodules	2	0
10. Blue to bluish brown limestone of which the layers are separated by beds of shale. These beds form the upper part of the falls and were quarried for the abutments of the Grand Trunk Railway bridge across the Ausable river east of Thedford	6	2
9. Rather soft, blue shale with layers of flattened calcareous concretions. *Spirifer mucronatus thedfordense* is an abundant fossil in the lower part	10	2
8. A soft, argillaceous, blue limestone with *Spirifer mucronatus thedfordense* abundant in the upper part	1	6
7. A soft, blue shale weathering rapidly into a stiff blue clay	17	4
6. Fairly massive, blue shale with several thin layers of argillaceous blue limestone	4	10
5. An argillaceous blue limestone	1	6
4. *Coral zone.* A decomposed, bluish grey calcareous shale or shaly limestone filled with corals	3	10
3. *Encrinal limestone.* A hard, pyritiferous, blue limestone	1	10
2. A black to brown, bituminous shale passing into a limestone below. The lower 4 inches, which is a hard limestone, has ramifying trails standing out in relief on the lower side and contains many fish teeth. These beds are usually considered to belong in the Encrinal limestone and all the evidence seems to favour that disposition of them	1	6

Olentangy shale	Feet	Inches
1. A very soft, blue shale weathering rapidly into a sticky blue clay. These beds extend to the level of the lower part of the run.......	6	7

The following fauna was collected in the beds at No. 4 hill.

	Horizons										
Anthozoa	1	2	3	4	5	6	7	8	9	10	11
Aulopora serpens Rominger.......	...	...	...	x	...	...	...	...	x	...	...
Ceratopora jacksoni Grabau......	...	...	...	...	...	...	...	...	x	...	...
Ceratopora sp..................	...	...	...	...	...	...	x	...	...	...	...
Cladopora fisheri (Billings).......	...	...	...	x	...	...	...	...	...	...	...
Cladopora frondosa (Nicholson)..	...	...	...	x	...	...	...	...	...	...	...
Cladopora roemeri (Billings)......	...	...	...	x	...	...	...	...	...	...	...
Cystiphyllum vesiculosum Goldfuss......................	...	...	...	x	...	...	...	...	...	...	...
Favosites arbuscula Hall.........	...	...	...	x	...	...	...	...	...	...	...
Favosites billingsi Rominger......	...	...	...	x	...	...	...	...	...	...	...
Favosites turbinatus Billings.....	...	...	...	x	...	...	...	...	...	...	...
Heliophyllum halli Milne-Edwards and Haime................	...	...	...	x	...	...	...	...	...	...	...
Heliophyllum infoviatum (Davis)	...	...	...	x	...	...	...	...	...	...	...
Trachypora elegantula Billings...	...	...	...	x	...	...	...	...	...	...	...
Blastoidea											
Codaster canadensis Billings......	...	...	...	...	...	...	x	...	...	...	...
Vermes											
Spirorbis omphalodes Goldfuss ..	...	...	...	...	...	...	...	...	x	...	...
Bryozoa											
Cystodictya hamiltonensis Ulrich.	...	...	x	x	...	...	...	...	...	x	...
Cystodictya sp..................	...	...	...	x	...	...	...	...	...	...	...
Fenestella arkonensis Whiteaves .	...	...	...	x	...	...	...	...	...	...	...
Fenestella emaciata Hall.........	...	...	...	x	...	...	...	...	...	...	...
Fenestella nicholsoni Whiteaves .	...	...	...	x	...	...	...	...	...	...	...
Fistulipora spinulifera Rominger .	...	...	...	...	...	...	x	...	...	...	...
Fistulipora utriculus Rominger...	...	...	...	...	...	...	x	...	...	...	...

Bryozoa—*Contd.*	Horizons										
	1	2	3	4	5	6	7	8	9	10	11
Fistulipora vesiculata (Hall and Simpson)	...	...	...	...	...	...	...	...	x	...	...
Hederella cirrhosa (Hall)	...	...	...	...	...	...	...	...	x	...	...
Hederella filiformis (Billings)	...	...	...	...	...	...	x	...	...	...	...
Heterotrypa (?) moniliformis (Nicholson)	...	...	...	...	...	...	x	...	...	...	...
Lioclema digitatum (Hall)	...	...	...	x	...	...	...	...	...	...	...
Orthopora carinata (Hall and Simpson)	...	...	...	x	...	...	...	...	...	...	...
Paleschara (?) reticulata Hall	...	...	...	...	...	...	x	...	...	...	...
Polypora arkonensis Miller	...	...	x	...	...	...	...	...	...	...	...
Reteporina striata (Hall)	...	...	...	x	...	...	...	...	...	...	...
Brachiopoda											
Ambocoelia umbonata (Conrad)	...	...	...	...	x	x	x	...	...	...	...
Athyris spiriferoides Eaton	...	...	x	...	...	...	...	...	...	...	...
Athyris vittata Hall	...	...	x	...	...	...	x	...	x	x	...
Atrypa reticularis (Linnaeus)	...	...	x	x	...	...	...	...	...	...	...
Camarotoechia sappho Hall	...	...	x	...	...	...	...	...	...	...	...
Chonetes deflectus Hall	...	...	x	...	...	...	x	...	...	...	x
Chonetes lepidus Hall	...	x	x	x	x	...	x	x	x	...	x
Chonetes scitulus Hall	...	...	...	...	...	x	x	...	x	...	...
Cyrtina hamiltonensis Hall	...	...	...	...	...	x	x	...	x	...	...
Delthyris sculptilis Hall	...	...	x	...	...	...	...	...	...	...	...
Eunella lincklaeni Hall	...	...	...	x	...	...	...	...	x	...	...
Leiorhynchus laura Billings	...	x	x	...	x	x	x	...	x	x	...
Nucleospira concinna Hall	...	...	...	x	...	...	...	...	...	...	...
Pentagonia unisulcata (Conrad)	...	...	x	...	...	...	...	...	...	...	...
Pholidostrophia iowaensis (Owen)	...	...	...	x	...	...	...	...	...	x	...
Rhipidomella penelope Hall	...	...	x	x	...	...	...	...	...	...	...
Rhipidomella vanuxemi Hall	...	...	x	x	...	...	...	...	...	...	...
Schellwienella perversus (Hall)	...	...	x	...	...	...	x	...	x	x	x
Spirifer audaculus (Conrad)	...	...	x	...	...	...	...	...	...	...	...
Spirifer granulosus (Conrad)	...	...	x	...	...	...	...	...	...	...	...
Spirifer mucronatus (Conrad)	...	x	x	x	x	x	x	x	x	x	x
Spirifer mucronatus thedfordense Shimer and Grabau	...	...	...	...	...	x	x	x	x	...	...
Stropheodonta concava Hall	...	...	x	x	...	...	...	...	...	...	x
Stropheodonta demissa (Conrad)	...	...	...	...	...	...	...	...	...	x	...
Stropheodonta inequistriata (Conrad)	...	...	...	x	...	...	...	...	...	...	...

	Horizons										
Brachiopoda—*Contd.*	1	2	3	4	5	6	7	8	9	10	11
Stropheodonta perplana (Conrad)	...	...	x	x	x	...	...	...	...	...	...
Tropidoleptus carinatus Hall.....	...	...	x	...	...	...	...	...	...	...	...
Pelecypoda											
Aviculopecten princeps (Conrad).	...	...	...	...	...	x	...	...	...	...	...
Cypricardella bellistriata Conrad.	...	...	...	...	...	x	...	...	...	...	...
Glyptocardia speciosa Hall.......	...	...	...	...	...	...	x	...	...	...	...
Grammysia globosa Hall.........	...	...	...	...	x	...	...	...	...	...	...
Nucula bellistriata (Conrad).....	...	...	...	...	...	...	x	...	...	...	...
Nucula lirata (Conrad)..........	...	...	...	...	...	x	x	x	...	...	...
Nuculites triqueter Conrad.......	...	...	...	...	...	...	x	...	...	...	...
Pterinea flabellum (Conrad)......	...	...	x	...	...	...	...	...	...	...	x
Gastropoda											
Bembexia sulcomarginata (Conrad)......................	...	...	...	...	...	...	x	...	...	...	...
Diaphorostoma lineatum (Conrad)......................	...	...	...	x	...	x	...	...	...	...	...
Phanerotinus laxus Hall.........	...	...	...	...	x	...	...	...	...	...	...
Platyceras erectum Hall.........	...	...	x	x	...	...	...	...	...	...	...
Pteropoda											
Styliolina fissurella (Hall)........	...	...	...	...	x	...	...	x	...	...	...
Tentaculites attenuatus Hall.....	...	...	...	...	...	...	...	...	...	...	x
Cephalopoda											
Bactrites arkonensis Whiteaves..	...	...	...	...	...	...	x	...	...	...	...
Orthoceras arkonense Whiteaves.	...	...	...	...	...	...	x	...	...	...	...
Orthoceras exile Hall............	...	...	...	...	...	...	x	...	...	...	...
Orthoceras subulatum Hall.......	...	...	...	...	...	...	x	...	...	...	...
Parodiceras discoideum (Hall)....	...	...	...	...	...	...	x	x	...	...	...
Tornoceras uniangulare (Conrad).	...	...	...	...	...	...	x	...	...	...	...
Ostracoda											
Bairdia devonica (?) Ulrich......	...	...	...	...	x	...	...	...	...	...	...
Isochilina fabacea Jones.........	...	...	...	...	x	...	...	...	...	...	...
Primitiopsis punctulifera (Hall)..	...	...	...	...	x	x	x	x	...	...	...
Trilobita											
Cryphaeus boothi Green.........	...	...	...	...	...	...	x	...	x	...	x
Phacops rana Green............	...	...	...	x	...	...	...	...	...	...	x
Pisces											
Aspidichthys (?) sp..............	...	x	...	...	...	...	...	...	...	x	x

THEDFORD.

Near the east line of Bosanquet township, on the Toronto-Sarnia division of the Grand Trunk railway, about 33 miles east of Sarnia, is the town of Thedford (formerly known as Widder Station), a famous collecting place for Hamilton forms. There are a number of outcrops near this town, but most of them are of slight importance at the present time. The clay pit of the old brick and tile yard at the north end of town gives a very good outcrop, of which the following is a section.

Section at the Brick and Tile Yard, Thedford.

	Feet	Inches
4. Soil and drift	2	0
Widder beds		
3. *Coral zone.* A decomposed blue to grey shaly limestone, which is chiefly a mass of corals and other fossils	2	0
2. *Encrinal limestone.* A hard blue to bluish grey crinoidal limestone in two or three layers, the lowest of which is separated from those above by 3 inches of brown shale	2	7
Olentangy shale		
1. Soft, gritless, blue shale, which weathers rapidly into a stiff blue clay; to the level of the run below the brick and tile plant	20	0

The following fauna was collected from the shale and limestone exposed at the brick and tile yard.

	Horizons		
	1	2	3
Anthozoa			
Alveolites goldfussi Billings	..	..	x
Aulocophyllum sulcatum (d'Orbigny)	..	..	x
Cladopora cryptodens (Billings)	..	..	x
Cladopora fisheri (Billings)	..	..	x
Cladopora frondosa (Nicholson)	..	..	x
Cladopora roemeri (Billings)	..	..	x
Craspedophyllum archiaci (Billings)	..	..	x
Cyathophyllum perlamellosum (?) Hall	..	..	x
Cystiphyllum vesiculosum Goldfuss	..	..	x
Eridophyllum strictum Milne-Edwards and Haime	..	..	x
Favosites alpenaensis Winchell	..	x	x
Favosites billingsi Rominger	..	..	x
Favosites clausus Rominger	..	..	x
Favosites digitatus Rominger	..	..	x
Favosites placentus Rominger	..	x	x
Favosites turbinatus Billings	..	..	x
Heliophyllum confluens Hall	..	x	..
Heliophyllum halli Milne-Edwards and Haime	..	x	x
Heliophyllum juvene (Rominger)	..	..	x
Syringopora nobilis Billings	..	..	x
Zaphrentis prolifica Billings	..	x	x
Vermes			
Autodetus lindstroemi Clarke	..	..	x
Ortonia intermedia Nicholson	..	..	x
Spirorbis angulatus Hall	..	..	x
Spirorbis arkonensis Nicholson	..	..	x
Spirorbis omphalodes Goldfuss	..	..	x
Spirorbis spinuliferus Nicholson	..	..	x
Bryozoa			
Botryllopora socialis Nicholson	..	..	x
Fenestella magnifica (?) Nicholson	..	..	x
Fistulipora incrassata (Nicholson)	..	..	x
Hederella canadensis (Nicholson)	..	..	x
Hederella cirrhosa (Hall)	..	..	x
Hederella filiformis (Billings)	..	..	x
Heterotrypa (?) barrandei (Nicholson)	..	..	x
Lioclema digitatum (Hall)	..	..	x
Lioclema multiculeatum (Hall)	..	..	x

	Horizons		
Bryozoa—*Contd.*	1	2	3
Orthopora elongata (Hall and Simpson)	..	x	..
Pinacotrypa stellata (Hall)	..	..	x
Polypora arkonensis Miller	..	..	x
Polypora multiplex (Hall)	..	..	x
Reteporina prisca (Nicholson)	..	..	x
Reteporina striata (Hall)	..	..	x
Taeniopora exigua Nicholson	..	x	..
Brachiopoda			
Ambocoelia umbonata (Conrad)	..	x	x
Athyris spiriferoides Eaton	..	x	..
Athyris vittata Hall	..	..	x
Atrypa reticularis (Linnaeus)	..	x	x
Chonetes coronatus Conrad	..	x	..
Chonetes deflectus Hall	..	..	x
Chonetes lepidus Hall	x	x	x
Delthyris sculptilis Hall	..	x	x
Leiorhynchus laura Billings	..	..	x
Pentagonia unisulcata (Conrad)	..	x	..
Pholidostrophia iowaensis (Owen)	..	x	x
Rhipidomella penelope Hall	..	x	..
Rhipidomella vanuxemi Hall	..	..	x
Spirifer audaculus (Conrad)	..	x	..
Spirifer mucronatus (Conrad)	..	..	x
Spirifer mucronatus thedfordense Shimer and Grabau	..	..	x
Strophalosia truncata (Hall)	..	..	x
Stropheodonta concava Hall	..	..	x
Stropheodonta demissa (Conrad)	..	x	x
Stropheodonta inequistriata (Conrad)	..	..	x
Stropheodonta perplana (Conrad)	..	..	x
Pelecypoda			
Actinopteria boydi (Conrad)	..	x	..
Gastropoda			
Platyceras carinatum Hall	..	..	x
Pteropoda			
Tentaculites attenuatus Hall	x	x	..

Cephalopoda	Horizons 1	2	3
Orthoceras lambtonensis Whiteaves	..	x	..
Trilobita			
Cryphaeus boothi Green	..	x	..
Phacops rana Green	..	x	..
Pisces			
Aspidichthys notabilis Whiteaves	..	..	x

The section exposed at the Grand Trunk Railway cut, three-quarters of a mile to the east of Thedford, is one of the most noted, and has been one of the best, of the region. At the present time, however, it is largely overgrown by vegetation and thus more or less obliterated. This section lies wholly within that portion of the Hamilton which is referred to in this report as the Widder beds. Somewhat lower beds, including the Encrinal limestone, are partially exposed along the hill-side in the adjoining fields of the Hunniford farm, where many good specimens have been collected, although at the present time that outcrop also is mostly covered by soil and vegetation. The following is a section of the shales and limestone exposed in the railway cut.

Section of the Grand Trunk Railway Cut at Thedford.

	Feet	Inches
5. Soil and drift	1	0
Widder beds		
4. Somewhat massive, bluish grey limestone containing a little chert and often quite crinoidal	7	10
3. Soft, argillaceous, blue shale with a few irregular layers of flat concretions and calcareous masses, some of which are filled with crinoid stems and bryozoans	7	0

	Feet	Inches
2. Soft and firmer layers of blue shale containing an abundance of fossils, especially *Spirifer mucronatus thedfordense.* Portions of these beds are really an impure limestone........	6	0
1. Soft, argillaceous, blue shale, of which very little is actually exposed, extending to the level of the railway track.................	8	0

The following fauna was collected from the rocks of the above section. Except for the upper layers, however, there is some doubt as to the exactness of the horizons from which certain specimens were derived.

	Horizons			
Anthozoa	1	2	3	4
Aulopora serpens Rominger......................	..	x	x	..
Aulopora sp..................................	..	x	..	..
Ceratopora agglomerata Grabau..................	..	..	..	x
Ceratopora dichotoma Grabau....................	..	..	..	x
Ceratopora intermedia (Nicholson)...............	..	x	..	..
Ceratopora jacksoni Grabau.....................	..	x	..	x
Ceratopora sp................................	..	x	..	..
Syringopora nobilis Billings.....................	..	..	x	..
Springopora perelegans Billings..................	..	..	x	..
Blastoidea				
Pentremitidae filosa Whiteaves..................	..	..	..	x
Vermes				
Spirorbis arkonensis Nicholson...................	..	..	x	..
Spirorbis omphalodes Goldfuss...................	..	x	..	x
Spirorbis spinuliferus Nicholson..................	..	..	x	..
Bryozoa				
Botryllopora socialis Nicholson..................	..	..	..	x
Cystodictya hamiltonensis Ulrich................	..	..	..	x
Cystodictya incisurata (Hall)....................	..	..	..	x
Cystodictya meeki (?) (Nicholson)...............	..	..	..	x

Bryozoa—*Contd.*	Horizons 1	2	3	4
Eridotrypa (?) obliqua (Ulrich)	..	..	..	x
Fenestella arkonensis Whiteaves	..	..	..	x
Fistulipora monticulata Ulrich	..	x	..	x
Fistulipora spinulifera Rominger	..	x	..	..
Fistulipora utriculus Rominger	..	..	..	x
Fistulipora vesiculata (Hall and Simpson)	..	..	x	..
Hederella canadensis (Nicholson)	..	x	..	..
Hederella cirrhosa (Hall)	..	..	x	..
Hederella filiformis (Billings)	x	x	x	..
Heterotrypa (?) barrandei (Nicholson)	..	x	..	..
Heterotrypa (?) moniliformis (Nicholson)	..	x	..	..
Leptotrypa (?) quadrangularis (Nicholson)	..	x	x	..
Orthopora carinata (Hall and Simpson)	..	..	x	..
Orthopora lineata (Hall and Simpson)	..	..	x	..
Pinacotrypa stellata (Hall)	..	..	x	..
Pinacotrypa variapora (Hall)	..	..	x	..
Reteporina striata (Hall)	..	..	..	x
Streblotrypa hamiltonensis (Nicholson)	..	x	x	x
Brachiopoda				
Athyris spiriferoides Eaton	..	..	x	x
Athyris vittata Hall	..	x	x	x
Atrypa reticularis (Linnaeus)	..	..	x	x
Camarotoechia sappho Hall	..	..	..	x
Chonetes deflectus Hall	..	..	x	..
Chonetes lepidus Hall	x	x	x	x
Chonetes scitulus Hall	x	x	..	x
Cyrtina hamiltonensis Hall	..	x	..	x
Eunella lincklaeni Hall	..	x	x	x
Leiorhynchus laura Billings	..	x	x	x
Meristella barrisi Hall	..	..	x	..
Meristella rostrata Hall	..	x	..	..
Pholidostrophia iowaensis (Owen)	..	..	x	x
Rhipidomella vanuxemi Hall	..	..	..	x
Schellwienella perversus (Hall)	..	x	x	x
Spirifer mucronatus (Conrad)	x	x	x	x
Spirifer mucronatus thedfordense Shimer and Grabau	x	x	x	x
Stropheodonta concava Hall	..	..	..	x
Stropheodonta demissa (Conrad)	..	..	x	x
Stropheodonta perplana (Conrad)	..	..	..	x

Pelecypoda	Horizons 1	2	3	4
Actinopteria boydi (Conrad)	..	..	..	x
Aviculopecten princeps (Conrad)	..	..	..	x
Nucula lirata (Conrad)	..	x	..	..
Pterinea flabellum (Conrad)	..	..	..	x
Gastropoda				
Gyroma capillaria (Conrad)	..	..	..	x
Phanerotinus laxus Hall	..	..	..	x
Platyceras carinatum Hall	..	..	..	x
Platyceras erectum Hall	..	..	..	x
Platyceras rarispinosum Hall	..	..	x	..
Platyceras thetis Hall	..	x	..	..
Trepospira rotalia Hall	..	x	..	..
Pteropoda				
Styliolina fissurella (Hall)	..	x	..	..
Tentaculites bellus Hall	..	x	..	..
Cephalopoda				
Orthoceras lambtonensis Whiteaves	..	..	..	x
Orthoceras subulatum Hall	..	x	..	..
Paradiceras discoideum (Hall)	..	x	..	..
Tornoceras uniangulare (Conrad)	..	x	..	..
Ostracoda				
Primitiopsis punctulifera (Hall)	..	x	x	..
Trilobita				
Cryphaeus boothi Green	..	x	..	x
Phacops rana Green	..	x	..	x

About 5 miles north of Thedford, or just south of Port Frank where the road descends to the sand dune region, the Encrinal limestone and the coral zone of the Widder beds outcrop. In fact the Hamilton lies under very shallow cover from

Arkona to the lake, often showing along the runs and ditches, or is exposed in post-holes and other similar openings. For the most part, however, the region is comparatively level and the bed-rocks remain under cover.

Four miles west of Port Frank, or just east of Ipperwash beach, there is a rather prominent but small projection of land into Lake Huron. This is known as Stony point and is caused by an outcrop of a limestone which lies much higher, stratigraphically, in the Hamilton than any of the beds outcropping in the immediate vicinity of Thedford. The section of rock exposed is as follows.

Section of the Rock Exposed at Stony Point on Lake Huron.

	Feet	Inches
3. Soil and drift.	6	0
Ipperwash limestone		
2. Semi-crystalline, blue to grey limestone with some shaly bands. The limestone layers are rough and irregular. Much pyrite occurs in this rock, especially in the lower layers...	3	0
1. Soft, blue shale to the level of the lake	0	8

These beds are evidently lower than those outcropping on the west side of Ipperwash Beach but they are considered to be a part of the Ipperwash limestone. At Petrolia[1] the total thickness of this subdivision is about 40 feet, while at Sarnia[2] more than double that amount of rock, presumably belonging to this horizon, has been penetrated in the deep wells.

The fauna collected from the Ipperwash limestone at Stony Point is as follows.

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[1]Brumell, H. P. H., Geol. Surv., Canada, Ann. Rept., vol. V, pt. Q, 1892, p. 62.

[2]Loc. cit. pp. 69, 70.

Anthozoa	Horizons 1	2
Cystiphyllum vesiculosum Goldfuss	..	x
Dendropora alternans Rominger	..	x
Heliophyllum halli Milne-Edwards and Haime	..	x
Syringopora nobilis Billings	..	x
Crinoidea		
Ancyrocrinus bulbosus Hall	..	x
Bryozoa		
Cystodictya incisurata (Hall)	..	x
Eridotrypa appressa (?) (Ulrich)	..	x
Fenestella emaciata Hall	..	x
Hemitrypa cribrosa (Hall)	..	x
Loculipora perforata (Hall)	..	x
Pinacotrypa stellata (Hall)	..	x
Reteporina hamiltonensis (?) (Prout)	..	x
Reteporina striata (Hall)	..	x
Streblotrypa hamiltonensis (Nicholson)	..	x
Brachiopoda		
Athyris spiriferoides Eaton	..	x
Atrypa reticularis (Linnaeus)	..	x
Camarotoechia horsfordi (?) Hall	..	x
Cyrtina hamiltonensis Hall	..	x
Pholidostrophia iowaensis (Owen)	..	x
Rhipidomella penelope Hall	..	x
Rhipidomella vanuxemi Hall	..	x
Spirifer granulosus (Conrad)	..	x
Spirifer mucronatus (Conrad)	x	x
Stropheodonta concava Hall	..	x
Stropheodonta demissa (Conrad)	..	x
Stropheodonta perplana (Conrad)	..	x
Tropidoleptus carinatus Hall	..	x
Pelecypoda		
Pterinea flabellum (Conrad)	..	x

Gastropoda	Horizons 1	2
Loxonema delficola Hall	..	x
Platyceras carinatum Hall	..	x
Pteropoda		
Tentaculites attenuatus (?) Hall	..	x
Cephalopoda		
Orthoceras eriense Hall	..	x
Tornoceras uniangulare (Conrad)	..	x
Trilobita		
Phacops rana Green	..	x
Pisces		
Fish plate (undetermined)	..	x

On the west side of Ipperwash beach, near Kettle point, the upper layers of the Ipperwash limestone appear in a small anticline projecting into the lake. This consists of 2 or 3 feet of hard, crinoidal, blue limestone with some dark grey to black chert. Among the common fossils in this rock are.

Chonetes lepidus Hall.
Rhipidomella penelope Hall.
Spirifer mucronatus Conrad.
Stropheodonta demissa (Conrad).

Kettle point or Cape Ipperwash is the promontory which projects into Lake Huron in the northwestern part of Bosanquet township and on the west side of Ipperwash beach. It is made up of 8 to 10 feet of black to brownish shale which on first exposure to the weather turns to a bluish colour. This is the shale which Dr. Kindle has correlated with the Huron of Ohio. To the southward the outcrop increases somwhat in thickness and includes some arenaceous, greenish layers. Old weathered surfaces of this shale are much iron stained and soon break into a yellowish brown clay. Fresh pieces have a strong odour of petroleum, and when thrown into a hot fire it burns, leaving a red residue. The highly carbonaceous character of the black shale at Kettle point is shown by the following analysis.[1]

Moisture	1.10
Inorganic matter	76.00
Volatile combustible matter	11.30
Fixed carbon	11.60

Concretions are numerous in this shale and vary from the small nodules of pyrite to the spheroidal masses several feet in diameter (see Plates XVI and XVII, figure 1). These latter are rather numerous and project from the shaly bottom of the shallow water like great inverted kettles and evidently gave the name to the point. The large concretions are chiefly composed of brown calcite arranged radially from a much less regularly arranged central aggregation of crystals. Some of them have been formed about a large fish-bone as a nucleus, and all have displaced the shales above and below in such a way as to show that they were formed in place. Along the Huron river in northern Ohio, and also along the tributaries to the Olentangy and Scioto rivers in central Ohio, somewhat similar concretions are abundant in a shale which differs but little from that at Kettle point. The black shale of northern Ohio (the Huron), which bears the spheroidal concretions, overlies beds of Hamilton age and either underlies or includes a mass of greenish shale which carries a Chemung fauna.[2]

The records of core drills at Kettle point indicate a total of about 30 feet for the black shale, although the wells along the St. Clair river show a much greater thickness. The Huron shale immediately overlies the Ipperwash or upper limestone of the Hamilton and was originally included in the Hamilton group by Alexander Murray. In 1855 James Hall, the eminent New York palæontologist, visited the various outcrops of the

[1]Hunt, T. Sterry, Ann. N. Y. Acad. Sci., Vol. II, No. 12, 1883, p. 9.
[2]Prosser, Charles S., Geol. Surv. Ohio, 4th ser., Bull. No. 15, 1912, pp. 462-464.

upper Devonian shales in Lambton county, in company with Murray, and "the black fissile slates were then identified by Prof. Hall with what he, long previously, had designated as the Genesee slate, in New York. . . . Overlying the black fissile slate, however, we find, at Kettle Point, alternations of a peculiar, somewhat arenaceous, green and black shale, which were recognized by him as the lower beds of the Portage group. In the same way at Kingstone's mills, the upper beds, which are compact, thick-bedded scarcely slaty, and dark olive or greenish-black in color, are by Prof. Hall referred to the Portage group, of which they were found by him to contain the characteristic fish-remains."[1]

In the black shale at Kettle point the following flora and fauna has been found:

Plantae

Knorria sp.
[2]Lepidodendron primaevum Rodgers.
Protosalvinia huronensis (Dawson).
Pseudobornia inornatus (Dawson).

Brachiopoda

Lingula ligea Hall.
Lingula spatulata Vanuxem.

Vermes (Conodonts)

[2]Polygnathus coronatus Hinde.
[2]Polygnathus dubius Hinde.
[2]Polygnathus immersus Hinde.
Polygnathus palmatus Hinde.
[2]Polygnathus (?) serratus Hinde.
[2]Prioniodus panderi Hinde.

Pisces

Dinichthys sp.
Rhadinichtys sp.
Stenosteus sp.

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[1]Hunt, T. Sterry, Geol. Surv., Canada, Rept. Progress 1863-1866, p. 242.
See also Murry, Alexander, Geol. Surv., Canada, Rept. Progress for the year 1855 (1856), pp. 129, 130.
And, Logan, Sir William E., Geology of Canada, 1863, p. 387.
[2]Collected by G. J. Hinde.

The upper Devonian or Huron shale outcrops at other places in Lambton county. Among these may be mentioned that along the upper part of (Bear creek) the North Branch of Sydenham river, north of Kingscourt, in Warwick township. The portion of the formation there exposed is essentially the same as that outcroppimg at Kettle point, but very much less in amount. The spheroidal concretions occur here in the bed of the stream and show the radial structure already referred to. G. J. Hinde described the following species of conodonts from the shale at this place.

Vermes (Conodonts)

Polygnathus (?) curvatus Hinde.
Polygnathus dubius Hinde.
Polygnathus duplicatus Hinde.
Polygnathus palmatus Hinde.
Polygnathus truncatus Hinde.
Prioniodus acicularis Hinde.
Prioniodus spicatus Hinde.

Along the Sydenham river at Alvinston, Brooke township, there is a very good outcrop, although only a few feet of the shale shows at any one place. At Shetland, Euphemia township, 10 feet of the Huron shale outcrops in a bank near the iron bridge above town. It contains the following fossils:

Plantae

Protosalvinia huronensis (Dawson).

Brachiopoda

Lingula spatulata Hall.

Vermes (Conodonts)

Polygnathus dubius Hinde.
Polygnathus palmatus Hinde.

Pisces

Rhadinichthys sp.

Then, about 8 miles southwest of Shetland, along the same river (Sydenham) there is another outcrop of the Huron shale just below Croton, in Camden township, Kent county. This is much smaller but contains beds resembling those above Shetland.

The shales, which have passed under the general name of the Devonian black shale, are widely distributed over the region from Ontario and Michigan southward to the Gulf states, and from the eastern states far into the west. Over this region these deposits vary in age from middle and upper Devonian in New York to early Mississippian in Oklahoma and adjoining states. The fauna of the Genesee shale of New York includes somewhat more than fifty species; but in most of the interior deposits that have been correlated with it, fossils are not abundant. In addition to certain plant remains, the most widely distributed forms of the Genesee and similar deposits are the Linguloid brachiopods, conodonts, and fishes. These brachiopods are forms with such a simple structure that it is often difficult to distinguish between the different species. Moreover they are apparently long lived forms which may have followed the black shale forming conditions from place to place and hence are of little value in correlation. *Orbiculoidea lodiensis*, for example, is said to occur in the Marcellus shale as well as in the Genesee. It is probable that the plants, the conodonts, and the fishes are much more reliable as an index to the age of these deposits. So far as the fossils are known they are in favour of the Genesee age of the black shale at Kettle point, and this is also suggested by the stratigraphic position of the deposit. And yet it has not seemed advisable to designate it by that name in this report.

Southward from Ontario the black shale seems to pass into the Huron shale of Ohio. This is suggested by the occurrence of the same fossil plant, the same *Lingula*, the same genera of fishes,[1] and the abundance of conodonts,[2] some of which at least are the same species. The Huron shale, however, rests on progressively older beds to the southward in Ohio. Near

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[1]Branson, E. B., Bull. Univ. of Missouri, vol. II, No. 2, 1911, pp. 24-32.
[2]Kindle, E. M., Am. Jour. Sci., vol. XXIV, 1912, pp. 209-211.

Sandusky it directly overlies the Prout or upper member of the Olentangy shale, a limestone which the associated fauna shows cannot be older than the Widder beds of Ontario and probably is the Encrinal limestone of the Thedford and Arkona regions. At Columbus the Huron shale, or lower portion of the Ohio, rests on the much reduced soft Olentangy (Hamilton) shale which in the northern part of that state underlies the Prout limestone and is sometimes more than 100 feet in thickness. At Kinkead Springs, Pike county, near the southern part of the state, the Ohio shale rests directly on the Silurian limestone and is firmly welded to it.

The conditions under which black shales are deposited have been much discussed by various geologists. Newberry thought that the fineness of the mineral matter and the uniform dissemination of the carbon in the shale, indicated that the black shales were deposited in a quiet sea and not immediately adjacent to the land. The shores of this almost land-locked sea, he thought, were lined with vegetation and even the surface was covered with a vigorous growth of floating sea-weed. The Sargasso sea through which Columbus is said to have "ploughed his way" is cited as a modern example of such a surface growth. "Under all such sheets of vegetation, in a sea where a fine mechanical sediment is being deposited, we must necessarily have an accumulation of mud containing a large percentage of carbonaceous matter; in other words the elements of a bituminous shale."[1] In this connexion it is interesting to note, that in the Sargasso sea "there are twenty to twenty-five plants, on the average, to each square mile and each plant when pressed together makes from a pint to a quart when wet or about one-eighth of this when dry."[2] Three or four pounds of dry plant matter to the square mile could hardly be expected to contribute an appreciable amount of bituminous matter even to very slowly accumulating deposits.

H. S. Williams suggested that the great body of black shale has been derived as land wash from a nearly base-levelled lime-

[1]Newberry, J. S., Geol. Surv. Ohio, vol. I, 1873, pp. 155-157.
[2]Johnson's Encyclopedia, Vol. VII, 1895, p. 316.

stone area. He says that the calcareous, carbonaceous, and phosphatic materials are of organic origin and in the southern region probably chiefly derived from the Cincinnati land mass. The unequal distribution of the black shale he regards as assignable to the ocean currents of the time and which differed much from those of to-day.[1]

More recently A. W. Grabau has enlarged and somewhat modified this theory in connexion with his discussion of progressive overlap. "Wherever the relief of the land has been reduced to the condition of a peneplain, the rock surface of the old land becomes mantled with the products of subaërial decay. Prolonged exposure to this process results in the complete disintegration of the mineral constituents of the rock, and in the removal, by solution, of all soluble portions. When the rock of the old land surface is a limestone, only the finest residual clay soil will remain behind. The surface of a peneplain is pre-eminently characterized by obstructed drainage conditions, and this character is the more pronounced the more closely the surface of the peneplain approaches that of an actual plain; hence swampy conditions may be regarded as normal to the peneplain surface; and this brings us to the conclusion that the residual soils of such an area must be highly tinged with the carbon of the decaying vegetation. On old limestone surfaces, the clay becoming thus highly stained with carbon and the residual soil of the limestone regions being exceedingly fine in texture, it follows that the resultant deposits from such areas of decomposition will be a fine and uniform grained black clay rock. When the sea encroaches upon such an area of residual soil, the basal formation of the resulting series of deposits will be a black shale, succeeded upward generally by calcareous members, since the shale itself constitutes the finest clastic of shore-derived origin, and any further deposits must be sea-derived, that is organic or chemical precipitates. It is by no means implied that all black mud deposits originate in this manner. The black muds of the protected lagoons and mud-flat areas of our coasts owe their colour and carbonaceous character to the growth

[1]Williams, H. S., Amer. Jour. Sci., 4th ser., vol. III, 1897, p. 398.

and decay of the sea grasses (Zostera, etcetera) and the animals living buried in this mud.........The black muds of partly enclosed basins like that of the Black Sea are deep-water deposits, where in the denser lower portions of the water H_2S is generated in great quantities by the activities of sulpho-bacteria."[1]

The carbonaceous matter of these black shales is undoubtedly of vegetable origin.[2] The Huron shale contains numerous plant fragments and quite often large pieces of the stems. The finely divided carbon is, therefore, thought to be of the same origin. In addition to these fragments, the sporangia, which have received the name *Protosalvinia huronensis*, occur in great numbers making the surfaces of certain layers appear covered with brown specks. These must contribute a considerable amount to the total carbon of the shale indicated in the analysis given for this rock. According to Grabau's theory, it is evident that these deposits must vary much in age from place to place and there is much evidence to indicate that this is the case. *.

SMITH FALLS.

On the Sydenham river 1½ miles above Shetland, Euphemia township, the Ipperwash limestone or upper member of the Hamilton outcrops. The falls are caused by a 2½ to 3-foot layer of bluish grey limestone which appears to be underlain by soft bluish shale. This outcrop contains an abundance of Hamilton fossils, among which the following were found.

Cystodictya hamiltonensis Ulrich.
Amboceolia umbonata (Conrad).
Chonetes deflectus Hall.
Cyrtina hamiltonensis Hall.
Spirifer mucronatus (Conrad).
Stropheodonta demissa (Conrad).
Stropheodonta perplana (Conrad).
Pterinea flabellum (Conrad).
Tentaculites sp.
Phacops rana Green.

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[1]Grabau, Amadeus W., Bull. Geol. Soc. Amer., vol. XVII, 1906, pp. 593, 594.

[2]Newberry, J. S., Ann. N. Y. Acad. Sci., vol. II, 1883, pp. 357-369.

Also Orton, Edward, Amer. Jour. Sci., 3rd ser., vol. XXIV, 1882, pp. 171-174.

Amer. Assoc. Adv. Sci. Proc., vol. XXXI, 1883, pp. 373-384.

There are no other important Devonian outcrops in this extreme southwestern part of Ontario, except those near the Detroit river and on the islands of Lake Erie. However, there have been numerous wells drilled into and through the Devonian, which lies immediately under the drift in most of that region, and many of these show interesting and important sections of rock. At Petrolia the most important record is that of the drilling done a number of years ago and known as the "Test Well."[1]

Record of the Petrolia Test Well.

	Thickness	Total
14. Drift	104 Ft.	104 Ft.
Hamilton beds		
13. Ipperwash limestone	40 "	144 "
12. Petrolia shale, perhaps including part of the Widder beds	130 "	274 "
11. Widder beds	15 "	289 "
10. Olentangy shale	43 "	332 "
9. Delaware limestone	68 "	400 "
Onondaga limestone (doubtless with part of the Detroit River series)		
8. Soft limestone	40 "	440 "
7. Grey limestone	25 "	465 "
6. Grey limestone	135 "	600 "
Detroit River series beds, including part of Salina		
5. Hard, white limestone with hard streaks of sandstone from 2 to 5 feet in thickness	500 "	1,100 "
Salina beds		
4. Gypsum	80 "	1,180 "
3. Salt and shale	105 "	1,285 "
2. Gypsum	80 "	1,365 "
1. Salt and shale	140 "	1,505 "

[1]Brumell, H. P. H., Geol. Surv., Canada, Ann. Rept., vol. V, pt. Q, 1892, p. 62.

This record is of much value because it shows the divisions and thicknesses of the Hamilton beds. A comparison of this record with others of the same locality shows little or no variation except in the amount of surficial deposits, and the absence of the upper portion of the Hamilton which has been removed by erosion. At Wyoming, 8 miles to the north of Petrolia, and at Kingstone mills, Warwick township, 12 miles to the east of Wyoming, the Hamilton subdivisions are reported to have the same thicknesses as in the above record. At these latter places the Hamilton beds are overlaid by 4 to 50 feet of the Huron shale. At Oil Springs, 12 miles to the south of Petrolia, the following record is given, by the same author,[1] as typical of the east side of that field.

Record of a Well on the East Side of the Oil Springs Pool.

	Thickness	Total
6. Drift	60 Ft.	60 Ft.
Hamilton beds		
5. Ipperwash limestone	35 "	95 "
4. Petrolia shale	101 "	196 "
3. Widder beds	27 "	223 "
2. Olentangy shale	17 "	240 "
1. Delaware limestone (undoubtedly including part or all of the Onondaga limestone)	130 "	370 "

This record shows a considerable decrease in the thickness of the Hamilton beds, especially in the shaly members. It is practically impossible to draw a line between the Delaware limestone and the Onondaga limestone in the record or samples from these wells. Since the oil producing stratum is usually found at the base of the Onondaga, the lowest division of the above section probably includes the rocks belonging to that formation.

[1]Brumell, H. P. H., Ibid p. 62 Q.

The following record, furnished by Mr. W. McIntosh of Petrolia, is that of a well completed June 28, 1910, on lot 5, concession XII, of Moore township.

Record of Well on Lot 5, Concession XII, Moore Township.

	Thickness	Total
6. Drift	147 Ft.	147 Ft.
Hamilton beds		
5. Ipperwash limestone	61 "	208 "
4. Petrolia shale, perhaps including part of the Widder beds	127 "	335 "
3. Widder beds	12 "	347 "
2. Olentangy shale	46 "	393 "
1. Delaware limestone	77 "	470 "

Gas in paying quantity was struck at 438 feet and the well is now a good producer of both oil and gas.

SARNIA.

At Sarnia the Hamilton strata seem to have changed considerably in composition and thickness. There is, however, a marked discrepancy between the various records; but it is probable that even these are as trustworthy as most drillers' records are.

Record of a Well Drilled at King's Grist-mill, Sarnia.[1]

	Thickness	Total
11. Drift	120 Ft.	120 Ft.
Huron shale		
10. Black shale	36 "	156 "
Hamilton beds		
9. Ipperwash limestone	30 "	186 "
8. Petrolia shale, including part of Widder beds	263 "	449 "
7. Widder beds (part only)	5 "	454 "
6. Olentangy shale	40 "	494 "

[1]Brumell, H. P. H., Loc. cit. p. 69 Q.

	Thickness	Total
5. Delaware limestone	60 Ft.	554 Ft.
Onondaga limestone		
4. Grey limestone	100 "	654 "
Detroit River beds		
3. Hard limestone	546 "	1,200 "
Salina beds		
2. Hard and flinty limestone	200 "	1,400 "
1. Limestone with gypsum	105 "	1,505 "

The most remarkable part of this record is the thickness of the Petrolia shale. In the various records of wells drilled in and near Sarnia, this member ranges in thickness from 85, 100, and 160 to the maximum in this well, although the thickness here given undoubtedly includes part of the Widder beds. In all of the other wells the Ipperwash limestone has a greater thickness assigned to it than in this one.

CORUNNA.

One of the most interesting wells drilled thus far, as regards the upper Devonian strata, is that at the village of Corunna,[1] in Moore township, where the following strata were penetrated.

Record of the Well Drilled at Corunna.

	Thickness	Total
5. Drift	120 Ft.	120 Ft.
Port Lambton beds		
4. Black shale	8 "	128 "
3. Greenish sandstone	20 "	148 "
Huron shale (probably including part of the Port Lambton beds)		
2. Black shale with pyrite	185 "	333 "
Hamilton beds		
1. (Ipperwash limestone) grey limestone and shale	17 "	350 "

[1]Hunt, T. Sterry, Geol. Surv., Canada, Rept. of Progress from 1863-1866 (1866), p. 243.

COURTRIGHT.

Another very important record is that of the Courtright Salt Company,[1] at Courtright, along the St. Clair river about 5 miles to the south of the preceding well.

Record of the Courtright Salt Company's Well, Courtright.

	Thickness	Total
12. Drift	160 Ft.	160 Ft.
Huron shale		
11. Black shale	32 "	192 "
Hamilton beds	"	
10. Ipperwash limestone	40	232 "
9. Petrolia shale, Widder beds, and Olentangy shale	310 "	542 "
8. Delaware limestone	50 "	592 "
Onondaga limestone		
7. Grey limestone	100 "	692 "
Upper Monroe or Detroit River series.		
6. Hard, white limestone (probably including much dolomite)	370 "	1,062 "
Sylvania sandstone		
5. Sandstone	32 "	1,094 "
Lower Monroe		
4. Limestone (probably including dolomite)	400 "	1,494 "
Salina beds		
3. Limestone (dolomite) and gypsum	136 "	1,630 "
2. Salt	22 "	1,652 "
1. Gypsum	13 "	1,665 "

PORT LAMBTON.

Early in 1911 Mr. W. J. Aikens, of Dunnville, drilled a well on part of lot F, in concession I of Sombra township, in order to investigate a rumoured occurrence of coal in the vicinity

[1]Brumell, H. P. H., loc. cit. p. 68 Q.

of Port Lambton. The well was drilled to a depth of only 302 feet, but it is most interesting because it gives more than usual detail in regard to the upper Devonian shale of that part of the province.

Record of the Well Drilled at Port Lambton in 1911.

	Thickness	Total
7. Drift, consisting of clay and sand	149 Ft.	149 Ft.
Port Lambton beds		
6. Grey shale	22 "	171 "
5. Black shale	40 "	211 "
4. Grey shale	1 "	212 "
3. Black shale	9 "	221 "
2. Sandy shale, mostly black	28 "	249 "
Huron shale ?		
1. Black shale	53 "	302 "

Oily scums and a little low pressure gas, the latter most noticeable at 249 feet, were reported but no values were obtained.

Another interesting record is that of a well drilled some years ago, at Port Lambton.[1]

Record of Well Drilled at Port Lambton in 1895.

Soil and drift	Thickness	Total
22. Blue clay	140 Ft.	140 Ft.
21. Hard pan and boulders	50 "	50 " 190
Port Lambton beds and Huron shale		
20. Slate and shale (evidently black and grey) somewhat gritty	270 "	460 "
Hamilton beds		
19. Limestone (Ipperwash)	100 "	560 "
18. Calcareous clay rock resembling blue clay	150 "	710 "
Delaware limestone		
17. Hard, fine-grained limestone	50 "	760 "

[1]Lane, A. C., Geol. Surv. Mich., vol. V, 1895, pl. LVIII.

Onondaga limestone	Thickness	Total
16. Soft, porous limestone	70 Ft.	830 Ft.
Detroit River series		
15. Grey dolomite with some pieces of black shale	160 "	990 "
14. Grey dolomite	40 "	1,030 "
13. Grey, arenaceous limestone	100 "	1,130 "
12. Yellowish, arenaceous limestone	70 "	1,200 "
Sylvania sandstone..		
11. Light grey, calcareous sandstone	20 "	1,220 "
10. Dirty yellow, calcareous sandstone	30 "	1,250 "
Bass Island series		
9. Dark yellow to buff ferruginous dolomite	120 "	1,370 "
Salina beds		
8. Bluish grey dolomitic limestone with some anhydrite	40 "	1,410 "
7. Calcareous gypsum	40 "	1,450 "
6. Greyish drab to buff dolomite	100 "	1,550 "
5. Gypsiferous limestone	10 "	1,560 "
4. Calcareous, gypsiferous clay	10 "	1,570 "
3. Argillaceous dolomite	100 "	1,670 "
2. Calcareous sandstone	40 "	1,710 "
1. Calcareous clay shale, salty taste	10 "	1,720 "

KENT COUNTY SECTIONS.

WALLACEBURG.

Another well, near Wallaceburg, drilled a number of years ago (1896) by Mr. D. A. Gordon,[1] on lot 5, concession I, of the gore of Chatham, is very much better as regards the thickness of the strata penetrated, although it is lacking in detail.

[1]See Geol. Surv., Can., Ann. Rept. New Ser., vol. XI, 1898 (1901), p. 138 S.

Record of Mr. D. A. Gordon's Well Near Wallaceburg.

	Thickness	Total
9. Drift, consisting of sand and boulder clay	140 Ft.	140 Ft.
Port Lambton beds and Huron shale		
8. Shale and limestone (probably including part of the Hamilton)	545 "	685 "
Hamilton beds		
7. Shale and limestone	165 "	850 "
Onondaga limestone		
6. Light coloured limestone	150 "	1,000 "
Detroit River, Sylvania, Bass Island, and Salina Beds		
5. Fine-grained dolomite and gypsiferous dolomite	700 "	1,700 "
Guelph dolomite		
4. Dolomite	120 "	1,820 "
Lockport dolomite		
3. Limestone (and dolomite)	105 "	1,925 "
Clinton beds and Rochester shale		
2. Calcareous and arenaceous shales	95 "	2,020 "
Medina formation		
1. Sandstone and shale	65 "	2,085 "

This well reached a total depth of 2,365 feet; but no data seem to have been given for the deposits lying below 2085 feet. At Dresden, 10 miles to the east of Wallaceburg, well drillers report 180 feet of black shale overlying the Hamilton beds, and the same outcrops in the river a short distance above Dawn Mills.

CHATHAM.

At Chatham there is only 118 feet of black shale, while 3 miles to the south of that city it is absent from some of the sections and reduced to but a few feet in others.

Record of a Well in the Northwestern Part of Chatham.[1]

	Thickness	Total
8. Drift	60 Ft.	60 Ft.
Huron shale		
7. Black shale	118 "	178 "
Hamilton beds		
6. Ipperwash limestone and Petrolia shale	200 "	378 "
5. Widder beds, chiefly limestone	18 "	396 "
4. Olentangy shale, soft grey	37 "	433 "
3. Delaware limestone	50 "	483 "
Onondaga limestone		
2. Limestone	100 "	583 "
Detroit River series		
1. Limestone (and dolomite)	417 "	1,000 "

Between Chatham and Charing Cross a number of wells have been drilled by the Canadian Crude Oil Producers. Among these the following is one of exceptional depth which was drilled on lot 24, concession VIII, township of Raleigh, and completed September 8, 1908. The record of this well was furnished by Mr. W. McIntosh of Petrolia, although a few slight modifications have been introduced in connexion with the interpretation of the driller's log.

Record of the Canadian Crude Oil Producers' Well, Lot 24, Concession VIII, Raleigh Township.

	Thickness	Total
9. Drift	122 Ft.	122 Ft.
Hamilton beds		
8. Ipperwash limestone	wanting	122 "
7. Petrolia shale, soft grey shale with hard shell	41 "	163 "
6. Widder beds (middle lime of the driller)	13 "	176 "
5. Olentangy shale, soft grey shale with brown streaks	69 "	245 "

[1]Brumell, H. P. H., loc. cit. p. 73 Q.

	Thickness	Total
4. Delaware limestone..................	60 Ft.	305 Ft.
Onondaga limestone		
3. Limestone showing strong blow of gas at 413 feet, good pay oil at 419 feet, strong gas at 430 feet, and lighter oil at 460 feet........................	155 "	460 "
Detroit River, Sylvania, and Bass Island beds		
2. Limestone and dolomite, with gas at 1,045, and 1,075 feet...............	615 "	1,075 "
Salina beds		
1. Limestone and shale with beds salt and streaks of dolomite................	334 "	1,409 "

RIDGETOWN.

Near the lake, 6 miles southeast of Ridgetown, Howard township, a deep well was being drilled during the summer of 1911. This well is located on Mr. Albert Coles' farm, lot 80, concession I south of the Talbot road, and was expected to reach a depth of about 3,000 feet before drilling would cease. Mr. Dalley of Leamington was drilling the well and in July of that year furnished a log of which the following is a partial interpretation.

Record of an Incomplete Well on Albert Coles' Farm, 6 Miles Southeast of Ridgetown.

	Thickness	Total
9. Drift...............................	150 Ft.	150 Ft.
Huron shale		
8. Black shale.........................	20 "	170 "
Hamilton beds		
7. Soft blue shale alternating with thin layers of black shale (no mention is made of the limestones which most likely occur in this mass of shale). The black shale portions are said to range from 5 to 15 feet in thickness and the blue shale up to 60 feet......	370 "	540 "

	Thickness	Total
Onondaga limestone		
6. Limestone with flint in upper part......130	Ft.	670 Ft.
Detroit River, Sylvania, and Bass Island beds		
5. Limestone and dolomite..............500	"	1,170 "
Salina beds		
4. Limestone and shale..................350	"	1,520 "
3. Rock salt...........................150	"	1,670 "
2. Limestone, easily drilled..............255	"	1,925 "
Guelph dolomite		
1. Hard drilling rock, probably dolomite.. 1	"	1,926 "

ESSEX COUNTY SECTIONS.

Numerous wells have been drilled in various parts of this county. They all show that the Devonian is very thin or wanting over much, and especially the middle portion of it. In the records given by Brumell,[1] it is hardly probable that more than the very uppermost beds belong in that system. Another and more recent well, with an important section, was drilled on lot 7, concession VI, Anderdon township, by the Sucker Creek Oil and Gas Company[2]. The following is a record of the rocks penetrated in that well.

Record of the Sucker Creek Test Well.

	Thickness	Total
12. Drift..............................	60 Ft.	60 Ft.
Onondaga limestone?		
11. Grey limestone, effervesces briskly in HCl..............................	90 "	150 "
Detroit River series		
10. Brown dolomite with some limestone..	260 "	410 "

[1]Brumell, H. P. H., Geol. Surv., Canada, Ann. Rept. vol. V, pt. Q, 1892, pp. 76-85.

[2]Nattress, Rev. Thomas, Ninth Ann. Rept. Mich. Acad. Sci., 1907, p. 180.

Sylvania sandstone	Thickness	Total
9. White sand	30 Ft.	440 Ft.
Bass Island series		
8. Coarse-grained dolomite	60 "	500 "
7. Blue dolomite	167 "	667 "
Salina beds		
6. Gypsum	16 "	683 "
5. Brown dolomite of varying hardness	157 "	840 "
4. Blue dolomite	50 "	890 "
3. Light grey dolomite	60 "	950 "
2. Dolomites of varying character and with a trace of salt	175 "	1,125 "
1. Salt-bearing beds underlain by a hard brown rock which is probably dolomite	19 "	1,144 "

In addition to the various wells there are a few good outcrops of the Devonian in this county which add materially to our knowledge of these rocks.

AMHERSTBURG.

This town lies along the Detroit river about 3 miles north of Lake Erie. Rock outcrops in the river at this place, and lies very near the surface at several localities in the immediate vicinity. The region is comparatively level and much of the rock surface is covered by a greater or lesser thickness of drift. Such is the structure of the bed-rock, however, that a great thickness of it is brought up immediately below the drift and this has been partly uncovered for various purposes. In addition to this the region has been punctured by numerous borings and the cores from these have added greatly to our knowledge of the local geology. Much of the rock lies within the Detroit River series and must, therefore, be left to the supplemental report; but there are several good outcrops of the Onondago which deserve consideration here. The best of these is at the quarry of the Amherstburg Stone Company (see Plate XVIII), in Anderdon township and about $1\frac{1}{4}$ miles northeast of town, of which the following is a section.

Section of the Amherstburg Stone Company's Quarry, Amherstburg.

		Feet	Inches
16.	Soil and drift	5	0
	Dundee –Onondaga limestone		
15.	A fairly compact, greyish brown limestone in layers from 1 to 2 feet in thickness	10	8
14.	An earthy grey to brown, rather thin-bedded limestone with much fossiliferous, grey chert	2	3
13.	A semi-crystalline, grey limestone full of fossils and comparatively thin bedded	3	0
12.	A compact, earthy, massive to semi-crystalline grey limestone with few fossils and rather thick bedded	4	9
11.	Rather massive, semi-crystalline, grey limestone full of fossils	3	4
10.	A semi-crystalline, slightly banded, grey to brown limestone with few fossils and in beds about 20 inches in thickness	5	9
9.	A saccharoidal, brown, magnesian limestone with very few fossils. This is often one massive bed but shows stylolites along the obscure bedding planes. Sometimes this part of the formation is separated into two, three, or even a half dozen beds. Pockets of calcite crystals occur in this rock	8	0
8.	A very massive, grey to brown, saccharoidal, magnesian limestone containing occasional pockets of calcite crystals and a little fossiliferous, chalky white chert about 3 feet from the bottom. Except for the cherty nodules, these beds are very poor in fossils. They rest unconformably on the Anderdon beds and usually show a basal conglomerate which often includes some sand	10	8

Anderdon beds	Feet	Inches
7. A compact, drab limestone with numerous fossils. A large, loosely coiled gastropod is usually very conspicuous on the eroded surface. The sand above mentioned has often sifted down into the cracks of these and the beds below, and may occasionally be found in considerable quantity even to a depth of 4 or 5 feet..............................	0	6
6. A semi-crystalline, grey limestone with very few fossils..............................	2	0
5. A semi-crystalline, grey limestone with an abundance of fossils. Corals and stromatoporoids are most abundant.............	4	8
4. Compact, banded, drab limestone with a conchoidal fracture, emitting a semi-metallic ring when struck with a hammer..........	18	0
Flat Rock dolomite? (?Lucas).		
3. A layer of brown, magnesian limestone which forms the base of the larger part of the deep cut of the quarry. It contains a few corals and stromatoporoids.....................	2	2
2. Indistinctly banded, rough, thin-bedded limestone with crinoidal stems and fragments...	1	10
1. Compact, drab limestone, rough and irregular. The top of these beds is sometimes very irregular and has a shale parting between it and the overlying rock. Corals and stromatoporoids are rather common in it.........	2	6

The following is a list of the Onondago species only in the quarry of the Amherstburg Stone Company, in Anderdon township.

	Horizons							
Anthozoa	8	9	10	11	12	13	14	15
Cystiphyllum vesiculosum Goldfuss	...	...	...	x	...	...	...	...
Favosites turbinatus Billings	...	...	...	x	x	x	...	x
Heliophyllum corniculum (Lesueur)	...	...	...	...	x	x	...	x
Heliophyllum halli Milne-Edwards and Haime	...	...	...	...	...	...	...	x
Zaphrentis prolifica Billings	...	...	...	...	...	x	...	...
Zaphrentis sp	...	...	...	x	...	...	x	...
Bryozoa								
Cystodictya gilberti (Meek)	x	...	x	...	x	x	x	...
Fenestella sp	...	...	...	x	x	...	x	...
Brachiopoda								
Athyris vittata indianaensis Stauffer	...	...	...	x	...	...	...	...
Atrypa reticularis (Linnaeus)	...	x	...	...	x	x	...	x
Atrypa spinosa Hall	...	...	x	x	x	...	...	...
Camarotoechia sp	x	...	...	...	...	...	...	...
Chonetes lineatus (Conrad)	...	...	...	...	...	x	...	...
Chonetes mucronatus Hall	x	...	...	...	...	x	x	x
Cyrtina hamiltonensis Hall	...	...	...	...	...	x	...	x
Leptaena rhomboidalis (Wilckens)	...	...	...	...	...	x	...	x
Nucleospira concinna Hall	...	...	...	...	...	...	x	x
Pholidops patina Hall and Clarke	...	...	...	x	...	...	...	...
Pholidostrophia iowaensis (Owen)	x	...	...	x	...	...	...	...
Rhipidomella vanuxemi Hall	...	...	...	x	x	x	...	x
Schellwienella pandora (Billings)	...	...	...	...	x	x	...	...
Schizophoria propinqua Hall	...	...	...	...	x	x	...	...
Spirifer lucasensis Stauffer	...	...	...	x	...	...	x	...
Spirifer macrus Hall	...	...	...	x	x	...	...	...
Spirifer varicosus Hall	x	...	...	...	...	...	...	x
Stropheodonta concava Hall	...	...	...	...	...	...	x	...
Stropheodonta demissa (Conrad)	x	...	...	x	...	x	...	x
Stropheodonta hemispherica Hall	...	...	...	x	...	x	...	x
Stropheodonta inequistriata (Conrad)	...	...	...	...	...	...	x	...
Stropheodonta perplana (Conrad)	...	...	...	...	...	x	...	x

	Horizons							
Pelecypoda	8	9	10	11	12	13	14	15
Conocardium cuneus (Conrad)	...	...	...	x	...	...	...	...
Paracyclas elliptica Hall	...	...	...	...	x	...	...	...
Gastropoda								
Euryzona lucina (Hall)	...	...	...	...	...	...	...	x
Pteropoda								
Tentaculites scalariformis Hall	...	...	...	x	...	x	x	...
Cephalopoda								
Gyroceras sp	...	...	...	...	...	x	x	...
Trilobita								
Dalmanites sp	...	...	...	...	...	...	x	...
Phacops cristata Hall	...	...	x	...	...	...	...	...
Proetus rowi (Green)	...	...	...	x	x	...	...	...
Pisces								
Macropetalichthys rapheidolabis Norwood and Owen	x	...	...	...	...	...	...	...
Onychodus sigmoides Newberry	...	...	x	...	...	...	...	...

On the McBride estate, Caldwell grant, a short distance back from the shore of Lake Erie, near the mouth of Big creek, there is a small outcrop consisting of about 2 feet of semi-crystalline, grey limestone in which the following Onondaga fossils were found.

Foraminifera

Calcisphaera robusta Williamson.

Anthozoa

Favosites turbinatus Billings.
Heliophyllum corniculum (Lesueur).
Zaphrentis prolifica Billings.

Bryozoa

Cystodictya gilberti (Meek).
Fenestella sp.

Brachiopoda

Atrypa reticularis (Linnæus).
Chonetes mucronatus Hall.
Leptaena rhomboidalis (Wilckens).
Nucleospira concinna Hall.
Schizophoria propinqua Hall.
Stropheodonta demissa (Conrad).
Stropheodonta perplana (Conrad).

Pelecypoda

Paracyclas elliptica Hall.

Pteropoda

Tentaculites scalariformis Hall.

PELEE ISLAND.

This is the largest of the group of islands near the western end of Lake Erie. It is situated off the main land about 25 miles to the south of Leamington. Much of the interior of the island lies low, while the south shore and the point are chiefly sand. Nevertheless, a large part of the island is rock, as is the case with all the others of the associated group. The Onondaga limestone skirts the north and east shores for a considerable distance and forms the back-bone of a ridge near the centre of the island.

The best sections are to be found where the chief quarrying has been done near the north and west docks. Capt. Jack McCormick's quarry (see Plate XIX) is near the club house at the northwest corner of the island where the following section may be seen.

Section of Capt. Jack McCormick's Quarry, Pelee Island.

	Feet	Inches
6. Soil and drift.	1	0
Onondaga limestone		
5. A rather thin-bedded, grey to brown limestone weathered to buff at the top.	6	0
4. Semi-crystalline, bluish grey limestone full of fossils and containing petroleum in the cavities of the fossils.	2	0
3. Rather porous, grey to brown limestone in which the fauna is large but conspicuous only on the weathered surfaces.	11	2
2. A massive, grey to brownish limestone which corresponds to the "Bottom Rock" of the Kelly Island quarries. It is usually one massive layer; but at places it breaks into several beds.	7	6
1. Covered interval to the level of Lake Erie.	1	6

From the rocks exposed in Capt. Jack McCormick's quarry the following fossils were collected.

	Horizons			
Foraminifera	2	3	4	5
Calcisphaera robusta Williamson	x	x	..	x
Anthozoa				
Acervularia rugosa Milne-Edwards and Haime	x	x	..	..
Cystiphyllum vesiculosum Goldfuss	x	x	..	..
Eridóphyllum vernuillianum Milne-Edwards and Haime	x	x	..	..
Favosites emmonsi Rominger	..	..	..	x
Favosites hemisphericus (Troost)	x	..	..	x
Favosites pleurodictyoides Nicholson	..	x	..	..
Favosites turbinatus Billings	x	..	x	..
Heliophyllum corniculum (Lesueur)	x	x	..	x

Anthozoa—*Contd.*	Horizons 2	3	4	5
Heliophyllum halli Milne-Edwards and Haime	..	..	..	x
Syringopora hisingeri Billings	..	..	..	x
Syringopora tabulata Milne-Edwards and Haime	..	..	..	x
Zaphrentis gigantea Lesueur	x	..	..	..
Zaphrentis prolifica Billings	x	x	..	..
Hydrozoa				
Stromatoporella granulata Nicholson	x	x	..	..
Stromatoporella tuberculata Nicholson	..	..	x	..
Bryozoa				
Cystodictya gilberti (Meek)	x	x	x	x
Fenestella sp	x	x	..	..
Monotrypa tenuis (Hall)	x	x	..	x
Semicoscinium miriable (Nicholson)	..	..	x	..
Brachiopoda				
Atrypa reticularis (Linnæus)	x	x	x	x
Camarotoechia carolina Hall	..	..	x	..
Camarotoechia sp	..	..	x	..
Chonetes mucronatus Hall	x	x	x	..
Crytina hamiltonensis Hall	..	..	..	x
Eunella lincklaeni Hall	..	..	..	x
Leptaena rhomboidalis (Wilckens)	..	x	x	..
Nucleospira concinna Hall	..	x	..	x
Pentamerella arata (Conrad)	..	..	..	x
Pholidops patina Hall and Clarke	..	x	..	x
Productella spinulicosta Hall	..	..	..	x
Rhipidomella vanuxemi Hall	..	x	x	..
Schizophoria propinqua Hall	x	..	x	x
Spirifer acuminatus (Conrad)	..	x	..	x
Spirifer duodenarius (Hall)	..	x	..	..
Spirifer manni Hall	x	..	..	x
Stropheodonta concava Hall	..	..	x	..
Stropheodonta demissa (Conrad)	x	x	x	x
Stropheodonta hemispherica Hall	x	x	x	x
Stropheodonta perplana (Conrad)	x	x	x	x

Pelecypoda	Horizons 2	3	4	5
Aviculopecten princeps (Conrad)	x	..	x	x
Conocardium cuneus (Conrad)	x	..	..	..
Paracyclas elliptica Hall	..	x	..	x
Gastropoda				
Euryzone lucina (Billings)	..	x	..	..
Pleuronotus decewi (Billings)	x	..	..	..
Pteropoda				
Tentaculites scalariformis Hall	..	x	x	x
Trilobita				
Proetus rowi (Green)	..	..	..	x

Near the west dock Mr. William McCormick has quarried in a rock which is very similar to that of the lower part of the quarry at the north end of the island, but including also somewhat lower layers (see Plate XX). The following is a section of the rocks exposed at that place.

Section of William McCormick's Quarry, Pelee Island.

	Feet	Inches
4. Soil and drift	1	6
Onondaga limestone		
3. Comparatively thin-bedded, grey to greyish brown limestone	5	3
2. Massive, grey to greyish brown limestone, almost a solid single layer, "Bottom Rock"	9	9
1. Grey to brown limestone which is fairly massive but breaks into several layers. Fossils occur in streaks which appear to be more crystalline than the rest. These beds extend to the level of the water in the bottom of the quarry	5	2

The following fauna was collected from the rocks exposed in the William McCormick quarry.

	Horizons		
Foraminifera	1	2	3
Calcisphaera robusta Williamson	x	x	x
Anthozoa			
Acervularia rugosa Milne-Edwards and Haime	x	x	..
Crepidophyllum archiaci Billings	x	..	..
Cystiphyllum vesiculosum Goldfuss	x	x	x
Eridophyllum vernuillianum Milne-Edwards and Haime	..	x	x
Favosites pleurodictyoides Nicholson	x	..	..
Favosites polymorphus Goldfuss	x	..	..
Favosites turbinatus Billings	x	x	x
Heliophyllum corniculum (Lesueur)	x	x	x
Heliophyllum halli Milne-Edwards and Haime	..	..	x
Syringopora tabulata Milne-Edwards and Haime	..	..	x
Zaphrentis gigantea Lesueur	x	x	x
Zaphrentis prolifica Billings	x	..	..
Hydrozoa			
Stromatoporella granulata Nicholson	..	..	x
Bryozoa			
Cystodictya gilberti (Meek)	x	..	x
Fenestella parallela Hall	..	x	..
Brachiopoda			
Athyris vittata indianaensis Stauffer	..	..	x
Atrypa reticularis (Linnaeus)	x	x	x
Chonetes hemisphericus Hall	..	x	x
Chonetes mucronatus Hall	x	x	x
Nucleospira concinna Hall	..	..	x
Productella spinulicosta Hall	..	x	x
Rhipidomella vanuxemi Hall	..	x	..
Schizophoria propinqua Hall	x	x	..
Spirifer acuminatus (Conrad)	..	x	..
Spirifer gregarius Clapp	..	..	x

Brachiopoda—*Contd.*	Horizons 1	2	3
Spirifer manni Hall	x	..	x
Stropheodonta demissa (Conrad)	x	x	x
Stropheodonta hemispherica Hall	x	x	x
Stropheodonta perplana (Conrad)	x	x	x
Pelecypoda			
Paracyclas elliptica Hall	..	..	x
Gastropoda			
Euryzone lucina (Hall)	..	x	..
Platyceras carinatum Hall	..	..	x
Platyceras sp	..	x	..
Pleuronotus decewi (Billings)	..	..	x
Pteropoda			
Tentaculites scalariformis Hall	..	x	..
Trilobita			
Coronura diurus (Green)	..	..	x
Proetus rowi (Green)	..	..	x

MIDDLE ISLAND.

This is a small island lying just south of Pelee and near the International Boundary line. It is practically a solid mass of limestone slightly covered by drift, with a spur of gravel extending to the westward. The following is a section of the rocks exposed on the south side of the island.

Section of the Onondaga Limestone Exposed on Middle Island.

	Feet	Inches
4. Soil and drift	0	6
Onondaga limestone		
3. Weathered grey limestone passing into a thin-bedded, grey to brown limestone above	4	8
2. Semi-crystalline, grey limestone containing *Spirifer acuminatus* associated with *Aviculopecten cleon*	0	4
1. Semi-crystalline, grey limestone extending to the level of Lake Erie	3	6

A general collection of fossils from the rocks of Middle island was made, and the following list obtained.

Foraminifera

Calcisphaera robusta Williamson.

Anthozoa

Acervularia rugosa Milne-Edwards and Haime.
Eridophyllum vernuillianum Milne-Edwards and Haime.
Favosites turbinatus Billings.
Favosites sp.
Heliophyllum corniculum (Lesueur).
Heliophyllum halli Milne-Edwards and Haime.
Zaphrentis prolifica Billings.
Zaphrentis sp.

Bryozoa

Cystodictya gilberti (Meek).
Fenestella sp.
Monotrypa tenuis Hall.

Brachiopoda

Athyris vittata indianaensis Stauffer.
Atrypa reticularis (Linnæus).
Chonetes mucronatus Hall.
Nucleospira concinna Hall.

Brachiopoda—*Contd.*

Pholidops patina Hall and Clarke.
Productella spinulicosta Hall.
Rhipidomella vanuxemi Hall.
Schizophoria propinqua Hall.
Spirifer acuminatus (Conrad).
Spirifer gregarius Clapp.
Spirifer manni Hall.
Stropheodonta concava Hall.
Stropheodonta demissa (Conrad).

Pelecypoda

Aviculopecten cleon Hall.
Aviculopecten princeps (Conrad).
Conocardium cuneus (Conrad).
Grammysia nodocostata (?) Hall.
Paracyclas elliptica Hall.

Gastropoda

Diaphorostoma lineatum (Conrad).
Platyceras carinatum Hall.
Platyceras echinatum Hall.
Pleuronotus decewi (Billings).
Pleurotomaria sp.

Pteropoda

Tentaculites scalariformis Hall.

Trilobita

Phacops cristata Hall.
Proetus rowi (Green).

SUMMARY AND CONCLUSION.

From the preceding pages it is evident that there is a marked unconformity between the uppermost Silurian and the lowermost Devonian of Ontario. This old erosion surface is often markedly uneven. The oldest undisputed Devonian formation of the province is the Oriskany sandstone which is identical in age with the formation of the same name in New York state. It is also evident that the Oriskany is patchy in its occurrence, due to the period of erosion which intervened between its deposition and the time when the Onondaga sea spread over the same region. The Springvale sandstone, which has sometimes been confused with the Oriskany, is distinct from it and is, in fact, basal Onondaga.

The three rather prominent lithological divisions of the Onondaga in the Fort Erie region are not faunally distinct and probably merge into each other to the westward. The fauna of the lowest division, which differs somewhat from the overlying beds and resembles slightly the Schoharie fauna may be traced northwestward to Port Elgin, but could not be found in the extreme southwestern part of the province. It thus seems probable that the lowest Onondaga beds are wanting there.

The Delaware limestone, a name taken over from the Ohio classification, is rather widespread in Ontario. In its outcrops it has usually been confused with the Onondaga limestone, as has often been the case with its Ohio equivalent; but in well sections it has been considered as Hamilton. It is, in fact, transitional in character and fauna between these two formations and of about the age of the Marcellus shale of New York. Its fauna contains many of the Marcellus forms.

The Hamilton includes rather more than the same formation in Ohio or even western New York, but is probably not quite so extensive as the Traverse group of northern Michigan. The four divisions used for this formation are probably not of very great importance. The name, Olentangy shale, of the lowest subdivision, is also taken over from the Ohio classification. In that state it is the only representative of the true Hamilton, except in the vicinity of Sandusky where the lower portion of the Widder beds also occurs. The other subdivisional names are of local origin. As a whole the Ontario Hamilton is more closely related to the Michigan deposits than to those of western New York and, like the former, its fauna shows a closer relationship to the late Onondaga.

The black shale at Kettle point, which Dr. Kindle has correlated with the Huron of Ohio, covers quite a large area in southwestern Ontario. Although it carries forms common to the Genesee shale of New York, it undoubtedly passes into the Huron shale and to the southward rests on progressively older and older beds.

The Port Lambton beds do not outcrop within the province, unless the uppermost layers at Kettle point, Kingstone mills, and Alvinston belong to them. It is possible that they include beds somewhat younger than those usually referred to the Devonian.

CHAPTER III.

FAUNAL DISCUSSION.

GENERAL STATEMENT.

The Devonian was a period during which more or less isolated portions of most of the continents were covered by shallow arms or embayments of the sea. In these lived faunas which, because of the limited possibility of intermigration, differed materially from each other and have, therefore, been called provincial. The more these faunas are studied, however, the more is found in common between them. Some of the more important areas of Devonian rocks occur in southern Australia and a portion of New Zealand, South Africa, the region north of Lake Tchad in the Sahara, the northern and southern provinces of Europe, a portion of Asia Minor and Persia, north central Siberia, central and southern China, Portions of Japan, several important areas in South America, and the various provinces of North America. Notwithstanding the provincialism of these areas they all bear certain broad faunal relations to each other, as might be expected in distant parts of the sea of any period. Certain species of corals and brachiopods are found in Europe, Asia, Australia, and South America which are either identical with or so closely related to North American forms that they are separated with great difficulty. The relationship between the Devonian faunas of North America and Europe, and again between those of North and South America is so close that it is certain conditions developed favouring migration between these portions of the Devonian sea.

In North America the Devonian outcrops and regions covered by these formations may be grouped into five general areas.[1]

[1]See Williams, H. S., Am. Jour. Sci., 3rd ser., vol. XXXV, 1888, pp. 51-59.

Kindle, E. M., Jour. Geol. vol. XV, 1907, pp. 314-337.

Stauffer, C. R., Geol. Surv. Ohio, 4th ser., Bull. 10, 1909, p. 158.

(a) *The Eastern Border Area*, including Gaspe, New Brunswick, and northern New England.

(b) *The Eastern Continental Area*, best known in New York, Ontario, Michigan, Ohio, Indiana, southern Illinois, Kentucky, and less perfectly southward to the Gulf states.

(c) *The Interior Continental Area*, developed in west central Illinois, in Missouri, Iowa, and thence northward through Manitoba and along the valley of the Mackenzie river to the Arctic.

(d) *The Western Continental Area*, in the Great Basin region, including portions of Nevada, California, and adjacent territory.

(e) *The Western Border Area*, including the Devonian rocks of the islands off the southeastern coast of Alaska.

The Ontario Devonian lies within the Eastern Continental Area, which itself was somewhat complicated by various expansions or basins with restricted connexions and oscillating boundaries. This has caused various parts of the area to differ slightly in their faunas at any particular interval and has produced differences which are not always clear in their fragmentary preservation. It includes the three most important types of sedimentary rocks—sandstone, shale, and limestone. Associated with these differing rocks are faunas which are markedly dissimilar although not always entirely distinct. Even within the same formation there is often a differentiation of the species into measurably independent faunules. Some of these are undoubtedly the result of the varying conditions of sedimentation, others are chiefly the inevitable result of the lapse of time, and still others are due to the intermigration of species from the more or less isolated basins in which provincial faunas had been developing since the close of the Silurian period. Probably this latter is chiefly connected with the interval rather late in the period, when the spreading seas permitted a mingling from the westward of the slightly different faunas of the various provinces. There is a noticeable difference, too, between the Ontario Devonian faunas and those of the typical deposits of New York. This is especially true of the most westerly deposits where the Ontario Devonian often contains forms which appear at a somewhat later Devonian date in the eastern states.

ORISKANY FAUNA.

The oldest Ontario fauna of undoubted Devonian age is the Oriskany. It is found in the remnant of that sandstone occurring a few miles to the west of DeCewville, and is the characteristic association of species which is so well known in the Oriskany deposits to the south and east. Of its species 83 per cent are known in New York state and $6\frac{2}{3}$ per cent of the remainder are doubtfully identified, while 3 species are not known to occur elsewhere in the Oriskany. Only one species not usually occurring in as old deposits was collected here and that, *Strophonella ampla*, is found at least in the Schoharie grit of New York and in the Grande Greve limestone (undifferentiated Oriskany) of Gaspe. Twenty-five per cent of the species are common to the Onondaga; but these have also been found in the Oriskany of other regions and in many cases are as characteristic of its fauna as of that of the Onondaga. Nearly as many are also found in the Helderbergian. The facts in the case, therefore, do not support the supposed mingling of the Oriskany and Onondaga faunas[1] at this place, but show them to be as distinct as at any other locality.

The Oriskany is a southern and eastern fauna. It is found undifferentiated among the Devonian deposits of the Gaspe region,[2] and partially developed in the lowest Devonian of Brazil.[3] Just how much influence this South American fauna may have had on the North American Devonian is rather difficult to say. There is some evidence indicating that both regions were receiving immigrants from the same faunal province rather than that either region acted as a recruiting station for the other. The South American Devonian fauna is probably more closely allied to that of the Bokkeveld[4] beds of South Africa than to any of the Devonian faunas of this continent.

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[1]Nicholson, H. A., Palæontology of Ontario, Toronto, 1874, pp. 7, 8.

[2]Clarke, J. M., N.Y. State Museum Memoir 9, 1908, p. 251.

[3]Katzer, Friedrich, Grundzuge der unteren Amazonas gebietes, 1903, pp. 192-211.

[4]Reid, Ann. South African Museum, vol. IV, pts. 3 and 4, 1903-4. (Cited and quoted by Schuchert). Jour. Geol. vol. 14, 1906, p. 739.

The Oriskany fauna also occurs in the Camden chert of western Tennessee and southern Illinois. Hence there must have been an embayment of shallow water extending northward from the Gulf of Mexico or westward from the Atlantic, as the Oriskany is not known to be continuous across the region intervening between Ontario and western Tennessee. This, however, was probably late in Oriskany time, as the deposit of southern Illinois seems to contain only the upper Oriskany fauna. In these beds there occur, in fact, many forms not usually found below the base of the Onondaga, and sedimentation is said to be continuous into the latter formation.[1]

ONONDAGA FAUNA.

The Onondaga fauna is made up of a great number of elements. Many species lingered over from the Oriskany of this region. Others immigrated from distant seas as the shallow waters became so connected as to make intermigration possible. Undoubtedly a great many forms changed rapidly under the modified conditions of life so that their descendants in the next younger stage are classed as new species. *Hindia fibrosa*, the only important sponge, was found to be quite common in the vicinity of Hagersville. This form, primarilly considered a Silurian species, occurs throughout the Devonian of Gaspe[2] and has been collected from the Helderbergian of New York, but has not been reported from the Onondaga limestone before. It represents an interesting invasion of the province, probably from Gaspe by way of New York, by a form which must have been approaching extinction. Corals are among the abundant and most characteristic fossils of the Onondaga of Ontario. The Devonian deposits of South America[3] are almost destitute of these organisms, while in southern Illinois they are few and unimportant. The same thing may be said regarding the deposits of this age in Gaspe. In the middle Devonian of western

[1]Savage, T. E., loc. cit. p. 113.

[2]Clarke, J. M., N.Y. State Mus. Mem. 9, 1908, pp. 243-249.

[3]For a recent account of the Devonian of Brazil see Clark, J. M., Monographias do Servico Geologico e Mineralogico do Brazil, vol. I, Rio de Janeiro, 1913.

Europe and of northern Asia, on the other hand, there is a rich coral fauna.[1] The identity of some of these species and the marked similarity of others makes it certain that intermigration took place between these Eurasian localities and this Ontario region. The abundance of corals in the Devonian deposits around James bay[2] has suggested that these forms may have been introduced into America from Europe by way of the north. Some additional strength is given to this conclusion by a consideration of the abundant Silurian corals in Wisconsin[3], Iowa[4], and Michigan. If at the close of the Silurian these forms migrated northward to some still unknown province,[5] just such relation might be expected when favourable conditions induced their return.

In the Detroit River series of southwestern Ontario and adjacent parts of Michigan, especially in the beds which have been called the Amherstburg dolomite[6], there is a large and varied fauna which contains many forms closely related to those of the Onondaga. This is true not only of the corals but of the brachiopods, pelecypods, gastropods, cephalopods, and trilobites as well. Although Dr. Kindle considers it to be Devonian, the fauna probably falls within the Silurian, according to the present definition of that system; but there can be no doubt that it is in part ancestral to the Onondaga of the same region. There is, however, a long break between the deposition of the sediments in which it occurs and the advance of the Onondaga sea. During this interval the Detroit River fauna must have migrated to some distant point for the region was converted into dry land and subjected to prolonged erosion.

Bryozoa are well represented in the Onondaga of Ontario as in most other parts of the Eastern Continental Area. These

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[1]Lebedew, N., Mem. du Comité Géologique, Vol. XVII, No. 2, 1902, pp. 1-130, 137-180.

[2]Parks, W. A., 13th Rept. Ont. Bur. Mines, 1903, p. 181.

[3]Chamberlin, T. C., Geol. Surv. Wisconsin, Vol. II, 1877, pp. 349-371.

[4]Calvin, Samuel, Geol. Surv. Iowa, Vol. V, 1896, pp. 79-81.

[5]Weller, Stuart, Jour. Geol., Vol. X, 1902, p. 429.

[6]Grabau, A. W. and Sherzer, W. H., Michigan Geol. and Biol. Surv., Pub. 2, Geol. ser. 1, 1909 (1910), pp. 87-223, pls. VIII-XXIX.

forms are rather unimportant in the Gaspe region,[1] while in the Parana district of Brazil they are entirely wanting. In the early Devonian of New York they are quite abundant and, in many cases, very similar to these middle Devonian forms under discussion. It thus seems probable that the Onondaga Bryozoa are largely a local evolution product of the earlier forms in the same period. Some of the brachiopods show evidences of origin in quite a different direction. *Anoplia nucleata*, *Centronella glansfagea*, *Chonostrophia reversa*, *Cyrtina hamiltonensis*, *Spirifer duodenarius*, *Spirifer macrothyris*, *Stropheodonta perplana*, etc., make their first appearance in the Oriskany of southern Illinois.[2] Some of these same forms lived in the lowest Devonian of South America.[3] Among these may be mentioned *Anoplia nucleata*, *Amphigenia elongata*, *Spirifer duodenarius*? *Stropheodonta demissa*, and seven or eight species closely related to Onondaga forms.[4] In the Grande Greve limestone of Gaspe a great many Onondaga brachiopods occur in what is essentially an Oriskany fauna. Among these are *Centronella glansfagea*, *Delthyris raricosta*, *Reticularia fimbriata*, *Stropheodonta parva*, *Stropheodonta patersoni*, *Strophonella ampla*, etc.[5] Undoubtedly these species migrated into this interior region with the advance of the sea in that direction.

The pelecypod element is not as important as in the same formation (Columbus limestone) in Ohio. In general the Pelecypoda is more widely distributed than other classes in the Onondaga fauna and they are thus of much less value as indicators of migratory routes. It is worthy of note, however, that in the Devonian area of Parana, Brazil, Dr. Clarke dis-

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[1]Clarke, J. M., N.Y. State Museum, Mem. 9. 1908, pp. 243-249.

[2]Savage, T. E., Op. cit. p. 113.

[3]Katzer, Friedrich, Grundzuge der unteren Amazonas gebietes, 1903, pp. 192-196, 202, 210, 211, and pls. X, XI.

Also Konold, Reinhart, Neues Jahrbuch, vol. XXV (Beilage Band), 1908, pp. 573-574.

[4]Clarke, J. M., Archivos do Museu Nacional do Rio de Janeiro, vol. X, 1897-1899 (1899), pp. 166-168.

[5]Clarke, J. M., N.Y. State Museum, Mem. 9, 1908, p. 251.

covered a complete absence of Aviculids and Pterineids,[1] both of which are not uncommon in the Ontario Devonian. The gastropods are rather abundant. Many of those in the check-list, given with this report, have been found only in the limited zone along the shore of Lake Erie to the east of Port Dover. This faunal horizon contains the same gastropods preserved in the chalky white chert in the same manner as they are in the Eversole chert zone[2] at the foot of Robinsons hill in central Ohio, to which it is certainly equivalent. Many of these forms also occur in the James Bay region; but the gastropods are not important members of the Onondaga of southern Illinois or of the Devonian of South America. The Detroit River series of south-western Ontario and the adjacent portions of Michigan contain a large number of gastropods, many of which are remarkably similar to those of the Onondaga. A like relation exists between it and certain of the older Silurian faunas, so that it would seem much of the gastropod element may have been indigenous to the region or at least a developmental product of the Silurian. The cephalopods are important, but not so abundant in Ontario as in the same deposit of Ohio. In southern Illinois they are rare, except Gomphoceras, while in Brazil only Orthoceras and Kionoceras have been found, and in Bolivia only one species of Orthoceras is known to occur.[3] The common occurrence of cephalopods in the James Bay region[4] and their abundance in the Silurian and Devonian of central Europe are suggestive of their migratory route. This is especially well indicated by the relation of the goniatites of Ohio[5] to those of Europe.

The trilobites are fairly abundant and identical with those found in the Devonian of New York and Ohio. They were probably derived, in part, from the preceding fauna, although some forms are widely distributed and may have been immigrants to this region.

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[1]See Dr. J. P. Smith's review of "Fosseis Devonianos do Parana," Jour. Geol. vol. XXII, 1914, p. 96.

[2]Stauffer, C. R., Geol. Surv. Ohio, Bull. 10, 1909, pp. 66-70.

[3]Knod, Reinhold, Neues Jahrbuch, vol. XXV (Beilage Band), 1908, pp. 502, 503.

[4]Parks, W. A., Op. cit. pp. 188-190.

[5]Stauffer, C. R., Op. cit. p. 174.

Only two species of fish have been identified from the Ontario Onondaga. They are those which are most common in the Ohio deposit of the same age. One of these, *Macropetalichthys rapheidolabis*, occurs in the Onondaga of the James Bay region.[1] All of the genera of fishes found in the Eifel and Bohemia regions of Europe, together with five additional, occur in the Eastern Continental Area of North America. It would thus seem that this region is nearer the ancestral home than Europe. Although a few fishes occur in the Devonian of Gaspe[2] the source of this element in the Onondaga fauna is not yet definitely known.

From these statements it appears that the Onondaga fauna is composed of at least three important elements. One of these is somewhat related to the faunas of the older Devonian deposits of Gaspe and of South America, which had migrated into Tennessee and southern Illinois by the late Oriskany. Another element, which includes many of the corals and is, therefore, more distinctive of the Ontario deposit, bears such marked relationship to the faunas of northern and central Europe that there can be no doubt that there was shallow water communication between Europe and the Eastern Continental sea of Onondaga time. The line of migration followed by this element is not clear. A study of the faunal lists published by Whiteaves[3] led Weller to write, "From the geological distribution of the Corniferous (Onondaga) fauna, it may be suggested that the province in which it originated was situated somewhere in the Arctic regions, and that representatives of it migrated southward both into North America and into Europe."[4] While there are still some serious objections to this Arctic origin of the Onondaga, it does seem that the practical identity of the major

[1]Whiteaves, J. F., Geol. Surv., Canada, Rept. of Prog. 1875-76 (1877), pp. 319, 320.

[2]Eastman, C. R., N. Y. State Museum Mem. 10, 1907, p. 13; Geol. Surv. Iowa, vol. XVIII, 1908, pp. 275, 276.

[3]Whiteaves, J. F., Geol. Surv., Canada, Rept. Progress for 1875-6, pp. 319-320; Idem 1877-8, pp. 5, 6; Idem 1878-9, p. 51 C; Idem 1879-80, p. 33 A; Proc. Am. Assoc. Adv. Sci., 1899, pp. 22-23; Am. Geol. vol. XXIV, 1899, p. 231.

[4]Weller, Stuart, Journal Geology, vol. X, 1902, p. 429.

part of the Devonian fauna of the James Bay region, now made certain by the work of Parks,[1] together with the Devonian remnants reported on Southampton island, and others less perfectly known to the northward, may indicate the migratory route of the European element of this fauna. Concerning the introduction of the northern European element Schuchert says "the path was along the shores of the great North Atlantic continent (Atlantis) to the north of Appalachia and down the Gulf of St. Lawrence through the Connecticut straits into the Mississippian sea"[2] which covered the region now occupied by the Eastern Continental Area of Devonian deposits. The Devonian rocks at the mouth of the St. Lawrence carry a fauna which is so different, in many respects, from the Onondaga that it seems impossible for it to have had such direct communication with the sea in which the latter was being deposited. As one marked example of the decided difference between these two faunas it is but necessary to call attention to the corals. Clarke lists only eleven species[3] in the whole Gaspe Devonian, and of these only two are common to the Onondaga. The check-list of this report shows one hundred species of corals occurring in the Ontario Onondaga, and the probability is that there are others not included in it. Hence it seems that had such a wealth of species passed over the Gaspe region they should have left a much better indication of their presence than has thus far been obtained. So it seems better to regard the Onondaga remnants at Lake Memphremagog[4] and near Famine river, Quebec,[5] as outliers of the extensive development of that formation in New York. If the corals are an European element, and their abundant development in Europe and Asia with species common to the Devonian of North America seems to prove it, the northern route through James bay was probably the only one open to such migration. Before that route becomes an established fact,

[1]Parks, W. A., Rept. Ont. Bur. Mines, 1904, pt. I, pp. 180-191.

[2]Schuchert, Charles, Am. Geol. vol. XXXII, 1903, p. 156.

[3]Clarke, J. M., N.Y. State Museum, Mem. 9, 1907, p. 249.

[4]Ami, Henry M., Ann. Rept. Geol. Surv., Canada, vol. VII, N.S., 1894, p. 157J.

[5]Ells, R. W., Geol. Surv., Canada, Rept. for 1887-8 (1889), pp. 9 K-11 K.

however, it will be necessary to know much more about the geological structure and stratigraphy of northern Canada than is at present known.

The third element of this fauna is undoubtedly indigenous to the general region and an evolution product of the earlier Devonian and Silurian forms now found in the same basin. Just as the Helderbergian contributed to the fauna of the Oriskany so, in turn, the Oriskany contributed to the Onondaga. The similarity and possible identity of some of the Detroit River species to those of the Onondaga make it rather certain that this series contributed to the ultimate fauna of the latter.

DELAWARE FAUNA.

The Delaware limestone of Ontario is essentially the western equivalent of the Marcellus shale of New York. Even in the western part of that state the Marcellus is often so like the Onondaga, lithologically, that it is almost impossible to separate them. Where this is the case, in parts of Ontario and Ohio, the fauna of the Delaware assumes more the character of the Onondaga than of the true Marcellus, but the fauna is made up of those species which are usually common to the Onondaga and Hamilton. Added to these are a number of forms which are rather characteristic of the Hamilton and the Delaware becomes a real transition between these two faunas. In a few cases the basal portion of the Delaware is a true brown shale carrying a characteristic Marcellus fauna; and wherever, at higher horizons, the formation becomes shaly, there the fauna tends to revert to the more typical Marcellus.

HAMILTON FAUNA

In the early part of this report, the rocks which properly belong to the Hamilton have been divided into the Olentangy shale, the Widder beds, the Petrolia shale, and the Ipperwash limestone. These rather persistent sub-stages contain partially differentiated faunules, but are not to be considered as independent formations. Some of the more characteristic fossil species of the Olentangy shale as exposed in Ontario are: *Arthracantha punctobranchiata*, *Palaeaster eucharis*, *Hederella canadensis*, *Hederella filiformis*, *Chonetes deflectus*, *Cyrtina hamiltonensis*, *Spirifer mucronatus arkonense*, *Stropheodonta demissa*, *Nuculites triqueter*, *Leda rostellata*, *Paracyclas lirata*, *Platyceras rarispinosum*, *Styliolina fissurella*, *Tentaculites attenuatus*, *Bactrites arkonensis*, *Tornoceras uniangularis*, *Spirorbis omphalodes*, *Phacops rana*, etc. Among these *Leda rostellata*, *Bactrites arkonensis*, *Tornoceras uniangularis*, and a few others are pyritized and always occur together just as they do in the Olentangy shale of northern Ohio. The Widder beds are characterized by an abundant fauna, among which the following may be cited as rather characteristic: *Cystiphyllum vesiculosum*, *Favosites billingsi*, *Heliophyllum halli*, *Trachypora elegantula*, *Codaster canadensis*, *Eleutherocrinus cassedayi*, *Pentremitidae filosa*, *Spirorbis angulatus*, *Spirorbis arkonensis*, *Spirorbis spinulifera*, *Ascodictyon stellatum*, *Botryllopora socialis*, *Cystodictya hamiltonensis*, *Fenestella arkonensis*, *Hederella canadensis*, *Vinella devonica*, *Ambocoelia umbonata*, *Athyris spiriferoides*, *Athyris vittata*, *Chonetes deflectus*, *Chonetes coronatus*, *Camarotoechia thedfordensis*, *Cyclorina nobilis*, *Delthyris sculptilis*, *Leiorhynchus laura*, *Pentagonia unisulcata*, *Schizophoria striatula*, *Spirifer mucronatus thedfordensis*, *Stropheodonta demissa*, *Stropheodonta concava*, *Tropidoleptus carinatus*, *Pterinea flabellum*, *Phanerotinus laxus*, *Orthoceras subulatum*, *Orthoceras lambtonensis*, *Cryphaeus boothi*, *Phacops rana*, etc. The Petrolia shale does not outcrop and consequently its fauna is not known. The Ipperwash limestone outcrops at several places, but chiefly along either side of Ipperwash beach, Lake Huron. Some of its more characteristic fossils are: *Dendropora alternata*, *Syringopora nobilis*, *Ancyrocrinus bulbosus*, *Cystodictya incisurata*, *Fenestella emaciata*, *Streblotrypa hamiltonensis*, *Athyris spiriferoides*, *Cyrtina hamiltonensis*, *Spirifer mucronatus*, *Spirifer granulosus*, *Stropheodonta demissa*, *Orthoceras eriense*, *Phacops rana*, etc.

These divisions represent the whole of the Hamilton in Ontario and their fauna is made up of the characteristic forms; but there is still another division, the Alpena limestone, which in many respects is markedly different from any other Devonian deposit in the province, also of Hamilton age. It is chiefly characterized by the abundance of stromatoporoids which occur, associated with corals, in great massive reefs. The fauna is made up chiefly of derivatives from the Onondaga. This is probably because it is a pure limestone deposit and, therefore, invited the return of the Onondaga remnant together with other forms suited to a calcareous sea. Its true relationship has been determined only by a study of the deposits at Alpena, Michigan, where it occurs in the middle Hamilton. As a whole the Hamilton is a derivative from the Onondaga fauna, but it also contains certain foreign elements which are equally characteristic. Among these latter forms are *Ambocoelia umbonata*, *Chonetes coronatus*, and *Tropidoleptus carinatus*, which occur in the early Devonian of Bolivia, Brazil, and Argentine,[1] although a single specimen of *Tropidoleptus carinatus* has also been found in the Oriskany of Maryland.[2] Other species, such as *Athyris spiriferoides* (*concentrica*) and *Schizophoria striatula* are represented in the middle Devonian of Europe and may have migrated from that locality.

The upper Devonian faunas are represented by the few fossils found in the black shale at Kettle point, which Dr. Kindle has correlated with the Huron of Ohio. *Lingula ligea* is common to the Hamilton, Genesee, and Portage of New York, and the Eureka district of Nevada. *Lingula spatulata*, which is occasionally found at Kettle point, occurs in the Genesee and Portage of New York, and is likewise found in Russia and Brazil. Among the conodonts *Prioniodus acicularis*, *Prioniodus spicatus*, *Polygnathus dubius*, and *Polygnathus palmatus*, are common to the Genesee of New York, while *Polygnathus truncatus* and *Prioniodus panderi* occur in the Hamilton of New York. This is certainly a significant fact when the age of these beds is under consideration. The fish remains are more or less fragmentary, but ap-

[1]Knod, Reinhold, Neues Jahrbuch, vol. XXV (Beilage Band), 1908, pp. 545-551.

Also Ulrich, Arnold, Neues Jahrbuch, vol. VIII (Beilage Band), 1893, pp. 73-75, 79, 80.

And Bordenberger, W., Zeit. d. Deut. Geol. Ges., vol. XLVII, 1896, pp. 748-754.

[2]Schuchert, Charles, Jour. Geol., vol. XIV, 1906, p. 733.

parently belong to the same forms as those occurring in the Huron shale of Ohio.

CHECK LIST OF THE DEVONIAN FAUNAS.

The following check-list of the Ontario Devonian includes all forms known to occur in these formations in this province. All provisional identifications, and usually those with no species identified, have been omitted.

Fauna and Flora of the Huron Shale of Ontario.

Plantae

Pseudobornia inornatus (Dawson).
Knorria sp.
Lepidodendron primaevum Rodgers.
Protosalvinia huronensis (Dawson).

Brachiopoda

Lingula ligea Hall.
Lingula spatulata Vanuxem.

Vermes

Polygnathus coronatus Hinde.
Polygnathus ? curvatus Hinde.
Polygnathus dubius Hinde.
Polygnathus duplicatus Hinde.
Polygnathus immersus Hinde.
Polygnathus palmatus Hinde.
Polygnathus radiatus Hinde.
Polygnathus ? serratus Hinde.
Polygnathus truncatus Hinde.
Polygnathus universus Hinde.
Prioniodus acicularis Hinde.
Prioniodus panderi Hinde.
Prioniodus spicatus Hinde.

Pisces

Dinichthys sp.
Rhadinichthys sp.
Stenosteus sp.

Fauna of the Hamilton Beds of Ontario.

Spongia

Astraeospongia hamiltonensis Meek and Worthen.
Receptaculites neptuni Defrance.

Anthozoa

Acervularia davidsoni Milne-Edwards and Haime.
Acervularia profunda Hall.
Alveolites goldfussi Billings.
Alveolites roemeri Billings.
Aulacophyllum sulcatum (d'Orbigny).
Aulopora cornuta Billings.
Aulopora serpens Rominger.
Aulopora tubaeformis Goldfuss.
Bothrophyllum conatum Hall.
Ceratopora agglomerata Grabau.
Ceratopora dichotoma Grabau.
Ceratopora intermedia (Nicholson).
Ceratopora jacksoni Grabau.
Cladopora alpenensis Rominger.
Cladopora cryptodens (Billings).
Cladopora fisheri (Billings).
Cladopora frondosa (Nicholson).
Cladopora labiosa (Billings).
Cladopora robusta Rominger.
Cladopora roemeri (Billings).
Craspedophyllum archiaci (Billings).
Craspedophyllum subcaespitosum (Nicholson).
Cyathophyllum zenkeri Billings.
Cystiphyllum conifollis Hall.
Cystiphyllum superbum Nicholson.
Cystiphyllum vesiculosum Goldfuss.
Dendropora alternans Rominger.
Eridophyllum strictum Milne-Edwards and Haime.
Favosites alpenensis Winchell.
Favosites arbuscula Hall.
Favosites billingsi Rominger.
Favosites canadensis (Billings).
Favosites clausus Rominger.
Favosites digitatus Rominger.
Favosites hamiltoniae Hall.
Favosites limitaris Rominger.
Favosites nitellus Winchell.

Favosites placentus Rominger.
Favosites radiatus Rominger.
Favosites radiciformis Rominger.
Favosites reticulatus deBlainville.
Favosites tuberosus Rominger.
Favosites turbinatus Billings.
Heliophyllum confluens Hall.
Heliophyllum corniculum (Lesueur).
Heliophyllum exiguum Billings.
Heliophyllum halli Milne-Edwards and Haime.
Heliophyllum infoviatum (Davis).
Heliophyllum juvene (Rominger).
Heliophyllum tenuiceptatum Billings.
Michelinia insignis Rominger.
Microcyclus discus Meek and Worthen.
Monilopora antiqua Whiteaves.
Phillipsastrea verneuilli Milne-Edwards and Haime.
Roemeria ramosa Whiteaves.
Striatopora linnaeana Billings.
Syringopora intermedia Nicholson.
Syringopora nobilis Billings.
Syringopora perelegans Billings.
Trachypora elegantula Billings.
Trachypora ornata Rominger.
Zaphrentis prolifica Billings.

Hydrozoa

Clathrodictyon retiforme (Nicholson and Murie).
Stromatoporella granulata Nicholson.
Stromatoporella incrustans Hall and Whitfield.
Stromatoporella mammillata Nicholson.
Stromatopora monticulifera Winchell.
Stromatopora pustulifera Winchell.

Crinoidea

Ancyrocrinus bulbosus Hall.
Arthracantha punctobranchiata Williams.
Botryocrinus crassus (Whiteaves).
Dolatocrinus canadensis Whiteaves.
Dolatocrinus lamellosus Hall.
Dolatocrinus liratus Hall.
Dolatocrinus subaculeatus Whiteaves.
Genneaocrinus arkonensis Whiteaves.
Gilbertsocrinus spinigerus Hall.
Megistocrinus rugosus Lyon and Casseday.
Taxocrinus lobatus Hall.

Blastoidea

Codaster canadensis Billings.
Eleutherocrinus cassedayi Shumard and Yandell.
Granatocrinus leda Hall.
Nucleocrinus elegans Conrad.
Nucleocrinus lucina Hall.
Pentremites lycorias Hall.
Pentremitidea filosa Whiteaves.

Asteroidea

Palaeaster eucharis Hall.

Vermes

Arabellites arcuatus Hinde.
Arabellites politus Hinde.
Aenonites compactus Hinde.
Autodetus lindstroemi Clarke.
Eunicites ? alveolatus Hinde.
Eunicites nanus Hinde.
Eunicites palmatus Hinde.
Eunicites tumidus Hinde.
Nereidavus solitarius Hinde.
Ortonia intermedia Nicholson.
Spirorbis angulatus Hall.
Spirorbis arkonensis Nicholson.
Spirorbis omphalodes Goldfuss.
Spirorbis spinuliferus Nicholson.

Bryozoa

Ascodictyon fusiforme Nicholson and Etheridge.
Ascodictyon stellatum Nicholson and Etheridge.
Botryllopora socialis Nicholson.
Coscinella cosciniformis (Nicholson).
Coscinella elegantula (Hall and Clarke).
Coscinium striatum Hall and Clarke.
Cycloporina hemicyclus Hall.
Cystodictya hamiltonensis Ulrich.
Cystodictya incisurata (Hall).
Cystodictya meeki (Nicholson).
Cystodictya rectilinea (Hall and Simpson).
Eridotrypa ? obliqua (Ulrich).
Fenestella arkonensis Whiteaves.
Fenestella emaciata Hall.

Fenestella nicholsoni Whiteaves.
Fenestrapora biperforata Hall.
Fenestrapora occidentalis Ulrich.
Fistulipora huronensis (Nicholson).
Fistulipora incrassata (Nicholson).
Fistulipora monticulata Ulrich.
Fistulipora ramosa (Hall and Simpson).
Fistulipora romingeri (Nicholson and Foord).
Fistulipora spinulifera Rominger.
Fistulipora subtrigona (Hall and Simpson).
Fistulipora utriculus Rominger.
Fistulipora vesiculata (Hall and Simpson).
Hederella canadensis (Nicholson).
Hederella cirrhosa (Hall).
Hederella filiformis (Billings).
Hederella magna Hall.
Hemitrypa cribrosa (Hall).
Heterotrypa ? barrandei (Nicholson).
Heterotrypa ? moniliformis (Nicholson).
Leptotrypa ? quadrangularis (Nicholson).
Lioclema digitatum (Hall).
Lioclema minutissimum (Nicholson).
Lioclema multaculeatum (Hall).
Lioclema subtile (Hall).
Loculipora perforata (Hall).
Meekopora stellifera (Rominger).
Orthopora carinata (Hall and Simpson).
Orthopora elongata (Hall and Simpson).
Orthopora lineata (Hall and Simpson).
Paleschara intercella Hall.
Paleschara ? reticulata Hall.
Pinacotrypa elegans (Rominger).
Pinacotrypa stellata (Hall).
Pinacotrypa variapora (Hall).
Polypora arkonensis Miller.
Polypora fistulata (Hall).
Polypora latitruncata (Hall).
Polypora multiplex (Hall).
Ptilopora striata Hall.
Reteporidra aduata (Hall).
Reteporidra cinctuta (Hall).
Reteporidra perundata (Hall).
Reteporina prisca (Nicholson).
Reteporina striata (Hall).
Rhombopora carinata Hall and Simpson.
Rhombopora subangulata Ulrich.

Scalaripora canadensis Whiteaves.
Semicoscinium davidsoni (Nicholson).
Semicoscinium labiatum (Hall).
Semiopora bistigmata Hall.
Stictopora ? ? incrassata (Hall).
Stictoporina plumea (Hall and Simpson).
Streblotrypa hamiltonensis (Nicholson).
Taeniopora exigua Nicholson.
Taeniopora penniformis Nicholson.
Taeniopora subcarinata (Hall).
Unitrypa scalaris (Hall).
Vinella devonica Cleland.

Brachiopoda

Ambocoelia umbonata (Conrad).
Athyris cora Hall.
Athyris spiriferoides Eaton.
Athyris vittata Hall.
Atrypa reticularis (Linneaus).
Atrypa spinosa Hall.
Camarotoechia billingsi Hall.
Camarotoechia dotis Hall.
Camarotoechia prolifica Hall.
Camarotoechia sappho Hall.
Camarotoechia tethys (Billings).
Camarotoechia thedfordensis Whiteaves.
Charionella scitula Hall.
Chonetes coronatus Conrad.
Chonetes deflectus Hall.
Chonetes lepidus Hall.
Chonetes lineatus Conrad.
Chonetes mucronatus Hall.
Chonetes scitulus Hall.
Cranaena romingeri Hall.
Crania crenistriata Hall.
Crania favincola Hall and Clarke.
Craniella hamiltoniae Hall.
Cryptonella planirostris Hall.
Cyclorhina nobilis Hall.
Cyrtina hamiltonensis Hall.
Delthyris consobrina (d'Orbigny).
Delthyris sculptilis Hall.
Eunella attenuata Whiteaves.
Eunella harmonica Hall.
Eunella lincklaeni Hall.

Eunella simulator Hall.
Eunella sullivanti Hall.
Gypidula comis (Owen).
Gypidula laeviuscula Hall.
Leiorhynchus iris Hall.
Leiorhynchus laura (Billings).
Leptaena rhomboidalis (Wilckens).
Lingula ligea Hall.
Lingula thedfordensis Whiteaves.
Martinia maia (Billings).
Meristella barrisi Hall.
Meristella haskinsi Hall.
Meristella rostrata Hall.
Nucleospira concinna Hall.
Orbiculoidea lodiensis media Hall.
Orbiculoidea doria Hall.
Parazyga hirsuta Hall.
Pentagonia unisulcata (Conrad).
Penetamerella pavilionensis Hall.
Pholidops hamiltoniae Hall.
Pholidostrophia iowaensis (Owen).
Productella productoides (Murchison).
Productella spinulicosta Hall.
Pugnax kernahani Whiteaves.
Reticularia fimbriata (Conrad).
Rhipidomella cyclas Hall.
Rhipidomella penelope Hall.
Rhipidomella vanuxemi Hall.
Schellwienella anomalus (Winchell).
Schellwienella arctostriatus (Hall).
Schellwienella perversus (Hall).
Schizophoria striatula (Schlotheim).
Spirifer audaculus (Conrad).
Spirifer divaricatus Hall.
Spirifer euryteines Owen.
Spirifer granulosus (Conrad).
Spirifer mucronatus (Conrad).
Spirifer mucronatus arkonense Shimer and Grabau.
Spirifer mucronatus thedfordensis Shimer and Grabau.
Spirifer macrus Hall.
Spirifer subdecussatus Whiteaves.
Strophalosia radicans (Winchell).
Strophalosia truncate (Hall).
Stropheodonta concava Hall.
Stropheodonta demissa (Conrad).

Stropheodonta inaequiradiata Hall.
Stropheodonta inaequistriata (Conrad).
Stropheodonta perplana (Conrad).
Stropheodonta plicata Hall.
Terebratula ontario Hall.
Trigeria ? lepida Hall.
Tropidoleptus carinatus Hall.

Pelecypoda

Actinodesma erectum (Conrad).
Actinopteria boydi (Conrad).
Aviculopecten bellus (Conrad).
Aviculopecten pecteniformis (Conrad).
Aviculopecten princeps (Conrad).
Conocardium normale Hall.
Cypricardella bellistriatus Conrad.
Cypricardinia indenta (Conrad).
Elymella nuculoides Hall.
Glyptodesma erectum (Conrad).
Glyptocardia speciosa Hall.
Goniophora hamiltonensis Hall.
Grammysia arcuata (Conrad).
Grammysia bisulcata (Conrad).
Grammysia globosa Hall.
Leda rostellata (Conrad).
Leiopteria rafinesquii Hall.
Limoptera macroptera (Conrad).
Macrodon hamiltoniae Hall.
Nucula bellistriata (Conrad).
Nucula lirata (Conrad).
Nuculites triqueter Conrad.
Nyassa arguta Hall.
Nyassa recta Hall.
Orthonota parvula Hall.
Paleoneilo emarginata (Conrad).
Paleoneilo plana (Conrad).
Paracyclas lirata (Conrad).
Pterinea flabellum (Conrad).
Sphenotus solenoides Hall.
Tellinopsis subemarginata (Conrad).

Gastropoda

Bembexia sulcomarginata (Conrad).
Cyclonema hamiltoniae Hall.
Diaphorostoma lineatum (Conrad).

Diaphorostoma plicatum (Whiteaves).
Euomphalus planodiscus Hall.
Gyroma capillaria (Conrad).
Hormatoma micula (Hall).
Igoceras conicum (Hall).
Loxonema delphicola Hall.
Loxonema laeviusculum Hall.
Macrochilina hebe Hall.
Phanerotinus laxus Hall.
Platyceras arkonense Shimer and Grabau.
Platyceras bucculentum Hall.
Platyceras carinatum Hall.
Platyceras erectum Hall.
Platyceras quinquesinuatum Ulrich.
Platyceras rarispinosum Hall.
Platyceras subspinosum Hall.
Platyceras symmetricum Hall.
Platyceras thetis Hall.
Pleurotomaria arkonensis Whiteaves.
Pleurotomaria filitexta Hall.
Pleurotomaria plena Hall.
Trepospira rotalia (Hall).
Turbonopsis shumardi (deVerneuil).

Pteropoda

Coleoprion ? tenuis Hall.
Hyolithes aclis Hall.
Styliolina fissurella (Hall).
Tentaculites attenuatus Hall.
Tentaculites bellulus Hall.

Cephalopoda

Bactrites arkonensis Whiteaves.
Gomphoceras raphanus Hall.
Nephriticeras bucinum (Hall).
Nephriticeras liratus Hall.
Orthoceras anax Hall.
Orthoceras constrictum Vanuxem.
Orthoceras eriense Hall.
Orthoceras exile Hall.
Orthoceras lambtonensis Whiteaves.
Orthoceras subulatum Hall.
Spyroceras crotalum (Hall).
Spyroceras nuntium (Hall).

Parodiceras discoideum (Hall).
Tornoceras uniangulare (Conrad).

Ostracoda

Bairdia devonica (Ulrich).
Barychilina walcotti Jones.
Isochilina fabacea Jones.
Moorea bicornata Ulrich.
Primitiopsis punctulifera (Hall).
Ulrichia conradi Jones.

Phyllopoda

Elymocaris hindei Jones and Woodward.

Trilobita

Cryphaeus boothi Green.
Phacops rana Green.
Phaethonides varicella Hall var.
Proetus crassimarginatus Hall.
Proetus rowi (Green).

Pisces

Aspidichthys notabilis? Whiteaves.
Ptyctodus calceolus Newberry and Worthen.

Fauna and Flora of the Delaware Limestone of Ontario.

Plantae

Sporangites bilobatus Dawson.

Anthozoa

Cladopora labiosa (Billings).
Cystiphyllum vesiculosum Goldfuss.
Diphyphyllum sp.
Favosites turbinatus Billings.
Heliophyllum halli Edwards and Haime.
Synaptophyllum simcoense? Billings.
Syringopora sp.
Zaphrentis prolifica Billings.
Zaphrentis sp.

Hydrozoa

Stromatoporella sp.

Bryozoa

Cystodictya hamiltonense Ulrich.
Fenestella sp.

Brachiopoda

Ambocoelia umbonata (Conrad).
Anoplotheca acutiplicata ? (Conrad).
Athyris vittata Hall.
Atrypa reticularis (Linnaeus).
Atrypa spinosa Hall.
Camarotoechia billingsi ? Hall.
Camarotoechia dotis Hall.
Camarotoechia prolifica Hall.
Camarotoechia tethys (Billings).
Chonetes deflectus Hall.
Chonetes lepidus Hall.
Chonetes mucronatus Hall.
Chonostrophia reversa (Whitfield).
Cranaena romingeri Hall.
Crania crenistriata Hall.
Craniella hamiltoniae (Hall).
Cryptonella planirostris Hall.
Cyrtina hamiltonensis Hall.
Crytina umbonata alpinensis Hall and Clarke.
Delthyris consobrina (d'Orbigny).
Eunella harmonica Hall.
Eunella lincklaeni Hall.
Leiorhynchus laura ? Billings.
Leiorhynchus limitare (Vanuxem).
Leptaena rhomboidalis (Wilckens).
Lingula delia Hall.
Lingula desiderata Hall.
Lingula ligea Hall.
Martinia maia (Billings).
Martinia subumbona (Hall).
Meristella barrisi Hall.
Meristella nasuta (Conrad).
Nucleospira concinna Hall.
Orbiculoidea lodiensis (Vanuxem).
Orbiculoidea minuta Hall.
Pentamerella arata ? (Conrad).

Pholidostrophia iowaensis (Owen).
Productella exanthemata Hall.
Productella spinulicosta Hall.
Rhipidomella cyclas Hall.
Rhipidomella vanuxemi Hall.
Schizophoria striatula (Schlotheim).
Spirifer divaricatus Hall.
Spirifer lucasensis Stauffer.
Spirifer macrus Hall.
Spirifer mucronatus (Conrad).
Strophalosia truncata Hall.
Stropheodonta concava Hall.
Stropheodonta demissa (Conrad).
Stropheodonta patersoni Hall var.
Stropheodonta perplana (Conrad).
Strophonella ampla Hall.

Pelecypoda

Actinopteria boydi (Conrad).
Aviculopecten bellus (Conrad).
Aviculopecten princeps (Conrad).
Conocardium normale Hall.
Goniophora hamiltonensis Hall.
Grammysia arcuata (Conrad).
Grammysia bisulcata (Conrad).
Grammysia ovata Hall.
Lunulicardium ornatum Hall.
Modiomorpha mytiloides Hall.
Nyassa arguta Hall.
Nyassa recta Hall.
Panenka alternata Hall var.
Paracyclas elliptica Hall.
Paracyclas lirata (Conrad).
Paracyclas ohioensis Meek.
Pterinea flabellum (Conrad).
Schizodus appressus (Conrad).
Sphenotus cuneatus (Conrad).
Tellinopsis subemarginata (Conrad).
Vanuxemia tomkinsi Billings.

Gastropoda

Bembexia planidorsalis Hall.
Bembexia sulcomarginata ? (Conrad).
Euryzone itys (Hall).
Loxonema hamiltoniae Hall.

Platyceras carinatum Hall.
Platyceras erectum Hall.
Platyceras rarispinosum Hall.
Pleuronotus decewi (Billings).

Pteropoda

Coleolus tenuicinctus Hall.
Styliolina fissurella Hall.
Tentaculites gracillistriatus Hall.
Tentaculites scalariformis Hall.

Cephalopoda

Centroceras ohioense (Meek).
Gigantoceras inelegans (Meek).
Nephriticeras bucinum (Hall).
Orthoceras constrictum ? Vanuxem.
Protokionoceras marcellense (Vanuxem).

Trilobita

Phacops rana Green.
Proetus sp.

Fauna of the Onondaga Limestone of Ontario.

Foraminifera

Calcisphaera robusta Williamson.

Spongia

Astraeospongia sp.
Hindia fibrosa Roemer.

Anthozoa

Acervularia rugosa Milne-Edwards and Haime.
Acrophyllum oneidaensis (Billings).
Alveolites confertus Nicholson.
Alveolites distans Nicholson.
Alveolites ramulosus Nicholson.
Alveolites squamosus Billings.
Amplexus exilis Billings.
Amplexus mirabilis Billings.
Amplexus yandelli Milne-Edwards and Haime.

Aulocophyllum sulcatum (d'Orbigny).
Aulopora conferta Winchell.
Aulopora cornuta Billings.
Aulopora serpens Goldfuss.
Bothrophyllum decorticatum Billings.
Bothrophyllum promissum Hall.
Cayugaea whiteavesiana Lambe.
Chonophyllum magnificum Billings.
Chonostegites clappi Milne-Edwards and Haime.
Chonostegites ordinatus (Billings).
Cladopora cryptodens (Billings).
Cladopora expatiata Rominger.
Cladopora fisheri (Billings).
Cladopora francisci Davis.
Cladopora imbricata Rominger.
Cladopora labiosa (Billings).
Cladopora lichenoides Rominger.
Cladopora pinguis Rominger.
Cladopora pulchra Rominger.
Cladopora rimosa Rominger.
Cladopora robusta Rominger.
Cladopora turgida Rominger.
Clisiophyllum conigerum Rominger.
Clisiophyllum oneidaensis Billings.
Coenites selwynii Nicholson.
Crepidophyllum archiaci Billings.
Cyathophyllum anna (Whitfield).
Cyathophyllum coalitum Rominger.
Cyathophyllum validum Hall.
Cyathophyllum zenkeri Billings.
Cystiphyllum aggregatum Billings.
Cystiphyllum sulcatum Billings.
Cystiphyllum vesiculosum Goldfuss.
Diphyphyllum strictum Milne-Edwards and Haime.
Diplophyllum arundinaceum (Billings).
Eridophyllum colligatum (Billings).
Eridophyllum vernuillianum Milne-Edwards and Haime.
Favosites basalticus Goldfuss.
Favosites canadensis (Billings).
Favosites cervicornis Milne-Edwards and Haime.
Favosites clausus Rominger.
Favosites emmonsi Rominger.
Favosites epidermatus Rominger.
Favosites goodwini Davis.
Favosites hemisphericus (Troost).

Favosites limitaris Rominger.
Favosites pleurodictyoides Nicholson.
Favosites polymorphus Goldfuss.
Favosites radiciformis Rominger.
Favosites tuberosus Rominger.
Favosites turbinatus Billings.
Favosites winchelli Rominger.
Heliophyllum annulatum Hall.
Heliophyllum corniculum (Lesueur).
Heliophyllum exiguum Billings.
Heliophyllum fecundum Hall.
Heliophyllum halli Milne-Edwards and Haime.
Michelinia convexa (d'Orbigny).
Michelinia favositoidea Billings.
Phillipsastraea billingsi Calvin.
Phillipsastraea gigas Owen.
Phillipsastraea verneuilli Milne-Edwards and Haime.
Phillipsastraea verrilli Meek.
Placophyllum tabulatum Simpson.
Pleurodictyum problematicum Goldfuss.
Ptycophyllum knappi Hall.
Ptycophyllum striatum Hall.
Romingeria umbellifera (Billings).
Streptelasma lamellatum Hall.
Striatopora cavernosa Rominger.
Synaptophyllum simcoense (Billings).
Synaptophyllum stramineum (Billings).
Syringopora hisingeri Billings.
Syringopora maclurei Billings.
Syringopora nobilis Billings.
Syringopora perelegans Billings.
Syringopora tabulata Milne-Edwards and Haime.
Zaphrentis compta Billings.
Zaphrentis davisana Miller.
Zaphrentis elcelleus Billings.
Zaphrentis eripyle Billings.
Zaphrentis genitiva Billings.
Zaphrentis gigantea Lesueur.
Zaphrentis invenusta Billings.
Zaphrentis mirabilis Billings.
Zaphrentis nodulosa Rominger.
Zaphrentis prolifica Billings.
Zaphrentis sentosa Hall.
Zaphrentis spatiosa Billings.
Zaphrentis subrecta Billings.

Hydrozoa

Clathrodictyon cellulosum Nicholson and Murie.
Stromatoporella granulata Nicholson.
Stromatoporella selwyni Nicholson.
Stromatoporella tuberculata Nicholson.
Syringostroma densa Nicholson.
Syringostroma nodulata Nicholson.

Crinoidea

Megistocrinus sp.

Blastiodea

Codaster pyramidatus Schumard.

Vermes

Spirorbis omphaloides Goldfuss.

Bryozoa

Callotrypa ? geniculata (Hall).
Clathropora intertexta Nicholson.
Cystodictya crescens (Hall).
Cystodictya gilberti (Meek).
Cystodictya meeki (Nicholson).
Cystodictya vermicula (Hall).
Fenestella ? erectipora Hall.
Fenestella magnifica Nicholson.
Fenestella marginalis Nicholson.
Fenestella parallela Hall.
Fenestella proctritas Hall and Simpson.
Fenestella tuberculata Hall and Simpson.
Fistulipora ? permarginata (Hall).
Hederella canadensis (Nicholson).
Hederella cirrhosa Hall.
Hemitrypa biordo Hall.
Hemitrypa columellata (Hall and Simpson).
Hemitrypa favosa (Hall).
Isotrypa conjunctiva (Hall).
Isotrypa consimilis Hall.
Loculipora circumstata (Hall and Simpson).
Monotrypa tenuis (Hall).
Nemataxis fibrosus Hall.
Pinnatopora tenuistriata (Hall).

Polypora brevisulcata (Hall).
Polypora celsipora (Hall).
Polypora celsipora minor (Hall).
Polypora halliana Nicholson.
Polypora granilinea (Hall).
Polypora hexagonalis (Hall).
Polypora hexagonalis foraminulosa (Hall).
Polypora latitruncata Hall.
Polypora mutabilis (Hall).
Polypora nexa (Hall).
Polypora porosa (Hall).
Polypora pulchella Nicholson.
Polypora robusta (Hall).
Polypora rustica (Hall and Simpson).
Polypora separata (Hall).
Polypora tenella Nicholson.
Prismopora triquetra Hall.
Ptilodictya gigantea (Nicholson).
Ptiloporella inaequalis (Hall and Simpson).
Ptiloporella laticrescens (Hall and Simpson).
Ptiloporina disparilis (Hall and Simpson).
Reteporidra perundata (Hall).
Reteporina coalescens (Hall and Simpson).
Reteporina phillipsi (Nicholson).
Reteporina prisca (Nicholson).
Reteporina rhombifera (Hall).
Semicoscinium hindei (Nicholson).
Semicoscinium mirabile (Nicholson).
Stictopora ? ? fruiticosa Hall.
Unitrypa acclivis (Hall and Simpson).
Unitrypa elegantissima (Hall).
Unitrypa ficticia (Hall and Simpson).
Unitrypa lata (Hall).
Unitrypa nana (Hall and Simpson).
Unitrypa pernodosa (Hall).

Brachiopoda

Amphigenia elongata (Vanuxem).
Anoplia nucleata Hall.
Anoplotheca camilla (Hall).
Anoplotheca flabellites ? (Conrad).
Athyris vittata indianaensis Stauffer.
Atrypa reticularis (Linnaeus).
Atrypa spinosa Hall.
Camarotoechia billingsi Hall.

Camarotoechia carolina Hall.
Camarotoechia tethys (Billings).
Centronella alveata Hall.
Centronella glansfagea Hall.
Centronella ovata Hall.
Centronella tumida Billings.
Charionella scitula Hall.
Chonetes arcuatus Hall.
Chonetes acutiradiatus Hall.
Chonetes hemisphericus Hall.
Chonetes lineatus (Conrad).
Chonetes mucronatus Hall.
Chonostrophia reversa (Whitfield).
Crania crenistriata Hall.
Cryptonella iphis Hall.
Cyrtina biplicata Hall.
Cyrtina crassa Hall.
Cyrtina hamiltonensis Hall.
Dalmanella lenticularis (Vanuxem).
Delthyris raricosta Conrad.
Eunella harmonica Hall.
Eunella lincklaeni Hall.
Eunella sullivanti Hall.
Leptaena rhomboidalis (Wilckens).
Lingula sp.
Meristella clusia (Billings).
Meristella doris Hall.
Meristella lenta Hall.
Meristella nasuta (Conrad).
Metaplasia disparilis (Hall).
Nucleospira concinna Hall.
Parazyga hirsuta Hall.
Pentagonia unisulcata (Conrad).
Pentamerella arata (Conrad).
Pholidops patina Hall and Clarke.
Pholidostrophia iowaensis (Owen).
Productella eriensis Nicholson.
Productella spinulicosta.
Reticularia fimbriata (Conrad).
Rhipidomella cleobis Hall.
Rhipidomella livia (Billings).
Rhipidomella medea Billings.
Rhipidomella semele Hall.
Rhipidomella vanuxemi Hall.
Rhynchonella ? eugenia (Billings).

Schellwienella pandora (Billings).
Schizophoria propinqua Hall.
Selenella gracilis Hall and Clarke.
Spirifer acuminatus (Conrad).
Spirifer arenosus unicus Hall.
Spirifer divaricatus Hall.
Spirifer duodenarius (Hall).
Spirifer gregarius Clapp.
Spirifer macrothyris Hall.
Spirifer macrus Hall.
Spirifer manni Hall.
Spirifer varicosus Hall.
Stropheodonta callosa Hall.
Stropheodonta concava Hall.
Stropheodonta demissa (Conrad).
Stropheodonta hemispherica Hall.
Stropheodonta inaequiradiata Hall.
Stropheodonta inaequistriata (Conrad).
Stropheodonta parva Hall.
Stropheodonta patersoni Hall.
Stropheodonta perplana (Conrad).
Strophonella ampla Hall.

Pelecypoda

Actinopteria boydi (Conrad).
Aviculopecten cleon Hall.
Aviculopecten princeps (Conrad).
Clinopistha telliniformis Hall.
Conocardium cuneus (Conrad).
Cypricardinia indenta Conrad.
Goniophora perangulata Hall.
Megambonia cardiiformis Hall.
Modiomorpha concentrica (Conrad).
Mytalarca percarinata Whitfield.
Paracyclas elliptica Hall.
Pararca praecedens Hall.
Plethomytilus ponderosus Hall.
Pterinea flabellum (Conrad).

Gastropoda

Bellerophon newberryi Meek.
Bellerophon pelops Hall.
Bellerophon propinquus Meek.
Callonema bellatulum (Hall).
Callonema lichas Hall.

Cyclonema crenulatum Meek.
Dentalium martini Whitfield.
Diaphorostoma lineatum (Conrad).
Diaphorostoma turbinatum (Hall).
Diaphorostoma turbinatum cochleatum (Hall).
Diaphorostoma unisulcatum (Conrad).
Euryzone dublinensis Stauffer.
Euryzone hyphantes (Meek).
Euryzone lucina (Hall).
Helicotomia serotina Nicholson.
Holopea eriensis Nicholson.
Hormotoma desiderata (Hall).
Hormotoma maia (Hall).
Igoceras conicum (Hall).
Lophospira adjutor (Hall).
Loxonema laeviusculum Hall.
Loxonema pexatum Hall.
Loxonema pexatum obsoletum Hall.
Loxonema robustum Hall.
Macrocheilus hebe (Hall).
Naticopsis aequistriata Meek.
Naticopsis laevis Meek.
Platyceras ammon Hall.
Platyceras attenuatum Hall.
Platyceras bucculentum Hall.
Platyceras carinatum Hall.
Platyceras concavum Hall.
Platyceras cymbium Hall.
Platyceras dentalium Hall.
Platyceras dumosum Conrad.
Platyceras echinatum Hall.
Platyceras erectum Hall.
Platyceras rictum Hall.
Platyceras thetis Hall.
Platyceras undatum Hall.
Platyceras uniseriale Nicholson.
Pleuronotus decewi (Billings).
Pleurotomaria insolita Hall.
Solenospira quadricarinata Stauffer.
Straparollus clymenioides Hall.
Straparollus corrugatus Stauffer.
Strophostylus obliquus Nicholson.
Strophostylus ovatus Nicholson.
Strophostylus subglobosus Nicholson.
Strophostylus varians Hall.
Turbonopsis shumardi (de Verneuil).

Pteropoda

Coleolus crenatocinctus Hall.
Tentaculites scalariformis Hall.

Cephalopoda

Cyclostomiceras metula Hall.
Cyrtoceras ammon Billings.
Gomphoceras numa Billings.
Poterioceras eximium Hall.
Orthoceras anax Billings.
Orthoceras pelops Hall.
Ryticeras citum Hall.
Spyroceras nuntium (Hall).
Spyroceras thoas (Hall).
Trematoceras ohioense Whitfield.

Trilobita

Acidaspis callicera Hall and Clarke.
Calymene platys Green.
Chasmops anchiops (Green).
Chasmops ? erina Hall.
Coronura diurus (Green).
Coronura myrmecophorus (Green).
Hausmania concinna serrulus Hall and Clarke.
Hausmania phacoptyx Hall and Clarke.
Hausmania pleuropteryx (Green).
Lichas grandis Hall.
Lichas hylaeus Hall and Clarke.
Lichas superbus Billings.
Odontocephalus selenurus (Eaton).
Phacops anceps Clarke.
Phacops cristata Hall.
Phacops cristata pipa Hall and Clarke.
Phacops rana (Green).
Phaethonides ? denticulatus Meek.
Proetus clarus Hall.
Proetus crassimarginatus Hall.
Proetus delphinulus Hall and Clarke.
Proetus rowi (Green).
Proetus tumidus Hall and Clarke.

Pisces

Macropetalichthys rapheidolabis Norwood and Owen.
Onychodus sigmoides Newberry.

Fauna of the Oriskany Sandstone of Ontario.

Anthozoa

Favosites conicus ? Hall.
Favosites helderbergiae Hall.
Zaphrentis roemeri Hall.

Bryozoa

Fenestella biseriata ? Hall.
Hederella magna ? Clarke.
Monotrypella sp.
Polypora hexagonalis ? (Hall).

Brachiopoda

Amphigenia elongata (Vanuxem).
Anoplia nucleata Hall.
Anoplotheca flabellites (Conrad).
Atrypa reticularis (Linnaeus).
Beachia suessana Hall.
Brachyprion schuchertanum ? Clarke.
Camarotoechia dryope (Billings).
Centronella tumida Billings.
Chonetes hudsonicus Clarke.
Chonostrophia complanata Hall.
Crania pulchella Hall and Clarke.
Cryptonella fausta ? Clarke.
Cyrtina rostrata Hall.
Cyrtina varia Clarke.
Eatonia peculiaris (Conrad).
Eatonia sinuata ? Hall.
Hipparionyx proximus Vanuxem.
Leptaena rhomboidalis (Wilckens).
Megalanteris ovalis Hall.
Meristella lata Hall.
Meristella lentiformis Clarke.
Meristella walcotti Hall and Clarke.
Metaplasia pyxidata Hall.
Nucleospira ventricosa Hall.
Oriskania navicella Hall and Clarke.
Pholidops arenaria Hall.
Pholidops terminalis Hall.
Plethorhyncha barrandii Hall.
Rensselaeria cayuga Hall and Clarke.
Rensselaeria ovoides (Eaton).

Rensselaeria ovulum Hall and Clarke.
Reticularia fimbriata (Conrad).
Rhipidomella musculosa Hall.
Rhipidomella oblata Hall.
Schellwienella deformis (Hall).
Spirifer arenosus (Conrad).
Spirifer murchisoni Castelnau.
Spirifer plicatus (Weller).
Spirifer saffordi Hall.
Spirifer tribulis Hall.
Stropheodonta callosa ? Hall.
Stropheodonta linckleani Hall.
Stropheodonta magnifica Hall.
Stropheodonta magniventer Hall.
Stropheodonta oriskania Clarke.
Stropheodonta vascularia Hall.
Strophonella ampla Hall.
Uncinulus mutabilis Hall.

Pelecypoda

Actinopteria textilis arenaria (Hall).
Cypricardinia lamellosa Hall.
Goniophora cerusus ? Clarke.
Megambonia ? lamellosa Hall.
Pterinopecten plumilus Clarke.

Gastropoda

Cyrtolites expansus Hall.
Diaphorostoma desmatum Clarke.
Diaphorostoma ventricosum (Conrad).
Platyceras nodosum Conrad.
Strophostylus matheri Hall.

Pteropoda

Tentaculites elongatus Hall.

Ostracoda

Beyrichia sp.

Trilobita

Chasmops anchiops (Green).
Hausmania phacoptyx Hall and Clarke.
Hausmania pleurophyx (Green).

Phacops correlator Clarke.
Phacops logani Hall.
Proetus conradi Hall.
Synphoria stemmatus Clarke.

Vermes

Antodetus beecheri Clarke.

CHAPTER IV.

ECONOMIC PRODUCTS OF THE ONTARIO DEVONIAN.

It is doubtful whether the economic possibilities of the Devonian formations of Ontario have as yet been fully realized. However, most of the deposits of that age have been used and some of them are now yielding important economic products.

PETROLEUM.[1]

From the standpoint of the value of that which has been produced, by far the most important product yielded by the Devonian formations is oil. The producing areas are limited to rather isolated pools scattered over the relatively narrow strip of land lying between the lower end of Lake Huron and the north shore of Lake Erie, and chiefly along a belt extending southeastward from Sarnia to Dutton. Petrolia and Oil Springs in Lambton county are the most noted localities and the history of the development of these regions has been very remarkable. Some of the wells have been producing since 1860, but the first flowing well was struck on February 19 (A. Winchell says January 11), 1862. During the spring and summer of that year 5,000,000 barrels of oil are estimated to have floated away on the waters of Black creek, where it formed a layer 6 inches in depth and eventually a film over the surface of Lake Erie. Before autumn of the same year the price of the crude product had fallen to ten cents per barrel. The best well yielded as many as 7,500 barrels of oil per day, while dozens yielded 1,000 to 6,000 barrels, and numerous others followed with 100 to 1,000 barrels per day.[2]

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[1]Brumell, H. P. H., Geol. Surv., Canada, vol. V, pt. Q, 1892, 94 pages.

[2]For well records and a detailed account of the early development, see Alexander Winchell's Sketches of Creation, New York, 1870, pp. 286-293, 443, 444.

In 1911 it was estimated that there were between 8,000 and 10,000 producing wells in Lambton county, but the number is continually changing. Some of the best of these were said to yield a barrel per day, although two or three barrels per month was probably more nearly the average since the total production for the county during that year (1911) was 184,450 barrels.

The producing rock has been found at various horizons. The first wells obtained their supply from the porous, gravelly accumulations at the bottom of the drift. Later wells, and the greatest producers, obtained their supply at a depth of 104 to 237 feet below the surface. Since the drift varies from 38 to 125 feet in thickness, the depth of bed-rock penetrated in these wells was less than 200 and often less than 100 feet. It seems certain, therefore, that these wells did not penetrate the real oil-bearing stratum, but obtained their supply from cracks and fissures into which it had escaped from lower levels. Present wells are mostly supplied from the oil-bearing stratum which lies 450 to 475 feet below the surface. It is sometimes described as a sandstone and again as a granular, porous dolomite which lies at the base of the Onondaga limestone. Either of these would be sufficiently porous to serve as a reservoir for the crude oil.

Regarding the source of the oil, Alexander Winchell said that "whether the supply originally ascended from the underlying Corniferous (Onondaga) limestone or not, it is certain that no supply has ever been found by boring into that formation."[1] He regarded the Marcellus shale as the source of "most of the petroleum which accumulates in the fissured shaly limestone of the Hamilton group, and thus supplies the Ontario oil region."[2] As has been indicated in an early part of this report, the representative of the Marcellus shale in Ontario is the Delaware limestone, which has usually been called the lower Hamilton limestone. It is decidedly bituminous and often shaly, at some localities even passing into what appears to be the true Marcellus beds, but at no place does it compare with the New York

[1]Am. Jour. Sci., 2nd ser. vol. 41, 1866, p. 178.
[2]Sketches of Creation, New York, 1870, pp. 292, 293.

deposits. It does not seem possible that the scattered remnants of black shale, which locally make up a part of the Delaware limestone where that formation passes into the real Marcellus beds, could possibly be the source of the large quantities of oil that have been taken from the Devonian deposits. Moreover, the oil-bearing stratum, which has been yielding oil for fifty years, lies below the horizon of the Marcellus beds by as much as 60 to 100 feet, and the oil is more likely to be found above than below its original source. It should be noted, however, that Winchell included the Onondaga limestone with the basal Hamilton and really referred to the Detroit River beds when he used the name "Corniferous limestone" in connexion with the Enniskillen wells. In order to find, if possible, the real source of the oil, test wells were drilled at Petrolia and Oil Springs. One of these reached a total depth of 1,505 feet and penetrated 405 feet into the Salina beds, but located no other source of oil than that already known. Dr. T. Sterry Hunt was apparently the first to point to the Onondaga (Corniferous) limestone as the true source, as well as the reservoir, of the oil,[1] and most later writers on the Ontario oil field have followed this suggestion. It is probably as near the truth as any other that has been suggested and there seems little ground for disputing it even to the present day.

In addition to the Petrolia and Oil Springs pools, a number of other smaller areas have produced petroleum, and some of these are still to be counted among the economically important fields. One of these lies to the north of London road and is so closely associated with the Petrolia field that it might be considered a part of it, although perhaps structurally separated. A very small pool was located at Smith falls on the Sydenham river in Euphemia township, Lambton county. In its prime it yielded about 500 barrels per month, but these wells are now mostly abandoned. A field of similar size was located in the southeastern part of Dawn township, Lambton county. These are to be considered as outliers of the more important pools at Bothwell. There are really two fields at Bothwell. The older one lies along the Thames river in Mosa township, Middlesex

[1]Canadian Naturalist, vol. VI, p. 242.

county, and the more recently located one in Zone township, Kent county. In this latter area the drift is more than 200 feet thick and is immediately underlain by a small amount of shale which soon gives place to limestone. The wells are 395 to 410 feet in depth and obtain their supply of oil from a stratum said to be located in the Onondaga limestone. Some of the better wells of this field, a few years ago, were yielding 1½ barrels per day, and perhaps averaged 10 to 50 barrels per month. During 1911 the whole Bothwell district yielded 35,224 barrels. Near the Lake Erie shore, south of Dutton, Dunwich township, Elgin county, there is another small oil field. At this place the drift is 255 feet thick and the oil-bearing stratum, which is reported as a sandstone at the base of the Onondaga limestone, lies about 435 feet below the surface. In 1901 the production was 30 to 40 barrels per month for each well. In 1911 the total production for the field was 6,732 barrels. Several good producing wells were located, some years ago, in the valley of Big Otter creek just south of Tillsonburg, Oxford county. There the drift is 81 feet thick and the wells strike the producing stratum, a sandstone at the base of the Onondaga limestone, at a depth of 268 feet.

In addition to these there are a few other fields that have yielded oil and several of them have been good producers. The Tilbury and Romney field yielded 48,708 barrels during 1911 and is, therefore, to be considered one of the important regions. This place was not visited, but, from such data as was available, it was considered to be yielding from rocks somewhat older than the Devonian. Near Comber, in Tilbury West, Brumell reports the finding of oil at a depth of 1,215 feet,[1] and a much more recent well on lot 171, concession of Talbot road, Tilbury East, yielded gas at 1,260 and 1,385 feet. This well was a good producer as evidenced by the fact that it gauged 3,537,000 cubic feet, but it is quite certain that the supply comes from a horizon much below the Devonian. The Onondaga field near Brantford, which produced 13,501 barrels during 1911, was visited when it was first being opened. It lies entirely outside of the Devonian

[1]Brumell, H. P. H., Loc. cit. p. 77 Q.

covered area and draws its oil from a sandy stratum in the Medina which corresponds to the usual gas bearing horizon.

While more or less related, as indicated by the general trend of the producing region, these different pools are measurably independent and drilling in each region has revealed the anticlinal structure of the rock strata. At Smith Falls this can be easily seen in the outcrop of Hamilton (Ipperwash) limestone in the river, and it is definitely known that the Oil Springs pool is separated from that at Petrolia by a syncline. At Petrolia the top of the arch is said to be more or less dome shaped and to have a diameter of about 1,200 yards. On all sides the rocks dip gently away from this apex at an average of about 10 feet per mile.

GAS.

Although the gas belt is mainly located within the area covered by Devonian formations, the producing rocks of south-western Ontario lie chiefly in the Silurian. However, some of the oil wells are good gas producers and in some of the gas wells, which have their chief supply from the Medina, the Onondaga is also productive. This is apparently true in the case of the wells to the south of Chatham in Raleigh township, Kent county, where some oil is obtained.

BUILDING STONE.

Among the economic products of the Devonian building stone has taken a high rank. This has been especially true of the Delaware limestone at St. Marys where it has furnished the building material for many of the better buildings of the city. It makes a pleasing appearance and a very satisfactory wall. The Onondaga limestone has also supplied much stone for basement walls and for foundation purposes, while the massive layers on Pelee island have been used to some extent for heavy construction work. The Oriskany sandstone of Haldimand county has been used for a like purpose. At the present time, however, there is such a preference shown for cement, where stone might ordinarily be used, that even a good building stone can with difficulty compete with it.

CRUSHED LIMESTONE.

The greatest present use made of the Devonian limestones is for crushing purposes. All of the larger quarries, in the Onondaga and Delaware limestones, with only two or three exceptions, are chiefly engaged in producing this product. The crushed limestone is used for railway ballast, for macadamizing the highways, for making concrete, and the finest or pulverized rock is sometimes used for fertilizing the land. The great quantities of this material which are constantly being taken from the quarries at Sherks, Hagersville, and St. Marys emphasize the importance of this industry, which is doubtless as yet in its infancy.

LIME.

The Onondaga has furnished large quantities of lime. At the present time, however, the kilns which formerly supplied this product, with the exception of one near Port Colborne and a few smaller ones in the country off the railways, have been abandoned. The industry has followed the same course that it has in much of the Ohio Onondaga region where the cause of the decadence is said to be the ease with which the Onondaga lime air-slakes. The Standard White Lime Company of Ontario has invariably chosen the Silurian limestone in preference to the Onondaga where both are available.

CEMENT.

One of the large industries connected with the Devonian limestone is that of the manufacture of portland cement. The cement plant at Port Colborne, which has a capacity of about 3,500 barrels per day, uses the Onondaga limestone and a post-Glacial clay in the process of cement production. At St. Marys during the summer of 1911 a similar plant was in the early stages of construction and it, too, was to utilize the Devonian limestones.

BRICK AND TILE.

The soft Olentangy shale of the Hamilton beds has been used in the manufacture of brick and tile at Thedford. Although the industry never grew to very great importance, it is worthy of mention here as one of those connected with the Devonian.

SAND.

Within the last few years a spur has been laid northward from the Grand Trunk railway near Nelles Corners, to the Oriskany sandstone deposit of North Cayuga township and a large crusher has been installed on lot 49, concession II, north of the Talbot road. At this plant the Oneida Lime and Sand Company is supplying sand to commerce for glass and sand-blast purposes. This is one of the newer industries connected with the Devonian, but, owing to the quality of the material and the increasing demand for sand, it promises to become more important. The supply is somewhat limited but yet sufficient for the expanding trade that may be expected within the next decade.

OTHER PRODUCTS.

It is difficult to predict the future industries that may attach themselves to these important rocks of Ontario. There is a possibility that some of the abandoned uses may again come into favour, but usually the causes for abandonment have been such as are still operative and would tend again to drive them out of use. However, in the near future the carbonaceous shale, which has been designated the Huron, is likely to be utilized in the distillation of oil, especially if the advance in the market price of that commodity should continue. This shale is highly bituminous and would probably yield a considerable percentage of hydrocarbons. A few years ago an English syndicate tested out these deposits quite thoroughly and it was then thought this prospective industry might be established, but nothing has as yet developed. It was said that the shale might be worked profitably if 18 per cent of hydrocarbon could be distilled from it. The shale probably does not contain as high a percentage as that, but the future will undoubtedly bring a higher value for oil and, what is more important, may bring a profitable use for the residue after distillation.

CHAPTER V.

BIBLIOGRAPHY.

Ami, Henry M.—"On a new and hitherto unrecognized geological horizon in the gas and oil region of western Ontario." Jour. Can. Min. Inst., Vol. II, 1899, pp. 186-190, 2 pls.

Ami, Henry M.—"Synopsis of the geology of Canada." Can. Roy. Soc., Proc. and Trans., New Ser., Vol. VI, sect. 4, 1900, pp. 187-225.

Bell, Robert.—"The petroleum field of Ontario." Can. Roy. Soc., Trans., Vol. V, sect. 4, 1888, pp. 101-113.

Bell, Robert.—"The geology of Ontario, with special reference to economic minerals." Rept. Roy. Com. on Min. Res. of Ontario, 57 pp., Toronto, 1899. Abst.; Am. Geol., Vol. V, 1889, pp. 238-240; Eng. and Mining Jour., Vol. XLIX, 1889, p. 468.

Bigsby, John I.—"Notes on the Geography and Geology of Lake Huron." Geol. Soc. Trans., Vol. I, 2nd ser., 1824, pp. 175-210.

Billings, Elkanah.—"Canadian formations." Can. Nat. and Geol., Vol. I, 1856 (1857), pp. 18-25.

Billings, Elkanah.—"Fossils of the Hamilton Group." Can. Nat. and Geol., Vol. I, 1856 (1857), pp. 471-479, with 18 wood-cuts.

Billings, Elkanah.—"Galt limestone, Onondaga and Corniferous limestones, etc." Geol. Surv. of Canada, Rept. of Prog. 1857 (1858), pp. 162-192.

Billings, Elkanah.—"New Genera and Species of fossils from the Silurian and Devonian formations of Canada." Can. Nat. and Geol., Vol. III, 1858, pp. 419-444.

Billings, Elkanah.—"Note on the structure of the Blastoidea." Am. Jour. Sci., 2nd ser., Vol. XLVII, 1869, p. 353.

Billings, Elkanah.—"Notes on the structure of the Crinoidea, Cystoidea, and Blastoidea." Am. Jour. Sci., 2nd ser., Vol. XLVIII, 1869, pp. 69-83. Continued in same series, Vol. XLIX, pp. 51-58, and in Vol. L, pp. 225-240.

Billings, Elkanah.—"On some new and little known fossils from the Silurian and Devonian rocks of Ontario." Can. Nat. and Quart. Jour. Sci., new ser. Vol. VII, 1875, pp. 230-240.

Billings, Elkanah.—"On some new Genera and Species of Brachiopoda from the Silurian and Devonian rocks of Canada." Can. Nat and Geol., Vol. IV, 1859, pp. 131-135.

Billings, Elkanah.—"On the Devonian fossils of Canada West." (Issued as a separate to the Canadian Journal). Can. Jour., new ser. Vol. V, pp. 1-34, May, 1860; Vol. VI, pp. 34-44, March, 1861; pp. 45-65, May, 1861; pp. 66-99, July, 1861.

Billings, Elkanah.—"On the Devonian fossils of Canada West." Can. Jour., new ser. Vol. V, 1860, pp. 249-282. Continued in Vol. VI, 1861, pp. 138-148; pp. 253-274; pp. 329-363.

Billings, Elkanah.—"On the fossil corals of the Devonian rocks of Canada West." Can. Jour., ser. 2, Vol. IV, 1859, pp. 97-140; Vol. V, 1860, pp. 242-282; Vol. VI, 1860, pp. 138-148, 253-274, 329-363.

Billings, Elkanah.—"On the genus Centronella, with remarks on some other genera of Brachiopoda." Am. Jour. Sci., 2nd ser., Vol. XXXVI, 1863, pp. 236-240.

Brumell, H. P. H.—"On the geology of natural gas and petroleum in southwestern Ontario." Bull. Geol. Soc. Am., Vol. IV, 1893, pp. 225-240.

Brumell, H. P. H.—"Report on natural gas and petroleum in Ontario prior to 1891." Geol. Surv. of Canada, Vol. V, new ser., pt. II, 1889-91 (1893), Rept. Q, 94 pp.

Calvin, Samuel.—"Adequacy of the Paleontologic Record." Pop. Sci. Mo., Vol. LXXVI, 1910, pp. 582-586.

Calvin, Samuel.—"Observations on the vertical range of certain species of fossils of the Hamilton period in western Ontario." Am. Geol., Vol. I, 1888, pp. 81-86.

Chalmers, Robert.—"On borings for natural gas, petroleum, and water; also notes on the surface geology of part of Ontario." Geol. Surv. of Can., Sum. Rept. for 1901 (1902), pp. 158-169.

Chapman, E. J.—"A popular exposition of the minerals and geology of Canada." Can. Jour., new ser. Vol. VI, 1861, pp. 149-165, 425-455, 500-518; Vol. VII, 1862, pp. 108-121; Vol. VIII, 1863, pp. 17-33, 111-126, 185-216, 437-462; and Vol. IX, 1864, pp. 1-10.

Chapman, E. J.—"An outline of the Geology of Canada, based on a subdivision of the Province into natural areas." XXXIII +105 pp., 12 pls., 1 map, Toronto, 1876.

Chapman, E. J.—"An outline of the Geology of Ontario." Can. Jour., new ser. Vol. XIV, 1875, pp. 580-588. Abstract, Am. Jour. Sci., 3rd ser. Vol. XI, 1876, p. 150.

Chapman, E. J.—"On leading geological areas of Canada." Can. Jour., Vol. XV, new ser., 1878, pp. 13-22, 92-121.

Corkill, E. J.—"Petroleum and Natural Gas." Ont. Bur. Mines Rept. Vol. XIV, pt. I, 1905, pp. 89-117.

Daly, Reginald A.—"The Calcareous concretions of Kettle Point, Lambton County, Ontario." Jour. Geol., Vol. VIII, 1900, pp. 135-150.

Dawson, Sir J. William.—"Handbook of Geology for the use of Canadian Students." 250 pp., Montreal, 1889.

Dawson, Sir J. William.—"On fossil plants from the Devonian rocks of Canada." Quart. Jour. Geol. Soc., Vol. XV, 1857, pp. 477-488.

Dawson, Sir J. William.—"On fossil plants from the Devonian rocks of Canada." Can. Nat. and Geol., Vol. V, 1860, pp. 1-14.

Dawson, Sir. J. William.—"On Rhizocarps in the Erian (Devonian) Period in America." Chicago Academy of Science, Bulletin Vol. I, 1886, pp. 105-118.

Dawson, Sir J. William.—"The fossil plants of the Devonian and Upper Silurian of Canada." Geol. Surv. of Canada, Montreal, 1871, 92 pp., 20 pls.

Dawson, Sir J. William.—"Notes on new Erian (Devonian) plants." Quart. Jour. Geol. Soc., Vol. XXXVII, 1881, pp. 299-308, pls. XII and XIII.

Dawson, Sir J. William.—"Spore-cases in the bituminous shale at Kettle Point." Am. Jour. Sci., 3rd ser., Vol. I, 1871, pp. 257, 258.

Dawson, Sir J. William.—"The Fossil Plants of the Erian (Devonian) and Upper Silurian formations of Canada." Geol. Surv., Can., pt. II, 1882, pp. 91-142.

DeCew, John.—"Geology of the townships of Windham and Middletown, county of Norfolk, Canada West." Can. Jour., Vol. VI, new series, 1861, pp. 295-297.

DeCew, John.—"Age of the Oriskany sandstone." Can. Jour., Vol. VII, new ser., 1862, pp. 190-193.

Fleming, Sanford.—"Notes on the present condition of the oil wells of Enniskillen." Can. Jour., new ser. Vol. VIII, 1863, pp. 246-249.

Gibson, John.—"The salt deposits of western Ontario." Am. Jour. Sci., 3rd ser., Vol. V, 1873, pp. 362-369.

Gibson, John.—"Geological features of Huron County, Ontario." Canadian Nat., Vol VII, new ser., 1875, pp. 34-40.

Gibson, Thomas W.—"The Raleigh Oil Field." Rept. Ont. Bur. Mines, Vol. XII, 1903, pp. 40-42.

Gilbert, G. K.—"Itinerary, Chicago to Niagara Falls." Int. Cong. Geol., Compte Rendu, 5th Session, 1893, pp. 453-458.

Grant, C. C.—"Coral Reefs, modern and ancient." Hamilton Sci. Assoc., Jour. and Proc., No. 18, 1902, pp. 43-45.

Haas, Hippolyt.—"Zur Geologie von Canada." Peterman's Mitteilungen, Bd. 50, 1904, pp. 20-28, 47-55.

Hall, James.—"Pal. of New York," Vols. IV to VI, 1878-87.

Hall, James, and Clarke, J. M.—"Pal. of New York," Vols. VII and VIII, pts. 1 and 2, 1888 to 1894.

Hinde, G. J.—"Annelid jaws from the Hamilton group of the Middle Devonian." Quart. Jour. Geol. Soc. of London, Vol. XXXV, 1879, pp. 384, 385, pl. XX.

Hinde, G. J.—"Conodonts from the Hamilton and Genesee shale divisions of the Devonian." Quart. Jour. Geol. Soc. of London, Vol. XXXV, 1879, pp. 359-369, pls. XV-XVII.

Hunt, T. Sterry.—"A Geological sketch of Canada." Can. Nat., new ser., Vol. II, 1865, pp. 356-363.

Hunt, T. Sterry.—"Contributions to the Chemical and Geological History of Bitumens and of Pyroschists, or Bituminous shales." Am. Jour. Sci., 2nd ser., Vol. XXXV, 1863, pp. 157-171.

Hunt, T. Sterry.—"Description geologique du Canada." Esquisse geologique du Canada, Paris 1867, pp. 3-35.

Hunt, T. Sterry.—"Notes on the Geology of southwestern Ontario." Am. Jour. Sci., Vol. XLVI, 2nd ser., 1868, pp. 355-362. Also Can. Nat., new ser., Vol. IV, 1869, pp. 11-20.

Hunt, T. Sterry.—"Petroleum (The Devonian strata reviewed in connection with discussion of petroleum)." Geol. Surv., Canada, Rept. of Prog., 1863-65, pp. 238-250.

Hunt, T. Sterry.—"The Goderich Salt Region (The Devonian strata reviewed in connection therewith)." Geol. Surv., Canada, Rept. of Prog., 1866-69 (1870), pp. 216-218.

Kindle, Edward M.—"Notes on the Oriskany sandstone and the Ohio shale of the Ontario peninsula." Geol. Surv., Canada, Summary Report, 1912 (1914), pp. 286-290.

Kindle, Edward M.—"The unconformity at the base of the Onondaga limestone in New York and its equivalent west of Buffalo." Journal of Geology, Vol. XXI, 1913, pp. 301-319.

Lambe, Lawrence M.—"On some species of Canadian Palæozoic Corals." Ottawa Naturalist, Vol. XII, 1899, pp. 217-226, 237-258.

Lambe, Lawrence M.—"A review of the genera and species of Canadian Palæozoic corals. Can. Geol. Surv., Cont. to Can. Pal., Vol. IV, pt. I, 1899, pp. 1-96, pls. 1-5.

Lambe, Lawrence M.—"On some Species of Canadian Palæozoic Corals." Ottawa Nat., Vol. XII, 1899, pp. 217-226, 237-258.

Lambe, Lawrence M.—"A review of the genera and species of Canadian Palæozoic corals." Geol. Surv., Canada, Cont. to Can. Pal., Vol. IV, pt. 2, 1901, pp. 97-197, pls. 6-27.

Logan, Sir William E.—"Geological Map of Canada and the adjacent Regions of the United States." (Scale 25 miles to 1 inch), Montreal, 1856.

Logan, Sir William E., and Hunt, T. Sterry.—"Esquisse Geologique du Canada," Paris, 1855, 100 pp. and coloured map.

Logan, Sir William E.—"On the Physical structure of the Western District of Upper Canada." Can. Jour., Vol. III, 1854 (1855), pp. 1-2.

Logan, Sir William E.—"The Hamilton formation and the Portage and Chemung group." Rept. Geol. Surv., Canada (Geology of Canada), 1863, pp. 380-389.

Logan, Sir William E.—"The Oriskany and Corniferous formations." Rept. Geol. Surv., Canada (Geology of Canada), 1863, pp. 359-379.

Lyell, Sir Charles.—"Geological Map of the United States, Canada, etc." Travels in North America, Vol. II, 1845, Map opp. title page.

McRae, John.—"The geological formation at Port Colborne as shown by drillings for natural gas." Can. Inst., Proc., Vol. VI, new ser., 1889, pp. 338-341.

Miller, Willet G.—"The Limestones of Ontario." Rept. Ontario Bur. Mines, Vol. XIII, pt. 2, 1904, pp. 1-126.

Milne-Edwards, H., and Haime, Jules.—"Monographie des Polypiers fossiles des Terraines Paléozoiques, précédée d'un tableau géneral de la classification des Polypes." Archives du Muséum, t. V, Paris, 1851, 502 pp., 20 pls.

Montgomery, Henry.—"A Blastoid found in the Devonian rocks of Ontario." Canadian Nat. and Quart. Jour. Sci., new ser., Vol. X, 1883, pp. 80-84.

Murray, Alexander.—"Report on the district lying between Georgian Bay, on Lake Huron, and the lower extremity of Lake Erie." Geol. Surv., Canada, Rept. Prog. 1863, Montreal, 1845. Abstr. Can. Jour., Vol. III, 1855, pp. 27-29.

Murray, Alexander.—"On work in the great peninsula bounded by Lakes Huron, St. Clair, and Erie." Geol. Surv., Canada, Rept. Prog. 1850-51, Quebec, 1852, pp. 13-33.

Murray, Alexander.—"Report on the shores and islands of Lake Huron." Geol. Surv. of Can., Rept. of Prog. for 1848 (1849).

Nattress, Thomas.—"The Corniferous exposure in Anderdon." Ont. Bur. Mines, Rept. for 1902, pp. 123-127.

Nattress, Thomas.—"The geological continuity of Essex and Kent counties, Ontario, and Monroe and Wayne counties, Michigan." Mich. Acad. Sci., 9th. Ann. Rept., 1907, pp. 177-184.

Nicholson, H. Alleyne.—"Descriptions of new fossils from the Devonian rocks of Canada West." Geol. Mag., Decade II, Vol. I, 1874, pp. 10-16, 54-60; 117-126, 159-163, 197-201, pls. II, IV, VI, IX, and 3 figs.

Nicholson, H. A.—"Description of new fossils from the Devonian rocks of western Ontario." Can. Nat., new ser., Vol. VII, 1873, pp. 138-147.

Nicholson, H. A.—"Descriptions of new species and of a new genus of Polyzoa from the Palaeozoic rocks of North America." Geol. Mag., Decade II, vol. II, 1873, pp. 33-38, pl. II.

Nicholson, H. A.—"Descriptions of new species of Cystiphyllum from the Devonian rocks of North America." Trans. British Assoc., 1874, pp. 30-38. Also Geol. Mag., Decade II, Vol. II, 1875, pp. 30-33, pl. 1.

Nicholson, H. A., and Thompson, James.—"Descriptions of some new or imperfectly understood forms of Palæozoic corals." Proc. Royal Soc. Edin., Vol. IX, 1876-77, pp. 149, 150. (Abstr.)

Nicholson, H. A.—"Descriptions of two new genera and species of Polyzoa from the Devonian rocks." Ann. and Mag. Nat. Hist., ser 4, Vol. XIII, 1874, pp. 77-85, with 2 engravings.

Nicholson, H. A., and Etheridge jun., R.—"Notes on the genus Alveolites, Lamarack, and on some allied forms of Palæozoic corals." Jour. Linn. Soc., Vol. XIII, 1877, pp. 353-370, pls. XIX, XX.

Nicholson, H. A.—"On some new species of Stromatopora." Ann. and Mag. Nat. Hist., ser. 4, Vol. XII, 1873, pp. 89-95, pl. IV.

Nicholson, H. A.—"On the affinities of the genus Stromatopora, with descriptions of two new species." Ann. and Mag. Nat. Hist., ser. 4, Vol. XIII, 1874, pp. 4-13, with 3 engravings.

Nicholson, H. A.—"On the minute structure of the corals of the genera Heliophyllum and Crepidophyllum. Ann. and Mag. Nat. Hist., ser. 5, Vol. I, 1878, pp. 44-54.

Nicholson, H. A.—"On the new species of Favosites of the Devonian rocks of western Ontario." Can. Jour., new ser., Vol. XIV, 1873 (1875), pp. 38-50.

Nicholson, H. A.—"Report upon the Palæontology of the Province of Ontario." 133 pp., 8 pls., 58 figs., Toronto, 1874.

Nicholson, H. A.—"Report upon the Palæontology of the Province of Ontario." 96 pp., 4 pls., 44 text figs., Toronto, 1875.

Nicholson, H. A.—"Summary of recent researches on the Palæontology of the Province of Ontario, with brief descriptions of some new genera." Can. Jour., new ser., Vol. XIV, 1873 (1875), pp. 125-136.

Parks, W. A.—"Fossiliferous rocks of southwestern Ontario." Rept. Ont. Bur. Mines, Vol. XII, 1903, pp. 141-156.

Parks, W. A.—"Building and Ornamental stones of Canada." Rept. Dept. Mines (Ottawa), Vol. I, 1912, pp. 272-291.

Rodgers, Wm. B., and Rodgers, H. D.—"Observations on the geology of the western peninsula of Upper Canada and the western part of Ohio." Am. Phil. Soc., Proc., Vol. II, 1842, pp. 120-125. Also Am. Phil. Soc., Trans., Vol. VIII, new ser., 1843, pp. 273-284.

Schuchert, Charles.—"A list of fossils occurring in the Oriskany of Maryland, New York, and Ontario." Eighth Ann. Rept. State Geol. of New York, 1888, pp. 50-54.

Schuchert, Charles.—"Dry dredging in the Mississippian sea." Science, new ser., Vol. II, 1895, pp. 679-681.

Schuchert, Charles.—"A Synopsis of American fossil Brachiopoda, including bibliography and synonymy." U. S. Geol. Surv., Bull. No. 87, 1897, 464 pp., 1 pl., 6 figs.

Schuchert, Charles.—"Lower Devonic aspect of the Lower Helderberg and Oriskany formations." Bull. Geol. Soc. Am., Vol. XI, 1900, pp. 241-332.

Selwyn, A. R.—"Geological map of the Dominion of Canada," Montreal, 1883.

Selwyn, A. R., and Dawson, J. W.—"Sketch of the Physical Geography and Geology of Canada." Montreal, 1884.

Shimer, H. W., and Grabau, A. W.—"Hamilton group of Thedford, Ontario". Bull. Geol. Soc. Am., Vol. XIII, 1902, pp. 149-186.

Stauffer, Clinton R.—"Geology of the Region around Hagersville." International Geol. Cong. Guide Book No. 4, Geol. Surv., Canada, 1913, pp. 82-91.

Stauffer, Clinton R.—"Geology of the Region around Port Colborne." International Geol. Cong. Guide Book No. 5, Geol. Surv., Canada, 1913, pp. 47-55.

Stauffer, Clinton R.—"The Devonian of southwestern Ontario." Summary Report for 1910, Geol. Surv.; Canada, 1911, pp. 193-195.

Stauffer, Clinton R.—"The Devonian of southwestern Ontario." Summary Report for 1911, Geol. Surv., Canada, 1912, pp. 269-272.

Stauffer, Clinton R.—"The Oriskany sandstone of Ontario." Bull. Geol. Soc. Am., Vol. XXII, 1912, pp. 371-376.

Thompson, and Nicholson, H. A.—"Chief generic types of Palæozoic corals." Ann. and Mag. Nat. Hist., 4th ser. Vol. XVII, 1876, pp. 60-70, 123-128, 290-305, 451-462.

Whiteaves, J. F.—"Canadian Stromatoporoids." Can. Rec. Sci., Vol. VII, 1896, pp. 129-146.

Whiteaves, J. F.—"Description of a new species of Panenka from the Corniferous limestone of Ontario." Can. Record of Sci., Vol. IV, 1891, pp. 401-404, pl. 1.

Whiteaves, J. F.—"The Devonian system of Canada." Am. Assoc. Adv. Sci., Proc., Vol. XLVIII, 1899, pp. 195-223; Am. Geol. Vol. XXIV, 1899, pp. 210-240; also Science, new ser., vol. X, 1899, pp. 402-412, 430-438.

Whiteaves, J. F.—"On some fossils from the Hamilton formation of Ontario, with a list of the species at present known from that formation and province." Geol. Surv., Canada, Contributions to Canadian Palæontology, Vol. I, 1885-98, pp. 91-125.

Williams, M. Y.—"The Hamilton formations at Thedford and vicinity." International Geol. Cong. Guide Book No. 4, 1913, pp. 101-110.

Williams, M. Y.—"Thedford and vicinity, Ontario." Summary Report for 1912, Geol. Surv., Canada, 1914, pp. 282-285.

Winchell, Alexander.—"Notes on the geology of petroleum in Canada West." Am. Jour. Sci., 2nd ser., Vol. XLI, 1866, pp. 176-178.

Winchell, Alexander.—"On the oil formation in Michigan and elsewhere." Am. Jour. Sci., 2nd ser., Vol. XXXIX, 1865, pp. 350-353.

Winchell, Alexander.—"Petroleum of southwestern Ontario." Sketches of Creation, New York, 1870, pp. 286-293, 443, 444.

CHAPTER VI.

THE DETROIT RIVER SERIES.

GENERAL STATEMENT.

South and westward from Woodstock the Devonian rests unconformably (disconformably) on the Detroit River series. This is the upper division of the Monroe formation, as it is known in Michigan and Ohio where it is the outcropping rock over a very large area and is considered to be the upper part of the Silurian system. The Detroit River series varies from a banded brown or buff porous dolomite to a compact drab limestone which sometimes runs so high in its percentage of calcium carbonate that it exceeds the overlying Onondaga limestone in purity. Associated with this purer limestone, and also with some of the highly dolomitic beds, there is a great variety of fossils, many of which resemble so closely the true Onondaga forms that it has been seriously questioned whether they do not belong in the Devonian rather than in the Silurian.

Dr. T. Sterry Hunt observed this fauna at Goderich and was the first to point out the remarkable similarity between it and that of the Onondaga limestone. In discussing the record of Mr. Attrill's well, he says "we now come to the consideration of an unexpected result of the examination of the cores from the Goderich boring; namely, the occurrence beneath 278 feet of beds, chiefly dolomite, which, according to the Geological Survey, underlie the Corniferous (Onondaga) limestone of the region, of not less than 276 feet, chiefly of grey, non-magnesian, coralline limestone, abounding in chert and seeming like a repetition of the Corniferous (Onondaga). Beneath this lower fossiliferous limestone, it will be noted, are dolomites with gypsum, succeeded by variegated marls, with an aggregate thickness of not less than 364 feet before reaching the saliferous strata, which latter have been penetrated 520 feet without reaching the underlying Guelph formation. Professor James Hall, who has kindly examined such specimens of the corals as I have obtained from this limestone recognizes in them two species of *Favosites*, *Favosites winchelli* and *Favosites emmonsi*, together with a section of *Acervularia* or *Diphyphyllum*."[1] A little quarrying along Maitland river to the east of Goderich has uncovered the total thickness of the Onondaga limestone in the steep banks of the river, and shows it resting unconformably on the non-fossiliferous dolomite which Hunt says is 278 feet thick. The fossiliferous limestone mentioned in the above quotation is, therefore, very evidently not the Onondaga limestone. The fossiliferous rocks, which carry the same fauna, at McRae point and Kincardine, have been described by Logan with the Devonian, and concerning which he says "there is little doubt that the fossiliferous beds in all these various exposures..........belong to the Corniferous (Onondaga) limestone."[2] The outcrop along the Thames river at Beachville has usually met the same fate, while still more recent attempts have been made to place the fossiliferous beds at Amherstburg and in the Detroit river, in the Onondaga.

Recently Grabau and Sherzer[3] have made a rather exhaustive study of the Monroe formation and have illustrated its fauna. In accordance with a preceding paper on the "Nomenclature and Subdivisions of the upper Siluric strata of Michigan, Ohio, and western New York" by Lane, Prosser, Sherzer, and Grabau[4] they recognize the following subdivisions.[5]

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[1]Hunt, T. Sterry, Geol. Surv. of Canada, Rept. Prog. for 1876-77 (1878), p. 242.

[2]Geology of Canada, 1863, p. 377.

[3]Mich. Geol. and Biol. Surv., Pub. 2, Geol. ser. 1, 1909 (1910), 248 pp., 28 pls.

[4]Bull. Geol. Soc. Am., vol. XIX, 1907, p. 556.

[5]Op. cit. p. 27.

Dundee (Onondaga) formation..........

			Feet
Monroe formation.	.............disconformity (unconformity).		
	C. Upper Monroe or Detroit River series.	Lucas dolomite	200+
		Amherstburg dolomite	20
		Anderdon limestone	35–50
		Flat Rock dolomite	40–100
	.............disconformity (unconformity).		
	B. Sylvania sandstone and dolomites		30–300
	.............disconformity (unconformity).		
	A. Lower Monroe or Bass Island series.	Raisin River dolomite	200
		Put-in-Bay dolomite	100
		Tymochtee shales	90
		Greenfield dolomite	100
	.............disconformity (unconformity).		

Salina formation..........

They very definitely correlate the upper part of the Monroe formation with the Cayugan series of eastern New York, although indicating that it is rather more comprehensive than the remnant of that series in western New York.[1] However, an alternative correlation is also suggested. "If correlation were to be based on faunal evidence alone, a different interpretation of the stratigraphy of Michigan would probably be adopted. In that case the lower Monroe would be correlated with the upper Cayugan, i.e., the beds from the Cobleskill upwards. Faunally there is a striking correspondence between the Raisin River and the Put-in-Bay beds and the Manlius of New York. This extends even to the Eurypterids as determined by Reudemann.........Faunally the upper Monroe might be considered as the indigenous lower Devonic, with a sparse mingling of foreign types of this age, such as Hercynella. On this hypothesis, the Sylvania would represent the continental condition appearing at the end of the Siluric during the temporary retreat of the Siluric sea and before the expansion of the Helderbergian sea. Thus considered the upper Monroe would represent a provincial phase of the lower Devonic distinct from the Helderbergian."[2] But the possibility of the truth of this correlation is rejected by the authors on the fact of the very long interval of time that must

[1]Op. cit. p. 234.
[2]Op. cit. p. 233.

have intervened between the latest Monroe and the basal Onondaga.

Ontario covers the region which must be transitional between the New York and Michigan deposits. Whether, of course, the transition is recorded by beds of rock or by an erosion surface, is quite another matter. In Welland and Haldimand counties the Devonian rests unconformably on either the Salina or the Cobleskill, which show little change from their New York characteristics. Just west of Springvale the Silurian-Devonian contact passes under drift cover and reappears next in the vicinity of Woodstock where it outcrops along the south branch of the River Thames. There the beds which immediately underlie the Devonian are no longer to be classed with any of the deposits to the east, but are similar to those of the Detroit River region.

BEACHVILLE SECTIONS.

At Beachville, about 5 miles down the river from Woodstock, the Standard White Lime Company has a quarry in the beds of the Detroit River series. The contact between Detroit River series and Onondaga lies much nearer Woodstock, probably at river level where the Gun Club is located, but the beds quarried at the lime-kilns evidently lie but little below that horizon. The total cut is 12 feet 8 inches in a grey to drab limestone, the lower part of which contains an abundance of small corals and stromatoporoids. The upper layers, especially in the old north portion of the quarry, have a much more abundant fauna which differs somewhat from that of the lower beds, although a distinct dividing line was not found. The rock is inclined to be thin bedded and often compact where fossils seem to be less abundant. The following fauna was collected chiefly from the upper rocks at Beachville.

Fauna of the Detroit River Series at Beachville.

Cladopora bifurcata Grabau.
Diplophyllum integumentum Barrett.
Heliophrentis sp.
Clathrodictyon osteolatum Nicholson.
Clathrodictyon variolare von Rosen.

Idiostroma nattressi Grabau.
Prosserella modestoides Grabau.
Prosserella subtransversa Grabau.
Schuchertella hydraulica (Whitfield).
Conocardium monroicum Grabau.
Pterinea cf. lanii Grabau (This specimen shows distinct radiating striæ).
Bellerophon sp.
Eotomaria sp.
Holopea sp.
Hormotoma subcarinata Grabau.
Loxonema sp.
Trochonema ovoides ? Grabau.
Cyrtoceras orodes Billings.
Trochoceras gebhardi ? Hall.
Proetus sp.

The fossils show that the upper beds of this locality probably belong in the Amherstburg dolomite, while the lower beds, which make most of the quarry, are evidently Anderdon. Somewhat lower rock outcrops at the same company's quarries several miles down the river where 3 or 4 feet of a compact drab limestone, evidently the Anderdon, contains the following fossils.

Fossils From Rock in Quarries 2 Miles below Beachville.

Diplophyllum integumentum Barrett.
Clathrodictyon osteolatum Nicholson.
Idiostroma nattressi Grabau.
Stylodictyon sherzeri Grabau.
Prosserella modestoides Grabau.
Conocardium monroicum Grabau.
Trochoceras anderdonense ? Grabau.

FORMOSA SECTIONS.

At Bruder's lime-kiln, 2½ miles north of Formosa, the Alpena limestone rests unconformably on the Detroit River series, which are chiefly soft brown to ashen in colour and more or less massive. The following fauna was collected from beds No. 3 of the Bruder's lime-kiln section.[1]

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[1]See page 146 of this report.

Fauna From the Detroit River Series at Bruder's Lime-kiln.

Alveolites cf. goldfussi Billings.
Ceratopora regularis Grabau.
Ceratopora tenella (Rominger).
Ceratopora sp.
Cystiphyllum americanum danerdonense Grabau.
Diplophyllum integumentum Barrett.
Romingeria sp.
Syringopora cf. hisingeri Billings.
Crinoid fragments.
Acanthonema sp.
Fenestella sp.
Monotrypa sp.
Prismopora sp.
Atrypa reticularis (Linnaeus).
Craniella cf. hamiltoniae Hall.
Cyrtina dalmani ? (Hall).
Meristella sp.
Metaplasia ? pixidata ? ? Hall.
Rhipidomella sp.
Rhynchospira cf. praeformosa Grabau.
Schuchertella sp.
Spirifer cf. divaricatus Hall.
Spirifer sulcata submersa Grabau.
Stropheodonta demissa homalostriatus Grabau.
Whitfieldella sp.
Conocardium monroicum Grabau.
Cypricardinia canadensis Grabau.
Eotomaria sp.
Platyceras cf. dumosum Conrad.
Cyrtoceras cf. citum Hall.
Dalmanites sp.
Proetus sp.

This fauna seems to correspond more closely to that of the Amherstburg dolomite of the Michigan section and it probably belongs to the same general horizon. The fossils are chiefly in the form of moulds, as is the case in the dolomites outcropping at Stony Island.

KINCARDINE SECTION.

Along the Penetangore river, 2½ miles east of Kincardine, there is a very considerable outcrop of rock on lots 8, 9, and 10, concession III south. The following section starts on Mr. Holland's land (lot 8) and extends up stream on Mr. McKenzie's place (lots 9 and 10).

Section Along the Penetangore River.

	Thickness	
5. Soil and drift	10 Ft.	0 In.
Amherstburg dolomite		
4. Ashen-coloured, banded dolomite in rather thin even beds	10 "	0 "
3. Massive, brown, irregularly-bedded dolomite containing a few poorly preserved fossils	5 "	0 "
2. Poorly banded, brown dolomite with an abundance of a few species of fossils	5 "	0 "
1. Brown dolomite to the level of the river at the end of the outcrop	5 "	0 "

The following species, which were collected from No. 2 of the above section, indicate that the outcrop belongs in the Amherstburg dolomite.

Diplophyllum integumentum Barrett.
Prosserella modestoides Grabau.
Hormotoma sp.
Trochonema ovoides Grabau.

MCRAE POINT SECTION.

In the northern part of Kincardine township, Bruce county, McRae point projects into Lake Huron about 1¾ miles south of Inverhuron. The end of the point is protected from wave erosion by an outcrop of rock which shows the following section.

Section at McRae Point on Lake Huron.

	Thickness
Devonian ?	
2. Massive, rough, brown limestone or dolomite which contains some chert and cavities filled with calcite. The bottom layers contain some sand and angular fragments derived from the underlying mass on which it lies with a distinct unconformity	5 Ft. 0 In.

Amherstburg dolomite	Thickness
1. Brown to drab dolomite and dolomitic limestone. This rock is rather thin bedded, contains bituminous films, and is often quite fossiliferous. The rock of the upper beds contains the flat blade-like crystals of celestite and the middle portion contains a layer of concretion-like beds. This part of the section extends to the lake level..........	15+ Ft. 0 In.

The full section exposed is rather large because of the 10 degrees to 15 degrees dip in the rock. This is chiefly to the southwest, but is reversed near the north end of the section. The following fauna occurs in the lower member of the above section.

Fauna of the Detroit River Series at McRae Point.

Ceratopora tenella Rominger.
Cladopora bifurcata Grabau.
Cyathophyllum cf. hydraulicum Simpson.
Diplophyllum integumentum Barrett.
Heliophrentis alternatum magna Grabau.
Clathrodictyon variolare? von Rosen.
Idiostroma nattressi Grabau.
Hederella sp.
Reptaria cf. stolonifera Rolle.
Prosserella modestoides Grabau.
Prosserella subtransversa Grabau.
Schuchertella amherstburgense Grabau.
Conocardium monroicum Grabau.
Panenka canadensis Whiteaves.
Acanthonema holopiformis Grabau.
Eotomaria areyi Clarke and Ruedemann.
Eotomaria galtensis? (Billings).
Hormotoma subcarinata Grabau.
Platyceras sp.
Dawsonoceras annulatum americanum Foord.
Trochoceras anderdonense Grabau.

This is doubtless the Amherstburg dolomite. The fauna is composed of forms chiefly characteristic of that division of the Detroit River series.

AMHERSTBURG SECTION.

There are two very important sections near this town, in addition to the numerous wells that have been drilled in the immediate vicinity. A very important section, showing the Anderdon-Onondaga contact, occurs at the quarries of the Amherstburg Stone Company.[1] One of the marked characteristics of this section is that the Onondaga limestone rests unconformably on the Anderdon limestone and that the uneven contact shows an abundance of sand, probably of Oriskany origin, penetrating the cracks and holes in the Anderdon limestone, and pebbles of this latter are included within the sandy basal layer of the Onondaga.

The following fauna occurs in the Anderdon limestone.

Fauna of the Anderdon Limestone, Amherstburg Quarries.

Ceratopora tenella (Rominger).
Cladopora bifurcata Grabau.
Cystiphyllum anderdonense Grabau.
Cyathophyllum sp.
Diplophyllum integumentum Barrett.
Favosites concavum Grabau.
Favosites rectangularis Grabau.
Helenterophyllum caliculoides Grabau.
Zaphrentis sp.
Clathrodictyon osteolatum Nicholson.
Clathrodictyon variolare von Rosen.
Coenostroma pustulosum Grabau.
Idiostroma nattressi Grabau.
Stromatopora galtensis Dawson.
Stylodictyon sherzeri Grabau.
Crinoid stems.
Atrypa reticularis (Linnaeus).
Prosserella modestoides Grabau.
Prosserella subtransversa Grabau.
Spirifer ohioensis ? Grabau.
Whitfieldella sp.
Eotomaria galtensis ? (Billings).
Platyceras sp.
Solenospira sp.

[1]See section on page 202 of this report.

Hyolithes sp.
Cyrtoceras sp.
Trochoceras anderdonense Grabau.
Leperditia sp.

This fauna shows strong Silurian affinities and, in addition to certain Onondaga elements, is more or less suggestive of the Guelph. If it lies above the faunas of the north end of the cut in the Detroit river, which is doubtful, it must complicate the correlation of the Detroit River series.

The lowest layers of the quarry, possibly belonging to the Flat Rock dolomite, contain the following forms.

Fauna of the Lowest Layers of the Amherstburg Quarry.

Cladopora bifurcata Grabau.
Diplophyllum integumentum Barrett.
Favosites sp.
Clathrodictyon osteolatum Nicholson.
Clathrodictyon variolare von Rosen.
Eotomaria areyi Clarke and Ruedemann.
Cyrtoceras orodes Billings.

The Amherstburg quarry is the type locality for the Anderdon limestone. When its fauna has been fully collected it will undoubtedly include a much larger number of forms. While the lowest beds of the quarry were pointed out as possibly belonging to the next lower formation, the above list of species does not support that assumption.

By far the most important section of the Detroit River series from the standpoint of its fauna, occurs in the dry cut of the Livingston channel along the International Boundary line in the Detroit river slightly above Amherstburg. During excavation the water was excluded from this portion of the channel by coffer-dams and in the dry workings[1] an excellent section was uncovered. In 1910 and 1911 one could walk through the entire cut, somewhat more than a mile in length, and collecting was good. There was also abundant opportunity to study the rock

[1] See Sherzer, W. H.—Mich., Geol. and Biol. Surv., Pub. 12, 1911, pls. XI, XX, XXI, XXIV.

walls. The rocks are dipping to the southward about 100 feet per mile in this cut. On the Michigan side of the river the dip of the rocks is to the westward and well records on the Ontario side show an eastward dip as the rule. In the quarry of the Amherstburg Stone Company, however, the dip is to the westward. It seems, therefore, that the general rock structure here is anticlinal with local sags of greater or less extent and that the dips in the quarry and cut are to be accounted for as such local interruptions in the otherwise northward plunging anticline. The following descriptions and measurements were supplied by Rev. Thomas Nattress of Amherstburg.

Section of the Stony Island Dry Cut, Livingston Channel.

		Thickness	
18.	Boulder till (Illinoian ?)	8 Ft.	9 In.
	Amherstburg dolomite		
17.	Dolomite with a seam of strontianite, weathered to mud, at the bottom	5 "	11"
16.	Dolomite	5 "	0 "
15.	Rather massive dolomite containing *Clathrodictyon osteolatum* in the lower half	6 "	6 "
14.	Dolomite	2 "	2 "
13.	Dolomite with rotten clayey strontianite seam at base	3 "	3 "
12.	Dolomite	3 "	3 "
11.	Dolomite showing stylolite seam. Lower surface petroleum spread	5 "	0 "
10.	Dolomite beds measuring, in order downward: 2′ 10″, 4′ 4″, 2′ 10″, 3′ 4″, 3′ 4″, 4′ 4″, 2′ 10″, 2′ 2″, and 4′ 0″	30 "	0 "
9.	Massive dolomite	4 "	4 "
8.	Bed of dolomite which is nodular or apparently concretionary in structure	1 "	9 "
7.	The zone of small gastropods and of *Panenka canadensis* (Whiteaves), with beds measuring, in order downward, 1′ 0″, 2′ 6″, 2′ 7″ to 3′ 3″ according to the irregularities of another apparently concretionary surface	6 "	5 "

		Thickness	
6.	Concretionary (?) layer....................	1 Ft.	9 In.
5.	Thick bed of dolomite with stromatopora-like forms in the middle......................	7 "	7 "
4.	Coarsely granular, brown dolomite..........	3 "	4 "
3.	Massive stratum of brown dolomite with cavities filled with partly decomposed strontianite and some calcite crystals. Other cavities are full of minute grains of white calcite looking like quartz sand from the Sylvania..	5 "	5 "
2.	Massive stratum like that above except that it contains some dark drab chert and stromatopora-like hydrozoans.....................	5 "	0 "
1.	Brown dolomite forming the base of the cut at the north end, west side. It has a wavy surface above and contains some petroleum..	2 "	10 "

All of these lower beds near the north end of the cut are full of fossils and an important horizon was found near the south end, but it is next to impossible to locate all the fossil-bearing strata definitely in the section, as collections have been made almost entirely from the rock material after removal from position. The following list, however, may be divided into a north and a south end fauna. Although fossils are abundant they are chiefly moulds which are not always well preserved.

Fauna Collected from the Stony Island Dry Cut, Livingston Channel.

	North	South
Ceratopora regularis Grabau..................................	x	..
Ceratopora tenella (Rominger)..............................	x	x
Cladopora bifurcata Grabau..................................	x	x
Cyathophyllum hydraulicum? Simpson....................	x	..
Cylindrohelium heliophylloides Grabau....................	x	..
Cylindrohelium profundum? Grabau........................	..	x
Cystiphyllum americanum anderdonense Grabau............	x	..
Diplophyllum integumentum Barrett........................	x	..
Diplophyllum sp..	..	x
Favosites basaltica nana Grabau.............................	x	..
Favosites cf. maximus Troost.................................	x	..

	North	South
Favosites sp.	x	..
Heliophrentis alternatum Grabau	x	..
Heliophrentis alternatum magnum Grabau	x	..
Heliophrentis carinatum Grabau	x	..
Romingeria sp.	x	..
Synaptophyllum multicaule Hall	x	..
Synaptophyllum cf. simcoense Billings	x	..
Syringopora cooperi Grabau	x	..
Syringopora sp.	x	..
Clathrodictyon osteolatum Nicholson	x	..
Clathrodictyon variolare ? von Rosen	x	..
Stylodictyon sherzeri ? Grabau	..	x
Fenestella sp.	x	..
Polypora 2 sp.	x	..
Atrypa reticularis (Linnaeus)	x	..
Crania cf. pulchella Hall and Clarke	x	..
Crania sp.	x	..
Hindella sp.	x	..
Meristella sp.	x	..
Meristospira michiganense Grabau	..	x
Pentamerella cf. arata (Conrad)	x	..
Prosserella modestoides Grabau	x	..
Prosserella modestoides depressum Grabau	..	x
Prosserella subtransversa Grabau	x	x
Reticularia sp.	x	..
Rhipidomella sp.	x	..
Schellwienella cf. pandora (Billings)	x	..
Schizophoria sp.	x	..
Schuchertella amherstburgense Grabau	x	..
Schuchertella hydraulica ? Whitfield	x	..
Schuchertella interstriata (Hall)	x	..
Spirifer cf. divaricatus Hall	x	..
Spirifer sulcata submersa Grabau	x	..
Spirifer sp.	x	..
Stropheodonta demissa homalostriatus Grabau	x	..
Stropheodonta cf. galeata (Billings)	x	..
Stropheodonta cf. inaequiradiata Hall	x	..
Stropheodonta vascularia Grabau	x	..
Stropheodonta sp.	x	..
Whitfieldella prosseri ? Grabau	x	..
Conocardium monroicum Grabau	x	x
Modiomorpha cf. concentrica (Conrad)	x	..
Nucula sp.	x	x

	North	South
Paracyclas sp	x	..
Schizodus sp	x	..
Acanthonema laxa Grabau	x	..
Bellerophon sp	..	x
Callonema cf. imitator Hall and Whitfield	x	..
Callonema sp	..	x
Eotomaria areyi Clarke and Ruedemann	x	..
Eotomaria galtensis (Billings)	x	x
Eotomaria sp	x	..
Hormotoma subcarinata Grabau	..	x
Hormotoma sp	x	..
Holopea sp	x	..
Loxomema sp	x	x
Platyceras 2 sp	x	..
Pleurotomaria velaris ? Whiteaves	x	..
Pleurotomaria sp	x	..
Poleumita ? cf. sulcata Hall	x	..
Hyolithes sp	x	..
Tentaculites sp	x	..
Cyrtoceras orodes Billings	x	x
Cyrtoceras sp	x	..
Dawsonoceras annulatum americanum Foord	x	..
Orthoceras sp	..	x
Poterioceras cf. sauridens Clarke	x	..
Proetus cf. crassimarginatus Hall	x	..

From this list it will be observed that the fauna collected in the south end of the cut differs considerably from that of the stratigraphically lower fauna found in the north end. This latter shows a more markedly middle Devonian character than as illustrated by Grabau and Sherzer, although few if any species can be positively identified with Onondaga forms. Even *Proetus crassimarginatus*, which has been identified from these beds, should be marked as doubtful. Moreover, associated with these Onondaga-like forms are others not known to occur in Devonian strata, unless we revise our classification of that system. In the fauna of the south end *Prosserella* and *Hormotoma* constitute a very large percentage. Some layers are fairly crowded with one or two species of these genera. The fauna of this southern end of the cut lies about 75 feet above the northern one and is markedly unlike any that is at present included within undisputed Devonian. It, too, must be taken into consideration in any correlation that may be suggested for these beds.

DISCUSSION OF FAUNAL RELATIONS.

A close study of the fauna of the Detroit River series shows it to be somewhat related to the Guelph and older Silurian faunas, but its marked middle Devonian appearance is most pronounced. In discussing the Detroit River series, Grabau and Sherzer remark that "if the fauna were considered by itself, it would probably be pronounced a Schoharie or an Onondaga fauna without a moment's hesitation," but "the position of this fauna beneath 200 to 250 feet of Lucas dolomite with a Siluric fauna, forces us to consider this as Siluric.[1]" They thus agree with Dr. Hunt's Goderich section in their interpretation of the horizon of the fauna.

The lowest layers of the Onondaga in Ohio and Ontario are usually a basal conglomerate. The pebbles of this conglomerate are identical in every way with the underlying dolomites of the Detroit River series from which they were unquestionably derived. This means that the time, which elapsed between the deposition of the sediments of the Detroit River series and the erosion which formed the gravels of the conglomerate, was sufficient for the consolidation of the Detroit River sediments into essentially their present condition. Adding this to the time necessary for the deposition of the 200 to 250 feet of dolomite composing the Lucas, it is certain that the time between the Flat Rock-Anderdon-Amherstburg dolomite and the Onondaga was very long. There is thus no possiblity that this fauna belongs in the Onondaga,[2] to which it is most nearly related. Its relation to the lowest Devonian of the eastern states is no nearer than to the middle Silurian of the same region or of this province. It seems, therefore, that it is proper to regard it as either a Silurian fauna

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[1]Mich. Geol. and Biol. Surv., Pub. 2, Geol. ser. 1, 1909 (1910), p. 217.

[2]See Nattress, Rev. Thomas, Geol. of the Detroit River Area, 21st Ann. Rept. Ont. Bur. Mines, 1912, vol. XXI, pt. 1, pp. 281-287.

with affinities to the Guelph, but possibly more closely related to other faunas of that general age to the northwest,[1] or an isolated fauna, contemporaneous with the Helderbergian, which eventually developed into the Onondaga. Certain members of this fauna, especially the hydrozoans, corals, brachiopods, pelecypods, gastropods, and trilobites are undoubtedly ancestral to the Onondaga forms belonging to these same groups, but it is a question whether that is sufficient reason to place these deposits in the Devonian, as that system is now constituted, when there is a strong probability that they preceded in time even the lowest eastern Devonian. Possibly these forms are representative of the faunas that somewhere bridged the gap between Silurian and Devonian, a real transitional stage which is more closely related to known middle Devonian than to any preceding or subsequent fauna thus far discovered.

The official practice of the Canadian Geological Survey is to treat the beds holding these faunas as part of the Devonian system.

[1]Grabau, A. W. and Sherzer, W. H., op. cit. pp. 238, 239.

PLATE I.

The north wall of the Canadian Portland Cement Company's quarry at Port Colborne. The quarry is entirely in the Onondaga limestone, the base of the black cherty part of which is indicated by the hat.

PLATE I.

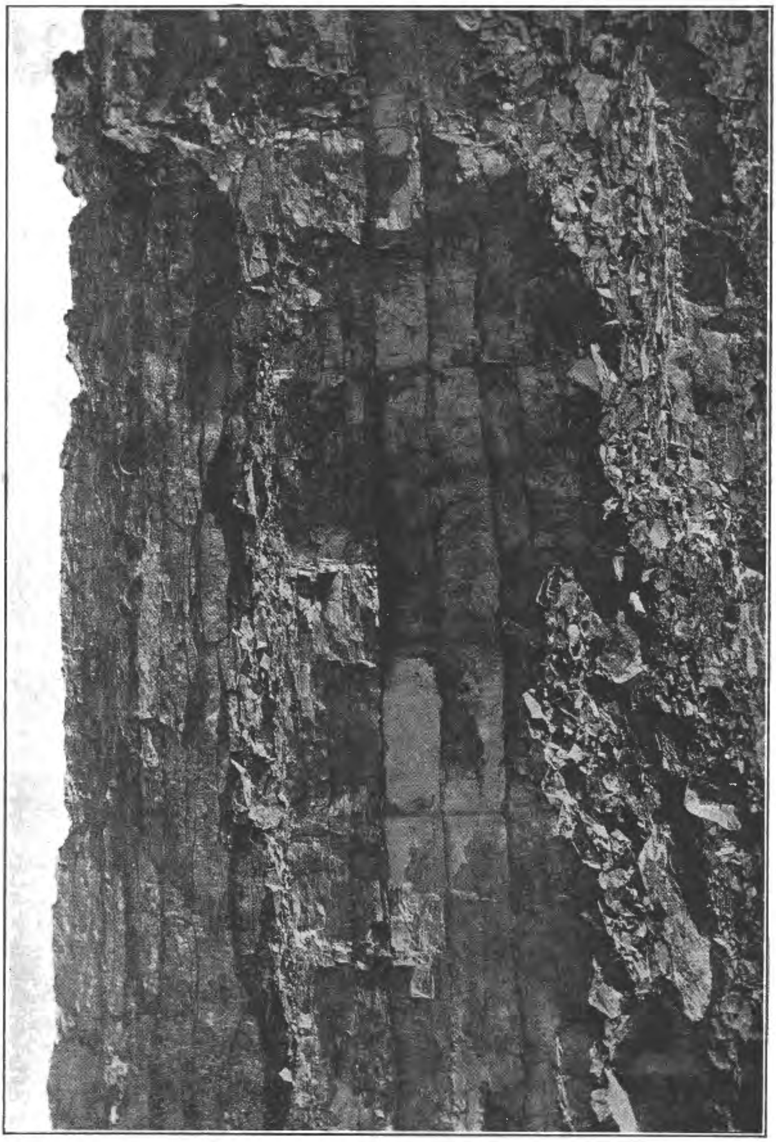


PLATE II.

Outcrop of the Onondaga limestone at Haggerty falls.

PLATE II.

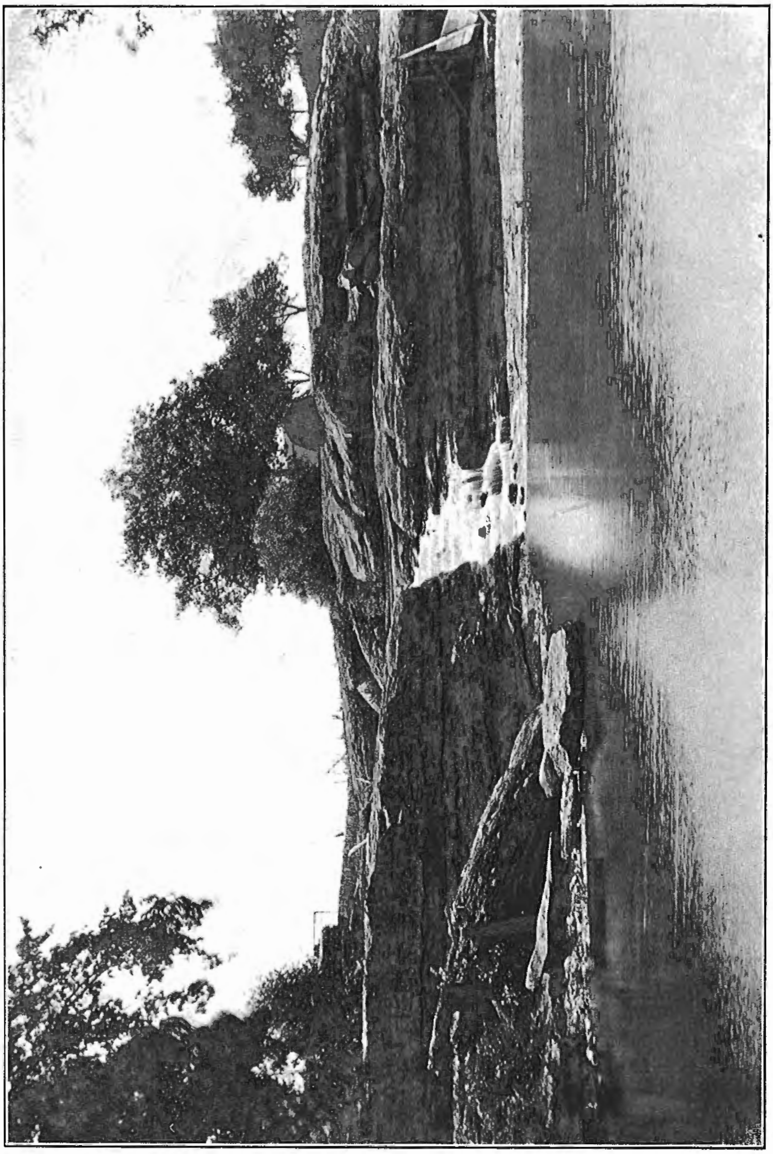


PLATE III.

The top of the Oriskany sandstone in the quarry on the Jacob McClung farm, at the north end of lot 46, concession I, north of the Talbot road, North Cayuga township. The illustration shows the basal conglomerate of the Onondaga limestone adhering to the Oriskany.

Plate III.

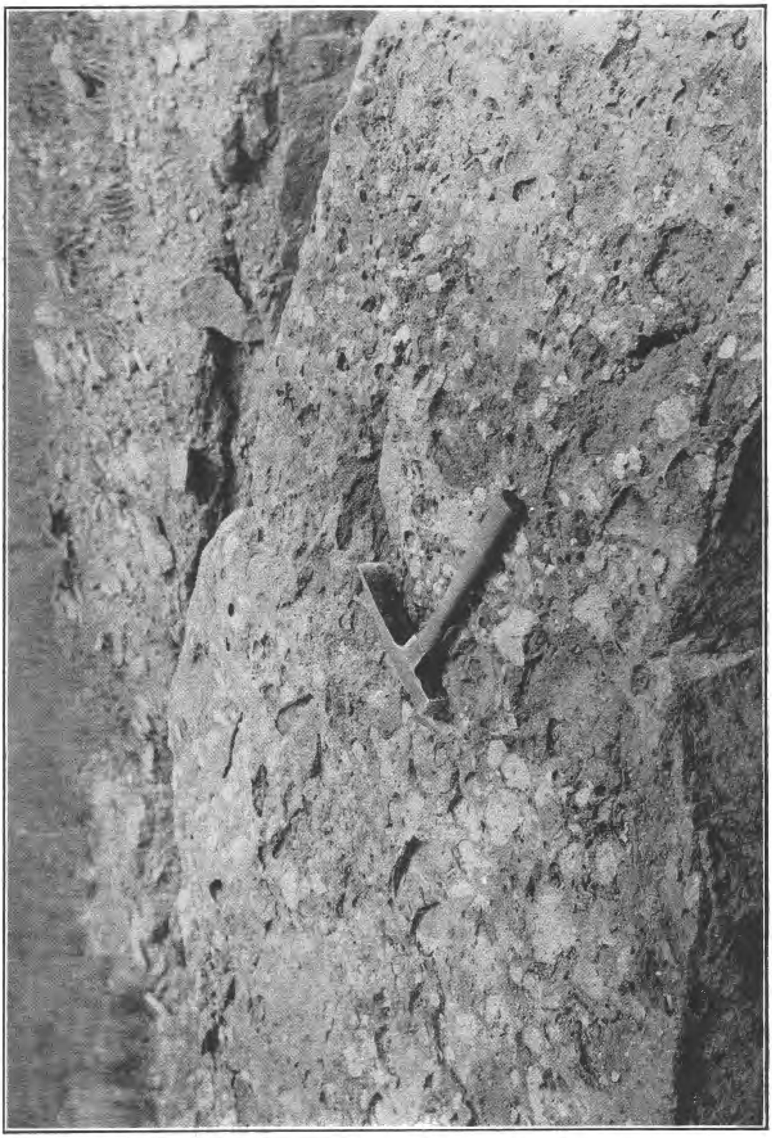


PLATE IV.

The north wall of the quarry in the Oriskany sandstone at the Oneida Lime and Sand Company's plant, northwest of DeCewville.

PLATE IV.

PLATE V.

The massive Oriskany sandstone overlying the Silurian dolomites unconformably just west of the Oneida Lime and Sand Company's quarry.

Plate V.

PLATE VI.

The cherty Onondaga limestone in J. C. Ingle's quarry at Hagersville.

PLATE VI.

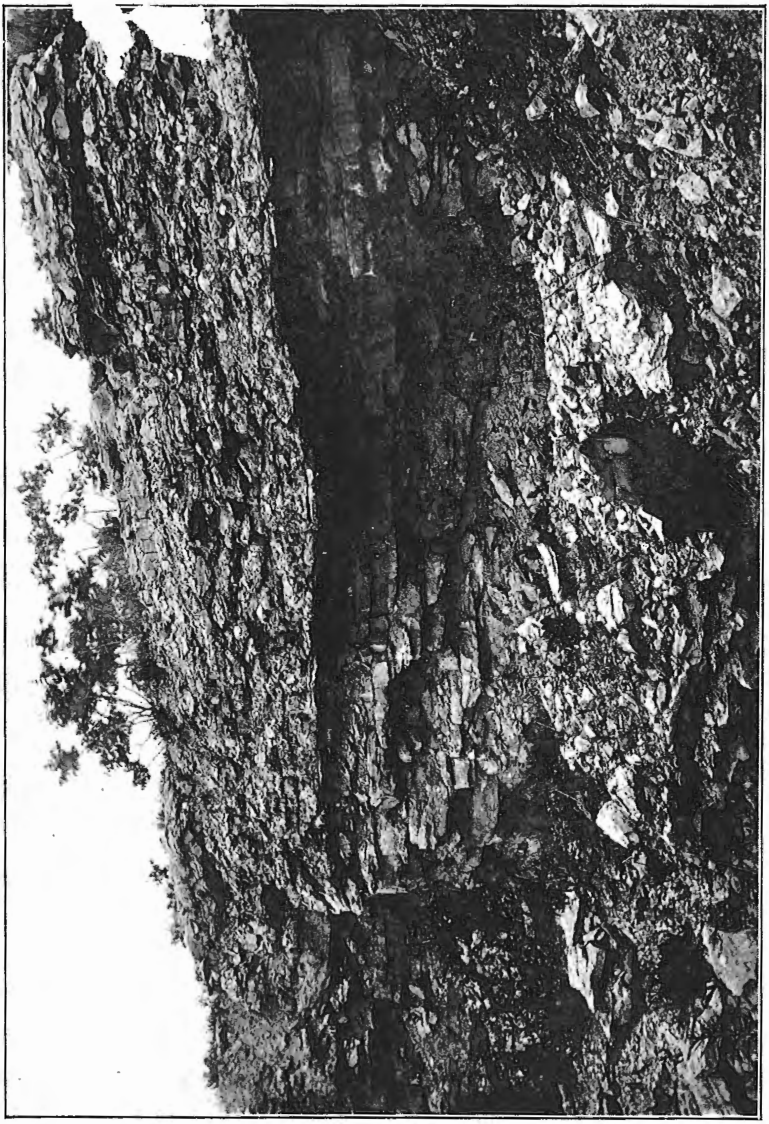


PLATE VII.

The sudden change in dip of the Onondaga limestone at the east end of the Horse Shoe quarry at St. Marys.

PLATE VII.

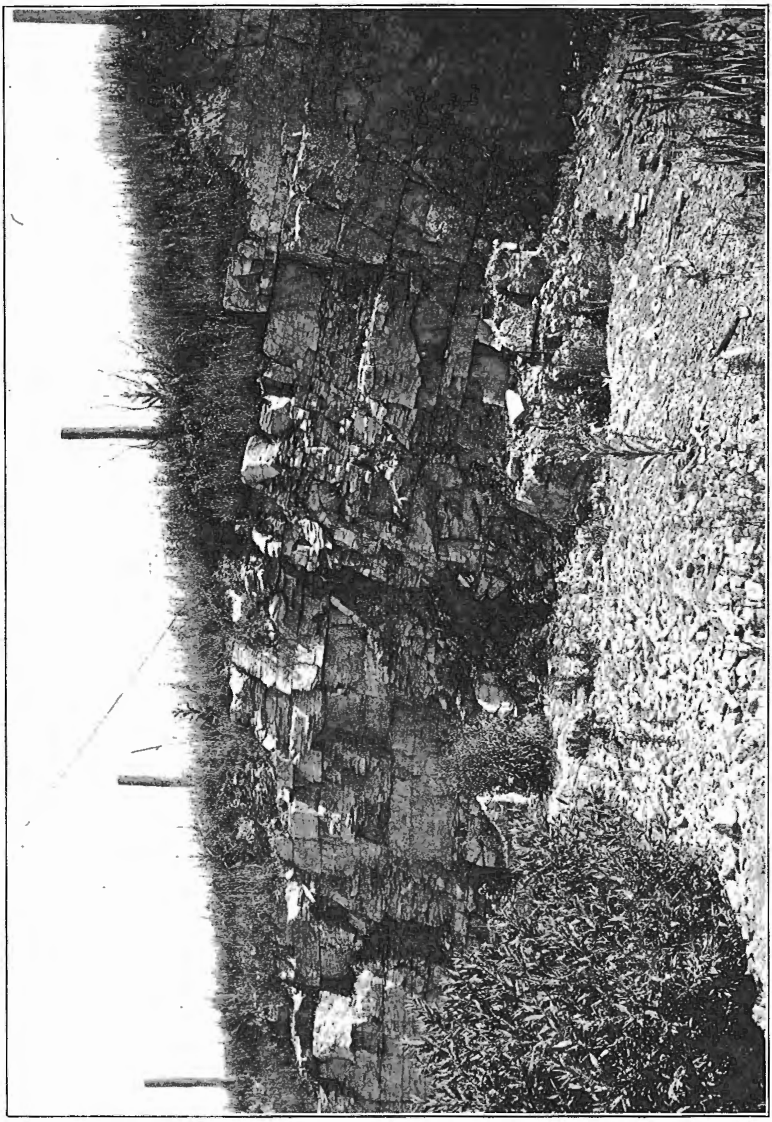


PLATE VIII.

The south wall of the Horse Shoe quarry at St. Marys. The coat and hat mark the probable contact between the Onondaga limestone and the overlying Delaware limestone.

PLATE VIII.

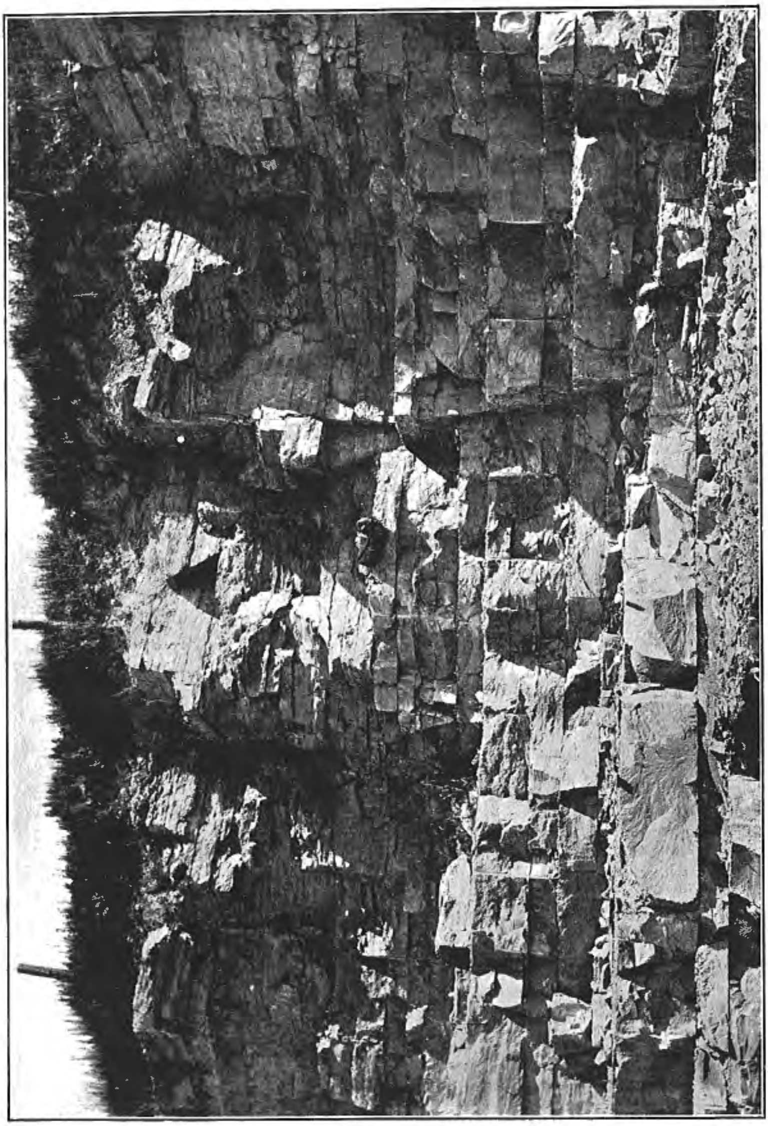


PLATE IX.

South wall of the Thames quarry at St. Marys. The hat marks the probable contact between the Onondaga and the Delaware limestone.

PLATE IX.

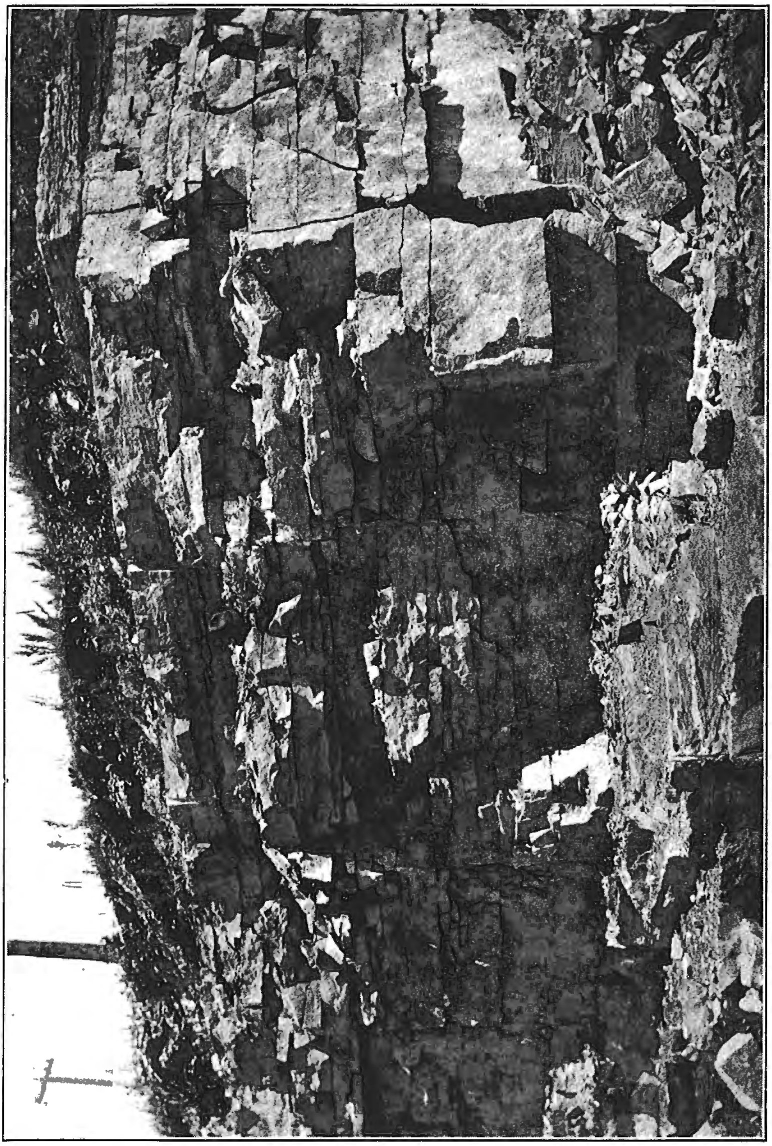


PLATE X.

The massive lower part of the Onondaga limestone along the Maitland river at Goderich. The uneven contact at the base of the Onondaga is indicated by the hammer and bag.

PLATE X.

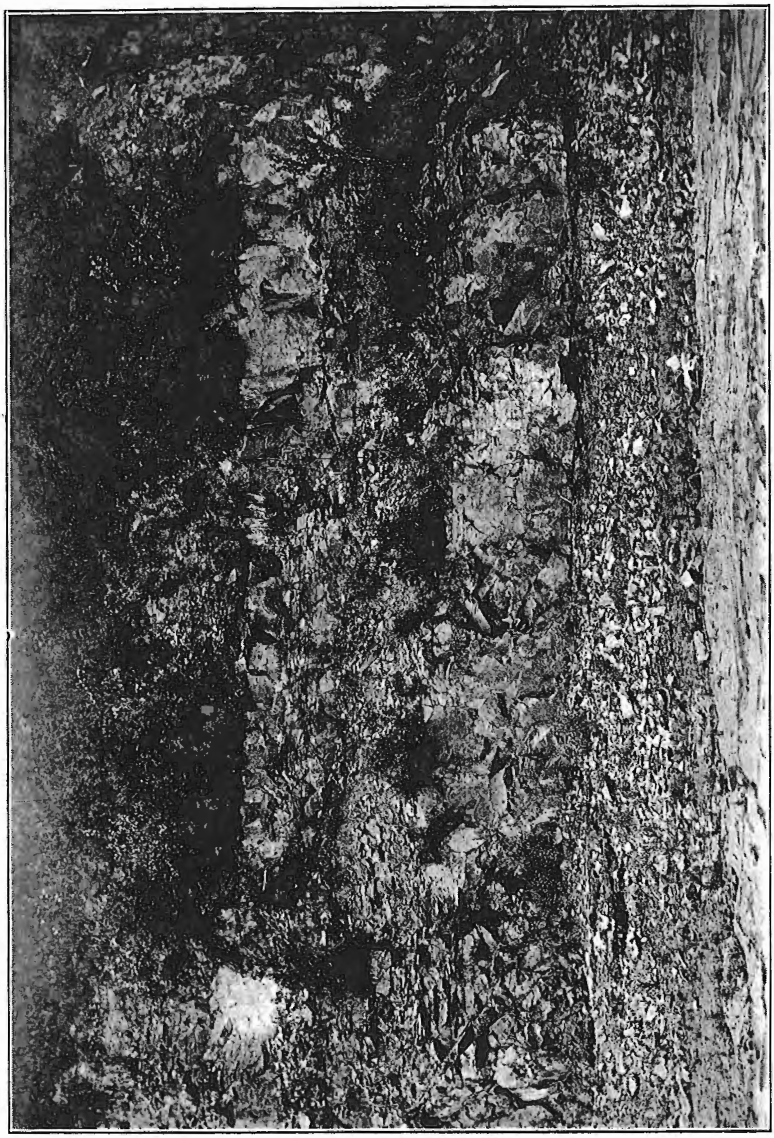


PLATE XI.

An outcrop of the Alpena limestone (middle Hamilton) at Bruder's lime-kiln, near Formosa.

Plate XI.

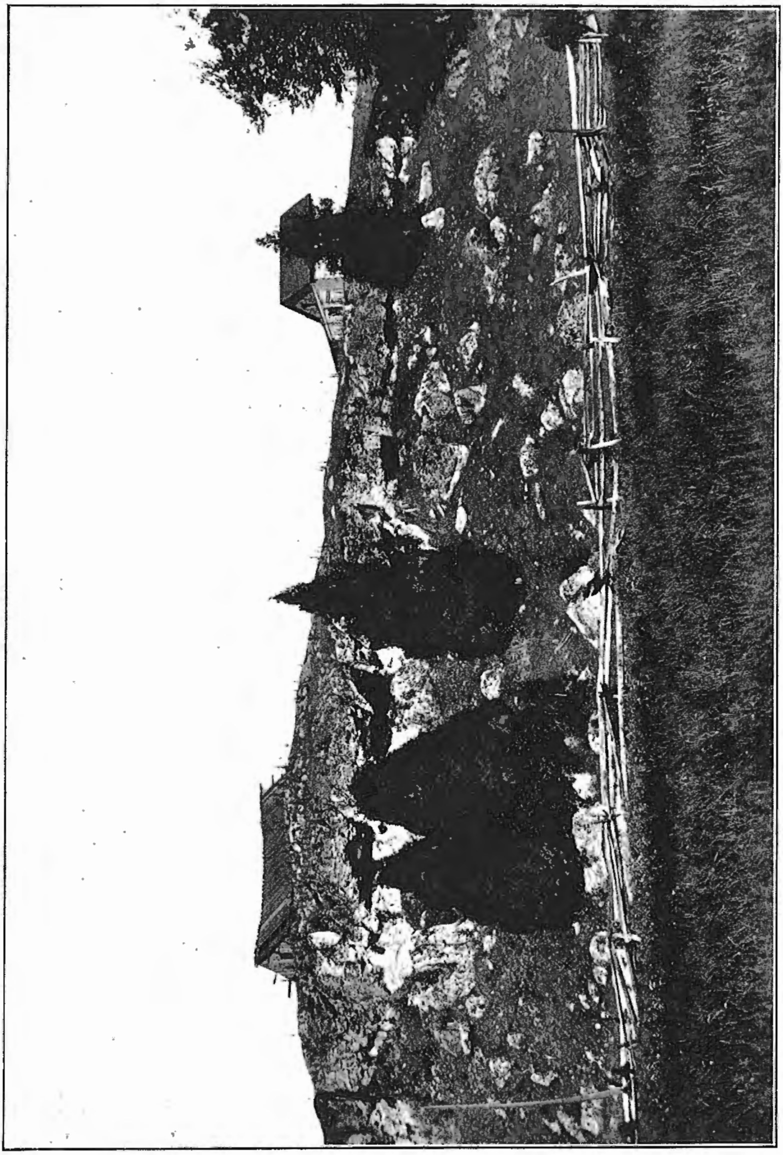


PLATE XII.

The unconformity between the Detroit River beds and the Alpena limestone at Bruder's lime-kiln.

PLATE XII.

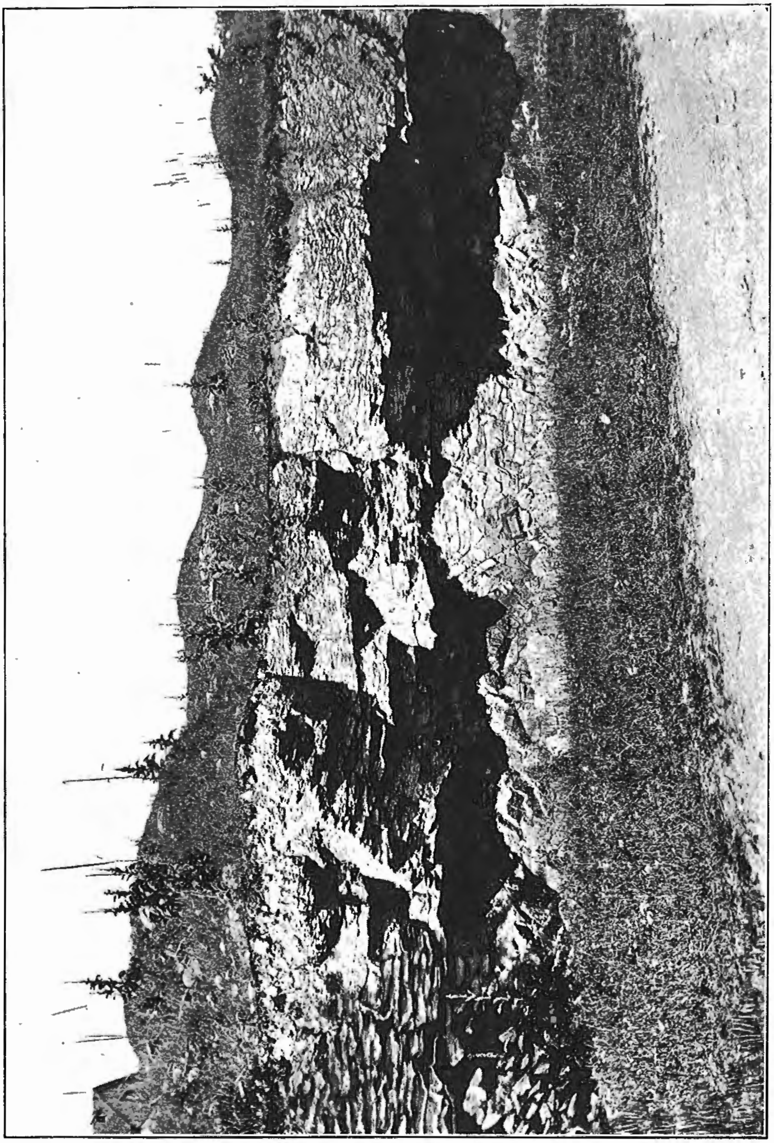


PLATE XIII.

A weathered bank of the Hamilton beds along the Ausable river at Marsh's (Marshall's) mill. The man is standing on the top of the coral zone.

Plate XIII.

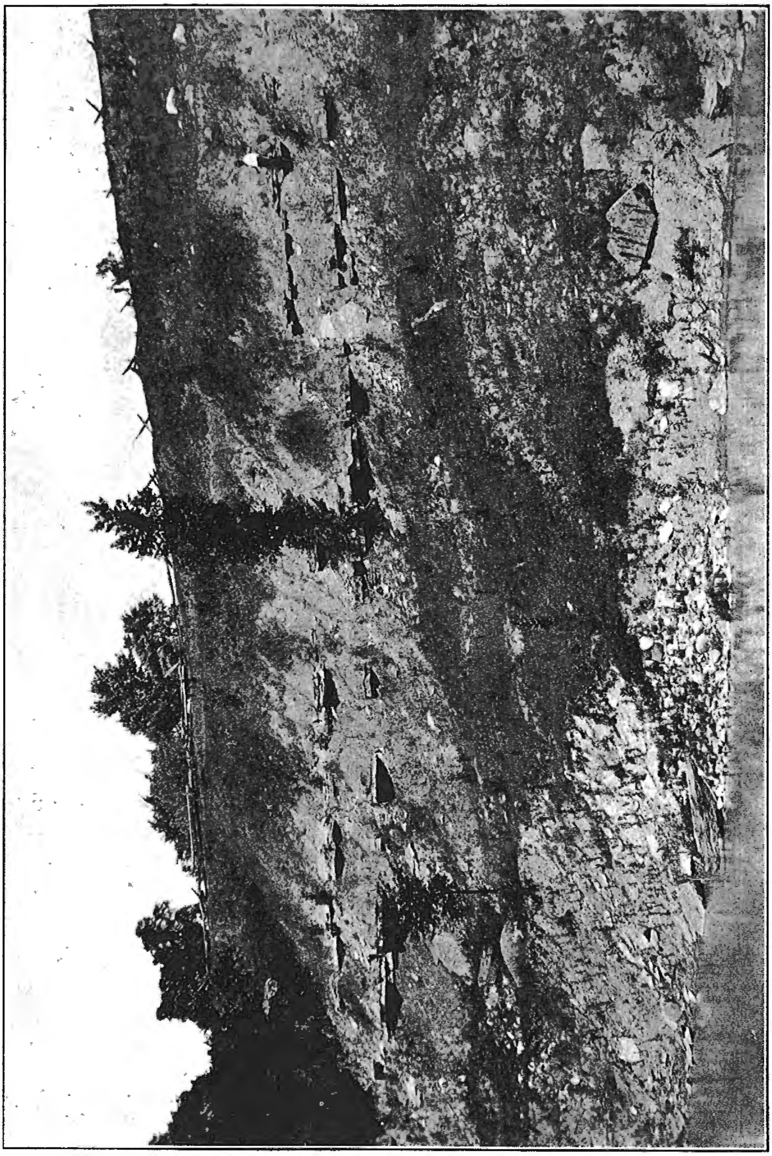


PLATE XIV.

Rock glen at Arkona. This view shows essentially the full thickness of the Widder beds. The prominent layer in the foreground is the encrinal limestone.

PLATE XIV.

PLATE XV.

The shale and top limestone of the Widder beds in Rock glen at Arkona.

PLATE XV.

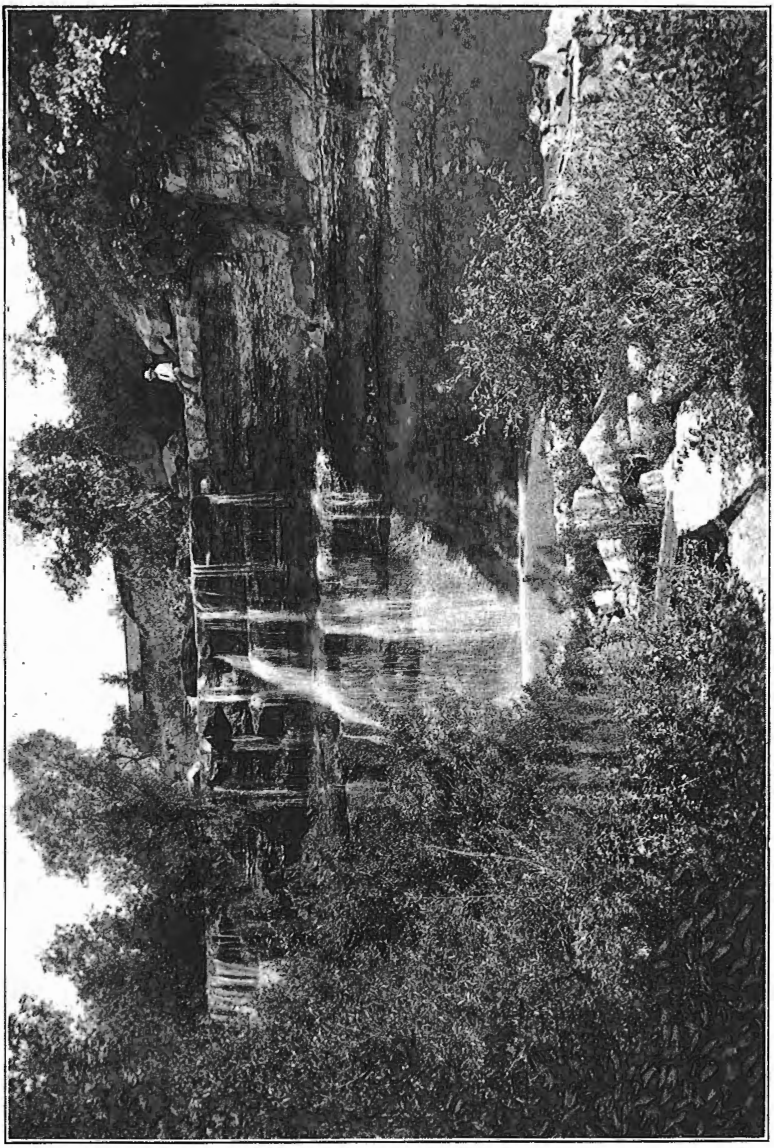


PLATE XVI.

The Huron shale at Kettle point on Lake Huron.

PLATE XVI.

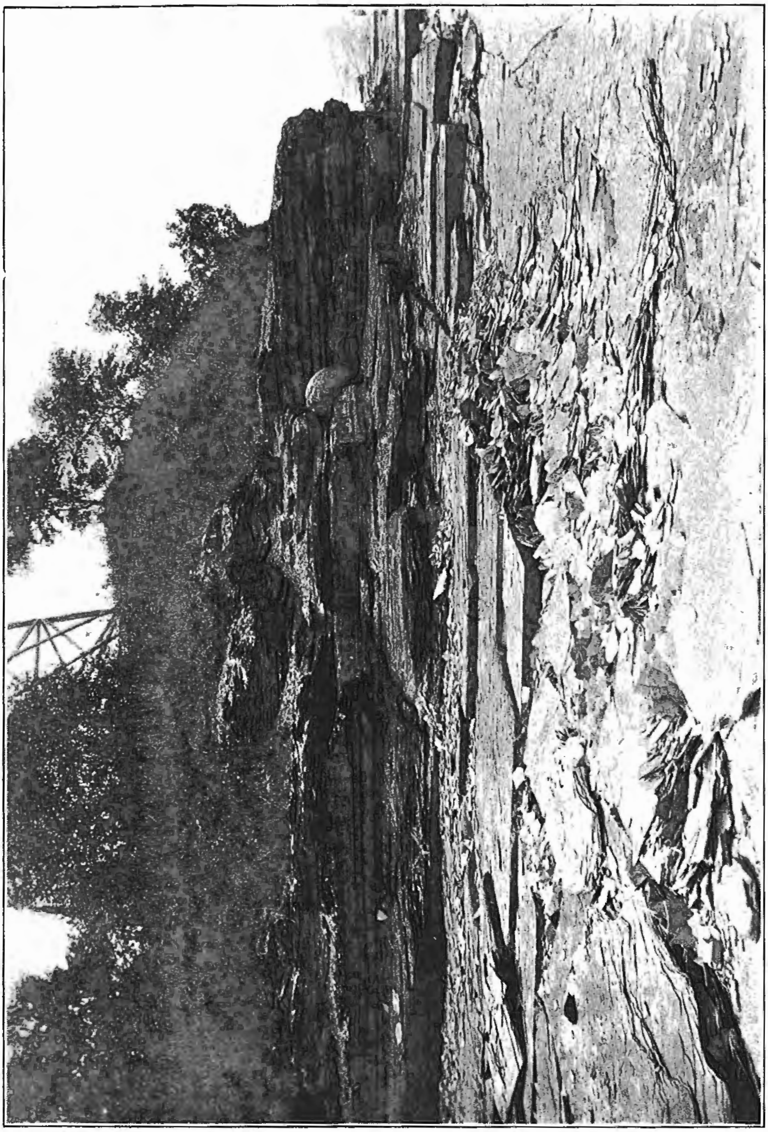


PLATE XVII.

A. The Huron shale at Kettle point showing one of the large spheroidal concretions embedded in the shale and the arching up of the layers due to the crowding of the concretion while growing.

B. The top of the Ipperwash limestone in the small anticline between Kettle point and Ipperwash beach.

PLATE XVII.

A.

B.

PLATE XVIII.

General view of the Onondaga limestone in the quarry at Amherstburg. The uneven surface in the foreground is the top of the Anderdon beds.

PLATE XVIII.

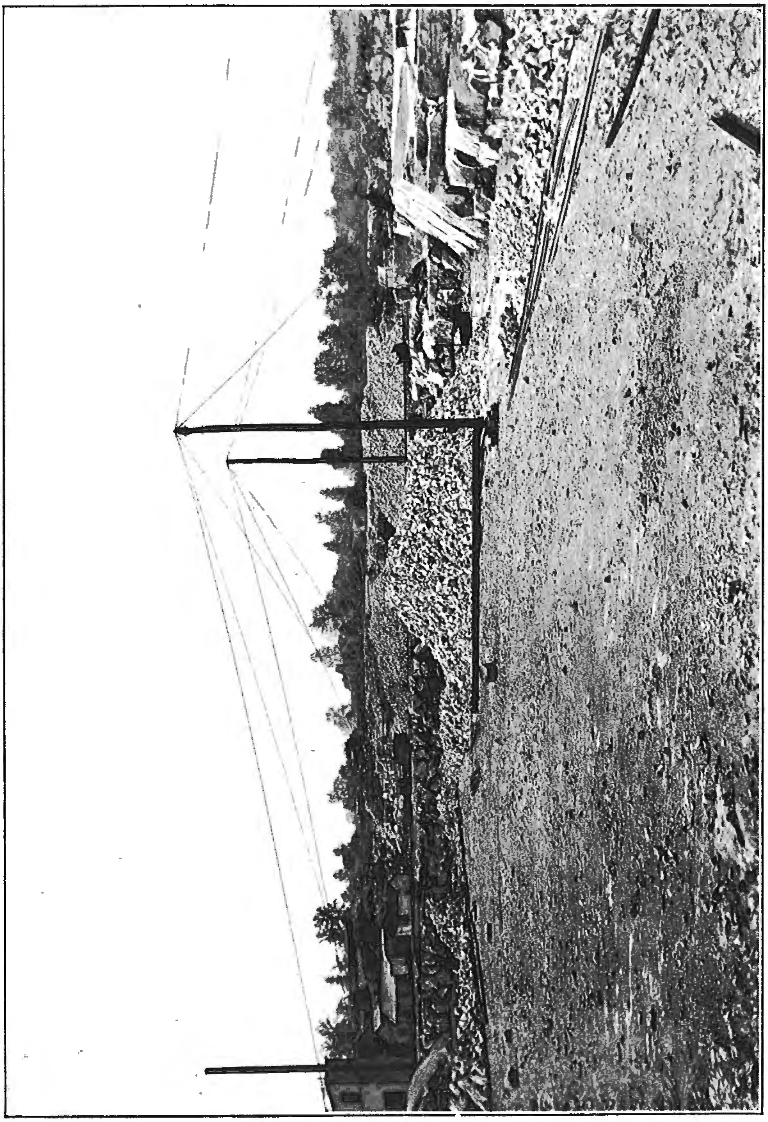


PLATE XIX.

The Onondaga limestone in Capt. Jack McCormick's quarry on the north shore of Pelee island. The man stands on the massive bed which is known as "Bottom Rock" on Kelley island and Marblehead, Ohio.

Plate XIX.

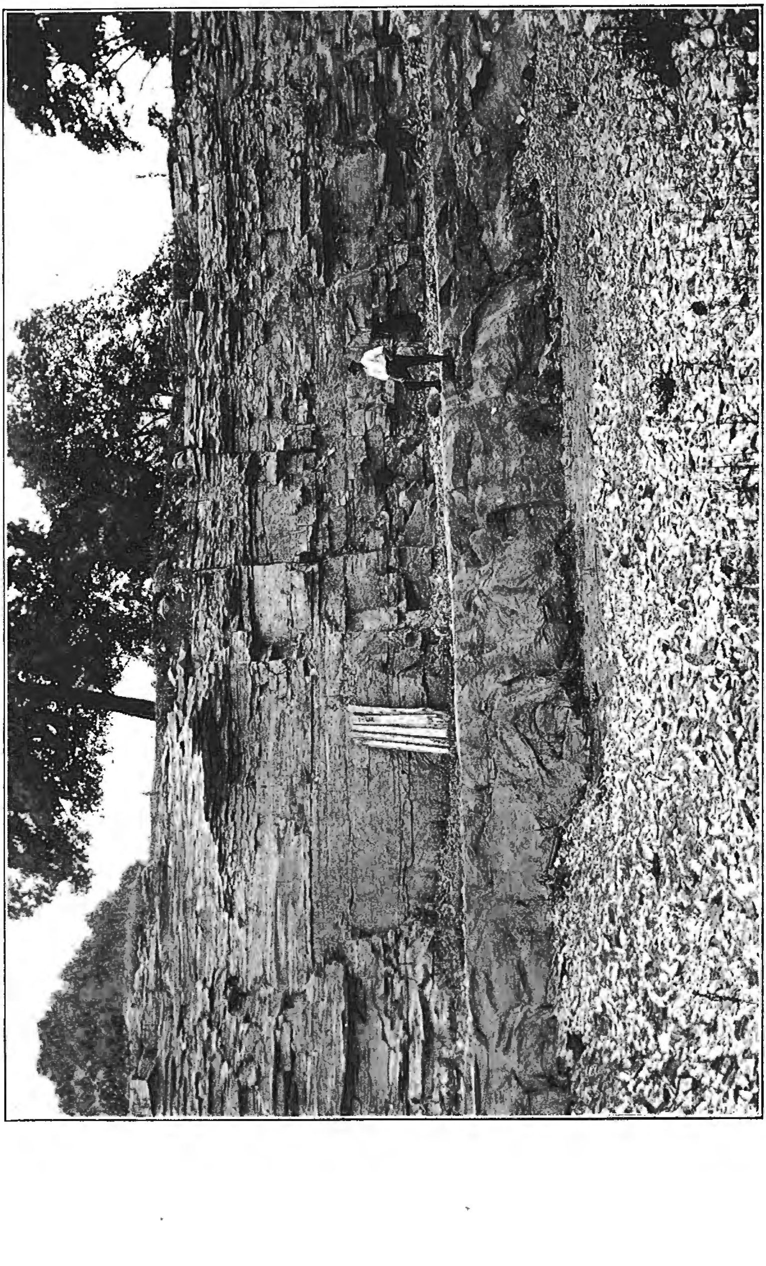
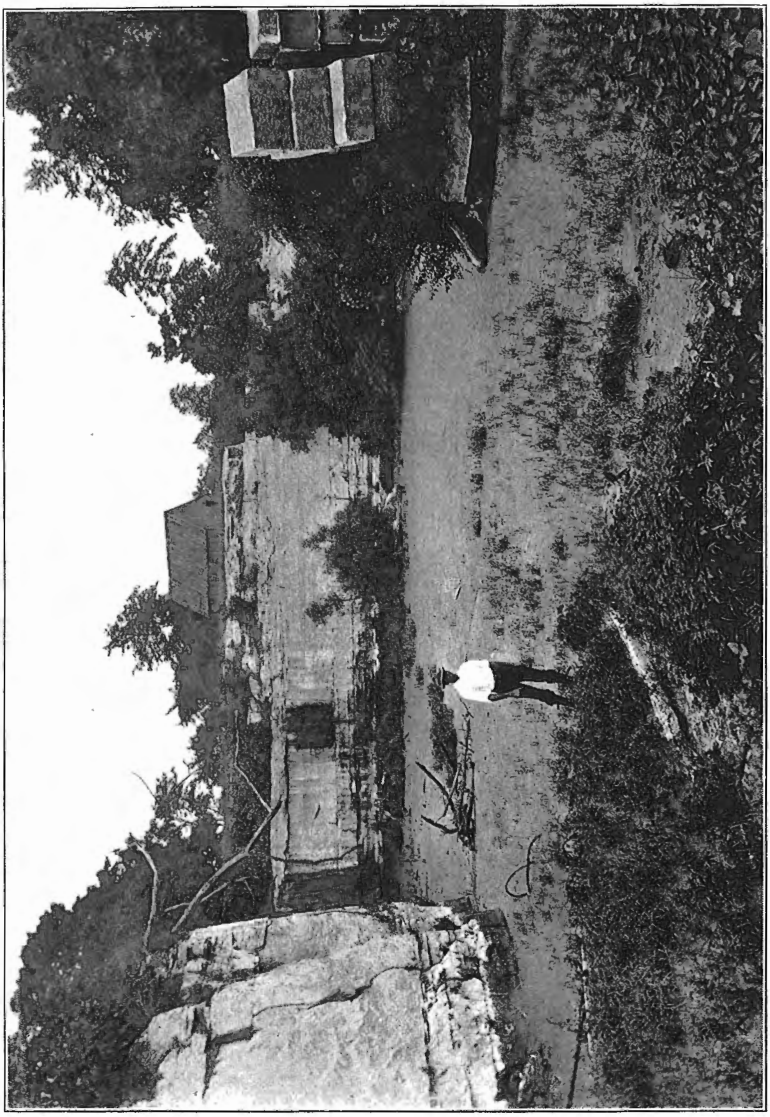


PLATE XX.

Massive Onondaga limestone in William McCormick's quarry near the west dock, Pelee island.

PLATE XX.



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LIST OF RECENT REPORTS OF GEOLOGICAL SURVEY

Since 1910, reports issued by the Geological Survey have been called memoirs and have been numbered Memoir 1, Memoir 2, etc. Owing to delays incidental to the publishing of reports and their accompanying maps, not all of the reports have been called memoirs, and the memoirs have not been issued in the order of their assigned numbers and, therefore, the following list has been prepared to prevent any misconceptions arising on this account. The titles of all other important publications of the Geological Survey are incorporated in this list.

Memoirs and Reports Published During 1910.

REPORTS.

Report on a geological reconnaissance of the region traversed by the National Transcontinental railway between Lake Nipigon and Clay lake, Ont.—by W. H. Collins. No. 1059.

Report on the geological position and characteristics of the oil-shale deposits of Canada—by R. W. Ells. No. 1107.

A reconnaissance across the Mackenzie mountains on the Pelly, Ross, and Gravel rivers, Yukon and North West Territories—by Joseph Keele. No. 1097.

Summary Report for the calendar year 1909. No. 1120.

MEMOIRS—GEOLOGICAL SERIES.

MEMOIR 1. *No. 1, Geological Series.* Geology of the Nipigon basin, Ontario —by Alfred W. G. Wilson.

MEMOIR 2. *No. 2, Geological Series.* Geology and ore deposits of Hedley mining district, British Columbia—by Charles Camsell.

MEMOIR 3. *No. 3, Geological Series.* Palæoniscid fishes from the Albert shales of new Brunswick—by Lawrence M. Lambe.

MEMOIR 5. *No. 4, Geological Series.* Preliminary memoir on the Lewes and Nordenskiöld Rivers coal district, Yukon Territory—by D. D. Cairnes.

MEMOIR 6. *No. 5, Geological Series.* Geology of the Haliburton and Bancroft areas, Province of Ontario—by Frank D. Adams and Alfred E. Barlow.

MEMOIR 7. *No. 6, Geological Series.* Geology of St. Bruno mountain, province of Quebec—by John A. Dresser.

MEMOIRS—TOPOGRAPHICAL SERIES.

MEMOIR 11. *No. 1, Topographical Series.* Triangulation and spirit levelling of Vancouver island, B.C., 1909—by R. H. Chapman.

Memoirs and Reports Published During 1911.

REPORTS.

Report on a traverse through the southern part of the North West Territories, from Lac Seul to Cat lake, in 1902—by Alfred W. G. Wilson No. 1006.

Report on a part of the North West Territories drained by the Winisk and Upper Attawapiskat rivers—by W. McInnes. No. 1080.

Report on the geology of an area adjoining the east side of Lake Timiskaming—by Morley E. Wilson. No. 1064.

Summary Report for the calendar year 1910. No. 1170.

MEMOIRS—GEOLOGICAL SERIES.

MEMOIR 4. *No. 7, Geological Series.* Geological reconnaissance along the line of the National Transcontinental railway in western Quebec—by W. J. Wilson.

MEMOIR 8. *No. 8, Geological Series.* The Edmonton coal field, Alberta—by D. B. Dowling.

MEMOIR 9 *No. 9, Geological Series.* Bighorn coal basin, Alberta—by G. S. Malloch.

MEMOIR 10. *No. 10, Geological Series.* An instrumental survey of the shore-lines of the extinct lakes Algonquin and Nipissing in southwestern Ontario—by J. W. Goldthwait.

MEMOIR 12. *No. 11, Geological Series.* Insects from the Tertiary lake deposits of the southern interior of British Columbia, collected by Mr. Lawrence M. Lambe, in 1906—by Anton Handlirsch.

MEMOIR 15. *No. 12, Geological Series.* On a Trenton Echinoderm fauna at Kirkfield, Ontario—by Frank Springer.

MEMOIR 16. *No. 13, Geological Series.* The clay and shale deposits of Nova Scotia and portions of New Brunswick—by Heinrich Ries assisted by Joseph Keele.

MEMOIRS—BIOLOGICAL SERIES.

MEMOIR 14. *No. 1, Biological Series.* New species of shells collected by Mr. John Macoun at Barkley sound, Vancouver island, British Columbia—by William H. Dall and Paul Bartsch.

Memoirs and Reports Published During 1912.

REPORTS.

Summary Report for the calendar year 1911. No. 1218.

MEMOIRS—GEOLOGICAL SERIES.

MEMOIR 13. *No. 14, Geological Series.* Southern Vancouver island—by Charles H. Clapp.

MEMOIR 21. *No. 15, Geological Series.* The geology and ore deposits of Phoenix, Boundary district, British Columbia—by O. E. LeRoy.

MEMOIR 24. *No. 16, Geological Series.* Preliminary report on the clay and shale deposits of the western provinces—by Heinrich Ries and Joseph Keele.

MEMOIR 27. *No. 17, Geological Series.* Report of the Commission appointed to investigate Turtle mountain, Frank, Alberta, 1911.

MEMOIR 28. *No. 18, Geological Series.* The Geology of Steeprock lake, Ontario—by Andrew C. Lawson. Notes on fossils from limestone of Steeprock lake, Ontario—by Charles D. Walcott.

Memoirs and Reports Published During 1913.

REPORTS, ETC.

Museum Bulletin No. 1: contains articles Nos. 1 to 12 of the Geological Series of Museum Bulletins, articles Nos. 1 to 3 of the Biological Series of Museum Bulletins, and article No. 1 of the Anthropological Series of Museum Bulletins.

Guide Book No. 1. Excursions in eastern Quebec and the Maritime Provinces, parts 1 and 2.

Guide Book No. 2. Excursions in the Eastern Townships of Quebec and the eastern part of Ontario.

Guide Book No. 3. Excursions in the neighbourhood of Montreal and Ottawa.

Guide Book No. 4. Excursions in southwestern Ontario.

Guide Book No. 5. Excursions in the western peninsula of Ontario and Manitoulin island.

Guide Book No. 8. Toronto to Victoria and return *via* Canadian Pacific and Canadian Northern railways; parts 1, 2, and 3.

Guide Book No. 9. Toronto to Victoria and return *via* Canadian Pacific, Grand Trunk Pacific, and National Transcontinental railways.

Guide Book No. 10. Excursions in Northern British Columbia and Yukon Territory and along the north Pacific coast.

MEMOIRS—GEOLOGICAL SERIES.

MEMOIR 17. *No. 28, Geological Series.* Geology and economic resources of the Larder Lake district, Ont., and adjoining portions of Pontiac county, Que.—by Morley E. Wilson.

MEMOIR 18. *No. 19, Geological Series.* Bathurst district, New Brunswick—by G. A. Young.

MEMOIR 26. *No. 34, Geological Series.* Geology and mineral deposits of the Tulameen district, B.C.—by C. Camsell.

MEMOIR 29. *No. 32, Geological Series.* Oil and gas prospects of the north-west provinces of Canada—by W. Malcolm.

MEMOIR 31. *No. 20, Geological Series.* Wheaton district, Yukon Territory—by D. D. Cairnes.

MEMOIR 33. *No. 30, Geological Series.* The geology of Gowganda Mining Division—by W. H. Collins.

MEMOIR 35. *No. 29, Geological Series.* Reconnaissance along the National Transcontinental railway in southern Quebec—by John A. Dresser.

MEMOIR 37. *No. 22, Geological Series.* Portions of Atlin district, B.C.—by D. D. Cairnes.

MEMOIR 38. *No. 31, Geological Series.* Geology of the North American Cordillera at the forty-ninth parallel, Parts I and II—by Reginald Aldworth Daly.

Memoirs and Reports Published During 1914.

REPORTS, ETC.

Summary Report for the calendar year 1912. No. 1305.

Museum Bulletins Nos. 2, 3, 4, 5, 7, and 8 contain articles Nos. 13 to 22 of the Geological Series of Museum Bulletins, article No. 2 of the Anthropological Series, and article No. 4 of the Biological Series of Museum Bulletins.

Prospector's Handbook No. 1: Notes on radium-bearing minerals—by Wyatt Malcolm.

MUSEUM GUIDE BOOKS.

The archæological collection from the southern interior of British Columbia—by Harlan I. Smith. No. 1290.

MEMOIRS—GEOLOGICAL SERIES.

MEMOIR 23. *No. 23, Geological Series.* Geology of the Coast and island between the Strait of Georgia and Queen Charlotte sound, B.C.—by J. Austin Bancroft.

MEMOIR 25. *No. 21, Geological Series.* Report on the clay and shale deposits of the western provinces (Part II)—by Heinrich Ries and Joseph Keele.

MEMOIR 30. *No. 40, Geological Series.* The basins of Nelson and Churchill rivers—by William McInnes.

MEMOIR 20. *No. 41, Geological Series.* Gold fields of Nova Scotia—by W. Malcolm.

MEMOIR 36. *No. 33, Geological Series.* Geology of the Victoria and Saanich map-areas, Vancouver island, B.C.—by C. H. Clapp.

MEMOIR 52. *No. 42, Geological Series.* Geological notes to accompany map of Sheep River gas and oil field, Alberta—by D. B. Dowling.

MEMOIR 43. *No. 36, Geological Series.* St. Hilaire (Beloeil) and Rougemont mountains, Quebec—by J. J. O'Neill.

MEMOIR 44. *No. 37, Geological Series.* Clay and shale deposits of New Brunswick—by J. Keele.

MEMOIR 22. *No. 27, Geological Series.* Preliminary report on the serpentines and associated rocks, in southern Quebec—by J. A. Dresser.

MEMOIR 32. *No. 25, Geological Series.* Portions of Portland Canal and Skeena Mining divisions, Skeena district, B.C.—by R. G. McConnell.

MEMOIR 47. *No. 39, Geological Series.* Clay and shale deposits of the western provinces, Part III—by Heinrich Ries.

MEMOIR 40. *No. 24, Geological Series.* The Archæan geology of Rainy lake—by Andrew C. Lawson.

MEMOIR 19. *No. 26, Geological Series.* Geology of Mother Lode and Sunset mines, Boundary district, B.C.—by O. Le Roy.

MEMOIR 39. *No. 35, Geological Series.* Kewagama Lake map-area, Quebec—by M. E. Wilson.

MEMOIR 51. *No. 43, Geological Series.* Geology of the Nanaimo map-area—by C. H. Clapp.

MEMOIR 61. *No. 45, Geological Series.* Moose Mountain district, southern Alberta (second edition)—by D. D. Cairnes.

MEMOIR 41. *No. 38, Geological Series.* The "Fern Ledges" Carboniferous flora of St. John, New Brunswick—by Marie C. Stopes.

MEMOIR 53. *No. 44, Geological Series.* Coal fields of Manitoba, Saskatchewan, Alberta, and eastern British Columbia (revised edition)—by D. B. Dowling.

MEMOIR 55. *No. 46, Geological Series.* Geology of Field map-area, Alberta and British Columbia—by John A. Allan.

MEMOIRS—ANTHROPOLOGICAL SERIES.

MEMOIR 48. *No. 2, Anthropological Series.* Some myths and tales of the Ojibwa of southeastern Ontario—collected by Paul Radin.

MEMOIR 45. *No. 3. Anthropological Series.* The inviting-in feast of the Alaska Eskimo—by E. W. Hawkes.

MEMOIR 49. *No. 4, Anthropological Series.* Malecite tales—by W. H. Mechling.

MEMOIR 42. *No. 1, Anthropological Series.* The double curve motive in northeastern Algonkian art—by Frank G. Speck.

MEMOIRS—BIOLOGICAL SERIES.

MEMOIR 54. *No. 2, Biological Series.* Annotated list of flowering plants and ferns of Point Pelee, Ont., and neighbouring districts—by C. K. Dodge.

Memoirs and Reports Published During 1915.

REPORTS, ETC.

Summary Report for the calendar year 1913, No. 1359.

Summary Report for the calendar year 1914, No. 1503.

Report from the Anthropological Division. Separate from Summary Report 1913.

Report from the Topographical Division. Separate from Summary Report 1913.

Report from the Biological Division: Zoology. Separate from Summary Report 1914.

Museum Bulletin No. 11. *No. 23, Geological Series.* Physiography of the Beaverdell map-area and the southern part of the Interior plateaus, B.C.—by Leopold Reinecke.

Museum Bulletin No. 12. *No 24, Geological Series.* On Eoceratops canadensis, gen. nov., with remarks on other genera of Cretaceous horned dinosaurs—by L. M. Lambe.

Museum Bulletin No. 14. *No. 25, Geological Series.* The occurrence of Glacial drift on the Magdalen islands—by J. W. Goldthwait.

Museum Bulletin No. 15. *No. 26, Geological Series.* Gay Gulch and Skookum meteorites—by R. A. A. Johnston.

Museum Bulletin No. 17. *No. 27, Geological Series.* The Ordovician rocks of Lake Timiskaming—by M. Y. Williams.

Museum Bulletin No. 6. *No. 3, Anthropological Series.* Pre-historic and present commerce among the Arctic Coast Eskimo—by N. Stefansson.

Museum Bulletin No. 9. *No. 4, Anthropological Series.* The glenoid fossa in the skull of the Eskimo—by F. H. S. Knowles.

Museum Bulletin No. 10. *No. 5, Anthropological Series.* The social organization of the Winnebago Indians—by P. Radin.

Museum Bulletin No. 16. *No. 6, Anthropological Series.* Literary aspects of North American mythology—by P. Radin.

Museum Bulletin No. 13. *No. 5, Biological Series.* The double crested cormorant (Phalacrocorax auritus). Its relation to the salmon industries on the Gulf of St. Lawrence—by P. A. Taverner.

MEMOIRS—GEOLOGICAL SERIES.

MEMOIR 58. *No. 48, Geological Series.* Texada island—by R. G. McConnell.

MEMOIR 60. *No. 47, Geological Series.* Arisaig-Antigonish district—by M. Y. Williams.

MEMOIR 67. *No. 49, Geological Series.* The Yukon-Alaska Boundary between Porcupine and Yukon rivers—by D. D. Cairnes.

MEMOIR 59. *No. 55, Geological Series.* Coal fields and coal resources of Canada—by D. B. Dowling.

MEMOIR 50. *No. 51, Geological Series.* Upper White River District, Yukon—by D. D. Cairnes.

MEMOIR 65. *No. 53, Geological Series.* Clay and shale deposits of the western provinces, Part IV—by H. Ries.

MEMOIR 66. *No. 54, Geological Series.* Clay and shale deposits of the western provinces, Part V—by J. Keele.

MEMOIR 56. *No. 56, Geological Series.* Geology of Franklin mining camp, B.C.—by Chas. W. Drysdale.

MEMOIR 64. *No. 52, Geological Series.* Preliminary report on the clay and shale deposits of the Province of Quebec—by J. Keele.

MEMOIR 57. *No. 50, Geological Series.* Corundum, its occurrence, distribution, exploitation, and uses—by A. E. Barlow.

MEMOIR 68. *No. 59, Geological Series.* A geological reconnaissance between Golden and Kamloops, B.C., along the line of the Canadian Pacific railway—by R. A. Daly.

MEMOIR 69. *No. 57, Geological Series.* Coal fields of British Columbia—by D. B. Dowling.

MEMOIR 72. *No. 60, Geological Series.* The artesian wells of Montreal—by C. L. Cumming.

MEMOIR 73. *No. 58, Geological Series.* The Pleistocene and Recent deposits of the Island of Montreal—by J. Stansfield.

MEMOIR 74. *No. 61, Geological Series.* A list of Canadian mineral occurrences—by R. A. A. Johnston.

MEMOIR 76. *No. 62, Geological Series.* Geology of the Cranbrook map-area—by S. J. Schofield.

MEMOIRS—ANTHROPOLOGICAL SERIES.

MEMOIR 46. *No. 7, Anthropological Series.* Classification of Iroquoian radicals and subjective pronominal prefixes—by C. M. Barbeau.

MEMOIR 62. *No. 5, Anthropological Series.* Abnormal types of speech in Nootka—by E. Sapir.

MEMOIR 63. *No. 6, Anthropological Series.* Noun reduplication in Comox, a Salish language of Vancouver island—by E. Sapir.

MEMOIR 75. *No. 10, Anthropological Series.* Decorative art of Indian tribes of Connecticut—by Frank G. Speck.

Memoirs and Reports in Press, July 29, 1915.

MEMOIR 70. *No. 8, Anthropological Series.* Family hunting territories and social life of the various Algonkian bands of the Ottawa valley—by F. G. Speck.

MEMOIR 71. *No. 9, Anthropological Series.* Myths and folk-lore of the Timiskaming Algonquin and Timagami Ojibwa—by F. G. Speck.

MEMOIR 34. *No. 63, Geological Series.* The Devonian of southwestern Ontario—by C. R. Stauffer.

MEMOIR 77. *No. 64, Geological Series.* Geology and ore deposits of Rossland, B.C.—by C. W. Drysdale.

MEMOIR 78. *No. 66, Geological Series.* Wabana iron ore of Newfoundland—by A. O. Hayes.

MEMOIR 79. *No. 65, Geological Series.* Ore deposits of the Beaverdell map-area—by L. Reinecke.

Museum Bulletin No. 18. *No. 28, Geological Series.* Structural relations of the Pre-Cambrian and Palæozoic rocks north of the Ottawa and St. Lawrence valleys—by E. M. Kindle and L. D. Burling.

Museum Bulletin No. 19. *No. 7, Anthropological Series.* A sketch of the social organization of the Nass River Indians—by E. Sapir.