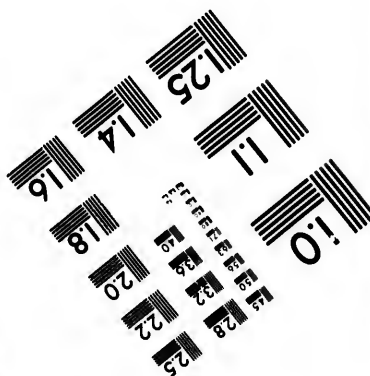
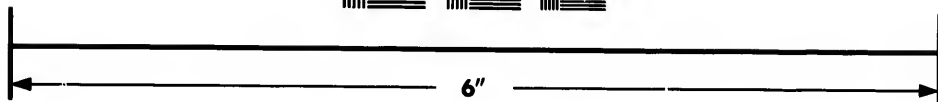
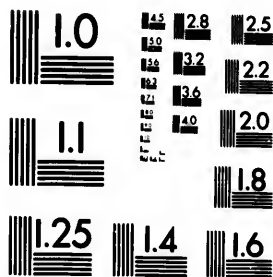


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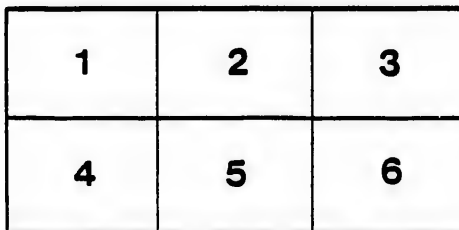
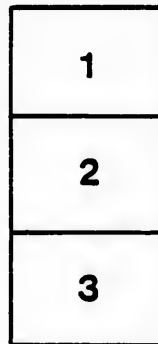
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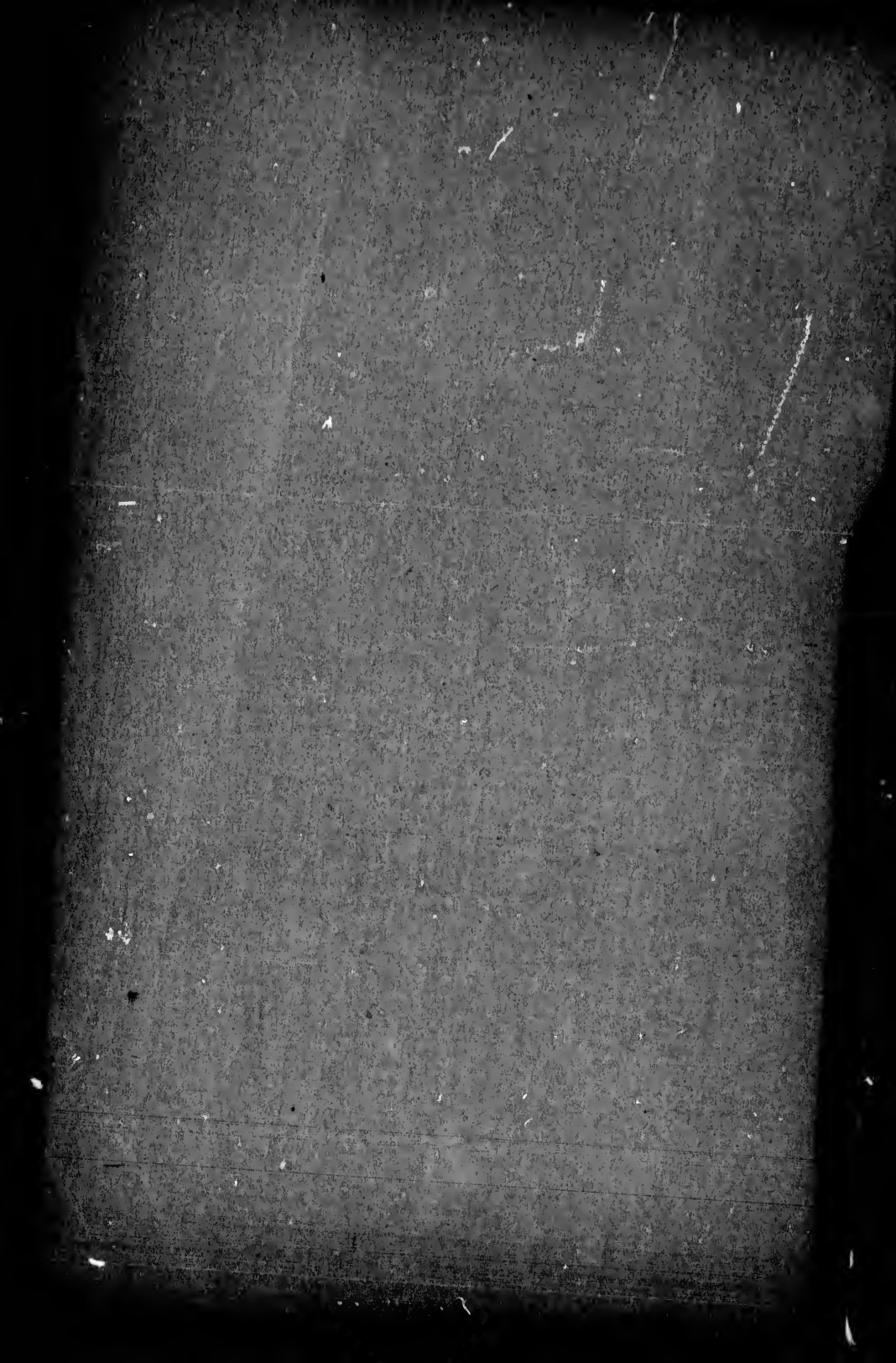
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THE UTICA TERRANE IN CANADA.

By HENRY M. AMI, M.A., F.G.S.,

OF THE GEOLOGICAL SURVEY OF CANADA.



"Reprinted from the Canadian Record of Science, October, 1892."

THE UTICA TERRANE IN CANADA.

By HENRY M. AMI, M.A., F.G.S., of the Geological Survey of Canada.

INTRODUCTION.

The following remarks on the Utica formation in Canada are put forth by the writer, not only in the hope of bringing together and recording a series of facts obtained regarding the history of this interesting formation, but also with the express purpose of arriving at some definite and decided conclusion as to the true horizon and age to which certain slates and associated strata belong, occurring in the highly disturbed and faulted regions of North-Eastern America, which have been referred to several horizons by various writers, and more recently placed in the "Quebec Group" of Sir William Logan—on palæontological, stratigraphical and lithological grounds.

To accompany this essay, or thesis, a table has been prepared showing the distribution of species known to date from localities where the Utica occurs in Canada, together with comparative lists of species from the same formation in the United States.

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The Utica Terrane in Canada.

Historical Sketch—Through the writings of Green, Orton, Rogers, Eaton, Muther, Conrad, Emmons, Hall, Whitfield, Walcott and others in the United States, together with those of Sir William Logan, Billings, Murray, Hunt, Dawson, Chapman, Laflamme, Nicholson and Smith in Canada, the Utica terrane has been fairly well established and defined as marking a distinct horizon or period in the series of strata constituting the Cambro-Silurian or Ordovician Epoch in North America.

Whether it is viewed from a palæontological, stratigraphical or lithological standpoint, the Utica characterizes an epoch in the evolution of this continent which may be readily recognized over wide areas.

First described by New York geologists from exposures of that formation near the town of Utica, N.Y., the *Utica* was defined as a "black and tender rock which reposes upon the Trenton limestone." By some of the early writers it was spoken of as consisting of shaly strata whose total thickness exceeded *nine hundred* feet, whilst by others the very humble, yet perhaps truer estimate, was given of "about seventy-five feet in thickness."

Stratigraphical characters and relations.—Inasmuch as the Trenton limestone is one of the most extensively developed and easily recognized terranes or horizons in America, and inasmuch as the Utica reposes directly upon it without any discordance of stratification whatever, the position of the Utica is therefore likewise easily known and ascertained. Wherever the sequence of Ordovician strata is unbroken, either by faults, foldings or denudation, from the Potsdam to the Hudson River, the presence of the Utica has been

observed,¹ its fossils recognized, its bituminous strata detected, and its position is everywhere the same between the Trenton (below) and the Hudson River (above).

The following table indicates the sequence of terranes in Canada during that portion of Paleozoic times when no break whatever occurred in the deposition of marine sediments, when life progressed and flourished in the quiet depths of the Ordovician seas or along their shores. The relative position of the Utica is herein also indicated. These Ordovician terranes are numbered from 1 to 7 in the natural order in which they were deposited:—

7. HUDSON RIVER (= LORRAINE).
6. UTICA.
5. TRENTON.
4. BIRD'S EYE AND BLACK RIVER.
3. CHAZY.
2. CALCIFEROUS.
1. POTSDAM.

The remarkable continuity of the Trenton limestone, so abundant in fossil remains, and so uniform in its mode of occurrence and deposition throughout the Provinces of Quebec and Ontario in Canada, is admirably kept up in the succeeding Utica terrane, whilst the next higher terrane—the Hudson River—also presents similar characters of continuity, uniformity in sedimentation, life, and in lithological characteristics. Coming in between the Trenton and Hudson River terranes the Utica is essentially a transitional series of strata, a link in the chain of terranes above noted.

The following is a section of a portion of the lower Utica strata as they were observed on Crichton street, New Edinburgh, near Ottawa, during the excavation for water-works purposes in 1887:—

	FEET. INCHES.	
1. Dark grey bituminous limestone band holding <i>Leptæna sericea</i> , Sowerby and other species....	0	9
2. Soft, friable, purplish black disintegrating and fossiliferous shales holding abundance of <i>Orthis testudinaria</i> , Dalman, bleached, and <i>Leptæna sericea</i> , Sowerby, and <i>Asaphus Canadensis</i> , Chapman	0	8

¹ This is true of Ontario, Quebec and New York State especially.

3. Unevenly bedded impure bituminous limestone band with <i>Asaphus Canadensis</i> , Chapman, <i>Orthis testudinaria</i> , &c.	0	7
4. Soft, friable and brittle shales, with abundance of fossil remains— <i>O. testudinaria</i> , <i>L. sericea</i> , &c..	0	2½
5. Light grey band of impure limestone, bituminous, and holding <i>Conularia Trentonensis</i> , <i>Leptana sericea</i> , <i>Asaphus Canadensis</i> , <i>O. testudinaria</i> , &c..	0	4
6. Thin, irregular and unevenly bedded soft friable shales which disintegrate readily, teeming with fossils which appear bleached or white on the brownish-yellow weathering grey shales holding <i>L. sericea</i> and <i>O. testudinaria</i> in abundance.	0	1½
Black bituminous impure limestone with <i>Leptana sericea</i> , <i>Orthis emacerata</i> , <i>Asaphus Canadensis</i> , &c.	0	8
8 Black bituminous shales holding abundance of trilobitic remains, especially those of <i>Asaphus Canadensis</i> . Resembles that band which crops out along the Rideau River shore near the Rifle Range.....	1	2
9. Band of impure, highly bituminous limestone, black in colour, with irregular splintery and at times conchoidal fracture, holding remains of <i>Asaphus Canadensis</i> , <i>Endoceras proteiforme</i> , <i>Strophomena alternata</i> , Conrad.....	0	11
10. Black, bituminous and somewhat splintery brittle shales Amongst the species of fossils observed there were: <i>Leptograptus flaccidus</i> , Hall, (?) <i>Sagenella ambigua</i> , Walcott, <i>Conularia Trentonensis</i> , <i>Leptana sericea</i> , <i>Schizocrania filosa</i> , Hall, <i>Leptobolus insignis</i> , Hall, <i>Endoceras proteiforme</i> , var. <i>unistriatum</i> , <i>Asaphus Canadensis</i> , <i>Primitia Ulrichi</i> , Jones, &c.....	0	7
	6	0¼

It would thus appear that we have shales and limestones interstratified with each other in this portion of the Utica, showing the intimate and close relationship to the underlying Trenton. A summary of the above section gives us :—

SUMMARY OF SECTION AT NEW EDINBURGH.

	FEET. INCHES.	
1. Limestone	0	9
2. Shales	0	8

3. Limestone	0	7
4. Shales	0	2½
5. Limestone	0	4
6. Shales	0	1½
7. Limestone	0	8
8. Shales	1	2
9. Limestone	0	11
10. Shales	0	7
	6	0½

Lithological characters.—The Utica terrane is essentially a shale formation, whence the designation “Utica shale” which numerous writers have applied to it. It is chiefly composed of shales and limestone, dark in colour and sometimes highly bituminous.

Whilst the uppermost measures of the Trenton formation are characterized by calcareous strata interstratified with shaly bands which increase in number and extent as we pass upward from the Trenton to the Utica, similarly, the lower measures of the Utica consist of shaly strata interstratified with calcareous or limestone bands, all of which are bituminous in character.

The accompanying sketch taken at New Edinburgh, Ottawa, along the right bank of the Ottawa River, shows the character of the strata at the summit of the Trenton and in the basal beds of the Utica:—

These characters of the upper Trenton and lower Utica point clearly to a subsidence which occurred towards the close of the Trenton and led to the deposition of finely divided muds and clays. The change in the nature of the sediments led to a change in the forms and characters of the fauna or life of this old Ordovician sea, so that new forms of animal life were ushered in, in these pelagic depths, which will be discussed later on.

The presence of many of these organic forms led to considerable change in the character of the strata as we find them at the present day. Graptolites and trilobites in great abundance characterize the Utica, and the shales are highly impregnated with bituminous materials from

which petroleum and oils can be extracted, but scarcely yet with sufficient readiness and cheapness to warrant the utilizing of these shales for economic purposes.

The shales of the Utica are for the most part soft dark-brown or black, brittle, earthy and bituminous. From the exposures of this formation as far east as Murray Bay, Que., along the north shore of the St. Lawrence in the vicinity and under the waters of Lake St. Peter; at Montreal, Lacolle, Clarenceville; and again between Lake Ontario (Whitby) and Collingwood Bay, near Collingwood, as also along the capes and bays of the great Manitoulin and other islands in the northern portion of Lake Huron, the shaly strata of the Utica are very similar throughout and the characters very closely related.

In certain areas they are more or less calcareous, at times they are highly argillaceous. The presence of volcanic and intrusive masses about Montreal, and in the Eastern Townships of Quebec, has considerably altered and hardened the Utica of that region, which is, as a rule, highly calcareous.

Chemical characters.—In the "Geology of Canada," 1863, Sir William Logan has given a number of interesting chemical analyses of the Utica shales or "pyroschists," as they are called, which were made by Messrs. Chardler and Kimball for Prof. Whitney, and were published in the "Geol. of Wisconsin," Vol. I, p. 184.

The five analyses there given are here inserted, as they serve to show clearly the chemical composition of these shales or pyroschists from various localities. They are as follows:—

"I. is a blackish-brown, very fine-grained rock, from Cape Smith, Lake Huron. It has a somewhat conchoidal fracture, is not schistose in its structure, and contains no traces of fossils. II. is from an Island north of Maple Cape, and is blackish-brown, fine-grained, and earthy in texture, with a laminated structure, and contains no fossils. III. is from Ste. Anne, Montmorenci, and is dark-brown, shaly, and contains graptolites. IV. is from Gloucester, and is a

black shale filled with fragments of trilobites and crinoids. In these analyses the carbonates of lime and magnesia, with the alumina and oxide of iron, were removed by solution in acids, and the elements of the organic matter determined in the insoluble portion.

	I.	II.	III.	IV.	V.
Clay and sand.....	38.45	34.60	37.26	48.27	73.57
Carbon.....	6.83	6.63	.61	6.99	15.08
Hydrogen.....	.74	.77	.83	1.13	1.65
Oxygen.....	3.20	2.96	1.71	3.39	5.39
Carbonate of lime.....	45.02	49.31	52.60	20.30	1.29
Carbonate of magnesia...	2.09	2.53	3.42	11.48	.76
Alumina and oxide of iron.	2.16	2.09	3.29	7.99	2.79
	<u>98.49</u>	<u>98.89</u>	<u>99.72</u>	<u>99.55</u>	<u>100.48</u>

"The analysis V in the above table is that of a pyroschist from this formation, in the lead region of Wisconsin."

The first four analyses are made from Canadian specimens, and give us a sufficiently typical series from remote outcrops of the Utica terrane, from which the lithological and chemical characters of the rock may be ascertained.

Mineralogical characters.—The minerals which characterize the Utica are not numerous, but it may be stated here that *iron pyrites* is tolerably abundant in the middle beds of the Utica, about Ottawa where it occurs in masses from the size of a man's fist to smaller dimensions, and often replacing entirely or simply coating organic remains, such as orthoceratites, trilobites, graptolites and sponges.

Strontianite has also been observed, determined and recorded by Dr. B. J. Harrington from the Utica shales of St. Helen's Island, opposite Montreal, Que.

Selenite.—A variety of gypsum occurs in fine scales or flakes either coating organic remains or between divisional planes of stratification as a secondary product of the decomposition of iron pyrites.

The Utica, except in its lowest measures, does not afford any building stone of any consequence.

A few of its calcareous strata, close to the base of the formation, might be utilized for building purposes, but they

are usually too thin or nodular and easily disintegrating to be of any commercial value.

Some bands, however, are magnesian and calcareous and break with a conchoidal fracture. These might very reasonably prove to be useful for cement or hydraulic purposes.

The bituminous character of the shales of this terrane induced a company to start operations at the village of Windsor, near Collingwood, Ont., for the purpose of extracting oil (petroleum) from these shales, but the process proved too costly and the work was abandoned. The shales used are reported to have contained an average of 8 per cent. of petroleum. The specimens collected by Mr. A. S. Cochrane, C.E., at the works, showed the shales to be highly fossiliferous.

The basal beds of the Utica have been described as consisting of interstratified bands of limestones and shales which gradually pass upward into shales exclusively as the middle portion of the terrane is reached. These middle beds consist for the most part of shales, dark-brown weathering and black along a fresh fracture, which become more or less compact in certain places, whilst many beds have a decided conchoidal fracture. They are rich in graptolites and trilobites, especially of the genera *Leptograptus* and *Triarthrus* respectively. The uppermost beds of the Utica, so far as they are known to the writer, show a strong tendency to become argillaceous and magnesian, especially in the Ottawa Palæozoic Basin. They consist of very thin and fissile, soft argillaceous shales, evenly bedded and rather destitute of fossils. They pass upward into the Hudson shales and strata whose lower measures are highly magnesian, as can be seen from the bright buff weathering character of the Hudson River rocks along the line of the Canada Atlantic Railway, near Ottawa and elsewhere.

The total thickness of the three subdivisions of the Utica, thus differentiated on lithological as well as other grounds, has nowhere been seen by the writer to exceed one hundred feet, but is usually much less.

Paleontological characters.—The Utica formation along the whole line of its outcrop in Canada may be said to be for the most part highly fossiliferous. This is especially true of the lower and middle portions of this terrane, *i.e.*, of those portions which are more calcareous than the upper series of strata. In the "Paleontology of Ontario," 1874, by Prof. A. H. Nicholson, that writer describes and records eleven species of fossils as constituting the fauna of this period in Cambro-Silurian times. In 1882, when the writer joined the Geological Survey staff, there were then exhibited in the cases of the museum some twelve species of fossils representing the then known fauna of the Utica.

By dint of collecting and gathering together the material which was in the possession of the Geological Survey of Canada, determining the same, and of losing no opportunity of collecting himself wherever the Utica formation was known or seen, the writer has been able to bring together an assemblage of upwards of sixty forms which marks a special horizon in Ordovician times and differentiates itself from the Trenton and Hudson River terranes. The fossils which are found entombed in the shales and limestones of this formation are often exceedingly well preserved, and being very abundant afford an excellent opportunity of studying the fragments or separate portions of individuals which are usually seen along the divisional planes of stratification in such vast numbers.

Just as the lithological characters of the Utica show a decided resemblance and similarity to the underlying Trenton and overlying Hudson River, so also the fossil remains of the Utica towards the base of that terrane show a decided affinity and close relationship to the Trenton *facies*, and towards the summit to the newer Hudson River fossils. In fact, we find that just as there are passage beds, or transitional strata, between the Trenton and Utica, and also between the Utica and Hudson River, so also do we find a number of species of fossils which pass upwards or are common to the three formations.

The following table has been prepared to show the

different species which have, so far, been recognized in Canada by the writer as common to the Utica and Trenton and to the Utica and Hudson River, pointing out, besides, the forms common to the Trenton and Hudson River terranes:—

TABLE SHOWING THE SPECIES OF FOSSIL REMAINS COMMON TO THE TRENTON AND UTICA, TO THE UTICA AND HUDSON RIVER, &c.

GENERA AND SPECIES.		Trenton.	Utica.	Hudson Riv.
1..	<i>Monotrypa undulata</i> , Nicholson	*	.	*
2..	<i>Discina Pelopca</i> , Billings	**	*	.
3..	<i>Lingula quadrata</i> , Eichwald	*	*	.
4..	<i>Lepidæna sericea</i> , Sowerby	*	*	*
5..	<i>Strophomena alternata</i> , Conrad	*	*	*
6..	<i>Orthis testudinaria</i> , Dalman	*	*	*
7..	<i>Platystrophia biforata</i> , v. <i>lynx</i> , Eichwald ..	*	*	*
8..	<i>Orthis emacerata</i> , Hall	*	.	.
9..	<i>Zygospira Healdi</i> , Billings	*	*
10..	" <i>modesta</i> , Say	*	*
11..	<i>Anazyga recurvirostra</i> , Hall	*	*	.
12..	<i>Rhynchonella increbescens</i> , Hall	*	*	.
13..	<i>Serpulites dissolutus</i> , Billings	*	.	.
14..	<i>Modiolopsis modiolaria</i> , Conrad	*	*
15..	<i>Orthodesma parallelum</i> , Hall	*	*
16..	<i>Pterinea insueta</i> , Conrad	*	*
17..	" <i>Trentonensis</i> , Conrad	*	*	.
18..	<i>Conularia Trentonensis</i> , Hall	*	*	.
19..	<i>Bellerophon bilobatus</i> , Sowerby	*	*	*
20..	<i>Plumotomaria subconica</i> , Hall	*	*
21..	<i>Murchisonia Milleri</i> , Hall	*	*	.
22..	<i>Endoceras proteiforme</i> , Hall	*	*	*
23..	<i>Asaphus platycephalus</i> , Stotts	*	*	*
24..	<i>Triarthrus Becki</i> , Green	*	*
		17	22	15
In common.				
		15	13	

The palæontological characters of the Utica are exceed-

ingly varied, the forms of life entombed in its strata belonging to almost all the classes of the Palæozoic fossils. No evidence of plant or fucoïdal remains has been detected in the Utica of Canada.

The mode of preservation of the fossil remains is similar to the manner in which most fossils are preserved in shales or finely divided clays and sands throughout palæozoic strata. The calcareous portions of the shells of brachiopoda, lamellibranchiata and cephalopoda, are preserved as such, but iron pyrites often replaces the lime, whilst the chitinous structure of crustaceans, graptolites, etc., is also replaced by iron pyrites in numerous instances.

Amongst the most characteristic species which distinguish this terrane from others, we find that trilobites play no unimportant part. In the lower half of the formation *Asaphus Canadensis*, Chapman—which may probably be identical with Hall's *A. latimarginatus* described in 1847—may be said to be very abundant indeed. Thousands of fragments of different sized individuals occur, which, when restored, would form individuals ranging from one inch to ten inches and more in length. The genus *Triarthrus* is also most characteristic of the Utica. In Canada the following forms occur: *T. Becki*, Green, *T. glaber*, Billings, *T. Canadensis*, Smith, and *T. spinosus*, Billings. Embryonic forms of this genus are very abundant in certain portions of the middle Utica about Ottawa, and a suite of specimens has been obtained, with few exceptions, similar to that obtained by Prof. Walcott, of the U. S. Geol. Survey, who has so admirably described the Utica of the United States and illustrated *Triarthrus Becki* in his "Utica and related formation" published in 1879.

Triarthrus glaber is characteristic of the Utica outlier in the Lake St. John region, Quebec, whilst *T. Canadensis*, with its peculiar genal angle produced into a prominent spine on each side of the head, is most abundant in the Utica shales of the islands in the northern portion of Lake Huron, such as the islands north of Maple Cape, &c.

Triarthrus spinosus occurs intimately associated with

T. Becki in the Utica of the Ottawa Palæozoic Basin, in the County of Carleton. It was armed with numerous spines both on its head and body, besides tubercles or blunted spines on the occipital segment and on the pygidium.

Besides these trilobites vast numbers of the remains of *Ceraurus pleurexanthemus* occur in the shaly strata which crop out south of Rochesterville, Ottawa, between that village and Carling Lake. This form occurs here associated with *Asaphus Canadensis* and *Triarthrus Becki*, Green. In the calcareous bands of Montmorenci, Pointe aux Trembles, Ottawa, Whitby and Collingwood *Calymene senaria* occurs in tolerable abundance, but usually in detached fragments, the cephalon and pygidium only, being usually preserved. Amongst the cephalopoda, may be mentioned shells of *Endoceras proteiforme* showing the large size and tapering character of the *endosiphon* as it is flanked all around and on each side of the septate or camerate portion of the shell. Individual specimens of this species have been found in the Utica of Gloucester and Ottawa whose probable length, when perfect, was not less than six feet. Thousands of small orthoceratites usually referred to the genus *Endoceras*:—*E. proteiforme*, *var tenuistriatum*, etc., etc., are also found throughout the Utica from Murray Bay and Lake St. John to Whitby and the islands north of the Great Manitoulin Island.

These individuals resemble closely the form described by Professor Hall as *O. lamellosum*, and as they are found appear to be true representatives of the genus *Orthoceras*. The shell in the younger examples must have been exceedingly delicate and thin from the mode of preservation.

These *Orthoceratites* are pre-eminently characteristic of the Utica.

The *Glossophora* or *Gasteropoda* are not numerous but interesting. As a rule they are crushed and preserved as casts. In a few instances the lines of growth and sculpture is shown with considerable precision.

Amongst the *Lamellibranchiata* we find such genera

as Pterinea and Modiolopsis represented. *Pterinea insueta*, Conrad, young individuals or a variety of the type species, also *Modiolopsis modiolaris*, Conrad, occur in tolerable abundance, but *Lyrodesma pulchellum*, Emmons, may be said to be the commonest and most characteristic of this class in the Utica terrane.

Of the brachiopoda—*Leptaena sericea*, Sowerby, *Orthis testudinaria*, Dalman, and *Strophomena alternata*, Conrad, are found in the lower Utica shales almost everywhere; but one of the most characteristic forms of this interesting class is the minute, though abundant, *Leptobolus insignis* of Hall.

Billings had observed its presence in the Montmorenci section and referred to it as a small *Discina*. On a small slab—the size of one's hand—there may be counted sometimes as many as twelve individuals—all in a tolerably good state of preservation—and presenting the characters of the genus remarkably well. At Murray Bay, Lake St. John, Montmorency—around Quebec, at Montreal, Ottawa, Gloucester, Whitby, Collingwood, etc., this form occurs in almost every collection made and serves as a very good indicator of the presence of the Utica. Small individuals of *Zygospira modesta*, Say, are also very characteristic and intimately associated with the previously mentioned species. The Utica representatives of this species are rather diminutive, some individuals being scarcely more than one or two millimetres in length, and indicate or present the protogulum very markedly in such nepionic forms as we find especially about Ottawa.

Amongst the most interesting of the brachiopoda however, *Siphonotreta Scotica*, Davidson, marks a very interesting horizon. One single individual of this species, alone, was found by the writer amongst the numerous collections of brachiopoda gathered together by the late Mr. Billings. To Mr. J. W. II. Watts, of the Ottawa Field Naturalists' Club, and to Mr. Whiteaves is due the honour of discovering and making known this beautifully ornamented and setate tretenterate brachiopod. In a paper prepared by the writer and read in the winter of 1887, entitled: "*Notes on and the*

precise Geological horizon of Siphonotreta Scotica, Davidson."

I had occasion to note the exact band from which this interesting fossil came and gave a list of sixteen other species which were found associated therewith. Since then I have had the good fortune to obtain additional forms, associated with which is the *Turrilepas Canadensis*, Woodward—described by Dr. Henry Woodward in the "Geol. Mag. No. 300, Dec. 3," vol. vi. p. 271 (1889.)

The following is a list of the species occurring in the "Siphonotreta band" along the bank of the Rideau River, opposite the Rifle Range, Ottawa:—

1. *Batostomella erratica*, Ulrich.
2. *Lingula curta*, Hall.
3. " *elongata*, Hall.
4. " *quadrata*, Eichwald.
(? = *L. Cincinnatiensis*, Hall and Whitfield.)
5. *Leptaena sericea*, Sowerby.
6. *Strophomena alternata*, Conrad.
7. *Orthis testudinaria*, Dalman.
8. *Zygospira Headi*, Billings.
9. " " var.
10. " *modesta*, Say.
11. *Conularia Trentonensis*, Hall.
12. *Leperditia cylindrica*, Hall.
13. *Beyrichia oculifera*, Hall.
14. *Asaphus Canadensis*, Hall.
15. " *platycephalus*, Stone.
vel. *A. megistos*, Locke.
16. *Calymene senaria*, Conrad.

The above sixteen species all occur in the one band, from nine inches to one foot in thickness, associated with (17) *Siphonotreta Scotica*, Davidson, and (18) *Turrilepas Canadensis*, Woodward.

The *Lingulae* are eminently characteristic, especially *Lingula Progne* and *L. curta*, the former of which is abundant almost everywhere the *Utica* shales holding *Asaphus Canadensis* occur.

The *monticulporidæ* and *Bryozoa* generally have afforded but little material as yet. *Batostomella erratica*, Ulrich, has been recognized and identified by Prof. E. O.

Ulrich, of Newport, Ky., U.S.A., whilst an obscure form allied to *Arthronema* occurs in certain shaly strata of Rideau Ward, Ottawa. The GRAPTOLITES are eminently characteristic of the Utica. The most common species is the *Orthograptus quadrimucronatus*, Hall, which is found almost invariably in all collections of the Utica. Then *Leptograptus flaccidus* comes next. With the graceful and slender curving stipes of the polypary the surfaces of many slabs of Utica shale are literally covered. Another species of this genus, *Lept. annectans*, Walcott, has been found in one or two localities. The genus *Climacograptus* has also one representative at least, and that a form closely related to *C. Scharenbergi*, Lapworth, or *C. teretiusculus*, Hisinger. Considerable difficulty has been met in identifying this *Climacograptus*, and especially on account of the fact that the earlier types and descriptions in many instances included several forms quite separate and distinct in structure, whose affinities have yet to be discussed and characters ascertained. Several small specimens of a diprionidian graptolite occurs abundantly in the Utica shales of Collingwood, Whitby, Ottawa, Montreal, &c., and is usually referred to the ubiquitous *Diplograptus pristis*, Hisinger. *Reteograptus* (?) *Eucharis*, Hall, another curious and interesting form, whose relations and affinities are still obscure, has been met with at Montreal in the Utica of St. Helen's Island, and resembling closely the forms from the typical locality Lake St. John basin.

The obscure parasitic hydroid ? *Sagenella ambigua*, Walcott, has been detected on the shells of several orthoceratites, but the identification of this form is very dubious.

Referring to parasites, a small *Cornulites*, *C. immaturum*, Hall, has also been found in the Utica of Montreal by Mr. Thos. Curry amongst the *débris* hauled up from the bottom of the harbour whilst the excavations were going on for the 28-foot channel. The material there obtained has kindly been placed at my disposal by Sir William Dawson, and amongst the forms detected the last mentioned proved to be

an interesting addition to the fauna of the Utica. *Serpulites dissolutus*, Billings, has also been found in several localities.

A fossil sponge—*Stephanella sancta*, Hinde, has recently been described from the Utica shales of Ottawa in the Geol. Mag., new series, Dec. III, vol. VIII, No. 1, for January, 1891, pp. 22-24, in a paper entitled: "Notes on a new Fossil Sponge from the Utica shale formation (Ordovician) at Ottawa, Canada." This sponge proved to constitute a new and very simple type of a Lithistid sponge—whose spicules resemble closely those of the modern *Tethæa*—many specimens of which occur in the Post-Tertiary clays of the Ottawa and St. Lawrence river basins.

GEOGRAPHICAL DISTRIBUTION.—Having glanced at the stratigraphical relations of the Utica terrane and at its lithological as well as chemical constituents, then surveyed over in a general way the palæontological characters, let us look for a moment at the geographical distribution of the same in Canada.

In the Province of Quebec, the Utica is first met in the East in loose blocks and specimens brought up on the north shore of the Island of Anticosti by floating ice. There is scarcely any doubt that the Utica shales occur in their proper and natural position between the Trenton and Hudson River terranes—in the unbroken and fine sequence of Ordovician strata northwest of Anticosti—and that on account of their soft, brittle and easily denuded character they have been washed and carried away from that section now occupied by the north channel of the St. Lawrence River. But the most easterly outcrop of the Utica as yet recorded *in situ* occurs near the mouth of the Murray River, Murray Bay—where Mr. W. F. Ferrier made an interesting collection of fossils which were determined and described by the writer in the "Can. Record of Science" for 1887, pp. 101-107. The paper is entitled: "Notes on Fossils from the Utica Formation at Point-à-Pic, Murray River, Murray Bay (Que.), Canada." In this paper twelve species of fossils were noted, as follows:—

1. *Diplograptus* sp. (resembling *D. pristis*, Hisinger.)

2. *Pachydietya* sp.
3. *Leptobolus insignis*, Hall.
4. *Siphonotreta* sp.
5. *Leptana sericea*, Sowerby.
6. *Orthis testudinaria*, Dalman.
7. *Trocholites ammonius*, Conrad.
8. *Endocerus protiforme*, Hall.
9. *Triarthrus* sp.
10. *Calymene senaria*, Conrad.
11. *Leperditia (Primitia) cylindrica*, Hall.
12. " probably n. sp.

The *Utica terrane* occupies a more or less narrow and continuous belt along the north shore of the St. Lawrence from Cape Tourmente below Quebec, to Montreal, whence the belt trends to the south and is seen in the neighbourhood of Lacolle, Clarenceville, etc.—then crossing the boundary line—rounding the edge of or skirting the Adirondack range—to reappear north of Lake Ontario at and in the vicinity of Whitby—it crosses the Province to Collingwood where it again disappears beneath the waters of the Georgian Bay and continuing north and west strikes numerous points, capes and islands about the great Manitoulin Island dying out to the west and overlaid by newer and overlying formations.

In the vicinity of Quebec the *Utica terrane* is met at several localities. Characteristic species were collected by Rev. Prof. Laflamme, Mr. St. Cyr, Mr. T. C. Weston, Dr. Ells and the writer within recent years, at Montmorenci, Beauport, St. Charles River Flats, Charlesbourg, half-mile west of Charlesbourg, at Grondines, Pointe aux Trembles and Cape Santé, and also across the river at St. Antoine [de Tilly] interesting collections were made.

At Montmorenci Falls, near the bottom of the falls and ravine the following characteristic *Utica* fossils were collected and detected by the writer and Dr. Ells:—

1. *Orthograptus quadrimucronatus*, Hall.
2. *Diplograptus* sp.
3. *Climacograptus* sp.
4. *Reteograptus ? Eucharis*, Hall.

5. *Lingula curta*, Hall.
6. *Leptobolus insignis*, Hall.
7. *Leptana sericea*, Sowerby.
8. *Triarthrus Becki* ? Green.

Near the mouth of the Montmorenci River—close to the Railway Bridge—the following species occur :—

1. *Diplograptus* sp. indt.
2. *Climacograptus* sp.
3. *Orthograptus quadrimucronatus*, Hall.
4. *Leptobolus insignis*, Hall.
5. *Endoceras proteiforme*, Hall.
6. *Triarthrus Becki*, Green.

Along the Beauport shore the following species were obtained by Mr. D. N. St. Cyr, a devoted and zealous naturalist at the Museum of the Department of Public Instruction, Quebec :

1. *Schizocrania filosa*, Hall.
2. *Leptana sericea*, Sowerby.
3. *Lyrodosma pulchellum*, Emmons.
4. *Endoceras proteiforme*, Hall.
5. *Asaphus Canadensis*, Chapman.

At Charlesbourg village—along the road from Quebec to Charlesbourg and a few yards south of the church—the following forms were collected by Dr. W. Ells, Prof. Laflamme and the writer, in light coloured, calcareous shales :—

1. *Leptograptus flaccidus*, Hall.
2. *Strophomena* or *Rafinesquina* sp.
3. *Leperditia cylindrica*. Hall.
4. *Triarthrus Becki*, Green.

But along a brook—about one mile west of Charlesbourg village, on the road to Lorette, the black bituminous shales of the Utica are seen to crop out and afforded the following characteristic forms :—

1. *Orthograptus quadrimucronatus*, Hall.
2. *Climacograptus* sp.
3. *Leptobolus insignis*, Hall.

All these are typical Utica fossils.

In the vicinity of Pointe aux Trembles, above Quebec, the following species were noted in a collection made by Sir Wm. Logan and his staff in 1852 (?) :—

1. *Diplograptus pristis* ? Hisinger.
2. *Orthograptus quadrimucronatus*, Hall.
3. *Climacograptus bicornis* ? Hall.
4. *Ptilodictya* (?) sp.
5. *Anazyga recurvirostra*, Hall.
6. *Modiolopsis* sp.
7. *Calymene callicephala*, Green.

From Cape Santé, the following species have been identified from a collection placed in the writer's hands in 1882 :—

1. *Cyathophycus reticulatus*, Walcott.
2. *Orthograptus quadrimucronater*, Hall.
3. *Dendrograptus* sp.
4. *Leptobolus insignis*, Hall.
5. " sp.
6. *Leptæna sericea*, Sowerby.
7. *Pterinea insæta*, Conrad.
8. *Endoceras proteiforme*, Hall.
9. *Triarthrus Becki*, Green.

From a small collection of fossils labelled "Grondines," north side of the St. Lawrence, the following three forms were observed :—

1. *Climacograptus bicornis* ? Hall.
2. *Diplograptus pristis* ? Hall.
3. *Leptobolus insignis*, Hall.

From a collection of fossils from St. Antoine de Tilly—made by Mr. Weston—in 1887, there occurs several portions of *Triarthrus Becki*, Green, in good state of preservation, and from along the "Grève de Beauport." L'Abbé Laflamme sent a slab of shaly rock to the museum of the Geological Survey, on which there were seen :—

1. *Climacograptus* sp.
2. *Leptobolus insignis*, Hall.
3. *Triarthrus Becki*, Green.

whilst on a similar slab, which from Charlesbourg, Que., Prof. Laflamme collected, the following forms occurred :—

1. *Orthograptus quadrimucronatus*, Hall.
2. *Leptobolus insignis*, Hall.
3. *Triarthrus Becki*, Green.

West of Pointe-aux-Trembles, near Quebec the Utica shales have not been observed to crop out from beneath the the overlying till, or from under the overlying Hudson River terrane, except in the vicinity of Montreal. Here, this formation, as well as most of the Cambro-Silurian or Ordovician strata occurring in the neighbourhood, have suffered or been subjected to considerable elevation, and consequent denudation, on account of the volcanic masses occurring at this locality. At Joliette, or "Industry Village," however, a small collection of fossils was made in 1852 by Sir William Logan, and contains the following species, which point clearly to the presence of or decided close proximity to the Utica terrane, whence these specimens were collected. They are:—

1. *Strophomena alternata*, Conrad.
2. *Leptæna sericea*, Sowerby.
3. *Orthis testudinaria*, Dalman.
4. *Asaphus Canadensis*, Chapman.

From an interesting collection made by Thos. Curry, of the Redpath Museum in connection with McGill University, at the northern extremity of the Victoria Tubular Bridge, Point St. Charles, Montreal, the following species were identified by the writer:—

1. *Climacograptus* sp.
2. *Leptograptus flaccidus*, Hall.
3. *Orthograptus quadrimucronatus*, Hall.
4. *Diplograptus* sp.
5. *Orthis testudinaria*, Dalman.
6. *Leptobolus insignis*, Hall.
7. *Cornulites immaturum*, Hall.
8. *Endoceras proteiferæ*, Hall.

The shales in which the above were found are dark grey and bituminous, somewhat more calcareous than the shales of the Utica usually are, and somewhat indurated or altered, on account of the presence of the numerous dykes of syenite and trap which occur in this district. Not only

near the above mentioned locality, but at the upper or western extremity of St. Helen's Island, opposite Montreal, the Utica is seen to crop out with its characteristic fossils.

Amongst the most recent additions to the knowledge of the Utica and its fauna about Montreal is the occurrence of a series of shales seen at low water last season (1891), which yielded the following forms:—

1. *Dendrograptus simplex*, Walcott.
2. *Reteograptus* ? *Eucharis*, Hall.
3. *Orthograptus quadrimucronatus*, Hall.
3. *Climacograptus Scharenbergi* ? Lapw.
5. *Endoceras proteiforme*, Hall.
6. *Triarthrus Becki*, Green.

The Utica is also seen to crop out at and above Longueuil and then sweep round to the south by Laprairie, and is then overlaid by the Hudson River shales of Chambly, St. Hyacinthe, &c. Its measures have been examined by Dr. Ells in the 4th Range, near Clarenceville, Que., during the summer of 1891, who made an interesting collection, in which the following fossils were detected:—*Cyathohhycus reticulatus*, Walcott, *Climacograptus* sp., *Orthograptus quadrimucronatus*, Hall, *Endoceras proteiforme*, Hall, and *Triarthrus Becki*, Green.

Near Lacolle, Que., one-eighth of a mile west of the Richelieu River Bridge Dr. Ells also obtained *Orthograptus quadrimucronatus*, Hall, and *Triarthrus Becki*, Green, which serve clearly to show that the Utica proper is here developed. About half a mile east of this village, however, and in the river alongside the road to Grand Trunk Station, the same gentleman has brought in a suite of specimens which yielded the following forms on examination:—

1. *Climacograptus bicornis* ? Hall.
2. *Diplograptus* cf. *D. mucronatus*. Hall.
3. *Leptæna sericea*, Sowerby.
4. *Triarthrus Becki*, Green.

South of here the belt of the Utica crosses the international boundary line, as stated above, and curving south, west and then trending north crosses the waters of Lake Ontario to

reach the Province of that name—forming a belt of several miles in breadth—whose strata are almost horizontal with a gentle almost imperceptible dip to the southwest.

Along the line of the Grand Trunk Railway, in some low cuttings, as well as in a number of localities between the lake and the track where openings were made for quarry and other purposes the Utica may be seen. About Oshawa and Bowmanville, the black bituminous and brittle shales of this terrane are evident and fossiliferous.

An interesting collection was made by the writer in 1883 at Whitby on a farm and lot, the property of Mr. Yerex, south of the G.T.R. track close to where a bore hole was put down by a company many years ago in order to find coal or petroleum. It was in spite of Sir Wm. Logan's assertions and statements regarding the strata in this neighbourhood not being coal-bearing or "carboniferous" that the company sank the hole and found that as soon as the bituminous shales capping the Trenton were traversed, the limestones formed a compact and solid thickness of rock beneath. It is almost needless to state here that neither coal nor petroleum were "struck" at this point, and furthermore that neither of these substances occur in this region. Except the very small percentage of oil which can be extracted from the more bituminous shales of the Utica here as elsewhere—no reservoir of petroleum or occurrence of that mineral oil can be obtained in the rocks of this age.

The fossil remains found at the pit or quarry, close to the bore-hole, Whitby, belong precisely to the same geological horizon as the shales in the vicinity of the Rideau Rife Range, Ottawa, or as the shales at Collingwood to be described later on.

The species recorded from this locality are:—

- 1 *Leptograptus fluccidus*, Hall.
- 2 *Orthograptus quadrimucronatus*, Hall.
- 3 *Leptobotus insignis*, Hall.
- 4 *Lingula* sp.
- 5 *Leptena sericea*, Sowerby.
- 6 *Zygospira modesta*, Say.

7. *Lyrodesma pulchellum*, Emmons.
8. *Trocholites ammonius*, Emmons.
9. *Endoceras proteiforme*, Hall.
10. *Primitia Ulrichi*, Jones.
11. *Asaphus Canadensis*, Chapman.
12. *Triarthrus Canadensis*, Smith.
13. *Triarthrus Becki*, Green.
14. Crustacean, ? (cf. fragment of *Echinognathus Clevelandi*, W.)

Then, following northward the belt of Utica crosses the Province of Ontario and is covered by a great deal of drift or superficial deposits belonging to glacial, inter-glacial and lacustrine deposits so as to cover it almost totally, reappears in the vicinity of Nottawasaga Bay, near Collingwood and Windsor, where it can be easily recognized by its lithological characters and fossils. The list of species collected by Mr. A. S. Cochrane, of the Geological Survey of Canada, at Collingwood, in 1887, and determined by the writer comprises the following forms:—

1. *Obscure Graptolite*, probably a *Diplograptus* cf. *D. pristis*, Hisinger.
2. *Lingula Progne*, Billings.
3. " sp.
4. *Orthis testudinaria*, Dalman.
5. *Leptena sericea*, Sowerby.
6. *Strophomena alternata*, Conrad.
7. *Rhynchonella increbescens* ? Hall.
8. *Lyrodesma pulchellum*, Emmons.
9. *Endoceras proteiforme*, Hall.
10. *Primitia Ulrichi*, Jones.
11. *Beyrichia* sp.
12. *Triarthrus Becki*, Green.
13. *Asaphus Canadensis*, Chapman.

The absence of *Leptobolus* in this list is almost phenomenal, inasmuch as the *L. insignis* of Hall occurs in large numbers, as a rule, in rocks of precisely the same horizon in other parts of Canada.

In the northern portion of Lake Huron and the Manitoulin Islands, where the Utica again crops out after disappearing beneath the waters of Georgian Bay, or where the shales, soft, friable, and easily denuded, have been carried

away along the line of a great pre-glacial river, it is seen on St. Joseph's Island, in the islands north of Maple Cape, and along the shores of the Shequanandod Bay and Islands. At the last mentioned locality—Shequanandod Bay and Islands—the following fossil remains have been determined by the writer :—

1. ? *Dendrograptus simplex*, Walcott.
2. ? *Climacograptus bicornis*, Hall.
3. *Orthograptus quadrimucronatus*, Hall.
4. *Leptobolus insignis*, Hall.
5. *Primitia*, *Ulrichi*, Jones.
6. *Endoceras proteiforme*, Hall.
7. *Triarthrus Becki*, Green.

The above forms occur in a rather poor state of preservation in a somewhat indurated and calcareous black bituminous shale.

From the islands north of Maple Cape the following species were determined by the writer in 1882 :—

1. *Sagenella ambigua*, Walcott.
2. *Ptilodictya* ? *sp.*
3. *Monticuliporidae*.
4. *Leptobolus insignis*, Hall.
5. *Streptorhynchus filitextum* ? Hall.
6. *Rhynchonella increbescens*, Hall.
7. *Lingula Progne*, Billings.
8. *Primitia Ulrichi*, Jones.
9. *Triarthrus Becki*, Green.
10. " *Canadensis*, Smith.

Amongst the specimens of *Triarthrus Canadensis*, Smith, found in this collection, one specimen is especially worthy of note. It exhibits the two characteristic spines attached to the freecheeks, the glabella, and eight body segments attached to the head. Several pygidia also occur in the collection, which may properly belong to this species. From a second collection of fossils examined from Collingwood, evidently collected by the late Alex. Murray early in the fifties, during his examination of the geographical distribution of the Lower Silurian formations belonging to the New York and Ontario systems, there are *nineteen* species

found, as follows. The collection is labelled "Nottawasaga Bay, Collingwood, Ont." :—

1. *Diplograptus priatis?* Hisinger.
2. *Dictyograptus* *vel.* *Dictyonema* *sp.*
3. *Crinoidal* fragments.
4. *Lingula obtusa*, Hall.
5. " *Progne*, Billings.
6. " *quadrata*, Eichwald.
7. *Leptobolus insignis*, Hall.
8. *Orthis testudinaria*, Dalman.
9. *Streptorhynchus filitextum*, Hall.
10. *Strophomena alternata*, Conrad.
11. *Leptena sericea*, Sowerby.
12. *Pleurotomaria* *sp.*
13. *Conularia Hudsonia*, Emmons.
14. *Orthoceras lamelloum*, Hall.
15. *Endoceras proteiforme*, Hall.
16. *Primitia Ulrichi*, Jones.
17. *Asaphus platycephalus*, Stokes.
18. " *Canadensis*, Chapman.
19. *Triarthrus Becki*, Green.

On the "west side St Joseph's Island," Lake Huron, a number of specimens thus labelled, probably collected by Mr. Murray also, indicated the presence of *Leptobolus insignis*, Hall, and *Orthis testudinaria*, Dalman, the latter being unusually large, and resembling a form which approaches *O. emacerata*, Hall.

The above localities and lists of fossils from various portions of Quebec and Ontario present the leading characteristics of the Utica as it is seen to crop out along the contour or edge of the archæan continent—in contact with it at times, and then overlapping the older members of the Ordovician system; at other times occurring as a more or less narrow belt of black bituminous strata lying intermediate between the Trenton and the Hudson River, but throughout an almost uninterrupted belt of continuous strata from Anticosti to the Manitoulin Islands. As can readily be seen the notes and remarks above made are from a palæontological standpoint, and show the distribution and

continuity of existing forms of life during Utica times as the shales were being deposited in the old Ordovician sea.

Besides the above localities occurring along this continuous belt or zone of Utica, there are two well-known palaeozoic basins, that of Lake St. John and Ottawa in which this terrane is well developed and in which there are numerous and varied forms of animal life entombed. This points clearly to the fact that in Utica times and in these two isolated and quite separate basins, similar conditions of deposition, sedimentation and conditions under which life existed were present in those early days similar to the conditions outside of these basins.

LAKE ST. JOHN BASIN.

From the Lake St. John and Upper Saguenay district the explorations of Sir Wm. Logan, James Richardson, Scott Barlow, Dr. Selwyn, Prof. Laflamme, Mr. F. D. Adams, Mr. D. N. Saint Cyr and others have afforded a considerable quantity of material wherewith to ascertain by means of the fossils to what age or precise geological horizon the different strata there met with belonged. As early as 1829, in a report by Captain F. H. Baddeley, addressed to the Legislature of Quebec, the black bituminous schists of the Utica were recorded in this Lake St. John or Upper Saguenay district. From the collections made by Mr. Richardson, Billings described the *Triarthrus glaber* of Lake St. John as a new and undescribed form. This trilobite is the largest one of the genus yet known, and the specimens obtained by Mr. Adams in 1883 and 1884 show that its dimensions vary greatly, and even surpass those mentioned in the type specimens.

From the "Mouth of the Ouatchouan River," Lake St. John, Mr. Adams obtained the following species in a rusty weathering somewhat indurated black bituminous shale:—

1. *Orthograptus quadrimucronatus*, Hall.
2. *Leptobolus insignis*, Hall.
3. *Endoceras protiforme*, Hall.
4. *Triarthrus glaber*, Billings.

Amongst the specimens of *T. glaber*, collected by Mr. Adams, we find that the occipital or neck segment is furnished with a small somewhat depressed linear tubercle about the centre, a character which had not heretofore been noted in this species. The fact that it is destitute of genal spines, of spines along the median axis of the body or attached to the occipital segment as in *T. spinosus*, and that the body segments of this species (*T. glaber*) are destitute of the tubercles along the median axis of the body, is quite sufficient warrant to retain the designation *glaber* for this Lake St. John species, although it does possess one occipital tubercle as single ornamentation visible.

It would thus appear that all the known Canadian species of *Triarthrus* possess this tubercle on the occipital segment, viz.: *T. Canadensis*, Smith; *T. Becki*, Green; *T. Fischeri*, Billings; *T. glaber* and *T. spinosus*, Billings and *T. Billingsi*, Barrande.

It was from the Lake St. John district that the Utica slate graptolites: *Graptolithus flaccidus*, *Graptolithus quadrimucronatus*, and *Reteograptus? Eucharis*, were described by Hall in 1865, "Canadian Organic Remains," decade II., pp. 143-147 (supplement.) The precise locality given is Blue Point, Lake St. John.

A peculiar organism occurs in the collection made by Dr. Selwyn, whose affinities are still doubtful. In some respects it has the character and structure of *Megalograptus* (Miller), and in others of a peculiar crustacean type. Further collections may afford better examples of this form whose affinities still remain unknown.

THE OTTAWA OUTLIER.

In the Ottawa Palaeozoic Basin the Utica terrane is fairly well developed, and numerous as well as interesting exposures may be seen, especially in the vicinity of Ottawa city. In the townships of Plantagenet and Alfred two outliers of the Utica are recorded by Sir William Logan. No fossil remains have been seen from these outliers by the writer, but the Utica terrane about Ottawa has afforded

him an excellent opportunity of studying its character and facies, as the outcrops are numerous and varied. Besides the natural exposures along the banks of the Rideau River, from the village of New Edinburgh up to near Billings' Bridge, along the Montreal Road and by the Beechwood Cemetery, as well as underlying almost the whole of Centre and Upper Town west of the canal and south of Sparks Street, with a slight dislocation along Bank Street, which brings the Utica shales in front of the Supreme Court buildings, and south of Rochesterville, as already cited, the Utica was examined by the writer along numerous pits and in excavations made by the city engineer or contractors of public buildings, throughout the city. From the lower, middle and upper divisions of the Utica, fossil remains have been found, most of which have already been recorded in scattered pages and pamphlets published by the writer since 1882.

I shall not attempt to describe at length the various outcrops as they were examined by me and recorded about Ottawa. Suffice it to state that Rideau Ward, Cummings' Bridge, the Rideau Rifle Range, the Montreal Road, excavations along Albert, Kent, Bank, O'Connor and Maria Streets, have afforded numerous collections of fossil remains, many of which were hitherto unrecorded or altogether new to science.

The following is a condensed list of the species of fossils from the Utica of Ottawa and its vicinity :—

UTICA FOSSILS FROM OTTAWA AND ITS ENVIRONS.

HYDROZOA.

- Leptograptus annectans*, Walcott sp.
- “ *flaccidus*, Hall.
- Diplograptus mucronatus* ? Hall.
- “ *pristis* ? Hisinger.
- “ *putillus*, Hall.
- “ *quadrimucroratus*, Hall.
- Sagenella ambigua*, Walcott.

BRYOZOA.

Stictopora acuta, Hall.

BRACHIOPODA.

Leptobolus insignis, Hall.

" *occidentalis*? Hall.

Siphonotreta Scotica, Davidson.

Lingula Daphne, Billings.

" *obtusa*, Hall.

" *Progne*, Billings.

" *quadrata*, Eichwald.

Orthis testularia, Dalman.

" *emacerata*, Hall.

Schizocrania filosa, Hall.

Leptæna sericea, Sowerby.

Strophomena alternata, Conrad.

Zygospira Headi, Billings.

LAMELLIBRANCHIATA.

Lyrodesma pulchellum, Hall.

Modiolopsis modiolaris, Hall.

Orthodesma parallelum, Hall.

Pterinea insueta, Conrad.

" *Trentonensis*, Conrad.

PTEROPODA.

Conularia Hudsonia, Emmons.

" *Trentonensis*, Hall.

GASTEROPODA.

Bellerophon bilobatus, Sowerby.

Murchisonia Milleri, Hall.

Pleurotomaria subconica, Hall.

CEPHALOPODA.

Trocholites ammonius, Conrad.

Endoceras proteiforme, Hall.

" " var. *tenuistriatum*, Hall.

Orthoceras amplicameratum, Hall.

" *coraliferum*, Hall.

" *lumellosum*, Hall.

ANNELIDA.

Serpulites dissolutus, Billings.

CRUSTACEA.

- Asaphus Canadensis*, Chapman.
" *platycephalus*, Stokes.
Calymene senaria, Conrad.
Cheirurus pleurexanthemus, Green.
Triarthrus Becki, Green.
" *glaber*, Billings.
" *spinosis*, Billings.
Leperditia cylindrica, Hall.

as per "*Classified List of Cambro-Silurian and Post-Tertiary Fossils from Ottawa and Vicinity*," published by the writer in 1884.

To the above may be added:—

1. *Stephanella sancta*, Hinde.
2. *Batostonella erratica*, Ulrich.
3. *Atrithronema* sp.
4. *Lingula elongata*, Hall.
5. " *Cobourgensis*, Billings.
6. *Pholidops* sp.
7. *Discina Pelopea*, Billings.
8. *Anazyga recurvirostra*, Hall.
9. *Zygospira modesta*, Say.
10. *Modiolopsis anodontoides*, Conrad.
11. *Metoptoma* sp.
12. *Cornulites immaturum*, Hall.
13. *Beyrichia oculifera*, Hall.
14. *Primitia Ulrichi*, Jones.
15. " *mundula*, Jones.
16. *Turrilepas Canadensis*, Woodward.

Appended to this is a classified table of the genera and species characterizing the *Utica* of Canada, giving also a series of localities in the United States, typical localities as *Utica*, Holland Patent, &c., for comparison.¹

From the same and the foregoing it will clearly be seen and naturally deduced that the so-called *Utica* or Hudson River shales of Quebec city, Cape Diamond, of the Marsouin

¹ This portion of the paper will appear in a subsequent issue of the CAN. REC. OF SCIENCE.—EDITOR.

River beds, of Norman's kiln and "Coenograptus" shales in general do not occur anywhere in Canada where the Utica shales are found in their natural and undisturbed position between the Trenton and Hudson River terranes.

These belong to a distinct and separate terrane—the Quebec terrane of the writer—and are characterized by a fauna whose affinities are more closely related to Lower Ordovician (Levis) faunas than to an upper member of the Ordovician system.



