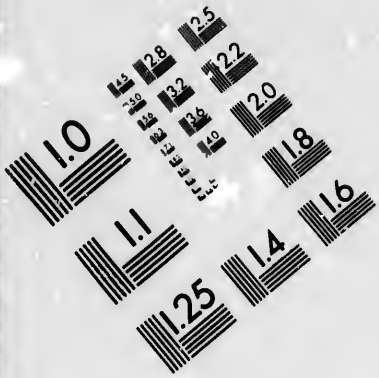
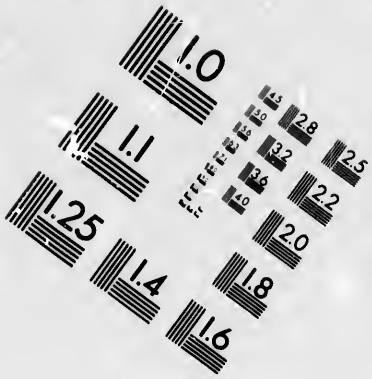
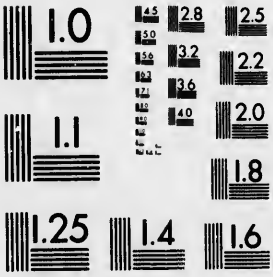
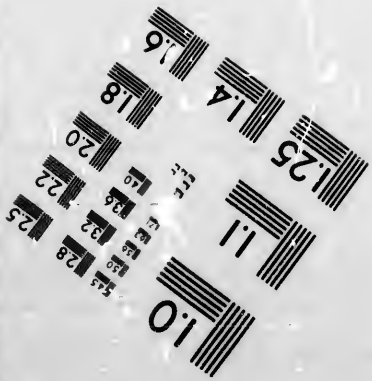
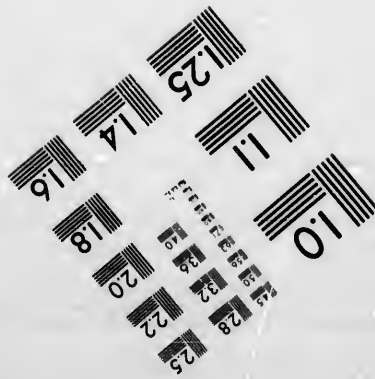




!MAGE EVALUATION
TEST TARGET (MT-3)







CIHM/ICMH Microfiche Series.

CIHM/ICMH Collection de microfiches.

Canadian Institute for Historical Microreproductions

Institut canadien de microreproductions historiques

1980

Technical Notes / Notes techniques

The Institute has attempted to obtain the best original copy available for filming. Physical features of this copy which may alter any of the images in the reproduction are checked below.

L'Institut a microfilmé le meilleur exemplaire qu'il lui a été possible de se procurer. Certains défauts susceptibles de nuire à la qualité de la reproduction sont notés ci-dessous.

- [x] Coloured covers/ Couvertures de couleur
- [ ] Coloured pages/ Pages de couleur
- [ ] Coloured maps/ Cartes géographiques en couleur
- [ ] Coloured plates/ Planches en couleur
- [ ] Pages discoloured, stained or foxed/ Pages décolorées, tachetées ou piquées
- [x] Show through/ Transparence
- [ ] Tight binding (may cause shadows or distortion along interior margin)/ Reliure serré (peut causer de l'ombre ou de la distortion le long de la marge intérieure)
- [ ] Pages damaged/ Pages endommagées
- [ ] Additional comments/ Commentaires supplémentaires

Bibliographic Notes / Notes bibliographiques

- [ ] Only edition available/ Seule édition disponible
- [ ] Pagination incorrect/ Erreurs de pagination
- [ ] Bound with other material/ Relié avec d'autres documents
- [ ] Pages missing/ Des pages manquent
- [ ] Cover title missing/ Le titre de couverture manque
- [ ] Maps missing/ Des cartes géographiques manquent
- [ ] Plates missing/ Des planches manquent
- [ ] Additional comments/ Commentaires supplémentaires

The images appearing here are the best quality possible considering the condition and legibility of the original copy and in keeping with the filming contract specifications.

Les images suivantes ont été reproduites avec le plus grand soin, compte tenu de la condition et de la netteté de l'exemplaire filmé, et en conformité avec les conditions du contrat de filmage.

The last recorded frame on each microfiche shall contain the symbol ⟶ (meaning "CONTINUED"), or the symbol ∇ (meaning "END"), whichever applies.

Un des symboles suivants apparaîtra sur la dernière image de chaque microfiche, selon le cas: le symbole ⟶ signifie "A SUIVRE", le symbole ∇ signifie "FIN".

The original copy was borrowed from, and filmed with, the kind consent of the following institution:

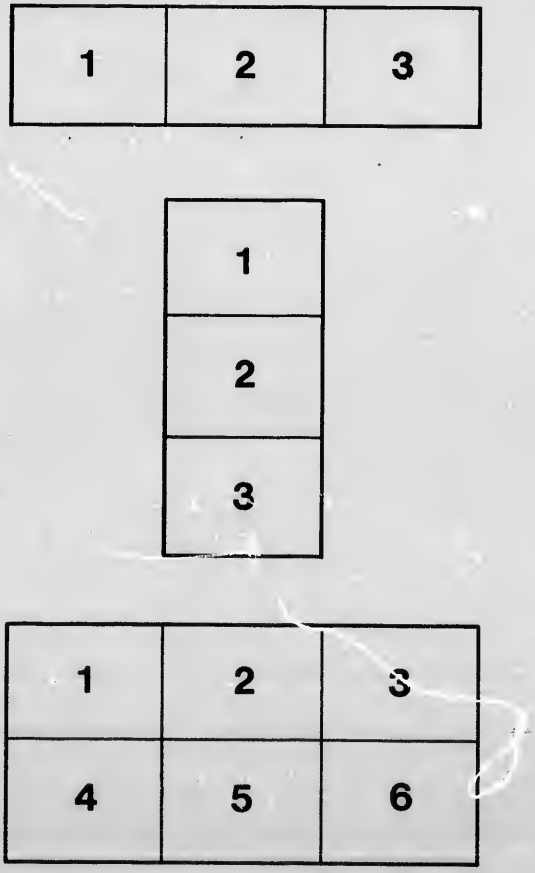
National Library of Canada

L'exemplaire filmé fut reproduit grâce à la générosité de l'établissement prêteur suivant :

Bibliothèque nationale du Canada

Maps or plates too large to be entirely included in one exposure are filmed beginning in the upper left hand corner, left to right and top to bottom, as many frames as required. The following diagrams illustrate the method:

Les cartes ou les planches trop grandes pour être reproduites en un seul cliché sont filmées à partir de l'angle supérieure gauche, de gauche à droite et de haut en bas, en prenant le nombre d'images nécessaire. Le diagramme suivant illustre la méthode :



Pam. Ami, Henry M. with regards of the writer.

THE

Utica Slate Formation

WITH ESPECIAL REFERENCE TO THE EXPOSURES OF THAT FORMATION AT AND NEAR

OTTAWA CITY.

By Henry M. Ami, B.A.

Ottawa, Canada:
Citizen Printing & Publishing Company, Metcalfe St.
1882.

THE

Utica Slate Formation,

With Especial Reference to the Exposures of that Formation at and near

OTTAWA CITY.

BY HENRY M. AMI, B.A.

(*The following is an Abstract from a Paper read before the Natural History Society of Montreal and the Ottawa Field-Naturalists' Club, in the Winter of* 1882, *as published in Transactions No.* 3 *of the latter Club.*)

The Utica Slate Formation derives its name from the town of Utica, N.Y., on account of the occurrence of an exposure of rock in the vicinity of that place, which American geologists have adopted as typical of the series.

It is further called a "slate" formation on account of the eminent slaty cleavage which the rock possesses; this generally corresponds with and is parallel to the divisional planes of stratification, but sometimes occurs cutting these planes at various angles. Instances of the latter may be observed at Montreal, on the Mountain side, or near Ottawa in a quarry on the Montreal Road; such cleavage is due to lateral and other pressure, acting at various angles on the beds.

The term "Utica Shale" has also been frequently applied to rocks of this formation, and may be said with greater accuracy to designate the character of the rock than the term "Utica Slate" does.

Until quite recently the Utica Slate has received very little attention at the hands of geologists and palæontologists. In the Geology of Canada (1863), however, we find that a considerable amount of valuable work has been done,

including researches into the palæontology, stratigraphy and lithology of the formation.

NATURE OF THE ROCKS.

To ascertain the nature of the rocks constituting these beds we must refer to some typical representative of the formation. In addition to the series at Utica, in the United States, which has been taken as the type of this formation, we have also, here in Canada, a good exposure situated near the mouth of the River Ste. Anne, Montmorenci, P.Q.

In the Geology of Canada (1863), there is a tabulated description of this series. The beds consist of a brittle black or brown, more or less bituminous shale, of much the same nature throughout. At the base of the section are two bands of yellow weathering (probably magnesian) limestone, and at the summit a thin band or two of sandstone and grit are found.

ORIGIN AND MODE OF DEPOSITION.

At the close of the Trenton formation, whether from subsidence of the northern part of this continent, or from the Arctic Seas having broken through their southern barriers—the Laurentian Hills—there seems to have come from the north, cold and muddy waters which carried down finely divided clay and sand and deposited them over the whole central plateau and synclinal hollows in various parts of the continent. Layer after layer was thus deposited, which, under the action of subsequent heat, pressure and other physical agencies, assumed their present character. Such a change of circumstances from those existing during the deposition of the Trenton formation also led to a change in the fauna of these Utica seas; the *Graptolites*, which in olden times had swarmed the seas, during the deposition of the Calciferous and Chazy, now finding a suitable *habitat* returned in such abundance that the presence of these fossils may be considered a chief characteristic of this formation. *Trilobites* also, of forms diverse from those of the Trenton now made their first appearance in these turbid waters. It is no doubt owing to the great prevalence of these two types of life in that period of the earth's history that the rock owes its bituminous character.

This change, which occurred at the close of the Trenton, was at first quite gradual, for, as may be clearly seen, the upper strata of that formation are for the most part separated from each other by thin bands of shale and argillaceous schists, indicating the oscillatory movements which then begun, foretold the complete disruption in the northern seas.

CHEMICAL COMPOSITION.

Several careful analyses of the rocks of this formation have been made by Messrs. Chandler & Kimball, for Prof. Whitney, who have published them in the Geology of Wisconsin, and mention of which is made in the Geology of Canada (1863). Of these analyses, chiefly of specimens from various parts of Canada, one from the Gloucester beds, in this neighbourhood, is noticed as yielding an especially large percentage of magnesia. The dolomitic nature of these beds is

further shown by the appearance of their weathered surfaces, which assume a brownish-yellow colour.

Very little can be said as to the existence of minerals in these rocks, for they are so few, and, with the exception of *bitumen*, there are none of any importance. The occurrence, however, of a considerable percentage of this mineral in the shale at Collingwood, induced a company, some few years ago, to start operations and extract the oil; but before much was accomplished the discovery of the same mineral in much greater abundance in the Hamilton shales, of Devonian age, caused the operations at Collingwood to be suspended; these, however, may prove of considerable value at some future date.

At the village of Windsor there is also said to be a valuable deposit of bitumen belonging to the Utica Slate. Other minerals occur sparingly, as *iron pyrites* (*pyrite or marcasite*) which is generally found replacing entirely or lightly coating fossils, particularly *trilobites* and *orthoceratites*. *Selenite*, or the hydrated sulphate of lime, also occurs in fine scales disseminated over the divisional planes of the strata, or, partly coating organic remains.

GEOGRAPHICAL DISTRIBUTION.

The remarks made will be in special reference to Canada; but in tracing out the belt along its line of outcrop, it will, of course, be necessary to notice parts of the United States. Beginning then with the deposit in its most easterly extension, it is found occurring near the mouth of the Ste. Anne River, Montmorenci, P.Q., where a portion of the rock exposure there shows 318 feet in thickness of Utica Slate. Proceeding thence in a westerly direction, it forms a belt, at times interrupted, along the northern shore of the St. Lawrence, with a general south-easterly dip, sometimes concealed beneath the waters of the river, at other times cropping out at the summit of various anticlinals and on the superior axes of disturbed areas, whilst large tracts of it lie hid beneath the soil or drift. Thus, the belt proceeds till it reaches the city of Montreal, where several exposures can be seen on the Mountain side, at St. Helen's Island, Point St. Charles, and other places in that locality, the rock being much altered and hardened on account of the numerous plutonic dykes that traverse it. Hence the belt bends to the south-east, and then again to the south till it reaches Lake Champlain, where the formation can be traced beneath the waters of the lake by means of the islands which are almost entirely made up of rocks belonging to this formation. Proceeding southward, and turning in a westerly direction round the base of the great Adirondack region, we find the formation for a considerable way completely obliterated. In the vicinity of Adams, N.Y., it again crops out, but gradually becomes narrower until the rocks of the Hudson River age conceal it; after this, proceeding in a course almost due west, it dips beneath the waters of Lake Ontario, and reappears again on the Canadian shore—a wide belt reaching from Port Newcastle to Canton, near Whitby—at which latter place some very fossiliferous strata occur. This extensive belt crosses the Province of Ontario through the counties of Durham, Ontario, York and Simcoe, reaches Collingwood and

there disappears. Subsequently following a north-westerly course beneath the waters of Georgian Bay, and striking points and capes of the Great Manitoulin Island, as well as many of the North Channel Islands, this belt narrows in gradually, diminishes likewise in thickness, crosses St. Joseph's Island, and again reaches the mainland, where, after a few miles of outcrop, it is lost sight of beneath the more recent overlying rocks and is not traceable further west.

Besides this continuous belt of the Utica Slate, there also occur isolated "patches" or "outliers" in other parts of Canada and of the United States. Along the Hudson River Valley there are many fine exposures, some of which give a total thickness of four hundred feet (Dana). It also occurs in Virginia, Alabama, Tennessee, Ohio and Wisconsin, besides its probable recognized existence in Nevada by Dr. C. A. White (Walcott). Returning to Canada, not an unimportant outlier is that which we find in the immediate vicinity of Ottawa city. Indeed, it may be said that the deposits of Gloucester and Ottawa will give the diligent searcher many new and interesting forms of life peculiar to this formation, and as yet unrecorded in Canada. The Gloucester beds, as they are called, are pretty extensively developed, stretching out for several miles south and east of this city.

At Cumberland, Clarence and North Plantagenet, more of these outliers occur and have been recorded. There are also beds of shale belonging to this formation in the neighbourhood of L'Orignal, Ont. Another outlier, very remote from these, but of much importance, is found in the immediate vicinity of Lake St. John, P. Q. This locality has yielded some very fine fossils, chiefly graptolites and trilobites. On the Islands of Anticosti and Orleans there are rocks and boulders belonging to this formation that have been drifted thither but do not occur *in situ*, as belonging to those islands.

From these facts, it may be safely predicated that the Utica seas must have occupied pretty generally the whole central portion of the North American Continent, bounded on the north by the *Laurentian Hills*, and on the east and west by the *Appalachian* and *Rocky Mountain* Ranges respectively.

THE OTTAWA AND GLOUCESTER BEDS.

These beds have proved a rich hunting ground to the palæontologist. From them the late Mr. E. Billings obtained and described many new and interesting species, and doubtless the careful collector will be well repaid for his labours in the same field. To the east of the city along the Rideau River the Utica Slate formation is particularly well developed and very rich in fossils. It also occurs at Rochesterville, but the rock is brittle and almost destitute of fossils. By the Rideau we have several exposures each of which gives us a different horizon, with its characteristic set of fossils. Their stratigraphical relations are more or less obscure, yet with a little attention they can be tolerably well ascertained.

The exposure taken as representing the lowest of the series is that which is found at low water along the Rideau River at the Rifle Range.

These beds are very fossiliferous and abound especially in specimens of *pygidia* and *glabellae* of *Asaphus Canadensis*, (Chapman,) also *Triarthrus Becki*, (Green); and crinoid stems associated with numerous specimens of *Leptæna sericea*, (Sowerby,) *Lyrodesma puichellum*, (Hall) *Orthoceras lamellosum*, (Hall) and species of *Orthis* and *Strophomena*, etc. It is immediately overlying this exposure that we find cropping out several bands of compact yellow-weathering magnesian limestone, probably similar to those found at the St. Anne River, Montmorenci. In these bands are found numerous specimens of *Conularia Trentonensis*, (Hall,) *Orthoceratidae* and *Calymene callicephala*, (Green,) etc. The beds here dip at a small angle to the east, across the river, where, a little above and in the vicinity of the rapids, beds overlying these are seen which present new forms such as *Modiolopeis modiolaris*, (Conrad,) *M. anodontoides?* (Hall,) another *Modiolopsis*, probably a new species, associated with *Avicula insueta*, (Conrad,) and a few graptolitic fragments. Following the line of outcrop down the river we come to Cummings' Bridge where a very interesting deposit occurs. Here the remains of *Triarthrus spinosus*, (Billings), are abundant, some very fine and probably perfect specimens having been obtained. *T. Becki* (Green), also occurs there, and with it very numerous specimens of *Orthoceras lamellosum* of Hall, which are often found completely pyritized. The trilobites also are often coated over with pyrites.

Graptolites occur in this deposit, but not in a very good state of preservation. With these are also associated numerous minute linguloid shells of the genus *Leptobolus*, most of which are referable to *L. insignis* of Hall (24th Annual Report, N.Y., State Cabinet).

The total thickness of the exposure is about ten feet, the beds presenting much fission and crumbling. The next deposit worthy of note, and but recently noticed, is that which lies beyond the track of the St. Lawrence and Ottawa Railway, to the north-east of the last mentioned deposit. The chief characteristic of this is the abundance of graptolites. Very little has been done here as yet, and it has yielded *Graptolithus pristis* (Hisinger?) *G. flaccidus* (Hall.) *G. annectans* (Walcott). *G. sagittarius* (Hall). *G. quadrimucronatus* (Hall).

The graptolites in this bed are in a very perfect state of preservation, their condition greatly facilitating the identification of the different species.

Exposures of more or less importance also occur in the village of New Edinburgh and on the Montreal Road. At New Edinburgh, during the excavations made for waterworks purposes, some very interesting forms were obtained by His Excellency Lord Lorne, among which may be mentioned *Ceraurus pleurexanthemus* (Green).

On the Montreal Road, about two miles from the Rideau River, and resting almost at the summit of an axis of disturbance in a Trenton anticlinal, we find another exposure some fifteen feet thick, consisting chiefly of *brown, brittle, and highly cleavable rock*, but very unpromising as to fossils.

Now, taking these exposures severally in order, and observing their stratigraphical arrangement as constituting different horizons, marked respectively by

different sets of fossils, and looking at them likewise in their lithological character, we obtain a series of beds, though scattered about, giving us a total thickness of probably not less than forty feet.

NOTES ON SOME OF THE MORE INTERESTING FOSSILS FROM THE OTTAWA BEDS.

1. *Conularia Trentonensis*, (Hall). Several specimens of this Pteropod have been found, as mentioned above, in the deposit at the Rifle Range. It was at first thought to be *C. Hudsonia* of Emmons, but after referring it to Principal Dawson, he writes thus:—"After careful examination I cannot make your *Conularia* distinct from *Trentonensis*. There are two species described from the Utica, *C. Hudsonic*, of Emmons, and another, but yours does not agree with either." This species has not been previously recorded as occurring in the Utica Slate either of Canada or of the United States.

2. *Triarthrus spinosus* (Billings.) Very fine and perhaps perfect specimens of this species have been found in the Cummings' Bridge deposit. Some new features with respect to this fossil may be worthy of being placed on record. The specimens from which Mr. Billings described and figured this species were either young and imperfectly developed, or else imperfectly preserved. The individuals besides attaining to greater dimensions, possess spines which differ in some respects from those represented. For instance, the spine said to be attached to the eighth thoracic segment, in well developed individuals, attains a total length of some twenty millimetres; in other words, is almost equal in length to the whole body of the trilobite and has a furrow or groove running throughout its entire length. In a few specimens collected at the Cummings' Bridge deposit, a spine is attached distinctly to the ninth instead of to the eighth thoracic segment as is generally the case. In addition, that spine, which is attached to the *occipital* or *neck segment*, projecting backwards over the five anterior thoracic segments, and about one-third the length of the other spine, often exhibits a similar longitudinal groove, whilst these spines often appear quite rounded or cylindrically attenuated, when completely pyritized. These spines, as well as the remaining two attached to the posterior angles of the cephalic shield, likewise grooved, and also the whole surface of the trilobite, present, under a low power of the microscope, some interesting features. There are minute tubercles scattered over the whole surface of the body and spines; on the latter they are somewhat larger in dimension. These give an appearance of striation to the spines when looked at with a lens.

Of the furrows on the glabella, besides the usual two pairs, we have a single one running in a direction transverse to the others. On each side of this furrow two crescent shaped depressions occur, similarly situated on the anterior part of the glabella and parallel to the two pairs of furrows. The precise function of these, and their place in the anatomy of the creature, the writer has not as yet been able to ascertain. Another feature about this curious little trilobite is the tubercle or short spine (akin to those on *Triarthrus Becki* (Green), when adult),

situated about the central portion of the occipital segment, immediately in front of the spine attached to this segment. Further investigation will no doubt determine the precise number of spines this species possessed; for the present, we are satisfied with stating that it possessed at least more than four spines.

3. *Orthoceras lamellosum*, (Hall). Numerous specimens of this species occur in the Cummings' Bridge deposit. These were at first referred to the genus *Endoceras* of Hall, and the species *E. proteiforme*; but after several perfect detached septa of this species were found, showing the position of the siphuncle very clearly, as being but very slightly eccentric, its nature as being that of a true Orthoceratite was revealed, only one siphuncle being evident.

4. *Siphonotreta Scotica* (Davidson). This very pretty and extremely rare brachiopod was first noticed as occurring on this continent by Mr. J. F. Whiteaves, in a paper read before the A.A.A.S. meeting at Montreal in August last.

Appended is a list of the fossils which have been found about Ottawa by the writer, and others, the names of whom are given opposite the fossils in the case where the writer has not also found specimens. In conclusion, my acknowledgments are due to Principal Dawson of McGill College, and Mr. J. F. Whiteaves of the Geological Survey, for assistance in naming specimens and for other information contained in this paper; and my thanks are also due to Mr. C. D. Walcott, of the United States Geological Survey, for a copy of his valuable memoir on the Utica Slate of the United States.

LIST OF THE FOSSILS FOUND IN THE UTICA SLATE, IN THE NEIGHBOURHOOD OF OTTAWA.

Genera and Species.	*References.*
Ptilodictya acuta	Hall, 1847, Pal. N.Y., I. p. 74.
" recta	Hall, Pal. N.Y., I. pl. 26, fig. 1.
Diplograptus pristis	Hisinger?; G. pristis, Hall.
Climacograptus bicornis	Hall, Pal. N.Y., I. pl. 73, fig. 2.
Diplograptus mucronatus	Hall, Pal. N.Y., I. pl. 73, fig. 1.
Graptolithus quadrimucronatus	Hall, Dec. II Can. Org. Rem. pl. 13, figs. 1–10.
" flaccidus	Dec. II. Can. Org. Rem. pl. 2, figs. 17–19.
" annectans	Walcott, Fossils of the Ut. Sl. pl. 1, figs. 2, 2 *a*.
Lingula Daphne	Pillings, Pal. Fossils, vol. 1, p. 47.
" Progne	" " " " "
" quadrata	Eichwald, (Hall, Pal. N.Y., I. p. 96.)
" obtusa	Hall, Pal. N.Y., I. p. 98.
Schizocrania filosa	Hall (*Orbicula filosa*), Hall, Pal. N.Y., I. pl. 30., fig. 9.
Leptobolus insignis	Hall, XXIV, Ann. Rep. N. York State Cabinet, p. 227.
" occidentalis	Hall, XXIV, Ann. Rep. N. York State Cabinet, p. 227.
Leptæna sericea	Sowerby, Murch, Sil. System.
Strophomena deltoidea	Conrad (Hall), Pal. N.Y., 1. p. 106.

FOSSILS FOUND IN UTICA SLATE, IN THE NEIGHBOURHOOD OF OTTAWA.—*Concluded.*

Genera and Species.	*References.*
Strophomena alternata	Conrad (Hall), Pal. N.Y., 1. p. 102.
Orthis testudinaria	Dalman, Hall, Pal. N.Y., I. p. 11.
" subquadrata	Hall, Pal. N.Y., I. pl. 32, figs. 1*a*–0.
Zygospira Headi	Billings, Pal. Foss. p. 47.
Siphonotreta Scotica	Davidson. (Found by R. C. Watts, R.C.A.)
Avicula insueta	Conrad, (Emmons, Geol. Rep., p. 399.)
" Trentonensis	Conrad, 1842, Jour. Acad. Nat. Sc., III. p. 240.
Modiolopsis modiolaris	Conrad, Pal. N.Y., I. p. 294
Lyrodesma pulchellum	Hall, Pal. N.Y., I. p. 302.
Orthodesma parallelum	" Pal. N.Y., I. p. 299, (*Orthonota parallela.*)
Conularia Trentonensis	" " " p. 222.
" Hudsonia	Emmons, Amer. Geol. p. 208. (Found by F. R. Latchford.)
Bellerophon bilobatus	Sowerby, Murch. Sil. System.
Murchisonia Milleri	Hall (*M. bicincta, Hall.*)
Trocholites ammonius	Conrad, Geol. Rep. N.Y., p. 119.
Endoceras proteiforme	Hall, Pal. N.Y., I. p. 209.
Orthoceras coralliferum	" " " " 312.
" lamellosum	" " " " 209–210.
Serpulites dissolutus	Billings, Pal. Foss. I. p. 56.
Leperditia cylindrica	Hall, 24th Reg. Rep. p. 231.
Asaphus Canadensis	Chapman, Can. Journal, 1856, p. 236.
" platycephalus	Stokes, (*Isotelus gigas*, Dekay.)
Calymene callicephala	Green, Monogr, p. 30.
Ceraurus pleurexanthemus	Green, Monogr. p. 84.
Triarthrus Becki	" " p. 87.
" spinosus	Billings, Rep. Prog. Can. Geol. Surv. 1857, p. 304.
" glaber	Billings, Can. Nat. Geol. IV. p. 382.

In addition to the above, it may be well to mention the following found in this locality, but so far not identified with certainty.

(*a.*) *Monticulipora.*—Several specimens referable to two species of this genus.

(*b.*) *Crinoidal stems.*—Probably those of the genus *Heterocrinus.*

(*d.*) *Modiolopsis.*—Showing both concentric lines of growth and numerous radiating lines proceeding from the anterior extremity of the shell, and extending to its margin, allied in some respects to *M. cancellatus* of Walcott, but specifically distinct from it. Only two specimens of this shell have been found. When more are obtained it may prove to be a new species.

(*e.*) *Pleurotomaria.*—Allied to *P. subconica,* (small sp.)