Dyer, William Spafford
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of the

Credit River Section

By W. S. Dyer

Accompanied by seven plates, also insert entitled "Composite section of the rocks of the Credit River."

A Thesis submitted in conformity with the requirements for the degree of Doctor of Philosophy in the University of Toronto.

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PART 5.—PALEONTOLOGY[1]

The Paleontology of the Credit River Section

By W. S. Dyer

INTRODUCTION

The source of the Credit river is on the western side of the Niagara cuest near the village of Coningsby. From this point the river flows in a south easterly direction and empties into Lake Ontario at the village of Port Credi seven miles west of the city of Toronto. In its upper reaches, at Credit Fork and Cataract, it cuts through the cuesta and exposes the Cataract and Lockpor divisions of the Silurian, and the Queenston red shales. Between Credit Fork and Meadowvale, it winds slowly over the flat-lying drift which covers th Queenston shales. Two miles south of Meadowvale, the grey fossiliferou beds of the Richmond are first exposed, and from here to its mouth, a distanc of about eight miles, the river cuts through these rocks in many places an in addition, exposes the upper part of the underlying formation herein calle "Dundas".

The present study deals only with the paleontology of that part of th section below the Queenston red shales and is based on field work performe during the summers of 1921 and 1922. The method of treatment depart somewhat from that used in the former numbers of this series. As the exposure on the Credit are farther from Toronto than the others referred to in this repor only those fossils which are new to science are treated in detail. This subjec forms the second section of this number, the first being devoted to faunal lists comments on important features, and the stratigraphic range of the species The succession of strata and the correlation of the faunas is reserved for Par 6, but the necessary stratigraphic introduction precedes the paleontolog in this number.

Acknowledgments.—The work in the field as well as in the laboratory ha been under the supervision of Dr. W. A. Parks of the University of Toronto to whom the author is greatly indebted for advice and assistance on innumerabl occasions. Thanks are also due Dr. A. F. Foerste of Dayton, Ohio, for valuabl advice concerning the identification of certain brachiopods; Prof. W. H. Shidele of Oxford, Ohio, for supplying lists of Richmond fossils of Ohio with the exac range of each; and Dr. E. O. Ulrich of Washington for advice regarding certai specimens and microscopic sections. The drawings have been made by Mis Emily and Mr. Theo. Logier and the photomicrographs by the author.

Previous Work.—It is a surprising fact that a very small amount of wor has been done in former years on the lower part of the Credit river, althoug the district is readily accessible and situated close to Toronto. The firs reference in geological literature to the Credit river is found in the Report o Progress of the Geological Survey of Canada for the year 1843. In this report A. Murray, assistant geologist to Sir William Logan, classes all the rock under lying the country between the Rouge river in the township of Pickering on th east and the Credit river on the west with his "bluish shales and sandstones" which he defines as including all the rocks between the bituminous Utica shale

[1]This thesis forms a section of the general report on "The Stratigraphy and Paleontolog of Toronto and Vicinity," issued in 1925 as Vol. XXXII, Part VII, Report of Ontari Department of Mines.

below and the Queenston shales above. In the same report he correlates the "red and green sandstones, shales and marls," which have since become the Queenston, with the Medina of the New York geologists. In the report of the Geological Survey of Canada for 1863, the Credit river is again mentioned. The rocks outcropping in its bed are referred to the Hudson River group, and on the authority of Billings the names of two or three fossils, including the abundant species *Favositella stellata* (*Columnaria alveolata*), are given. In the report upon the "Palaeontology of Ontario," which appeared in the years 1874 and 1875, Nicholson describes certain species of fossils from the Credit River rocks, which he includes in the Hudson River group.

Dr. W. A. Parks next described the Ordovician section on the Credit river in a short article in Guide Book No. 5, issued by the Geological Survey of Canada at the time of the Geological Congress in Toronto in 1913. He refers the rocks in part to the Richmond and in part to the Lorraine, listing a few species from each formation. The first mention of the prominent coral reef at Streetsville is made in this article, although corals were among the fossils from the Credit river listed by Billings and Nicholson.

The only other work of importance appeared in Memoir No. 83 of the Geological Survey of Canada. In this memoir, Dr. A. F. Foerste gives an account of the stratigraphy and paleontology of the rocks at Streetsville, naming the fossils which he found and giving their position and range in the section. He did not find any distinctive species in the coral reef, but it was his opinion that these rocks are contemporaneous with the Gore Bay reef on Manitoulin island, which is referred with greater certainty to the Whitewater or Saluda of Ohio and Indiana. He found *Strophomena varsensis* which he listed as *Strophomena sulcata*, *Strophomena planumbona erindalensis* listed as *Strophomena planumbona*, and *Catazyga headi* at the base of the cliff northeast of the home of William Crozier, and he correlates this part of the section with the Waynesville of Ohio, a conclusion which finds support in this paper. Between this level and the coral reef, he found other species, chiefly pelecypods, which are also suggestive of the Waynesville. Below the former level he found nothing diagnostic. He did not find any indication of the Liberty, which is not surprising, for the establishment of the Streetsville member (*vide postea*) with relationship to the Liberty is based entirely on bryozoan remains, and Foerste records only two species of bryozoans from the whole Credit River section.

Outline of Stratigraphy.—The classification given below of the Cincinnatian strata in the vicinity of Toronto is founded on observations by Professor Parks at Toronto and by the writer on the Credit river.

CLASSIFICATION OF CINCINNATIAN STRATA OF TORONTO DISTRICT

Series	Time Scale	Formation	Member
Cincinnatian	Richmond	Richmond	Queenston Meadowvale Streetsville Erindale
	Maysville-Lorraine	Dundas	Credit Humber Danforth Rosedale
	Utica	Utica	Utica

The strata on the Credit river between Meadowvale and the lake show exposures in descending order of the lower part of the Queenston member, the whole of the Meadowvale, Streetsville, Erindale, and Credit members, and the upper part of the Humber member.

With the exception of the overlying red Queenston shale, the rocks consist largely of greyish shale showing in many places harder beds of impure arenaceous shale and argillaceous sandstones on which ripple marks are frequently seen and even mud cracks at some levels. At intervals, more or less defined, are layers of fossiliferous limestone. All these rocks indicate a deposition near a shoreline as attested by the markings mentioned and by the manner in which the fossiliferous limestone layers rapidly wedge out into unfossiliferous shales and sandstones.

The following table indicates the detailed subdivisions of the rocks on the Credit river, with an approximate correlation with those of the Ohio valley.

STRATIGRAPHY AND CORRELATION OF THE CREDIT RIVER ROCKS[1]

Credit River				Ohio Valley	
Formation	Member	Zone	Thickness	Foerste	Shideler
Richmond	Queenston		feet ?	Whitewater-Saluda	Upper Whitewater
	Meadowvale	Upper Meadowvale *Columnaria* reef	30		Saluda
	Streetsville	*Bythopora meeki* *Stromatocerium* reef *Homotrypa streetsvillensis* *Ischyrodonta miseneri*	20	Liberty	Lower Whitewater Liberty
	Erindale	Upper Erindale *Strophomena varsensis*	65	Waynesville	Waynesville
Dundas	Credit	*Stigmatella sessilis crassa*	50	Maysville	Maysville
	Humber	Unfossiliferous	100		
		Fossiliferous	26		

PALEONTOLOGY

Under this heading will be found a complete list of the species occurring on the Credit river, together with notes on important features and the strati-

[1]Since this table was printed, a new classification has been published by Dr. Foerste. See Mem. 138, Geol. Surv. Can., 1924.

graphic range of each, both in the Credit Valley basin and at points outside of it.

The total fauna consists of 101 species or varieties, of which 46 are *Bryozoa*. This feature constitutes one of the strongest peculiarities of the fauna. Next to the *Bryozoa*, the *Pelecypoda* are most abundant, with 22 species. The remaining fossils are in order of importance as follows: *Brachiopoda*, 12 species; *Gastropoda*, 8 species; *Anthozoa*, 5 species; *Nautiloidea*, 2 species; *Trilobita*, 2 species; *Hydrozoa*, 1 species; *Echinodermata*, fragments of 2 genera; *Incertae sedis*, 1 species. At least three-quarters of the total fauna is from the Richmond.

Of the above 101 species or varieties, 23 are described as new; of the *Bryozoa*, 13 species and 7 varieties; and of the *Brachiopoda*, 1 species and 2 varieties.

Hydrozoa

Stromatocerium huronense (Billings).—This species is very abundant in the *Stromatocerium* reef of the Streetsville member and in the *Columnaria* reef of the Meadowvale member. In some cases it forms masses as great as eight inches in diameter. As this species is known to occur at different horizons in the Richmond, it is of no particular formational significance.

Anthozoa

Calapoecia huronensis, Billings.—Foerste[1] in reference to this species, states that *C. cribriformis*, Nicholson, appears to be identical and that Nicholson's name should be abandoned, an opinion endorsed at a later date by that author himself.

Foerste records this species from a locality on the Credit river which seems to accord with the section in the Meadowvale member just above Castler's bridge. A fine specimen from Streetsville is in the collections of the University, but its exact stratigraphic level is not indicated. No further examples were found.

Columnaria alveolata, Goldfuss.—This coral occurs abundantly in the *Columnaria* reef of the Meadowvale member, and sparingly in the upper part of the Streetsville. The range of the species is long but it is most abundant elsewhere in the Saluda division.

Columnaria calicina, Nicholson.—On the Credit this species is found in the *Columnaria* reef and sparingly in the *Stromatocerium* reef. In other parts of Ontario, it is most abundant in strata correlated with the Whitewater, only one occurrence being recorded from rocks below this horizon (Waynesville of Manitoulin island). According to Foerste the species occurs in the Cincinnati basin at the base of the Liberty.

Streptelasma rusticum, Billings.—Foerste records the occasional occurrence of small examples of this species (one-quarter inch long) on the Credit at an outcrop above Castler's bridge (Meadowvale member). The species is common in all the divisions of the Richmond in Ohio and Indiana, and on Manitoulin isla d.

Tetradium approximatum, Ulrich.—Abundant in the *Columnaria* reef and in the *Stromatocerium* reef. Coralla as great as 18 inches in diameter are sometimes found. This fossil has frequently been ascribed to *T. minus* described by Safford from the Trenton of Tennessee, but it agrees more closely with *T. approximatum*, the common species of the Ohio, Indiana, and Ontario localities.

[1]Bull. Sci. Lab. Denison Univ., 14, 1909, p. 310, pl. 11, fig. 4.

Echinodermata

Glyptocrinus sp.—A portion of a column, apparently referable to this genus, was collected by Joseph Townsend at Streetsville, and is now in the possession of the University. Similar columnals are not uncommon in the Humber member in the quarry at Port Credit.

Lichenocrinus sp.—Stems possibly referable to this genus are found in the Humber member in the quarry at Port Credit.

Bryozoa

Amplexopora solitaria, sp. nov.—See page 17.

Atactopora sp.—A single example of a thin, frondescent, unilaminar bryozoan with elevated, sub-solid monticules was found in the Erindale member. It is herein referred to the genus *Atactopora*, but it is not sufficiently well preserved to admit of specific identification. In the spacing of the monticules, it appears to differ from other members of the genus from the Cincinnatian series. See Plate V, Figure 10.

Atactoporella densa, sp. nov.—See page 18.

Arthropora shafferi (Meek).—A single example of this species was found among the collections of the Royal Ontario Museum of Paleontology, labelled "Richmond, Credit River". It probably came from the Erindale member, since it is on the same piece of rock as a specimen of *Hallopora aequalis*, a new species from this member. It is identical in form and structure with the specimen described and figured by Parks and Dyer from the Humber River section.

Batostoma cf. *varians* (James).—A small fragment of a bryozoan was found in the *Bythopora meeki* zone of the Streetsville member, which is herein referred to the genus *Batostoma*. The character of its growth could not be ascertained, but the vertical section prepared from it seems to show that its relationships are with the species *B. varians* of the Waynesville rather than with *B. variabile* of the Liberty and Whitewater.

Bythopora meeki, James.—This species is comparatively abundant in the uppermost five feet of strata of the Streetsville member (zone of *Bythopora meeki*). The following remarks in reference to it are made by Bassler.[1]

> The various species of *Bythopora* are so much alike in internal structure that it is not strange that Nicholson considered the species under discussion only a variety of his *Monticulipora gracilis*. However, the fact that it occupies and is characteristic of a different geological horizon and always forms a considerably larger zoarium seems to me reason enough for its rank as a distinct species.
>
> *Bythopora gracilis* forms long, slender stems seldom over three millimetres in diameter and characterizes the Fairview and McMillan formations while the branches of *Bythopora meeki* are seldom less than six or seven millimetres in diameter and occur only in the Waynesville.

The forms from the Streetsville member vary in diameter from one and a half to six millimetres, the average being four millimetres. Thus, in size, they are intermediate between the two species mentioned above. They are referred in this paper to *B. meeki* on account of their occurrence in rocks which are even higher stratigraphically than those of the Waynesville. See Plate V, Figures 4 and 5.

Calloporella vacua, sp. nov.—See page 19.

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[1]Proc. U.S. Nat. Mus., 30, 1906, p. 21.

Ceramoporella ohioensis (Nicholson).—Three or four examples of this species were found growing over the zoaria of *Homotrypella* in the Streetsville member. In the Cincinnati basin it is a long-ranging fossil and is therefore of little use for purposes of correlation. See Plate V, Figure 11.

Constellaria cf. *limitaris* (Ulrich).—A small piece of a ramose species of *Constellaria*, measuring one-half inch in length, was found among the collections of the University from Streetsville. It resembles *C. limitaris* of the Ohio Richmond more than any other form, but a definite determination of the species cannot be made until better material is found. The stratigraphic level from which it came cannot be determined. See Plate VI, Figure 6.

Constellaria polystomella, Nicholson.—This species is found in abundance in the *Columnaria* reef at the base of the Meadowvale member. It is an interesting fact that *C. polystomella* as well as *Rhombotrypa quadrata* have not yet been found at a lower horizon than this on the Credit river, although in the Cincinnati basin and on Manitoulin island they are found throughout the Richmond.

Fenestella sp.—One poorly preserved specimen, probably referable to this genus, was found in the *Columnaria* reef in the Meadowvale member.

Eridotrypa cf. *simulatrix*, Ulrich.—A form which is here referred with some doubt to *E. simulatrix* was found in the Erindale and the Streetsville members. The ramose zoaria vary in diameter from two to four millimetres and have low monticules, consisting of average-sized zooecia, scattered evenly over their surfaces, with an average distance of two millimetres between them. The internal characteristics, as shown by tangential and vertical sections, agree fairly well with the type, except that the acanthopores cannot be clearly seen. They are apparently extremely small. According to Shideler, *E. simulatrix* ranges from the Lower Arnheim to the Lower Whitewater in Ohio. See Plate VII, Figure 6.

Hallopora aequalis, sp. nov.—See page 19.

Hallopora maculosa, sp. nov.—See page 20.

Hallopora cf. *onealli* (James).—A small form which occurs in the Erindale member and in the *Columnaria* reef of the Meadowvale member, appears to be closely related to *H. onealli* of the Eden shales of Ohio and the Indian Ladder shales of New York. Satisfactory sections could not be prepared, owing to the poor state of preservation in which the fossils were found, and definite specific determination is therefore impossible. A very similar form has been found in the Humber River section at Toronto. See Plate VII, Figure 3.

Hallopora onealli creditensis, var nov.—See page 20.

Hallopora cf. *rugosa* (Milne-Edwards and Haime).—Two examples of a small, ramose bryozoan were found in the Streetsville member, which possess the prominent, ridged monticules of *Hallopora rugosa* of the McMillan formation of Ohio. As good sections of it could not be prepared, its reference to the above species and even to the genus *Hallopora* is somewhat doubtful. Cumings[2] describes a similar species from the Whitewater member of Indiana, which he also ascribes to *H. rugosa*. See Plate VII, Figure 7.

Hallopora subnodosa, Ulrich.—This species occurs in the *Strophomena varsensis* zone of the Erindale member, in association with *Hallopora onealli*

[2]32nd Ann. Rep. Dep. Geol. Nat. Res. Indiana, 1908, p. 793, pl. 10, fig. 2; pl. 27, figs. 14, 14a.

creditensis, and in the lower part of the Streetsville member. The character of the surface is like that of the type in being somewhat variable; in some forms it is quite smooth and in others it has low monticules scattered over it. The groups of large-sized tubes, often seen in the type species, are apparently wanting in the Credit River specimens. The peculiar tabulation of the zooecial tubes and mesopores so characteristic of *H. subnodosa* is very clearly seen in vertical sections. *H. subnodosa* ranges from the Lower Arnheim to the Elkhorn in Ohio, and, therefore, is of little use in the determination of the more detailed geological subdivisions.

Heterotrypa definita, sp. nov.—See page 21.

Heterotrypa prolifica, Ulrich.—This species occurs in the bryozoan reef in the *Strophomena varsensis* zone of the Erindale member. It differs from the type species in a few minor details. The acanthopores in the Credit River forms are a little larger than in the type and show a slight variation in size. There is also a greater tendency toward the grouping of mesopores in the type species. In Ohio, according to Shideler, *H. prolifica* ranges from the Lower Arnheim to the Upper Whitewater and, accordingly, is of little use for purposes of exact correlation. See Plate V, Figure 3.

Heterotrypa robusta, sp. nov.—See page 22.

Heterotrypa simplex, sp. nov.—See page 22.

Heterotrypa simplex maculosa, var nov.—See page 23.

Heterotrypa cf. *subfrondosa* (Cumings).—A large frondescent form with indistinct monticules is common in the bryozoan reef in the *Strophomena varsensis* zone of the Erindale member. In general appearance, it is like *H. prolifica*, but differs surficially in being smoother and internally in the possession of more numerous mesopores and a much more distinct variation in size of the acanthopores. It closely resembles *H. subfrondosa* (Cumings), of the Fairmount of the Ohio valley.

Heterotrypa subpulchella parvulipora, var nov.—See page 23.

Homotrypa communis, Bassler.—This species is found in association with *H. streetsvillensis* in the Streetsville member. The two species cannot be distinguished from each other until tangential sections, prepared from each, are examined. The tangential section of *H. communis* reveals the presence of maculae, consisting of secondarily calcified mesopores, which are lacking in *H. streetsvillensis*. Of the two species *H. streetsvillensis* is much more abundant on the Credit river. According to Shideler, *H. communis* is found in the Upper Waynesville and Lower Liberty of Ohio.

Homotrypa creditensis, sp. nov.—See page 24.

Homotrypa cf. *richmondensis*, Bassler.—A fourth species of *Homotrypa* occurs in the *Homotrypa streetsvillensis* zone, but in such a poor state of preservation that the species can not be determined with any degree of satisfaction. The character of the growth can not be ascertained, but the features shown by tangential sections are like those of *H. richmondensis* of the Whitewater of the Ohio valley.

Homotrypa streetsvillensis, sp. nov.—See page 24.

Homotrypella dubia (Cumings and Galloway).—Thin, bifoliate expansions are found in the *Bythopora meeki* zone of the Streetsville member, which can without doubt be referred to this species. This is a rather interesting occurrence, since, heretofore, the species has not been found in rocks higher than the Arnheim in Indiana and Ohio. See Plate VII, Figure 10.

Homotrypella expansa, sp. nov.—See page 25.

Homotrypella hospitalis (Nicholson).—This species is abundant in the Credit River section, being found in all three members of the Richmond formation. It is most abundant in the Meadowvale member. The species may form very regular hemispheric masses as in Plate V, Figure 2, or irregular lobate masses as in Plate V, Figure 1. The smallest specimen measures 16 millimetres in diameter by 12 millimetres in height; the largest specimen is twice this size. In the Ohio valley, *H. hospitalis* occurs in all the members of the Richmond formation.

Homotrypella hospitalis peculiaris, var nov.—See page 25.

Mesotrypa patella (Ulrich).—One good example of this species was found in the Streetsville member. It agrees with the type from the Whitewater of the Ohio valley in all details except one: the maculae, consisting of larger tubes than the average, which are characteristic of *M. patella*, have not been seen in the Credit River example. If the absence of the maculae is found, after an examination of more material, to be a constant feature of the Streetsville form, a new variety would be justified. See Plate V, Figure 9.

Monotrypella curvata, sp.nov.—See page 26.

Monticulipora parasitica multipora, var nov.—See page 27.

Rhinidictya cf. *parallella* (James).—Abundant specimens of a cryptostomatous bryozoan are found in the Erindale member on the Credit river. They are very close in their relationships to *R. parallella* of the Southgate member of the Eden of the Ohio valley, but as no well-preserved specimens were obtained, and as they are characteristic of a much higher zone, it is thought best not to refer them too definitely to James' species.

Rhombotrypa quadrata (Rominger).—This species and *Constellaria polystomella* are abundant in and confined to the *Columnaria* reef in the Meadowvale member. This is an interesting fact, since both species are found in all the members of the Richmond formation, in the Cincinnati basin and on Manitoulin island. See Plate IV, Figure 5; Plate VI, Figure 4.

Stigmatella crenulata, Ulrich and Bassler.—Typical representatives of this species are found in the Erindale formation. The Credit River forms differ from those described by Parks and Dyer from the Humber river at Toronto, which they ascribe to the same species, in that the walls of the former are inflected by the acanthopores, to a greater extent. The Humber River forms are probably forerunners of *S. crenulata*, but should at least be given a new varietal name. In Ohio, according to Shideler, *S. crenulata* is confined to the Waynesville member of the Richmond. See Plate IV, Figure 6; Plate VII, Figure 8.

Stigmatella hybrida, sp. nov.—See page 27.

Stigmatella incrustans, Cumings and Galloway.—Several examples of a bryozoan have been found in the *Homotrypa streetsvillensis* zone of the Streetsville member of the Richmond, which are referred to *S. incrustans* of the Liberty of Indiana. They incrust crinoid columns and brachiopod and pelecypod shells. Many forms of incrusting bryozoans, referred to the genus *Stigmatella*, are very close to one another in their relationships; among this number are: *S. incrustans*, *S. sessilis*, *S. clavis*, and *S. nicklesi*. *S. incrustans* is distinguished by the possession of monticules and by its loose, irregular habit of growth. See Plate VI, Figure 7.

Stigmatella interporosa, Ulrich and Bassler.—A fragment of a ramose bryozoan was found in the Streetsville member which is herein referred to *S. interporosa*. This species, according to Cumings and Galloway resembles *S. catenulata*, being distinguished from that species by the less robust growth and thinner mature region, by the weaker development of chain-like mesopores, and by the greater number of these mesopores. According to Ulrich and Bassler, *S. interporosa* occurs in the Waynesville of the Cincinnati basin.

Stigmatella cf. *lambtonensis*, Parks and Dyer.—Two or three specimens which resemble this species were found in the Erindale member. In the original description of the species, *S. lambtonensis* was distinguished from *S. sessilis*, Cumings and Galloway, by a difference in growth. The latter species is incrusting and forms rather delicate discs, while the former is not incrusting and forms coarser, more irregular zoaria. Internally, the two species are identical. It is possible that future study will show that the two species are identical, or more probable still that *S. lambtonensis* is identical with the variety *Stigmatella sessilis crassa*, of the Credit member of the Dundas formation. See Plate V, Figure 8.

Stigmatella catenulata var. B., Parks and Dyer.—A single example of this variety was found in the quarry at Port Credit, incrusting a joint of the column of *Lichenocrinus* sp. The zoarium of the Credit River form is less robust than that of the type specimen from the Humber member of the Dundas formation, and the development of the chain-like mesopores is not so great. In these features it is more like *S. sessilis crassa* of the Credit member. It agrees, however, with the type of *S. catenulata var. B.* in the neat regular growth about a crinoid column.

There is evidently very little difference between certain species of the genus *Stigmatella* of the Dundas and Richmond formations. When more material is procured and a further intensive study made upon the genus, it may be found that *S. catenulata*, *S. sessilis crassa*, *S. lambtonensis*, *S.* cf. *clavis*, and *S. incrustans* are variants of single species. On the other hand, *S. crenulata*, at least the form found on the Credit river, *S. hybrida*, *S. interporosa*, and *S. personata* seem to be better defined species.

Stigmatella sessilis crassa, var. nov.—See page 28.

Stigmatella personata lobata, var. nov.—See page 28.

Brachiopoda

Catazyga headi, Billings.—This species undoubtedly occurs on the Credit river, but no good examples of full-grown forms have been found during recent investigations. Several typical examples were found by Joseph Townsend and are now in the collections at the University, labelled as coming from Streets-

ville. Young forms of *Catazyga* were found on Mullet creek in the zone of *Strophomena varsensis*, which in all probability are the young of *C. headi*, and it is probable, also, that Townsend procured his specimens from this zone.

C. headi is represented in the Cincinnati basin by the variety *C. headi schuchertana* (Ulrich), which is with difficulty separated from the type species of Canadian localities. According to Foerste,[1] this variety differs in not possessing the broad but very shallow median depression along the anterior part of the pedicle valve, and also in the greater tendency in the Ohio variety toward a subquadrate outline in the case of the brachial valve, at least posteriorly, owing to the considerable lateral extension of the hinge line. Foerste evidently considers these distinctions of little value, as he says:—

> If these features do not prove comparatively constant for the Cincinnatian specimens all attempt to distinguish them under a separate designation may prove of little value.

C. headi schuchertana occurs in the upper part of the middle or Clarkesville division of the Waynesville and at the base of the Blanchester or upper division, according to Foerste. *C. headi* occurs in strata correlated with the Waynesville on Manitoulin and at Meaford; in Quebec, in addition to occurring abundantly in Waynesville strata, it ranges for many feet down into rocks which are correlated with the Maysville.

Hebertella occidentalis, Hall.—This is a very abundant species in the Richmond of the Credit river. It occurs in all three members although perhaps in greatest abundance at the top of the Meadowvale. *H. occidentalis* is the only species of brachiopod usually regarded as typically Richmond to be found in the Dundas formation on the Credit river, a few examples being found in the Credit member at Erindale.

Platystrophia cf. *acutilirata* (Conrad).—One specimen was selected from a trayful of brachiopods labelled "*Platystrophia clarkesvillensis* Streetsville," which resembles *P. acutilirata* more closely. It is more extended along the hinge line than *P. clarkesvillensis*, and has more numerous lateral plications than the latter. The exact horizon from which the specimen came is not known.

Platystrophia clarkesvillensis, Foerste.—This is one of the most abundant species of brachiopods on the Credit river, being found in the Meadowvale, in the Streetsville, and in the upper part of the Erindale members of the Richmond. In Ohio, according to Shideler, it is confined to the Waynesville. Its range is thus considerably higher in the Credit River section than in Ohio.

Rafinesquina alternata, Emmons.—Two forms of *R. alternata* are found on the Credit river. One of these forms is herein referred to the type, while the other is given the new varietal name *R. alternata subcircularis*. *R. alternata* is abundant in the bryozoan reef in the Erindale member and in the rocks immediately overlying the *Columnaria* reef in the Meadowvale member, but has not yet been found in the Streetsville. No evidence of the presence of either of the forms has yet been obtained from the Dundas formation on the Credit river, although *R. alternata* is abundant in this formation on the Humber river

Rafinesquina alternata subcircularis, var. nov.—See page 29.

[1]Bull. Sci. Lab. Denison Univ., 16, 1910, p. 32, *et seq.*

Rafinesquina mucronata torontonensis, Parks and Dyer.—This brachiopod is very abundant in the Humber member on the Credit river, where it occurs in limestone in association with *Zygospira erratica*. It does not differ from the form described by Parks and Dyer from the Humber River section.

Strophomena planumbona erindalensis, var. nov.—See page 30.

Strophomena varsensis, sp. nov.—See page 31.

Trematis millepunctata, Hall.—This species has been found in all formations of the Cincinnatian series in the United States and Canada, from the Eden to the Richmond. A single fragment only was found on the Credit river, in the zone of *Strophomena varsensis* in the Erindale member of the Richmond, but this fragment shows the ornamentation characteristic of the species so clearly that there can be no mistake about its identity.

Zygospira (?) *erratica* (Hall).—This species is found in great abundance in the Humber formation in the quarry at Port Credit, in association with *Rafinesquina mucronata torontonensis*, Parks and Dyer. These two forms are also abundant on the Humber river at Weston and Lambton. *Z. erratica* forms one of the connecting links between the Dundas formation of Toronto and the Lorraine of New York, being common to these two formations but absent from the Cincinnatian rocks of the Ohio valley.

Zygospira modesta, Hall.—This is the most abundant brachiopod on the Credit river, being found in the Dundas formation and in all the members of the Richmond except the Queenston. It is a long-ranging form and, therefore, is of little use for purposes of correlation.

Pelecypoda

Anoptera cf. *miseneri*, Ulrich.—The exterior of a left valve of a pelecypod was found at the foot of the cliff on the Credit river opposite the Streetsville fair grounds. It is either from the upper part of the Erindale or lower part of the Streetsville member, these portions of the two members being exposed at this locality. The outline of the shell and the character of the plications are like *A. miseneri*, but as no interiors have been seen and since the horizon at which the species occurs in the Ohio valley (Elkhorn) is much higher than on the Credit, it is thought best not to refer the shell definitely to this species.

Byssonychia grandis, Ulrich.—This species occurs in the Streetsville member of the Richmond formation. In Ohio, according to Shideler, it occurs at a somewhat higher horizon than it does on the Credit, namely, in the Saluda and Whitewater divisions.

Byssonychia radiata (Hall).—This is not a very common species on the Credit river, but typical specimens do occur at various horizons, namely, in the Humber and Credit members of the Dundas formation and in the Erindale and Streetsville members of the Richmond.

Byssonychia robusta, Miller.—Beautifully preserved examples of *B. robusta*, of the Whitewater and Saluda members of the Richmond of Ohio, are found in the zone of *Ischyrodonta miseneri* in the Streetsville member on the Credit river. *Byssonychia robusta* and *B. richmondensis*, Ulrich, are very similar and occur at the same horizon in the Cincinnati basin. The ribs are coarser in the former species, varying, according to Foerste, from 38 to 41 in number, while in the

original description of *B. richmondensis*, Ulrich states that although the ribs are difficult to count, there are not less than 50 of them on each valve. Foerste also states that the valves of *B. robusta* are relatively shorter and broader than those of *B. richmondensis*. It is Foerste's opinion, however, that these two forms are very closely allied if not identical, *B. richmondensis* being a laterally compressed form of *B. robusta*.

Byssonychia cf. *praecursa*, Ulrich.—Pelecypods resembling *B. radiata*, but with the flattening of the anterior side characteristic of *B. praecursa*, are found in the *Strophomena varsensis* zone in the Erindale member of the Richmond and in the Credit member of the Dundas formation on the Credit river. Typical forms are found in the Pulaski shale of New York and in the Maysville of Ohio.

Clidophorus fabula (Hall).—This species is found in the shale overlying the *Columnaria* reef in the Meadowvale member of the Richmond. In Ohio, it ranges from the Eden to the Richmond.

Clidophorus planulatus (Conrad).—This is a common species in the Eden and Maysville of Ohio and the Pulaski shale of New York, but in Canada it extends its range upward into the Richmond. It has been reported from the Waynesville of eastern Ontario and Quebec. On the Credit river, one example was found in the Credit member of the Dundas formation and one in the Erindale member of the Richmond.

Ctenodonta cingulata (Ulrich).—A single well-preserved example of this species was found in the *Strophomena varsensis* zone. *C. cingulata* occurs in the Richmond in Ohio, Kentucky, and on Manitoulin island, but one example from the Dundas formation of the Humber river has been referred to it by Miss H. Stewart.

Ctenodonta filistriata, Ulrich.—Two or three examples of this species were found in the Humber member on the Credit. It is found all through the Dundas formation of Toronto with the exception of the Credit member. In the United States it is found only in the Eden of Kentucky.

Cuneamya scapha brevior, Foerste.—This form occurs abundantly in shale of the Humber member in the quarry at Port Credit. In the State of New York and the Province of Quebec, it is found in the Lower Lorraine shales, and in the vicinity of Toronto it is found both on the Don and on the Humber river.

Cymatonota cf. *lenior*, Foerste.—Fragments of the shells of a species of pelecypod evidently referable to *C. lenior* were found in the Credit member of the Dundas formation. Previously *C. lenior* had been reported by Foerste from rocks in Quebec which he correlates with the Pulaski and by Stewart from the Dundas formation of the Humber river.

Ischyrodonta miseneri, Ulrich.—Well preserved examples of this species were found on the Credit river, in the lower five feet of the Streetsville member, herein called the zone of *I. miseneri*. The Streetsville specimens are a little thinner than the type forms from Indiana, but in all other respects they are very similar. In Indiana and Ohio, according to Shideler, *I. miseneri* is found in the Upper Whitewater.

Ischyrodonta unionoides (Meek).—One beautifully preserved and unmistakable example was found in the Credit member of the Dundas formation. A

few doubtful forms from the Humber member of the Dundas at Port Credit have also been referred provisionally to this species. It is found in the Maysville of Ohio and the Pulaski of New York.

Modiolopsis concentrica, Hall and Whitfield.—This is a common species throughout the Cincinnatian series of Ontario, but in Ohio it is found only in the Richmond. On the Credit river it is found in both members of the Dundas formation and in all three members of the fossiliferous Richmond.

Modiolopsis postplicata, Foerste.—A single example of this species was found in the Humber member in the quarry at Port Credit. It has previously been reported from the Pulaski of Quebec, Dundas of the Humber river, and doubtfully from the Waynesville of Quebec.

Modiolopsis versaillensis, Miller.—A single example of this species is among the older collections of Streetsville fossils in the Royal Ontario Museum of Paleontology. The exact stratigraphical horizon from which it came is not known.

Modiolopsis borealis, Foerste.—A single right valve of this species was found in the Credit member on the Credit river, just below Erindale. Foerste reports the same species from the Lorraine, one mile south of the clay cliffs, at the eastern end of Manitoulin island.

Opisthoptera fissicosta, Meek.—The range of this species is higher in the Credit River section than in the Ohio valley. In Ohio it occurs in the Waynesville, but on the Credit it is found in the Streetsville and Meadowvale members of the Richmond. It has not yet been obtained from the Erindale.

Orthodesma cf. *canaliculatum*, Ulrich.—A pelecypod was found in the Streetsville member which in outline, in the character of the concentric striae, and in the prominence of the anterior and posterior muscle scars, is close to *Orthodesma canaliculatum* of the Blanchester division of the Waynesville of Ohio. The peculiar pallial line and radiating striae seen in the type are not present on the Credit River specimens.

Ortonella cf. *hainesi* (Miller).—One specimen of a pelecypod was found in association with *Ischyrodonta miseneri* in the Streetsville member, which greatly resembles the above species in outline and in the character of the concentric plications. The preservation of the specimen, however, is too imperfect to allow any indication of the lunule and escutcheon characteristic of *O. hainesi* to be seen, and hence it can only be placed provisionally under that species.

Pterinea demissa, Conrad.—This species is abundant and evenly distributed throughout all the divisions of the Cincinnatian series of the Credit River section.

Whiteavesia pholadiformis (Hall).—Fragments of the shells of this species showing the characteristic transverse plications are found in all the divisions of the Dundas and Richmond formations of the Credit River section with the exception of the Queenston. No complete specimens, however, were found. *W. pholadiformis* is a characteristic Richmond species in the Ohio valley, but has not been found in the Maysville or Eden of that area. In Ontario, on the other hand, it has been found in all the divisions of the Cincinnatian series with the exception of the Utica.

Whitella cf. *hindi*, Billings.—A few examples of a pelecypod, very similar in form to this species were found in both the Credit and Humber members of

the Dundas formation on the Credit river. The type of the species was obtained in the Dundas formation on the Humber river.

Whitella cf. *torontonensis*, Stewart.—One of the specimens of *Whitella* from the Humber member at Port Credit is more quadrate in form than the specimens referred to *W. hindi* and more closely resembles *W. torontonensis*. This latter species was founded on a single specimen, which was thought to have come from the Don River valley.

Gastropoda

Bellerophon cf. *mohri*, Miller.—A single specimen of a gastropod closely related in form to this species was found in the zone of *Ischyrodonta miseneri* in the Streetsville member of the Richmond formation. The character of the mouth, whether widely flaring as in *B. mohri*, or relatively narrow as in *B. subangularis*, Ulrich, can not be determined; but in general proportions and in the smooth character of the surface, the Streetsville specimen more closely resembles the former species. According to Shideler, both of these forms are found in the Saluda and Upper Whitewater in the Ohio valley.[1]

Clathrospira cf. *subconica*, Hall.—Two specimens in the older collections of the Royal Ontario Museum of Paleontology are referred to this species. One was labelled as coming from "Credit river" and the other from "Streetsville".

Cyclonema sp.—A few body whorls of a gastropod showing the characteristic surface markings of the genus *Cyclonema* were found in the *Columnaria* reef of the Meadowvale member of the Richmond on the Credit river.

Cyrtolites ornatus, Conrad.—This species occurs in the strata overlying the *Columnaria* reef of the Meadowvale member of the Richmond.

Liospira helena (Billings).—This species occurs in the *Columnaria* reef on the Meadowvale member on the Credit river. It is an Anticosti species, but has been reported from rocks correlated with the Whitewater on Manitoulin island.

Lophospira bowdeni, Safford.—This is the most abundant gastropod in the Richmond of the Credit river, being found in all three members. It is a long-ranging form and, therefore, is of little use in determining the sequence of the rocks.

Lophospira tropidophora, Meek.—This is another common gastropod in the Richmond of the Credit river. In the Ohio valley, it ranges from the Eden to the Richmond, but in Ontario it is more common in the Richmond formation than in the Dundas.

Oxydiscus sp.—One poorly preserved example of the genus *Oxydiscus* was found among the older collections of Streetsville fossils at the University.

Cephalopoda

Actinoceras crebriseptum (Hall).—A single example of this species was found in the Credit member of the Dundas formation at Erindale. It is a very abundant species in the Humber member of the Dundas formation in the prison quarry at New Toronto; in New York state it occurs in the Pulaski shales.

[1]Foerste has described a new species from a similar horizon on Manitoulin island as *Bellerophon parksi*. It is possible that our specimen belongs to this new species.

Orthoceras lamellosum, Hall.—A single example of this species was found in the Humber member in the quarry at Port Credit. It has been reported by Parks and Fritz from the Humber member of the prison quarry at New Toronto, but it is not so abundant as *Actinoceras crebriseptum* at that locality. *A. crebriseptum* has not yet been found in the quarry at Port Credit, but its presence there is to be expected, since it is so abundant in the prison quarry at New Toronto, which occupies practically the same stratigraphic level. In New York, *O. lamellosum* is found in the Pulaski shales.

Trilobita

Calymene sp.—An indeterminate specimen belonging to this genus was found among the collections at the University, labelled as coming from the Richmond of Streetsville.

Isotelus maximus, Locke.—Fragments of *Isotelus* probably belonging to the above species occur at many horizons in the Dundas formation and in the Erindale member of the Richmond in the Credit River section. It is most abundant in the Credit member of the Dundas where it is found incrusted with the zoaria of *Stigamatella sessilis crassa*. Some of the fragments occurring in this member are very large. On comparing the measurements of some of the largest fragments found with corresponding fragments of the large forms of the Don Valley brick yard, it was found that the specimens from the Credit compared favourably with the largest forms from the Don.

Incertae Sedis

Pasceolus cf. *camdenensis*, Foerste.—The impression of part of the external surface of a specimen of *Pasceolus* was found at the foot of the cliff at Section No. 12, near Streetsville; it came either from the Erindale or Streetsville member of the Richmond, parts of both members being exposed at this locality. The impression of the plates is very distinct and shows that the plates were convex when looked upon from the exterior as in *P. camdenensis*.

DESCRIPTION OF NEW SPECIES

AMPLEXOPORA SOLITARIA, *sp. nov.*

Plate I, Figures 1 and 3; Plate VII, Figure 2

This species is represented by one small fragment of a ramose zoarium from the *Homotrypa streetsvillensis* zone of the Streetsville member. The surface of the specimen is so thickly covered by limestone that its character can scarcely be seen, but it is apparently smooth.

In tangential sections cut from the mature zone, it is seen that the zooecial tubes, which average eight in two millimetres, have extremely thick walls, as much as two-fifths of the diameter of each tube being taken up by the walls. A peculiar feature, however, is that at certain places the walls become thin as if monticules had been cut through. In tangential sections, the dark boundary between the walls of the adjacent tubes is not always seen, but in deeper tangential sections it is clearly marked. Mesopores are numerous and are usually found scattered throughout the zoarium. The arrangement of the acanthopores is much the same as in *Heterotrypa robusta* (see p. 22). They are found between the angles of junction of the zooecial walls, usually inflecting the latter.

One of the most distinctive features of the species is seen in vertical sections. The walls of the zooecia are very thin in the sub-mature region, but assume their great thickness very suddenly as the mature region is reached. The dark boundary line between the walls of the zooecia is very clearly seen in vertical sections. In the mature region, diaphragms cross the tubes at distances, approximately equal to the internal diameter of the latter, but are much less frequent in the immature region.

Although in the opinion of the writer (see p. 22), the division of the trepostomatous bryozoans into the *Amalgamata* and *Integrata*, on the basis of the presence or absence of the dark line bounding adjacent zooecial walls, is an artificial one, still it must be admitted that certain forms show this boundary line more clearly than others and can with convenience be assembled into the family *Amplexoporidae*. *Amplexopora solitaria* is one of these forms and is the only member of the family with acanthopores to be found on the Credit river. It can be distinguished from other species of the genus by the great thickness of the zooecial walls and by the sudden manner in which they thicken on passing from the immature to the mature zone.

Locality.—Credit river, Streetsville.
No. 12147, Royal Ontario Museum of Paleontology.

Atactoporella densa, *sp. nov.*

Plate I, Figures 2 and 4

A single example of a bryozoan, showing the internal characters of the genus *Atactoporella*, was found in the zone of *Bythopora meeki* in the Streetsville member. It is not well preserved, but it differs so decidedly from any previously described member of the genus from the Cincinnatian series that it has been decided to erect a new species for its reception.

The zoarium consists of four superimposed layers, which are rather thick for the genus, each layer varying from two to three millimetres in a vertical direction. It could not be ascertained, on account of the poor preservation of the fossil, whether the surface is monticulose or smooth. It apparently is not an incrusting form.

In characters shown by both tangential and vertical sections, *A. densa* resembles *A. ortoni* (Nicholson), of the Maysville of Ohio. The tubes are small, nine to ten in two millimetres, with the comparatively thick walls lined by average-sized acanthopores. As many as twelve acanthopores have been counted surrounding a single zooecial tube. The mesopores, so far as can be determined, are not as numerous as in *A. ortoni*, and are not filled by secondary deposits as in that species, but are open throughout their length. The mesopores are crossed by numerous diaphragms, while the zooecia have both diaphragms and cystiphragms.

In addition to the differences already enumerated, *A. densa* differs from *A. ortoni* in the manner of growth. The latter species forms exceedingly thin, monticulose crusts, usually attached to the shells of brachiopods. The Streetsville form differs from *A. schucherti*, Ulrich, the only other member of the genus found in the Richmond, in the much smaller size of the acanthopores, in the smaller number of mesopores, and in the manner of growth.

Locality.—Credit river, Streetsville.
No. 12148, Royal Ontario Museum of Paleontology.

Calloporella vacua, *sp. nov.*

Plate I, Figures 5 and 6

This species occurs in the *Strophomena varsensis* zone of the Erindale formation, on Cooksville creek. The zoarium is discoidal, with a convex upper surface and a concave lower surface, as in *Mesotrypa patella* (Plate V, Figure 9). The lower surface is covered by an epitheca. The discs measure about 15 mm. in diameter and are 2.5 mm. thick at the centre. The character of their surfaces can not be ascertained as the apertures of the tubes are filled with limestone.

The zooecial tubes are of average size and thin-walled, as seem in tangential sections. Mesopores are large, but are less numerous than in other members of the genus, there being usually only three or four in contact with each zooecial tube. This disposition of the mesopores allows adjacent zooecia to touch one another at many points. Acanthopores are absent.

In vertical sections, it is seen that the mesopores and zooecial tubes alternate with one another with considerable regularity. Diaphragms are crowded in the mesopores, but the zooecial tubes have few or no diaphragms. The arrangement of the bases of the alternating zooecia and mesopores is quite regular as in *Peronopora vera*, Ulrich, as described by Parks and Dyer for specimens from the Don River section at Toronto. The bases of the zooecia are small and trapezohedral in shape, while the bases of the mesopores are larger and hexagonal.

C. vacua differs from any other member of the genus in the paucity of the mesopores and in the apparent lack of diaphragms in the zooecial tubes. The latter feature is so marked that the reference of the species to *Calloporella* is doubtful, as the genus is characterized by numerous diaphragms in the zooecial tubes. On the other hand, there is no other described genus to which the form could be more suitably ascribed.

Locality.—Cooksville creek.
No. 12149, Royal Ontario Museum of Paleontology.

Hallopora aequalis, *sp. nov.*

Plate I, Figure 7; Plate II, Figures 1 and 2; Plate VII, Figure 15

A species of *Hallopora* which differs from any previously described form is well represented in the Streetsville and Erindale members; it is ramose in growth and rather large, the branches averaging seven millimetres in diameter. The surface is smooth. The zooecial apertures are polygonal, somewhat variable in size, and comparatively small, nine to ten occurring in two millimetres. Mesopores are extremely few.

In tangential sections cut from near the surface, the mesopores ares omewhat more numerous than at the actual surface, there being on the average two or three mesopores for every zooecial tube, but considerable portions of these sections can be found in which mesopores are entirely absent. The mesopores occur at the angles of the walls and are very often found in pairs. In deeper tangential sections, the mesopores are more numerous, showing that they pinch out on approaching the surface. In still deeper tangential sections, the mesopores are very numerous, entirely surrounding the zooecial tubes.

Vertical sections demonstrate beautifully the manner in which the mesopores pinch out on approaching the surface. In deeper parts of the zoarium they are numerous, but outwards they grow smaller and finally disappear altogether

before the surface is reached. There is no definite boundary between the mature and submature regions, but one fades gradually into the other.

Hallopora aequalis differs from *Hallopora onealli creditensis*, the only other species on the Credit river for which it might be mistaken, in the manner in which the mesopores pinch out at the surface, resulting in the polygonal shape of the apertures in the former, while in the latter species the zooecial apertures are rounded or oval, with numerous mesopores between them.

H. aequalis resembles *H. onealli communis* (James) in the manner in which the mesopores pinch out at the surface, but differs distinctly in having no maculae, in having smaller tubes, and by the fact that the branches do not appear to form bushy masses by anastomosis as in the case of *H. onealli communis*.

Bassler in his study of the James types of bryozoans makes a few comments on *H. onealli communis*, but does not infer that "maculae or monticules occupied by calices much larger than the average occur in most specimens" as stated by James in the original description of the same species. If it is true that the presence of maculae is not a varietal feature in *H. onealli communis*, then our species differs from it chiefly in the smaller size of the tubes.

Locality.—Credit river, Streetsville.
No. 12150, Royal Ontario Museum of Paleontology.

Hallopora maculosa, *sp. nov.*

Plate II, Figures 3 and 4

A single specimen of *Hallopora* was found in the *Stromatocerium* reef in which the arrangement of the mesopores is very peculiar. Instead of being more or less regularly distributed throughout the zoarium, as in all other species of *Hallopora* which have been studied for this paper, the mesopores are confined to maculae in each of which they occur to the number of 15 or 20. In the features shown by the vertical section, *H. maculosa* does not differ from *H. onealli* or the variety of that species so common on the Credit river, *H. onealli creditensis*.

Very little of the specimen was left after the sections were made; in consequence, the general shape of the zoarium cannot be described. Vertical sections, however, show that the specimen had grown over the ramose zoarium of another species of *Hallopora*, indicating a probable encrusting habit. It is hoped that further search will yield other examples of this species, which will serve for further description as to structure and manner of growth.

Locality.—Credit river, Streetsville.
No. 12151, Royal Ontario Museum of Paleontology.

Hallopora onealli creditensis, *var. nov.*

Plate I, Figure 8; Plate V, Figures 6 and 7

A form of *Hallopora* is abundant in the Credit member and at various levels in the Erindale and Streetsville members, which closely resembles *Hallopora onealli sigillarioides* (Nicholson) of the Eden, forming branching stems with an average diameter of 4.5 mm. It also resembles that species closely in internal characters, but is given a new varietal name partly on account of one small internal difference and also because of the much higher horizon at which it is found. No sign of larger tubes has ever been seen in the Credit River variety; a feature which is often present to some extent in *H. onealli sigillarioides*.

The form is very close to *Hallopora onealli danforthensis*, Parks, of the Danforth member of the Dundas formation of the Don River valley. The present form differs only in a somewhat less robust zoarium and in the manner in which the tubes turn out toward the surface, as seen in longitudinal sections; in *H. onealli danforthensis* they turn rather sharply outwards at the boundary between the mature and the immature zones, while in *H. onealli creditensis* they bend very gradually outward, the boundary between the two zones being scarcely distinguishable. It should be stated, however, that certain specimens have been found on the Credit which cannot be distinguished from the Don Valley forms.

Locality.—Credit river, Streetsville.
Nos. 12152, 12153, Royal Ontario Museum of Paleontology.

Heterotrypa definita, *sp. nov.*

Plate II, Figures 5 and 6; Plate VI, Figure 11

The coarse branching zoaria of this well-defined species are found in great numbers in the bryozoan reef in the *Strophomena varsensis* zone of the Erindale member.

The branches are large, commonly reaching 15 mm. in diameter. Maculae, each one made up of about 20 mesopores, are arranged evenly over the surface with an average distance of two millimetres between them.

In tangential sections, *H. definita* resembles *H. simplex maculosa* of the Streetsville member in that the acanthopores are arranged very regularly, one to each angle of junction of the zooecial walls. It differs, however, from that species in the distribution of mesopores. In *H. definita* they are gathered into maculae as well as being distributed evenly throughout the whole zoarium, while in *H. simplex maculosa* they are found only in the maculae. In addition, the groups of mesopores are never surrounded by zooecia of larger than average size in the former as they are in the latter.

The most striking characteristic of this species is observed in the longitudinal sections. At definite periods of the growth of the zooecia the walls become so swollen that a long continuous line of swellings can be followed for considerable distances along the same level through the zoarium, sometimes for the whole length of the section, in one instance, a distance of three millimetres. The diaphragms are comparatively numerous, an average of 10 being found in each tube, but they are entirely wanting in the axial zone. In the same manner as the swellings referred to above, the diaphragms occur at similar levels in the various zooecia, giving the appearance of continuous horizontal lines in vertical section. In some cases the lines of diaphragms coincide with the lines of swellings, and in other cases they alternate with them.

This species has been placed under the genus *Heterotrypa* on account of the numerous diaphragms, thick walls, and general resemblance to undoubted members of that genus from the Credit River section. In one feature, however, it greatly resembles *Stigmatella*, namely, in the possession of the periodic thickenings which is considered by Ulrich and Bassler as one of the characteristics of the latter genus.

The coarse, branching growth, the surface covered with maculae, and the periodic thickening of the walls form a combination of features by which this form is easily distinguished from any other species of *Bryozoa*.

Locality.—Mullet creek, Erindale.
Nos. 12154, 12155, Royal Ontario Museum of Paleontology.

Heterotrypa robusta, *sp. nov.*

Plate II, Figures 7 and 8; Plate VI, Figure 2

In the Streetsville member, several specimens of a coarse, ramose, smooth-surfaced bryozoan were found, in which the zoarium varies from 12 to 15 mm. in diameter.

In tangential sections, the outstanding features of the species are the strong inflection of walls by the acanthopores and the fact that most of these acanthopores are found between the angles of junction of the zooecial walls. They are fairly numerous and of medium size. The zooecial tubes are small, 11 being found in a space of two millimetres. The mesopores are not numerous and are usually distributed evenly throughout the zoarium but are occasionally gathered into maculae.

In some parts of the tangential sections, distinct dark boundaries are seen between the adjacent zooecial walls, while in other parts of the same sections no evidence of a separation is visible, the walls being completely fused. Less diversity is seen in the immature region where the walls are usually separate. The variability in this respect leads to the conclusion that the fusion of the walls is not a specific feature. A similar conclusion was reached with regard to other species. In view of these observations the writer is inclined to question the value of subdividing the trepostomatous bryozoans into *Integrata* and *Amalgamata*.

In longitudinal sections the axial portion is seen to be comparatively small, with a diameter not more than one-half that of the whole zoarium. In this axial part the tubes run upward and outward with very thin and crenulated walls. There are no diaphragms. On reaching the mature zone, the tubes turn abruptly and run directly to the surface of the zoarium at the same time becoming thick-walled. In this zone the walls are even and straight with a slight suggestion of periodic thickening. Diaphragms are present with a distance equalling one tube-diameter between them. Mesopores and acanthopores are seldom seen in longitudinal sections.

Heterotrypa robusta resembles *Heterotrypa microstigma*. Cumings and Galloway, of the Waynesville of Indiana, more than any other species, but the average diameter of the ramose zoarium in the former is greater, and the minute, raised, sub-solid maculae of *H. microstigma* are wanting.

Locality.—Credit river, Streetsville.
Nos. 12156, 12157, 12158, Royal Ontario Museum of Paleont

Heterotrypa simplex, *sp. nov.*

Plate III, Figure 1

This species is rather common in the Streetsville member where it forms ramose or sub-ramose, smooth-surfaced zoaria, with an average diameter of 10 mm., as in *H. simplex maculosa* (Plate VII, Figure 10).

In tangential sections, it is seen that the tubes are of a very uniform size and rather small, twelve being found on the average in a distance of two millimetres. Mesopores are entirely absent. Acanthopores are numerous, comparatively small, and the regularity of their distribution is remarkable, one being found at each angle of junction of the zooecial wall. Very rarely is a departure from this occurrence found.

In vertical sections, *Heterotrypa simplex* is almost identical with *H. robusta* (Plate II, Figure 7). The structure is so similar, as thus revealed, that a repetition of the description is unnecessary.

In internal characters, *Heterotrypa simplex* resembles *H. solitaria*, Ulrich, of the Fairmount, but this species is frondescent rather than ramose in its manner of growth. From all other species of *Bryozoa* occurring in the Credit River section, the present species may be distinguished by the very regular arrangement of the acanthopores and the entire absence of mesopores.

Locality.—Credit river, Streetsville.
No. 12159, Royal Ontario Museum of Paleontology.

Heterotrypa simplex maculosa, *var. nov.*

Plate III, Figure 2; Plate VII, Figure 9

The above variety differs from *Heterotrypa simplex* only in the occurrence of maculae. These are placed at wide irregular intervals over the surface of the zoarium and are not raised above the general level of the zoarial surface. They are composed of mesopores, five to twenty in number, and in certain places are surrounded by zooecia larger than the average.

In both *Heteroptrypa simplex* and *H. simplex maculosa*, quite definite boundaries between the zooecia are seen in sub-mature regions, but, as in *Heterotrypa robusta*, the walls become fused in the mature regions.

The variety occurs in the Streetsville member, very often in association with *Heterotrypa simplex.*

Locality.—Credit river, Streetsville.
Nos. 12160, 12175, Royal Ontario Museum of Paleontology.

Heterotrypa subpulchella parvulipora, *var. nov.*

Plate VI, Figure 9

Among the older collections of *Bryozoa* from Streetsville in the Royal Ontario Museum of Paleontology, one specimen was found which closely resembles *Heterotrypa subpulchella* (Nicholson), of the Maysville of Ohio. In form it is a flattened sub-ramose mass, measuring 32 mm. in length, 20 mm. in width, and 13 mm. in height. It probably branched, since the broken bases of branches are still seen. Maculae are scattered over the surface of the zoarium, with an average distance of one millimetre between them. They are scarcely raised above the general surface of the zoarium.

The variety resembles the type in tangential sections, particularly in the character of the maculae, which consist of mesopores to the number of 10 or 15 in each, surrounded by zooecial tubes of distinctly larger than average size. The acanthopores are numerous and vary considerably in size, some of them being abnormally large. They are usually found between the angles of junction of the zooecial walls. The zooecia of the new variety are smaller than in the type of the species, 11 to 12 being found in two millimetres, in the former; while in the latter, no specimens have been recorded in which they are more numerous than nine in two millimetres, and according to Nicholson there are only six to seven tubes in this distance. This is the most outstanding difference between the two forms. Another difference is that in *H. subpulchella parvulipora*, the mesopores are confined to the maculae, while in Nicholson's species they are sometimes found between the maculae.

The two forms are very similar in vertical sections. They possess thin, crenulated walls, with the average number of diaphragms for the genus to

which they are referred. Even here, however, there is a difference, *H. subpulchella* having more diaphragms in the axial region than *H. subpulchella parvulipora*.

Locality.—Credit river, Streetsville.
No. 12161, Royal Ontario Museum of Paleontology.

Homotrypa creditensis, *sp. nov.*

Plate III, Figures 3 and 4; Plate VII, Figure 5

This member of the *Homotrypa communis* group of *Bryozoa* occurs in the zone of *Homotrypa streetsvillensis*, in association with the type species of the zone. *H. creditensis* is the only member of the genus in the Credit River section which bears monticules. These are distributed regularly over the surface of the zoarium with an average distance of three millimetres between them. Their character cannot be determined by an examination of the surface, but tangential sections show them to be composed of mesopores, surrounded by zooecial tubes of almost twice the average size.

In tangential sections, the zooecial tubes are seen to be small, twelve occurring in two millimetres. Their walls are thin for the greater part of their course but appear thicker near the surface of the zoarium, as the mesopores in this part are filled with a secondary deposit of calcite. Numerous angular mesopores are scattered throughout the zoarium as well as being grouped into the monticules as mentioned above. Acanthopores are present but are small and unimportant.

In vertical sections, it is seen that cystiphragms only are present in the zooecial tubes. They are restricted to the younger part of the mature region, both zooecia and mesopores being empty near the surface. Closely crowded diaphragms are found in the mesopores.

H. creditensis is closer to *H. nodulosa*, Bassler, than to any other form, these two species being very similar in vertical sections, but differing decidedly in tangential sections, and in growth.

Locality.—Credit river, Streetsville.
No. 12162, Royal Ontario Museum of Paleontology.

Homotrypa streetsvillensis, *sp. nov.*

Plate III, Figures 5 and 6; Plate VI, Figure 5a, b, c; Plate VII, Figure 4

A ramose representative of the *Homotrypa communis* group is found in such numbers in a definite horizon of the Streetsville member that it has been selected as the type fossil of the zone.

In this species the branches vary from five to ten millimetres in diameter, and in some cases reach a length of 50 mm. The surface is smooth without any indication of maculae; the apertures indicate thick-walled zooecia of small but uniform size—twelve in two millimetres.

In tangential sections, the mesopores are few in number and the tubes polygonal in shape, but as the axial region is approached the mesopores become numerous and the tubes become rounded or oval in shape. Acanthopores of medium size are usually found at the angles of junction of the walls. The characters of this species as revealed by vertical sections are very like those of *Homotrypa communis*, diaphragms being absent and the broken type of cystiphragms, so characteristic of that species, being well shown.

The relationships of the present form, as already stated, are with *H. communis*, but a decided difference from that species is indicated by the smaller

size of the tubes and by the absence of maculae of any kind. It perhaps resembles *H. austini*, Bassler, still more closely, but differs in having the cystiphragms distributed evenly throughout the peripheral zone, whereas in that species they are confined to the maculae.

Locality.—Credit river, Streetsville.
Nos. 12163, 12164, 12165, Royal Ontario Museum of Paleontology.

Homotrypella expansa, *sp. nov.*

Plate V, Figure 11

A specimen was found in the Streetsville collection of *Bryozoa* in the Royal Ontario Museum of Paleontology, which in its internal characters resembles *Homotrypella hospitalis* (Nicholson), very closely. The growth, however, is vastly different from the typical growth of the latter species, the zoarium being a broad, undulating expansion, 90 mm. in diameter, with an average thickness of three millimetres instead of a sub-hemispheric, sub-conical, or irregular compact mass. In places the expansion consists of a single layer, in other places of two or more successive layers. Over the surface are evenly distributed low but distinct monticules, which consist of tubes somewhat larger than average in size.

The presence of monticules and the peculiar form suggest that the species might be referred to the genus *Monticulipora*, but it has been retained in the genus *Homotrypella* on account of its very close similarity, internally, to *H. hospitalis*, and because the walls are clear and definite in structure. Bassler states that one of the best features for the determination of the genus *Monticulipora* is the hazy, indefinite character of the walls.

Locality.—Credit river, Streetsville.
No. 254, Royal Ontario Museum of Paleontology.

Homotrypella hospitalis peculiaris, *var. nov.*

Plate IV, Figure 1

Monticulipora (Prasopora) Selwynii, *var.* hospitalis, *Nicholson.* Genus Monticulipora, 1881, p. 209, fig. 45.
Prasopora hospitalis, *Cumings.* 32nd Rep. Dept. Geol. Nat. Res. Indiana, 1908, p. 871, pl. 23, figs. 1, 1b; pl. 31, fig. 6.
Homotrypella hospitalis, *Bassler.* Bull, U.S. Nat. Mus., 77, 1911, p. 174 (gen. ref.).

The original description of *Homotrypella hospitalis* appears below:—

M. selwynii var. *hospitalis* is invariably an attached form, all the numerous examples which I have seen being fixed to the exteriors of the shells of brachiopods. In form they are hemispheric, rarely nearly globular, and their general size is from six to ten lines (about 12 to 20 mm.) in diameter and from three to four to seven or eight lines (6 to 16 mm.) in height.

Tangential sections show a close correspondence in general structure with the type form of *M. selwynii* from the Trenton Limestone. The corallum (zoarium) is composed of large and small corallites (zooecia) the former being oval or circular in shape and varying from 1/50 to 1/70 of an inch in diameter (four to six in two millimetres), each showing an excentrically perforated tabula (diaphragm). The small corallites (mesopores) are numerous, sub-angular and wedged in between all the larger tubes occasionally being aggregated into star-shaped groups or maculae.

Besides the normal two kinds of corallites, a considerable number of thick-walled, hollow spines (acanthopores) may be observed which I have not detected as present in the examples from the Trenton Limestone.

Vertical sections show the same marked difference in the tabulation of the large and small corallites as has been previously noticed in the type form with some differences. The large tubes are always doubly tabulate, one set of tabulae forming a series of large lenticular vesicles (cysts) while the remaining tabulae are horizontal and remote. The small corallites are furnished with numerous complete horizontal tabulae.

Cumings (*op. cit.*) states that:—

In form *H. hospitalis* is fairly typical, although rather more inclined to form irregular masses than its Trenton relatives which are usually very regularly hemispherical or sub-conical in form.

H. hospitalis is abundant in all the subdivisions of the Richmond formation on the Credit river, with the exception of the Queenston. At times it forms very regular, hemispheric or sub-conical zoaria, while at other times the zoaria are very irregular in shape (Plate V, Figures 1 and 2). In addition, a few specimens have been ascribed to a new variety.

H. hospitalis peculiaris differs from the type in one feature only, namely, in the possession of numerous minute acanthopores, which are situated along the zooecial walls between the large acanthopores characteristic of the type. These small acanthopores are much more pronounced near the surface of the zoarium, where as many as six have been counted between two large acanthopores. Deeper in the zoarium they may disappear altogether. They are apparently of the nature of true acanthopores since hollow centres have been seen in many instances.

Locality.—Credit river, Streetsville.
No. 12166, Royal Ontario Museum of Paleontology.

Monotrypella curvata, *sp. nov.*

Plate IV, Figures 3 and 4; Plate VI, Figure 3

This species is represented by a single specimen, which was found among the Townsend collection of Streetsville fossils in the Royal Ontario Museum of Paleontology. The exact stratigraphic level from which it came is not known, but it was probably from the *Columnaria* reef of the Meadowvale member, since a fragment of *Columnaria calicina*, a species very common in the reef, was found adhering to the zoarium. In form it is an irregular, sub-ramose mass, 35 mm. in length and 25 mm. in diameter, with a smooth surface.

Tangential sections show the zooecia to be of large size, six occurring in two millimetres. A few small tubes are scattered among the larger ones which are probably not of the nature of mesopores as no evidence of the presence of two types of tube is seen in vertical sections. The zooecial walls are comparatively thick near the surface, but are much thinner in sub-mature regions. The line of demarcation between adjacent tubes is very distinct and there is a total absence of acanthopores.

In vertical sections, numerous well-defined diaphragms are seen crossing the tubes. They are in most cases considerably curved and approach the funnel-shaped diaphragms of *Amplexopora robusta*, Ulrich. These curved diaphragms appear in tangential sections as complete rings, within the walls of the zooecia.

M. curvata differs from other members of the genus in the curved diaphragms and the large size of the tubes. It resembles *Amplexopora robusta* in some features but differs in the absence of groups of larger tubes and in the absence of acanthopores.

Locality.—Credit river, Streetsville.
No. 12167, Royal Ontario Museum of Paleontology.

Monticulipora parasitica multipora, *var. nov.*

Plate IV, Figure 2; Plate VI, Figure 8

Monticulipora parasitica, *Ulrich.* Jour. Cincinnati Soc. Nat. Hist., 5, 1882, p. 238, pl. 10, figs. 3, 3a.
Monticulipora parasitica, *J. F. James.* Ibid., 18, 1895, p. 81.
Monticulipora parasitica, *Cumings.* 32nd Rep. Dept. Geol. Nat. Res. Indiana, 1908, p. 862, pl. 21, figs. 2, 2b; pl. 31, fig. 2.

The original description of *Monticulipora parasitica*, somewhat abbreviated, is as follows:—

The zoarium is usually attached to *Streptelasma* (*corniculum*). Regularly arranged in decussating series and at distances apart of about .1 inch, the surface presents small conical monticules, the summits of which usually appear to be solid, as they are occupied by minute cells; while on their slopes they carry the apertures of cells slightly larger than the average. The largest of these have a diameter of 1/85 of an inch (about seven to two millimetres). The spaces between the monticules are flat and are occupied by the polygonal and moderately thin-walled ordinary cells varying from 1/110 to 1/100 of an inch (eight to nine in two millimetres). Interstitial cells (mesopores) are developed only in the monticules, the summits of which are usually occupied by their apertures.

Tangential sections show the tubes to be polygonal. Their angles of junction are usually thickened and the small space thus formed incloses almost invariably a minute lucid spot. They represent in all probability very small spiniform tubuli (acanthopores). Between the groups of slightly larger cells a few thick-walled minute tubes (mesopores) may generally be observed.

Longitudinal sections show that all the matured tubes have one or both sides lined by a series of cystoid diaphragms while the space between the double series and opposite wall is crossed by straight diaphragms, which are placed at distances apart of about one-third of a tube-diameter. (Diaphragms only are found in the mesopores.)

Cumings (*op. cit.*) makes the following remarks concerning a form which he finds at the base of the Liberty at Weisburg, Indiana, and which he refers to *Monticulipora parasitica*:—

The specimen figured by me may not belong to this species as it has well developed mesopores. Its habit and superficial appearance are, however, the same as those of Ulrich's species. In its internal characters it is more like *M. cincinnatiensis*, James.

Two specimens were obtained from the Streetsville member which appear to belong to *Monticulipora parasitica* except for the fact that they possess numerous mesopores. In this respect they agree with the form described and figured by Cumings from the Liberty of Indiana, as belonging to this species. The apparent identity of our specimens with those of Cumings and the constant departure from the type of the species, as indicated by the presence of mesopores, seems to justify the creation of a new variety. The new variety resembles *M. cincinnatiensis*, as stated by Cumings, but it differs in having acanthopores and in the lower type of monticule.

Locality.—Credit river, Streetsville.
Nos. 12168, 12169, Royal Ontario Museum of Paleontology.

Stigmatella hybrida, *sp. nov.*

Plate IV, Figures 7 and 8; Plate VII, Figure 1

A bryozoan, which differs from any previously described species, was found in the *Strophomena varsensis* zone of the Streetsville member at Cooksville creek. The zoarium consists of a large, more or less cone-shaped mass, measuring 40-45 mm. in diameter, with a smooth surface, there being no evidence of either maculae or monticules.

In tangential sections, the typical appearance of *S. crenulata*, Ulrich and Bassler, is presented. Zooecial tubes are of medium size. The acanthopores,

which are numerous, are found between the junction angles of the walls of the zooecia and strongly inflect the walls. The mesopores are gathered into maculae.

The features of the species as shown by vertical sections, differ decidedly from those of *S. crenulata*, and suggest *S. catenulata*, Cumings and Galloway. The zooecial walls are not crenulated as in the former species but are straight as in the latter. There is also a marked development of chain-like mesopores as in *S. catenulata*.

S. hybrida is one of the best-defined species of the genus *Stigmatella*. It differs quite strongly in growth and in the combination of characters as seen in sections from any other form in the Cincinnatian series.

Locality.—Cooksville creek.
No. 12170, Royal Ontario Museum of Paleontology.

Stigmatella personata lobata, *var. nov.*

Plate VI, Figure 1

Stigmatella personata, *Ulrich and Bassler.* Smiths, Misc. Coll., Quart., 47, 1904, p. 36, pl. 12, figs. 1-3.
Stigmatella personata, *Cumings.* 32nd Rep. Dept. Geol. Nat. Res. Indiana, 1908, p. 884, pl. 24, figs. 3, 3d.
Stigmatella *cf.* personata, *Parks and Dyer.* Dept. Mines Ontario, Vol. 30, pt. 7, 1921, p. 16, pl. 3, fig. 61; pl. 4, figs. 6, 7.

The original description of *Stigmatella personata* is as follows:—

This is one of the non-mesopored species of the genus and forms smooth, branching zoaria very much like *S. crenulata* and *S. spinosa*. From the former it is distinguished by having fewer acanthopores and in lacking the crenulation of the walls in the immature region. From *S. spinosa* it is separated by its larger zooecia, seven to eight being found in two millimetres, while 10 are required in that species to cover an equal distance. The acanthopores in *S. personata* also afford a difference, being but seldom more numerous than the junction angles which they usually occupy. In *S. spinosa* it will be remembered they are so abundant that they almost completely surround the zooecium.

A new variety of this species was found among the older collection of fossils at the University. The exact horizon at which it occurs is not known.

S. personata lobata differs from the type species in the manner of growth and in the character of the surface; it forms an irregular, lobate mass 30 mm. in diameter, with the surface covered by low but conspicuous monticules composed of tubes which are slightly greater in size than the average. The specimens from the Humber river, ascribed by Parks and Dyer (*op. cit.*) to *S. personata*, are more branching in form than the Credit River variety, but resemble it in the possession of low monticules.

Locality.—Credit river, Streetsville.
No. 12171, Royal Ontario Museum of Paleontology.

Stigmatella sessilis crassa, *var. nov.*

Plate VI, Figure 10

Stigmatella sessilis, *Cumings and Galloway.* 37th Ann. Rep. Dept. Geol. Nat. Res. Indiana, 1913, p. 87, pl. 19, fig. 3; pl. 20, figs. 2-2b.
Stigmatella sessilis, *Parks and Dyer.* Dept. Mines Ontario, vol. 30, pt. 7, 1921, p. 15 (gen. ref.).

Cumings and Galloway (*op. cit.*) describe the species *Stigmatella sessilis* in the following terms:—

Zoarium discoidal about 15 mm. in diameter and three millimetres thick in the centre, growing parasitically upon foreign objects. There is no basal epitheca.

The zooecia as shown by tangential sections, are polygonal, their apertures oval or circular, 10 zooecia in two millimetres. Surrounding the aperture is a ring of very light coloured schlerenchyma, which is in turn surrounded by a very thin dark ring. The median line is usually light in colour, but is absent in some places, in which case the two dark rings constitute the median line. Mesopores are practically absent. Acanthopores are numerous, 10 in 10 zooecia, quite constant in size about 2/3 the size of number 1, that is 1/30 mm. in diameter. The lumen is clear.

The zooecia at first are crossed by thin diaphragms, their own diameter or less apart. In this region there is also a considerable number of chain-like mesopores. In the remaining portion of the zooecia the diaphragms are twice their diameter apart. At several successive levels, four in the type specimen, the acanthopores and walls show the characters of maturity, at these levels there is one diaphragm, occasionally two in each tube, at the same height in adjacent zooecia. That these levels represent successive stages of maturity is proven by the specimen, for the growth is interrupted completely in one part of the zoarium at these four levels. This characteristic of rejuvenation and overgrowth is not confined to the genus *Stigmatella*. It is a common feature of a good many species of *Trepostomata* and we consider it as an inadequate basis upon which to found a genus. We consider *Stigmatella* as a valid genus; but we rely chiefly upon the thin walls, small acanthopores, few diaphragms and the presence of mesopores for its recognition.

The variety *Stigmatella sessilis crassa* is abundant in the Credit member. It is very similar to *S. sessilis* in internal characters, but differs decidedly in manner of growth. The variety forms coarse irregular zoaria, tightly adhering to the fragments of other fossils, chiefly the trilobite *Isotelus*. In some parts, the zoarium is as thin as two millimetres, but in other parts it is very coarse, approaching 20 mm. in thickness.

Locality.—Credit river, Erindale.
No. 12172, Royal Ontario Museum of Paleontology.

Rafinesquina alternata subcircularis, *var. nov.*

Plate VII, Figure 14

In examining the various specimens of *Rafinesquina alternata* from the Credit River localities, it was found that they can be separated into two groups. The members of one group resemble the type and are retained under it. The members of the other group differ decidedly from the first and it was decided to give them a new varietal name.

R. alternata subcircularis is a long form, the length being equal to or slightly greater than the width. The greatest width is not along the hinge line but slightly in front if it, giving a more circular outline to the shell than exists in any previously described form of the species. The shell is very flat; the alternation of the striae is very clearly shown and the median stria is always most prominent.

R. alternata subcircularis resembles *R. alternata fracta* (Meek), more than any other form, but it is more circular in outline and without the parallel sides so characteristic of the latter variety.

The average width of the specimens is 23 mm. and the height 22 mm. The smallest specimen measures nine millimetres in length, by the same in width, while the largest is 28 mm. long and 32 mm. wide. It is most abundant in the *Strophomena varsensis* zone in the Erindale member but also occurs in the rocks immediately above the *Columnaria* reef in the Meadowvale member.

Locality.—Credit river, Streetsville.
No. 12173, Royal Ontario Museum of Paleontology.

Strophomena planumbona erindalensis, *var. nov.*

Plate VII, Figures 11, 12, and 16

Leptaena planumbona, *Hall.* Pal. New York, 1, 1847, p. 112, pl. 31, fig. 4.
Strophomena planumbona, *Emmons.* Amer. Geol., 1, pt. 2, 1885, p. 198, pl. 11, fig. 2; p. 186, figs. 54-56.
Strophomena planumbona, *Foerste.* Bull. Sci. Lab. Denison Univ., 17, 1914, p. 26, pl. 2, figs. 4a, 4b.

The original description of *Strophomena planumbona* follows:—

Shell resupinate, robust, length and breadth as nine to eleven; cardinal line straight, suddenly deflected at the extremities, equal to or greater than the width of the shell; sides a little contracted just below the cardinal extremities, leaving slightly salient angles; ventral (dorsal) valve flat or slightly depressed near the beak, elevated and very convex in the middle, somewhat abruptly and concentrically deflected towards the margin; dorsal (ventral) valve flat on the disc, slightly elevated towards the beak and deflected to correspond to the other valve; surface marked by radiating striae, every third, fourth or fifth of which is alternated by a stronger one; entire surface (in perfect specimen) marked by fine concentric elevated lines and a few imbricating lines of growth.

Foerste (*op. cit.*) referring to the same species, makes the following remarks as to the proportions of the shell and the number of striae:—

In the specimen represented by Fig. 4a the length is 20 mm.; the width, 25 mm.; and the convexity about six millimetres. In the specimen represented by Fig. 4b the convexity equals seven millimetres and in the most gerontic specimens it may attain even 11 mm. Surface striae fine and thread-like, about 13 in a width of five millimetres, occasionally as few as 11, rarely as many as 20.

Numerous examples of a variety of this species occur in the zone of *Strophomena varsensis* in the Erindale member on Mullet creek. They differ from the type of the species in the more evenly-rounded antero-posterior outline, and in the finer striation. The dorsal valve of the variety from the Credit river is more rounded in the portion anterior to the beak and is not so incurved along the anterior margin, while the convexity of the valve is less than in the type. The radiating striae are much finer in *S. planumbona erindalensis:* they average 30 in five millimetres at the anterior margin, but certain specimens were found in which the number reaches 35 in an equal distance. The striae may be sub-equal or there may be an alternation of coarse and fine ones. On some valves, it has been observed that three or four fine striae may group themselves between two coarse ones. By the aid of a good lens extremely fine concentric lines can be seen to cross the radiating striae.

The average width of the Credit River variety is 18 mm. and the length 12.3 mm. The smallest specimen measures 12 mm. in width by nine millimetres in length. The type specimen (a dorsal valve) is 28 mm. wide and 17 mm. long, with a convexity of 2.5 mm.

Examples of the above form were sent to Dr. Foerste whose opinion was that they should be given a new varietal name, based on the flatter form and finer striation. He also said that in many of the forms from the Credit river which were already in his possession, the callosity bordering the margin of the pedicle valves, a small distance back of their anterior and lateral edges, was rather narrower than in typical *S. planumbona*. No valves showing good interiors are contained in our collections.

According to Foerste, the forms most closely resembling *S. planumbona erindalensis* are found in the Waynesville division of the Richmond in Ohio and Indiana.

Locality.—Mullet creek, Erindale.
No. 12174, Royal Museum of Paleontology.

Strophomena varsensis, *sp. nov.*

Plate VII, Figure 13

Strophomena varsensis, *Foerste*, MSS.

In the lowermost 20 feet of the Erindale formation, a brachiopod which resembles *Strophomena sulcata*, De Verneuil, is so abundant that it is taken as the type species of the zone.

S. varsensis resembles *S. sulcata* in being a moderately convex, rather short shell with a well-defined mesial sulcus in the anterior of the ventral valve and a corresponding elevation in the anterior of the dorsal valve. The Credit River species differs from *S. sulcata* in its smaller size and coarser radiating plications. The former averages 14 mm. in width and nine millimetres in length, with a convexity of two millimetres, but many specimens are not over 11 mm. in width by seven millimetres in length. The fold and sulcus are scarcely perceptible in these smaller forms, which may represent the immature stages in the life history of the species. The type specimen, somewhat larger than the average, is 16 mm. in width by nine millimetres in length. The radiating plications appear to be much coarser than those of *S. sulcata*, since in addition to being actually coarser, they are on a considerably smaller shell. They average nine in five millimetres at a distance of five millimetres from the beak, and eight in five millimetres at the anterior margin. The increase in their number is accomplished by fission.

S. varsensis approaches *S. sinuata*, James, in the coarseness of the plications, but the latter species is even larger than *S. sulcata*, while our species is smaller than that form.

Foerste in a letter to the writer makes the following remarks in reference to *S. varsensis:*—

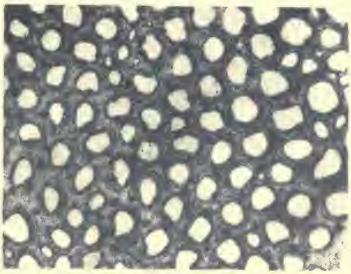
> Many of your specimens contain also a coarse ribbed form of *Strophomena* belonging to the *Strophomena sulcata* group. The nearest approach to this form in Ohio occurs in the base of the Blanchester division of the Waynesville member of the Richmond formation, where it is associated with *Catazyga headi* just as in the case also with your Credit River specimens. It so happens, however, that I studied forms of this kind from the Waynesville of the Richmond area east of Ottawa, in Canada, where I called it *Strophomena varsensis*, in the unpublished manuscript on the fossils of that area. Your specimens resemble the Ottawa Basin specimens more closely than the Ohio and Indiana representatives in having slightly wider radiating plications.

Locality.—Mullet creek, Erindale.
No. 12174, Royal Ontario Museum of Paleontology.

Plate I

Unless otherwise stated, figures are magnified thirty diameters.

Plate I



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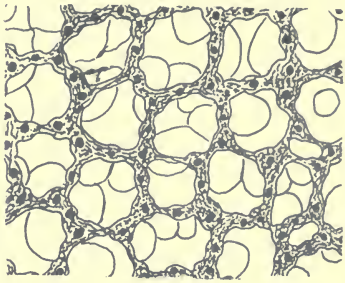

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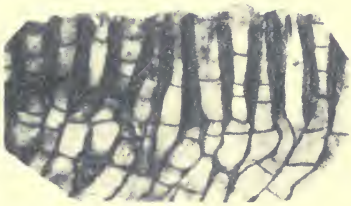

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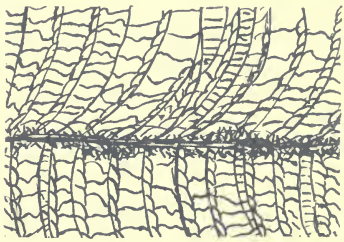

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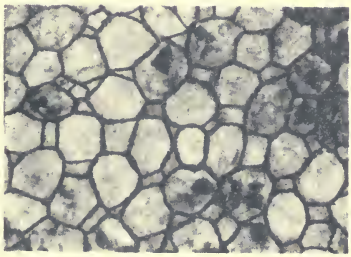

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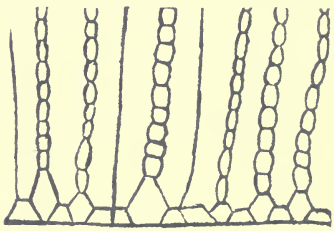

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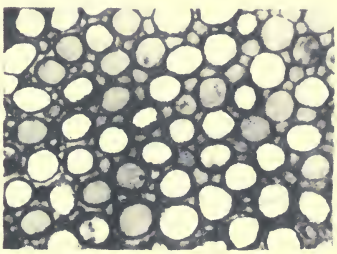

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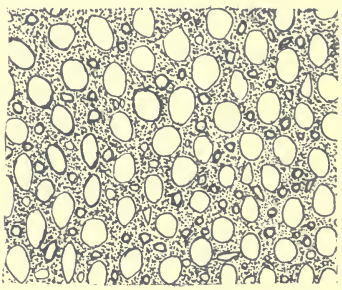

8

Plate II

Unless otherwise stated, figures are enlarged thirty diameters.

Plate III

All figures are magnified thirty diameters.

Plate IV

All figures are × 30 except Fig. 1, which is × 60.

Plate V

All figures are natural size.

Plate VI

All figures are natural size.

Plate VII

Unless otherwise stated, figures are natural size.

PART 6.—STRATIGRAPHY[2]

B.—Stratigraphy and Correlation of the Credit River Section

By W. S. Dyer

Introduction

The strata exposed on the Credit river between Lake Ontario and Meadowvale, as pointed out in Part V of this series, belong in ascending order to the Humber and Credit members of the Dundas formation; the Erindale, Streetsville, and Meadowvale members of the Richmond formation; and the Queenston, a red shaly member of the Richmond, probably representing an estuarine phase of the latter formation.

With the exception of the overlying Queenston shales, the rocks consist of grey to blue or brown fissile shales with interstratified beds of harder rock which vary in composition from pure crystalline limestone to impure calcareous sandstone or arenaceous shales. The rocks indicate deposition in comparatively shallow water as attested by the ripple marks which are frequently seen, as well as by the discontinuity of the limestone and other hard layers.

The rocks of the Dundas formation, as exposed on the Credit, are very similar to those of the same formation as exposed in the Humber valley to the east and form a direct upward extension of these rocks. They are largely of shale, there being on the average one foot of hard rock to six feet of shale. The Dundas formation on the whole is much less fossiliferous than the Richmond, as many feet of shale are entirely devoid of fossils, which, nevertheless, are found in abundance in the limestone at two rather distinct horizons.

The Richmond formation rests conformably on the Dundas formation without any apparent change in the lithological character of the rocks; the faunal break, however, is distinct. The Erindale member of the Richmond is very similar lithologically to the Dundas formation, but the Streetsville member differs considerably in that it contains more limestone. The lower part of the Meadowvale is also limy, but the upper part of this member consists largely of shale.

In both formations on the Credit, very few of the fossils are found in the shale, although they nearly always occur in profusion in the limestone layers. With regard at least to the lower or Dundas formation, this paucity of fossils in the shale is rather surprising, as the similar shales on the Don and Humber rivers at Toronto are usually very rich in fossils.

The continuity of the section on the Credit river is interrupted very little. The chief unexposed interval is of 50 feet and occurs in the unfossiliferous zone of the Humber member. At this horizon, near the Mississauga golf links, the river drops very little and there are no rock outcrops.

The following table indicates the detailed subdivision of the rocks of the Credit river, together with an approximate correlation with those of the Ohio valley.

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[2]*See* footnote, page 3.

STRATIGRAPHY AND CORRELATION OF THE CREDIT RIVER ROCKS

Credit River				Ohio	
Formation	Member	Zone	Thickness	Foerste	Shideler
Richmond	Queenston		feet ??	Whitewater—Saluda	Upper Whitewater
	Meadowvale	Upper Meadowvale *Columnaria* reef	30		Saluda
	Streetsville	*Bythopora meeki* *Stromatocerium* reef *Homotrypa streetsvillensis* *Ischyrodonta miseneri*	20	Liberty	Lower Whitewater Liberty
	Erindale	Upper Erindale *Strophomena varsensis*	65	Waynesville	Waynesville
Dundas	Credit	*Stigmatella sessilis crassa*	50	Maysville	Maysville
	Humber	Unfossiliferous	100		
		Fossiliferous	26		

Attitude of the Strata.—It has been known for years that the Paleozoic rocks of Ontario dip in a general southwesterly direction, and various estimates have been made as to the angle of dip. Very recently, Colonel Harkness, Commissioner of Gas, Ontario, has gathered together much information with regard to this matter, based chiefly on records of well-boring, and has made a contour map of the top of the Trenton limestone in Ontario. According to this map, the dip in the vicinity of Streetsville was determined to be about 20 feet to the mile and in a direction a few degrees west of south.

There are two beds in the Richmond which can be recognized at localities some distance apart, both by their lithological character and by their fossils. One of these beds is the bryozoan reef of the Erindale member, which has been recognized on Mullet creek and on Cooksville creek, just north of stop No. 35, Toronto Suburban Railway, three and a quarter miles northeast of Mullet creek. Another bed is the limestone layer, eight feet above the reef, recognized not only by the numerous specimens of *Strophomena planumbona erindalensis* and *Strophomena varsensis* contained in it, but also by the fact that it is the uppermost layer of limestone in the *Strophomena varsensis* zone. This stratum was seen at Mullet creek and five feet above the water level at the outcrop on the west side of the river, northeast of the home of William Crozier (Section No. 10).

By means of the wye level, the exact elevations of these two beds above sea-level at the localities mentioned were obtained. From these observations the dip was determined to be in a direction S. 26° W., at the rate of 20 feet per mile. Estimates based on other distinctive beds, which could be followed down the river, such as the *Columnaria* reef in the Meadowvale member and the heavy bed of limestone in the *Homotrypa streetsvillensis* zone of the Streetsville member, bore out the accuracy of these figures. Once the dip was determined with satisfaction, the stratigraphic intervals between all the exposures on the river could be calculated, as well as the intervals between them and the exposures to the east and west.

Explanation of Composite Section.—A composite section, making use of these figures will be found on the folded page. All figures referring to level in this section and throughout the article are not elevations above the sea, but denote the position of the horizon under discussion in the above composite section, the base of which is the bottom of the quarry at the mouth of the Credit river (this horizon being taken as 234 feet above sea-level).

Dundas Formation

Humber Member

The lower 26 feet (234 to 260) as exposed in the quarry at the mouth of the Credit river at Port Credit, and for some distance above, consist of rocks which are more calcareous than usual and contain very large numbers of *Rafinesquina mucronata torontonensis*, described by Parks and Dyer from the Dundas formation of the Humber river, and *Zygospira erratica* (Hall) from the New York Pulaski.

The following fossils were found at this horizon:—

Stigmatella catenulata var. B, *Parks* and *Dyer*.
Rafinesquina mucronata torontonensis, *Parks* and *Dyer*.
Byssonychia radiata (*Hall*).
Ctenodonta filistriata, *Ulrich*.
Cuneamya scapha brevior, *Foerste*.
Ischyrodonta *cf.* unionoides (*Meek*).
Modiolopsis postplicata, *Foerste*.
Modiolopsis concentrica, *Hall* and *Whitfield*.
Pterinea demissa (*Conrad*).
Whiteavesia pholadiformis (*Hall*).
Whitella *cf.* hindi (*Billings*).
Whitella *cf.* torontonensis, *Stewart*.
Orthoceras lamellosum, *Hall*.
Isotelus maximus, *Locke*.
Glyptocrinus *sp.*
Lichenocrinus *sp.*

This fauna is very similar to that of the Humber River section to the east. Compared with the faunas of the Ohio Valley formations, it shows a mixture of typical Waynesville and Maysville types but with a much stronger leaning toward the Maysville. In view of the relative paucity of species, it seems impossible to correlate the strata with any of the divisions of the Maysville recognized in Ohio. It is to be noted also that six out of the fifteen definite species listed are unrecorded from the Ohio valley or from New York.

For a distance of 100 feet above the top of the fossiliferous zone of the Humber member, shales greatly predominate, and up to the present no fossils have been found. At some localities the shales look inviting to the collector, being of a rubbly or nodular character, and it was only after much searching that the writer gave up hope of finding fossils.

Credit Member

From the 360- to the 370-foot levels, the limy layers appear again, and several species of fossils are found, the most striking occurrence being that of *Isotelus* cf. *maximus* in large and numerous fragments, each fragment encrusted with the bryozoan *Stigmatella sessilis crassa*.

The following species occur:—

Hallopora onealli creditensis, *var. nov.*
Stigmatella sessilis crassa, *var. nov.*
Zygospira modesta, *Hall.*
Byssonychia radiata (*Hall*).
Clidophorus planulatus (*Conrad*).
Cymatonota *cf.* lenior, *Foerste.*
Ischyrodonta unionoides (*Meek*).
Modiolopsis borealis, *Foerste.*
Modiolopsis concentrica, *Hall* and *Whitfield.*
Pterinea demissa (*Conrad*).
Whiteavesia pholadiformis (*Hall*).
Whitella *cf.* hindi (*Billings*).
Whitella *sp.*
Actinoceras crebriseptum (*Hall*).
Crinoid columns.
Isotelus *cf.* maximus, *Locke.*

This fauna is very different from that of the upper part of the Humber member as seen at the exposures at the mouth of the Credit with its profusion of *Zygospira erratica* and *Rafinesquina mucronata torontonensis*.

Most of the species from the Credit member, however, are represented on the Humber river: they indicate almost equally strong affinities with the Maysville of Ohio and the Pulaski of New York, with a sprinkling of local Dundas forms. Many of the species found in the Credit member are also found in the Salmon River sandstone, and it is probable that these two subdivisions are correlatable.

From the 370- to the 380-foot levels, a small number of species is found, including *Stigmatella sessilis crassa*, *Hebertella occidentalis*, and *Zygospira modesta*. The fauna alone does not give much clue as to where these ten feet of rock should be placed, but they are included in the Credit member for reasons appearing below.

Dundas-Richmond Contact

It has been found that between the 380- and the 410-foot levels, the shales are devoid of life, but from the 410 foot level upward, the rocks again become calcareous and yield a rather large assemblage of fossils which are beyond doubt of Richmond age. This 30-foot band of barren shale forms the boundary between the Dundas and the Richmond. The contact cannot be sharply drawn, but the faunal break is distinct, comparatively few species being common to the uppermost zone of the Dundas and the lowermost zone of the Richmond.

In eastern Ontario and Quebec, Foerste describes a somewhat different set of conditions. In that area the Richmond sea entered the Maysville sea very slowly, its fauna replacing the older fauna, species by species; consequently for many feet above and below the boundary the fauna is not definite, typical Richmond species such as *Catazyga headi* being found low in undoubted Maysville strata, while many Maysville species such as *Cymatonota lenior*, *Clidophorus planulatus*, and *Cuneamya scapha brevior*, range high up into the Richmond.

Richmond Formation

Erindale Member

The first fossiliferous rocks, after the barren zone marking the boundary of the Dundas and the Richmond is passed through, are also shales of the same character as the shales of the Dundas formation, but containing *Strophomena varsensis* and numerous examples of *Hebertella occidentalis*.

Zone of Strophomena varsensis.—The shales referred to above mark the base of the *Strophomena varsensis* zone, which forms the lower part of the Erindale member. Above, calcareous bands become more common and *Strophomena varsensis* much more abundant, and at the 420-foot level a bryozoan reef occurs. This reef is one of the most characteristic beds in the whole Credit River section.

An exposure of Erindale shale and sandstone on the Credit river near Streetsville.

It consists of compact crystalline limestone, varying in thickness from four to 18 inches. In places it forms a single massive stratum, while at other places, usually where it is thickest, it is separated into two or three strata by thin layers of shale. It is full of *Heterotrypa definita*, a species of *Bryozoa* herein described as new. This species is easily recognized in the field by its robust branching zoaria and by the fact that the surfaces are covered with well-marked maculae. It is almost confined to the reef, only a few specimens having been found at any other level. *Heterotrypa prolifica*, Ulrich, and *Stigmatella hybrida*, another new species, are confined to the reef but are much less abundant than *Heterotrypa definita*. Eight feet above the reef, at the 428-foot level, the stratum of limestone which marks the top of the zone of *Strophomena varsensis* makes its

appearance. This layer is filled with *Strophomena planumbona erindalensis*. *Strophomena varsensis* is also common, as well as young forms of *Catazyga headi*.

In addition to the fossils already mentioned, the following species occur rather abundantly in the limestone of the zone. *Hallopora onealli creditensis*, *Hebertella occidentalis*, *Rafinesquina alternata*, and *Rafinesquina alternata subcircularis*.

There seems to be very little doubt that the rocks of the above zone represent a time equivalent to the Waynesville of the Cincinnati basin. Foerste first found *Strophomena varsensis* in the Cincinnatian area east of Ottawa and has recorded it in an unpublished manuscript on the fossils of that area. He states that the nearest approach to this species can be seen in the Blanchester division of the Waynesville of Ohio. The variety *Strophomena planumbona erindalensis* differs only slightly from the type form of the species from the Waynesville of Ohio, and *Catazyga headi* of the Erindale member is also represented in that state by the variety *Catazyga headi schuchertana*.

Upper Erindale.—Above the zone of *Strophomena varsensis*, the rocks greatly resemble those of the lower members of the Dundas formation as seen at Toronto. Limestone layers are few and far between, and the fossils are less abundant than in the lower part and are of less determinative value.

The fauna is made up of long-ranging forms, such as *Whiteavesia pholadiformis*, *Pterinea demissa*, *Byssonychia radiata*, and *Modiolopsis concentrica*, mingled with a few other species which are characteristic of the Richmond as a whole, but which are of very little use in more detailed correlation, such as *Homotrypella hospitalis*, *Hebertella occidentalis*, and *Rafinesquina alternata subcircularis*. Only two species typical of the Waynesville are present, *Stigmatella crenulata* and *Platystrophia clarkesvillensis*, and of these the former is represented on the Humber by a form which was described as *S. crenulata* by Parks and Dyer but which more correctly should be known as a variety of *S. crenulata*. *Platystrophia clarkesvillensis* on the Credit river ranges up into the Meadowvale member.

Correlation.—While the relationships of the Erindale are with the Waynesville of Ohio and Indiana, nevertheless great differences are noticed. Many of the most characteristic Cincinnati forms have not been found on the Credit, such as *Dalmanella meeki*, which gave the original name "*Dalmanella meeki zone*" to the Waynesville, *Hebertella insculpta*, *Protarea vetusta*, *Streptelasma divaricans*, *Rhynchotrema dentata*, and *Batostoma prosseri*. In addition, five new species of *Bryozoa* and one new species of *Brachiopoda* are found on the Credit, and one brachiopod shows varietal differences from a related Ohio form.

Streetsville Member

Zone of Ischyrodonta miseneri.—The lower beds of the Streetsville member (from the 475- to the 480-foot levels) consist of argillaceous limestone, varying from six to 18 inches in thickness, separated by narrower bands of shale, and characterized by the occurrence of *Ischyrodonta miseneri* and *Byssonychia robusta*. The following fossils also occur: *Hebertella occidentalis*, *Platystrophia clarkesvillensis*, *Byssonychia grandis*, *Ortonella* cf. *hainesi*, *Opisthoptera fissicosta*, and *Bellerophon* cf. *mohri*.

Zone of Homotrypa streetsvillensis.—From the 480- to the 489-foot level, the rocks are still calcareous; and at the 483-foot level, there is a massive bed of limestone, 18 inches to two feet in thickness, which can be followed for some distance down the river and which was of use in the determination of the dip

of the strata. *Homotrypa streetsvillensis* is very abundant, and the lower three feet are practically composed of its ramose zoaria. *Homotrypa creditensis*, *Homotrypa communis*, and *Homotrypa* cf. *richmondensis* also occur but are much less abundant. Numerous specimens of *Stigmatella incrustans* were found incrusting the shells of brachiopods and pelecypods and also the zoaria of other *Bryozoa*. Other species are: *Heterotrypa simplex*, *Heterotrypa robusta*, *Stigmatella interporosa*, *Amplexopora solitaria*, *Monticulipora parasitica multipora*, *Mesotrypa patella*, *Hallopora aequalis*, *Hebertella occidentalis*, *Platystrophia clarkesvillensis*, and *Zygospira modesta*.

Stromatocerium Reef.—From the 489-foot level to the 492-foot level, *Stromatocerium huronense* is sufficiently abundant to form a reef. Many specimens measuring one foot in diameter are found. The corals *Columnaria alveolata*, *Columnaria calicina*, and *Tetradium approximatum*, and the bryozoans *Heterotrypa simplex*, *Hallopora maculosa*, and *Homotrypella hospitalis peculiaris*, are also present.

Zone of Bythopora meeki.—Above the *Stromatocerium* reef and continuing to the top of the member, the rocks consist of thin bands of limestone, weathering to a buff colour, alternating with shale and arenaceous shale, the latter showing good ripple marks. Numerous specimens of *Bythopora meeki*, *Heterotrypa simplex*, *Heterotrypa simplex maculosa*, and *Hallopora onealli creditensis*, and occasional specimens of *Atactoporella densa*, *Homotrypella dubia*, *Homotrypella hospitalis*, *Hebertella occidentalis*, *Batostoma* cf. *varians*, and *Byssonychia grandis* are found.

Correlation.—The Streetsville member is the best-defined subdivision on the Credit, 23 out of its total of 40 species being confined to it. The problem of correlating it with any of the subdivisions of the typical section in Ohio has, however, presented some difficulties, as the fauna of the Streetsville includes elements of several of the Ohio subdivisions. Before proceeding further, however, in the faunal discussion, it should be explained that Shideler differs from the majority of the workers on the Richmond in that he divides the Upper Liberty of other authors into two parts by the *Gyroceras baeri* bed, calling the upper part Lower Whitewater, and the lower part Upper Liberty. The Whitewater of other authors thus becomes the Upper Whitewater of Shideler. On the basis of Shideler's tables, we find that three Streetsville species are Upper Whitewater forms: *Ortonella* cf. *hainesi*, *Bellerophon* cf. *mohri*, and *Homotrypa* cf. *richmondensis*, while a fourth, *Homotrypa streetsvillensis*, a new species exceedingly abundant in this formation, is very like *Homotrypa austini*, an Upper Whitewater form. According to Shideler, four of these species listed from the Streetsville range in Ohio from the Upper down into the Lower Whitewater: *Ischyrodonta miseneri*, *Byssonychia grandis*, *Byssonychia robusta*, while a fourth, *Monticulipora parasitica multipora*, a new variety from the Streetsville, is probably identical with the form listed as *Monticulipora parasitica* from the same horizon in Indiana. One species, *Eridotrypa* cf. *simulatrix*, ranges in Ohio from the Lower Arnheim to the Lower Whitewater, and another species *Stigmatella incrustans*, which is comparatively abundant in the *Homotrypa streetsvillensis* zone, is confined to the Liberty in Indiana. Again, according to Shideler, three Streetsville species range from lower horizons up into the Lower Liberty: *Opisthoptera fissicosta*, *Homotrypa communis*, and *Batostoma* cf. *varians*. Three species are characteristic of lower horizons than the Liberty: these are *Homotrypella dubia* and *Stigmatella interporosa*, both of the Lower Arnheim, and *Platystrophia clarkesvillensis*, of the Blanchester division of the Waynesville. The latter species,

however, ranges up into the Meadowvale on the Credit. The remaining species are either new or long-ranging.

It will be seen from the above analysis of the fauna that the closest relationships are with the Liberty as defined by the majority of authors or with the Liberty and Lower Whitewater of Shideler.

Although the relationships of the Streetsville are as stated above; nevertheless, the member differs greatly from the Liberty of Ohio. The predominant fossils of the former are *Bryozoa*, and of the latter *Brachiopoda*. Many of the characteristic fossils of the Liberty are entirely absent from the whole Credit River section, such as *Dinorthis subquadrata*, *Plectambonites sericeus*, *Rhynchotrema capax*, *Strophomena planumbona*, and *Amplexopora granulosa*. In addition, the Streetsville member has yielded eight new species and three new varieties which are almost entirely confined to it.

In connection with the fauna of the Streetsville, it must be stated that Dr. E. O. Ulrich, in a letter to the writer, records the occurrence of *Modiolopsis valida* associated with *Opisthoptera alternata* and *Modiolopsis concentrica*. No examples of *Modiolopsis valida* were found at this horizon, but Dr. Ulrich identifies the species from the Prison Farm quarry in strata which are ascribed to the Humber member of the Dundas formation.

Meadowvale Member

Columnaria Reef.—The Meadowvale member begins with the conspicuous *Columnaria* reef, in which *Columnaria alveolata*, *Tetradium approximatum*, and *Stromatocerium huronense* are very abundant. *Columnaria calicina* is also present but is not so abundant as the foregoing species. *Tetradium approximatum* assumes at times very large proportions, one specimen being found with a diameter of 18 inches. In addition to the above coelenterates, the two bryozoans, *Rhombotrypa quadrata* and *Constellaria polystomella*, are very abundant. It is strange that these two species, which in other areas are found in nearly all of the divisions of the Richmond, should be found only at this horizon on the Credit. The following fossils, also, are found in the *Columnaria* reef: *Hallopora* cf. *onealli*, *Homotrypella hospitalis*, *Hebertella occidentalis*, *Platystrophia clarkesvillensis*, *Zygospira modesta*, *Byssonychia* sp., *Opisthoptera fissicosta*, *Lophospira bowdeni*, *Lophospira tropidophora*, *Cyclonema* sp., and an indeterminable species resembling *Fenestella*. Foerste lists from this horizon *Calapoecia cribriformis* and small specimens of *Streptelasma rusticum*. The reef varies in thickness from 18 inches to five feet and consists chiefly of limestone, but thin bands of shale are also present, and in many cases the corals lie embedded in shales.

Upper Meadowvale.—From the reef to the top of the section, the rocks are chiefly shale with a few beds of limestone and arenaceous limestone and shale. The fossils occurring in these upper layers are: *Hebertella occidentalis*, *Platystrophia* cf. *clarkesvillensis*, *Rafinesquina alternata*, *Rafinesquina alternata subcircularis*, *Zygospira modesta*, *Homotrypella hospitalis*, *Clidophorus fabulus*, *Byssonychia* sp., *Modiolopsis concentrica*, *Opisthoptera* cf. *fissicosta*, *Pterinea demissa*, and *Whiteavesia pholadiformis*.

There is only one horizon above the *Columnaria* reef worthy of special mention and that is at the 525-foot level at the very top of the section. Here there are a few beds of limestone in which *Hebertella occidentalis* is exceedingly abundant. *Platystrophia clarkesvillensis*, indeterminable species of *Modiolopsis* and *Byssonychia*, and casts of *Bryozoa* are also found.

Correlation.—There is nothing very diagnostic about the fauna occurring in the Meadowvale, but what there is points to a relationship with the Saluda or Whitewater. The *Columnaria* reef is an important paleontological horizon since it marks the disappearance of the greater part of the Streetsville fauna. Foerste says that *Columnaria alveolata*, which is so abundant in the *Columnaria* reef, is most abundant at the base of the Saluda in Ohio. *Columnaria calicina*, which is more abundant in the reef than at any other horizon, is most abundant in the Saluda, although it occurs in most of the Richmond members in other areas. The Meadowvale member resembles the lower part of the Whitewater section on Manitoulin island from the Gore Bay reef to the Mudge Bay reef, but the upper part of the Whitewater of Manitoulin, with its ostracod fauna and characteristic Whitewater species, is missing.

Comparison of the Credit River Section with the Manitoulin Section

In comparing the Credit River section with the Manitoulin Island section, many differences will be noticed. In the first place, the upper part of the Whitewater of Manitoulin with its typical ostracod fauna is entirely missing from the Credit river. In the second place, on Manitoulin, the Gore Bay coral reef and the Mudge Bay *Stromatocerium* reef above are separated by practically unfossiliferous strata, the whole being included in the Whitewater. On the Credit, the *Stromatocerium* reef is below and is separated from the coral reef by four feet of limestone and shale containing a bryozoan fauna which is distinctly lower than Whitewater in aspect. The *Stromatocerium* reef itself contains species of bryozoans which are characteristic of the Liberty or even lower horizons. The *Stromatocerium* reef on the Credit is, therefore, distinctly lower than Whitewater; in this report it is included in a member which is correlated with the Liberty. In the above discussion, the terms Whitewater and Liberty are based on Foerste's classification of the Richmond formation.

Many fossils which are abundant in the rocks below the Gore Bay reef on Manitoulin island are entirely missing from the Credit River section, such as *Hebertella insculpta*, *Protarea papillata*, *Plectambonites sericeus*, *Rhynchotrema perlamellosa*, *Rhynchotrema capax*, *Strophomena nutans*, *Crania scabiosa*, and *Strophomena neglecta*.

Apart from the bryozoans, which have not been studied on Manitoulin, the fauna of that island is richer than the fauna of the Credit river. A careful investigation of the *Bryozoa* of Manitoulin should yield a correspondingly large number of species.

It would appear from a study of Foerste's report on the Manitoulin section that no rocks equivalent to the Streetsville or Liberty members were laid down on that island. No mention is made of a more calcareous part and the occurrence of numerous bryozoans which are the outstanding features of the Streetsville. The zone of *Strophomena sulcata* and *S. planumbona* runs practically as far up as the Gore Bay reef leaving very little room for another member; while on the Credit, the highest occurrence of any of the strophomenoids is 65 feet below the *Columnaria* reef marking the base of the Meadowvale. It appears, however, that no study of the Ontario Richmond localities can be satisfactory without a study of the *Bryozoa*.

Comparison of Eastern Canadian Sections with the Section on the Credit River

The differences between the Richmond of the island of Anticosti and of the Credit river are very marked. Very few Anticosti species occur on the Credit river with the exception of certain very wide-spread corals, such as *Columnaria alveolata*, *Calapoecia cribriformis*, and *Streptelasma rusticum*. Another great difference is the almost total absence of trepostomatous bryozoans in Anticosti.[1]

Farther west we find that the sections at Nicolet river and adjoining localities in western Quebec and eastern Ontario resemble somewhat more strongly the Credit River section, but even here the differences are still marked. In the first place, the coral reef is missing from the former sections, and one passes directly upward from strata equivalent to the Waynesville into the red Queenston shales. In the second place, the Anticosti brachiopods, *Strophomena hecuba*, *Strophomena fluctuosa*, and *Rhynchotrema perlamellosa*, which are so abundant in western Quebec, are missing from the Credit river. Foerste does describe a stratigraphic interval in the Nicolet River section which more or less corresponds with the *Strophomena varsensis* zone of the Credit. This interval consists of the rocks from 76 feet to 156 feet below the base of the Queenston. In the upper part of the interval, *Strophomena sulcata* (or *S. varsensis*) is common, and in the lower 100 feet *Strophomena planumbona* is common. Associated with the latter species at various levels are *Catazyga headi*, *Heterotrypa prolifica*, and *Hallopora subnodosa*, which also are associated with it on the Credit. A study of the *Bryozoa* from the upper levels of these eastern regions may bring to light a fauna corresponding to that of the Streetsville member.

Detailed Description of Sections on the Credit River with Complete Faunal Lists

Port Credit, which is at the mouth of the Credit river and near which the lowest exposure on the river is situated, is reached directly by the cars of the Toronto and York radial railway; it is not more than a forty minutes' journey west of the city limits. The exposure which is about a mile west of the terminus of the radial must be reached on foot. It is here that the rocks of the Humber member are seen.

The village of Streetsville, about six miles up the river from Port Credit, is reached directly by the Canadian Pacific railway. Section No. 14, where the Streetsville member of the Richmond and its included bryozoan fauna can best be seen, is directly opposite the middle of the village. The *Stromatocerium* reef and the *Columnaria* reef can also be seen here, but the latter is better exposed immediately above Castler's bridge, a little more than a mile farther up the river.

The outcrops of the *Strophomena varsensis* zone at the base of the Erindale member of the Richmond with its bryozoan reef are not so accessible. This zone can best be studied at Section No. 8 on Mullet creek which flows into the Credit river one mile northwest of Erindale, the latter village being about two miles south of the station of the same name on the Canadian Pacific railway.

A detailed account of the various sections exposed on the Credit river with complete faunal lists follows.

The base of the whole series, at the bottom of the quarry near the mouth of the river, is 234 feet above sea-level; the figures given with each section, indicate the position in a vertical column above this datum level, not the actual elevation above sea-level.

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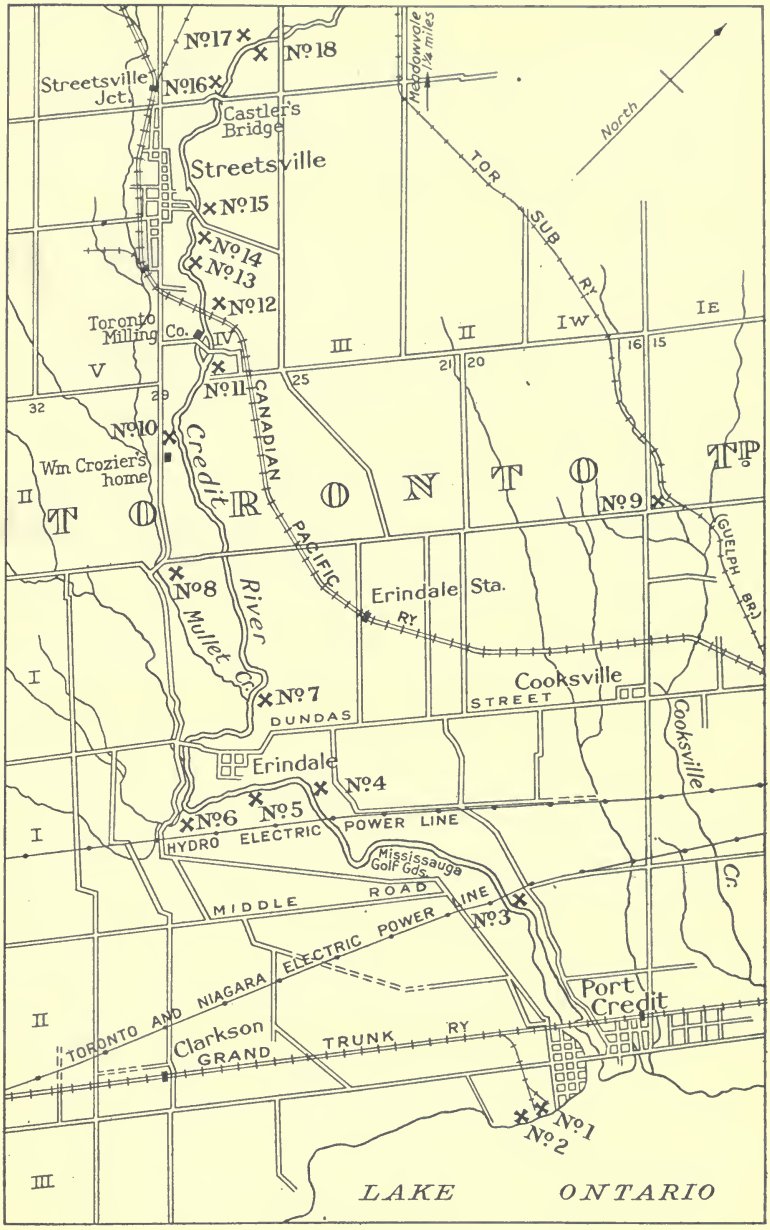
[1]Schuchert and Twenhofel, Bull. Geol. Soc. Amer., Vol. 21, No. 4, p. 700.



Sketch map of the lower Credit river, showing location of outcrops described in detail in the text.

SECTION No. 1.—QUARRY AT PORT CREDIT (234 TO 251)

HUMBER MEMBER:	THICKNESS feet
In descending order:—	
(3) Grey to blue, fissile shales with limestone bands near the top. Sandy layers in places. In the limestone bands the following fossils occur: *Zygospira erratica* (abundant), *Zygospira modesta*, *Rafinesquina mucronata torontonensis* (abundant), *Byssonychia radiata*, *Modiolopsis concentrica*, *Whiteavesia pholadiformis*, *Ctenodonta filistriata*, *Whitella* cf. *torontonensis*, *Whitella* cf. *hindi*, *Modiolopsis posplicata*, *Pterinea demissa*, *Lophospira* sp., *Glyptocrinus* sp., *Isotelus* sp.	5
(2) Grey, unfossiliferous, fissile shale with a few bands of impure argillaceous sandstone and one band of limestone with *Byssonychia radiata*, *Modiolopsis* sp., *Isotelus* (fragments), *Zygospira modesta*	4
(1) Grey, unfossiliferous shale with a few bands of hard, argillaceous sandstone, extending to the bottom of the quarry which is 12 feet below the level of Lake Ontario. In one band of limestone six feet above the bottom of the quarry, the following fossils were found: *Zygospira erratica* (abundant), *Rafinesquina mucronata torontonensis* (abundant), *Zygospira modesta*, *Ischyrodonta* cf. *unionoides*, *Byssonychia* cf. *radiata*, *Modiolopsis* sp., *Pterinea demissa*, *Whiteavesia pholadiformis*, *Orthoceras lamellosum*	8

The bottom of Section No. 1 is at the same level as the top of the section, exposing the highest strata of the Dundas formation east of the Credit river, namely, the Prison quarry at New Toronto. The Humber member as seen in the quarry at Port Credit is, therefore, the immediate upward extension of the Humber member as seen in sections east of the river.

SECTION No. 2.—LAKE SHORE 100 YARDS SOUTH OF SECTION No. 1 (246 TO 256)

HUMBER MEMBER:	THICKNESS feet
In descending order:—	
(2) Brownish to black shale, badly weathered at the top, fresh at the bottom, containing abundant specimens of *Cuneamya scapha brevior*; also: *Stigmatella catenulata* (*var. B.*), *Glyptocrinus* (columnals), *Lichenocrinus* (columnals), *Rafinesquina mucronata torontonensis*, *Byssonychia* sp.	4
(1) Limestone with very numerous specimens of *Zygospira erratica* and *Rafinesquina mucronata torontonensis*. The level of Lake Ontario is taken as 246 feet above sea-level	6

SECTION No. 3.—EAST SIDE OF CREDIT RIVER, ONE MILE NORTH OF PORT CREDIT (247 TO 275)

HUMBER MEMBER:	THICKNESS feet
Grey fissile shale with bands of argillaceous sandstone varying from one-half to three inches in thickness, unfossiliferous for the most part, but 13 feet above the water level, a limestone band contains the following fossils: *Zygospira erratica* (abundant), *Rafinesquina mucronata torontonensis* (abundant), *Zygospira modesta*, *Byssonychia* sp., *Pterinea demissa*, *Orthoceras* sp., *Isotelus* (fragments). The fossiliferous band represents an upward extension of the fossiliferous zone of the Humber member, while the upper 15 feet is part of the unfossiliferous zone of the Humber member.	28

SECTION No. 4.—EAST SIDE OF RIVER, TWO MILES NORTH OF SECTION No. 3 (315 TO 335)

HUMBER MEMBER:	THICKNESS feet
Grey, fissile shales with bands of argillaceous sandstone, but no limestones and no fossils. The rocks of this section all belong to the upper unfossiliferous part of the Humber member	20

SECTION No. 5.—SOUTH SIDE OF RIVER, ONE-HALF MILE DOWNSTREAM FROM SECTION No. 6 (335 TO 395 ?)

HUMBER MEMBER: THICKNESS feet

Almost entirely shale, brown to black in colour, with a few bands of argillaceous sandstone. The shale is rubbly and looks inviting to the collector, but nothing but an indeterminable species of *Byssonychia* was found. Sixty feet above the water-level, there are some limestone beds, containing *Hebertella occidentalis*, which judging by the dip of the strata probably correspond to the rocks in Section No. 7 (Credit member), which also contain *Hebertella occidentalis*..... 60 ?

SECTION No. 6.—ON A SMALL CREEK EMPTYING INTO THE RIVER FROM THE SOUTHWEST, ONE-HALF MILE SOUTH OF ERINDALE (360 TO 400)

CREDIT MEMBER: THICKNESS feet

In descending order:—

(2) Shale and argillaceous sandstone with no limestone and no fossils. 30

(1) Shale and argillaceous sandstone as above, but with a few lens-like layers of limestone containing numerous fossils. One of these beds, eight feet above water-level, is remarkable for the abundance of large fragments of *Isotelus* cf. *maximus* contained in it and for the abundance of *Stigmatella sessilis crassa* usually covering the fragments of the foregoing trilobite. This upper bed also contains: *Hallopora onealli creditensis*, *Zygospira modesta*, *Byssonychia* cf. *praecursa*, *Pterinea demissa*, *Whiteavesia pholadiformis*, *Whitella* cf. *hindi*, *Modiolopsis borealis*, *Cymatonata* cf. *lenior*, *Ischyrodonta unionoides*, *Modiolopsis* sp., *Byssonychia radiata*, *Actinoceras crebriseptum*, crinoid columns. Another bed three feet above the water-level yielded: *Zygospira modesta*, *Clidophorus planulatus*, *Modiolopsis concentrica*, *Byssonychia* sp., *Isotelus* cf. *maximus*, *Stigmatella sessilis crassa*..... 10

SECTION No. 7.—EAST SIDE OF RIVER OPPOSITE MOUTH OF MULLET CREEK (370 TO 390)

CREDIT MEMBER: THICKNESS feet

Brownish to black shale with bands of argillaceous sandstone with fucoids and ripple marks. At a height of four feet above the water-level, a four-inch band of limestone contains: *Zygospira modesta*, *Byssonychia radiata*, *Modiolopsis* sp., and fragments of *Isotelus*. Six feet above the water level, another band of limestone contains a few specimens of *Hebertella occidentalis*, one small specimen of *Stigmatella sessilis crassa*, and numerous fragments of *Isotelus*. The upper unfossiliferous shales belong to the barren zone marking the boundary between the Dundas and the Richmond formations. The lower part, with fossils, is a continuation of the lower fossiliferous zone of the Credit member, as seen in Section No. 6..... 20

SECTION No. 8.—MULLET CREEK (410 TO 450?)

UPPER ERINDALE: THICKNESS feet

In descending order:—

(6) Grey to brown and black fissile shale with bands of argillaceous sandstone, unfossiliferous..... 20?

ZONE OF STROPHOMENA VARSENSIS:

(5) Crystalline limestone, characterized by the abundance of *Strophomena planumbona erindalensis* and *Strophomena varsensis*. The elevation of the under side of this layer obtained by wye level is 401.19 feet above sea-level. *Heterotrypa* cf. *subfrondosa*, *Heterotrypa definita*, *Catazyga headi*, *Hebertella occidentalis*, *Rafinesquina alternata*, *Zygospira modesta*, *Byssonychia* sp., *Isotelus* sp., *Conularia* sp. also occur..... ½

(4) Shale with a few thin layers of limestone containing fragments of *Isotelus* sp..... 8½

(3) The bryozoan reef, in places a single massive bed of limestone, at other places separated into two or three beds by thin layers of shale. It varies in thickness from six inches to 18 inches and is characterized by the abundance of *Heterotrypa definita*. Examples of *Rafinesquina alternata* are numerous and the following species also occur: *Rafinesquina alternata subcircularis, Catazyga headi, Hebertella occidentalis, Hallopora subnodosa, Hallopora* cf. *onealli, Byssonychia* sp., *Modiolopsis* sp. By wye level the under side of this reef, where it first outcrops east of the bridge over the creek, was found to be 392.77 feet above sea level..... 1½

(2) Shale with thin layers of limestone and argillaceous sandstone. The limestone yielded: *Hallopora subnodosa, Rhinidictya* cf. *parallella, Hallopora onealli creditensis, Strophomena planumbona erindalensis* (abundant), *Strophomena varsensis, Rafinesquina alternata, Rafinesquina alternata subcircularis, Hebertella occidentalis, Zygospira modesta, Ctenodonta cingulata, Modiolopsis concentrica, Byssonychia* sp., *Isotelus* sp..... 4½

(1) Grey fissile to brown and black, rubbly shale with: *Rafinesquina alternata, Hebertella occidentalis, Strophomena varsensis, Byssonychia radiata, Byssonychia* cf. *praecursa, Whiteavesia pholadiformis, Pterinea demissa, Lophospira tropidophora, Lophospira bowdeni, Clathrospira* cf. *subconica, Isotelus* cf. *maximus*..... 4

The rocks below and above the road bridge, one mile west of the mouth of the creek, belong to Horizon No. 6 (Upper Erindale). The bryozoan reef (Horizon No. 3) is seen about 100 yards east of the bridge.

SECTION No. 9.—COOKSVILLE CREEK (394 TO 447)

THICKNESS
feet

A full account of this section will not be given here, with the exception of a few features which have a bearing on the Credit River section proper. The *Strophomena varsensis* zone is well exposed and the bryozoan reef is seen approximately in the middle of the zone, just as it is in Mullet creek. By wye level, the elevation above sea-level of the under side of the reef in this section is 459.95 feet. In Cooksville creek as well as in Mullet creek, the zone is characterized by the abundance of *Heterotrypa definita*. *Stigmatella hybrida*, a new species, was also found. *Calloporella vacua*, another new species, was found about 10 feet below the reef..... 53

SECTION No. 10.—WEST SIDE OF RIVER, NORTH OF HOME OF WILLIAM CROZIER (424 TO 447)

ERINDALE MEMBER:

THICKNESS
feet

In descending order:—

(3) The upper zone consists of shale with numerous layers of argillaceous sandstone varying in width from one inch to one foot. Limestone layers are rare, but two or three one-half inch slabs which evidently came from this horizon were found on the side of the cliff. They contain: *Homotrypella hospitalis, Hallopora onealli creditensis, Hallopora* cf. *onealli, Whiteavesia pholadiformis, Byssonychia* cf. *radiata*..... 18

(2) The lower zone (*Strophomena varsensis* zone) consists of limestone with very abundant examples of *Strophomena varsensis*; also: *Strophomena planumbona erindalensis, Rafinesquina alternata subcircularis, Trematis millepunctata, Heterotrypa definita, Hallopora onealli creditensis, Rafinesquina alternata*. The under side of this band was determined by wye level to be 409.41 feet above sea-level..... 1

(1) The lower four feet, extending to water-level, consists of fissile, grey shale, with no fossils. By wye level, the creek bed at this locality was determined to be 405.27 feet above sea-level..... 4

SECTION No. 11.—EAST SIDE OF RIVER, 200 YARDS SOUTH OF BRIDGE OPPOSITE THE PROPERTY OF THE TORONTO MILLING COMPANY (436 TO 450)

UPPER ERINDALE MEMBER:

	THICKNESS feet
Massive beds of hard, calcareous and arenaceous shale, separated by soft, fissile, clay shale. Three feet above the water-level there is a bed of argillaceous sandstone, showing contorted pillow structure with contemporaneous erosion of underlying beds. The following fossils were found in a limy layer about seven feet above the water-level: *Homotrypella hospitalis, Stigmatella crenulata, Zygospira modesta, Rafinesquina alternata Modiolopsis concentrica, Pterinea demissa, Byssonychia* sp., *Isotelus* sp.	14

SECTION No. 12.—WEST SIDE OF RIVER NORTH OF CANADIAN PACIFIC RAILWAY BRIDGE (460 TO 483)

STREETSVILLE MEMBER:

	THICKNESS feet
In descending order:—	
(4) Alternating limestone and shale belonging to the zone of *Homotrypa streetsvillensis*. See Section No. 13 below. The bottom of the projecting, massive bed of limestone (485) was determined by hand level to be 23½ feet above the water-level.	8

UPPER ERINDALE MEMBER:

(3) Grey, fissile shale, marking the top of the Erindale member. One bed of argillaceous sandstone contains: *Rafinesquina alternata, Stigmatella crenulata, Clidophorus planulatus, Pterinea demissa, Atactopora sp., Lophospira* sp., *Byssonychia* sp.	5
(2) Grey, fissile shale with one thin layer of limestone and a few inches of brownish-coloured shale, containing: *Hebertella occidentalis, Rafinesquina alternata, Platystrophia clarkesvillensis, Zygospira modesta, Hallopora aequalis, Hallopora* cf. *onealli, Hallopora onealli, H. creditensis, Stigmatella* cf. *lambtonensis, Byssonychia* sp., *Isotelus* sp.	5
(1) Grey, fissile shale with a few thin layers of limestone extending to water-level. The surfaces of these limestone layers are covered by the zoaria of the cryptostomatous bryozoan *Rhinidictya parallella.* Three feet above the water-level, there is a layer of argillaceous sandstone showing contorted pillow structure with contemporaneous erosion of the underlying shale.	5
In the talus at the bottom of this cliff the following species were found: *Byssonychia radiata, Rafinesquina alternata subcircularis, Platystrophia clarkesvillensis, Hebertella occidentalis, Anoptera* cf. *miseneri, Pasceolus* cf. *camdenensis.*	

SECTION No. 13.—EAST SIDE OF RIVER, 600 YARDS NORTH OF SECTION No. 12 (475 TO 492)

STREETSVILLE MEMBER

STROMATOCERIUM REEF:

	THICKNESS feet
In descending order:—	
(6) Clay with *Stromatocerium huronense* large and abundant, *Tetradium approximatum, Columnaria alveolata, Heterotrypa simplex,* and *Homotrypella hospitalis*	5½
(5) Thin limestone bands alternating with shale containing: *Columnaria alveolata, Stromatocerium huronense, Heterotrypa simplex, Hallopora maculosa,* and *Homotrypella hospitalis peculiaris*	¾

ZONE OF HOMOTRYPA STREETSVILLENSIS:

(4) Thin limestone bands, alternating with shale. A few examples of *Homotrypa streetsvillensis* are found and hence the interval is provisionally included in the zone of *H. streetsvillensis.* The fauna includes: *Hebertella occidentalis, Byssonychia* sp., *Homotrypella hospitalis, Stigmatella interporosa, Monticulipora parasitica multipora, Homotrypella hospitalis peculiaris, Hallopora onealli creditensis, Platystrophia clarkesvillensis, Byssonychia* cf. *grandis, Byssonychia radiata, Lophospira* sp., *Heterotrypa simplex maculosa*	3

THICKNESS
feet

(3) Massive crystalline limestone which projects beyond the face of the cliff and forms a persistent horizon-marker. Numerous examples of *Homotrypa streetsvillensis* are found..... 1½

(2) Alternating limestone and shale, characterized by exceedingly numerous examples of *Homotrypa streetsvillensis*. The large fauna is composed of *Homotrypa streetsvillensis, Byssonychia radiata, Hebertella occidentalis, Zygospira modesta, Modiolopsis* sp., *Stigmatella incrustans, Platystrophia clarkesvillensis, Heterotrypa* cf. *robusta, Orthodesma* cf. *canaliculatum, Byssonychia robusta, Opisthoptera fissicosta, Homotrypa communis, Homotrypa* cf. *richmondensis, Hallopora subnodosa, Heterotrypa* cf. *rugosa*..... 4½

ZONE OF ISCHYRODONTA MISENERI:

(1) Massive limestone beds which become argillaceous toward the bottom, crowded with well-preserved specimens of *Ischyrodonta miseneri, Byssonychia robusta*, and *Opisthoptera fissicosta*. Other species occurring in the interval are: *Platystrophia clarkesvillensis, Hebertella occidentalis* (abundant), *Modiolopsis concentrica, Byssonychia grandis, Pterinea demissa, Bellerophon* cf. *mohri, Ortonella* cf. *hainesi, Orthodesma* cf. *canaliculatum, Lophospira bowdeni*. This horizon extends to water-level..... 2

In examining the rocks of this last interval, thin sections were accidentally cut of numerous small round objects, measuring about one-quarter of a millimetre in diameter, with hollow centres and with radiating structures in their walls. They were at first thought to be organic in origin, but the opinion of Dr. Ulrich, to whom they were referred, is that they are oolites.

SECTION No. 14.—EAST SIDE OF RIVER, SOUTH OF BRIDGE OPPOSITE FLOUR MILL, OPPOSITE MIDDLE OF STREETSVILLE VILLAGE (480 TO 493½)

MEADOWVALE MEMBER

COLUMNARIA REEF:

THICKNESS
feet

(6) Limestone with *Columnaria alveolata, Columnaria calicina, Tetradium approximatum, Stromatocerium huronense, Hebertella occidentalis, Platystrophia clarkesvillensis*, etc..... 2

STREETSVILLE MEMBER

ZONE OF BYTHOPORA MEEKI:

(5) Alternating layers of shale and thin limestone. The weathered limestone contains numerous examples of *Bythopora meeki*. The following fossils also occur: *Columnaria alveolata, Stromatocerium huronense, Hebertella occidentalis, Platystrophia clarkesvillensis, Atactoporella densa, Homotrypella dubia, Homotrypella hospitalis, Heterotrypa simplex, Heterotrypa simplex maculosa, Hallopora onealli creditensis, Batostoma* cf. *varians, Byssonychia grandis*..... 2

STROMATOCERIUM REEF:

(4) Clay with *Stromatocerium huronense* large and abundant, also *Columnaria alveolata, Columnaria calicina*, and *Tetradium approximatum*. 3

ZONE OF HOMOTRYPA STREETSVILLENSIS:

(3) Thin alternating bands of shale and limestone. The fauna consists of the following species: *Columnaria alveolata, Hebertella occidentalis, Platystrophia clarkesvillensis, Zygospira modesta, Ceramoporella ohioensis, Homotrypella hospitalis, Homotrypa streetsvillensis, Monticulipora parasitica multipora, Mesotrypa patella, Heterotrypa robusta, Hallopora onealli creditensis, Hallopora aequalis, Stigmatella incrustans, Byssonychia* sp., *Lophospira bowdeni*..... 3½

(2) Projecting, massive limestone layer with: *Homotrypa streetsvillensis, Homotrypa creditensis, Amplexopora solitaria, Orthoceras* sp., *Lophospira bowdeni, Lophospira tropidophora*..... 1½

(1) Alternating beds of shale and limestone extending to water-level. The limestone is literally one mass of the zoaria of *Homotrypa streetsvillensis*. The following fossils also occur: *Hebertella occidentalis, Platystrophia clarkesvillensis, Heterotrypa* cf. *rugosa, Eridotrypa* cf. *simulatrix, Stigmatella incrustans, Byssonychia robusta*..... 3½

SECTION No. 15.—EAST SIDE OF RIVER, NORTH OF BRIDGE IN SECTION No. 14 (480 TO 504)

MEADOWVALE MEMBER:	THICKNESS feet
(4) Hard, compact shale alternating with impure, argillaceous limestone and soft clay shale. The following fossils were found: *Hebertella occidentalis, Rafinesquina alternata, Rafinesquina alternata subcircularis, Zygospira modesta, Byssonychia* sp.	6
(3) The *Columnaria* reef with: *Stromatocerium huronense, Columnaria alveolata, Columnaria calicina, Tetradium approximatum, Hebertella occidentalis, Platystrophia* sp.	2
STREETSVILLE MEMBER:	
(2) Interbedded shale and limestone with: *Hebertella occidentalis, Platystrophia clarkesvillensis, Columnaria alveolata*	2½
(1) Talus-covered interval extending to water level	13½

Horizon No. 2 is regarded as the upper part of the *Bythopora meeki* zone and is included in the Streetsville member, since the *Columnaria* reef which is an easily recognized horizon is made the base of the Meadowvale member.

SECTION No. 16.—WEST SIDE OF RIVER, 100 YARDS NORTH OF CASTLER'S BRIDGE (495 TO 505)

MEADOWVALE MEMBER:	THICKNESS feet
(2) The *Columnaria* reef made up of the coralla of *Columnaria alveolata, Columnaria calicina, Tetradium approximatum*, and *Stromatocerium huronense*. The two bryozoans, *Rhombotrypa quadrata* and *Constellaria polystomella*, are very numerous. The following fossils also occur: *Hebertella occidentalis, Platystrophia clarkesvillensis, Rafinesquina alternata, Zygospira modesta, Hallopora* cf. *onealli, Homotrypella hospitalis, Fenestella* sp., *Opisthoptera fissicosta, Byssonychia* sp., *Cyclonema* sp., *Liospira* cf. *helena*	6½
STREETSVILLE MEMBER:	
(1) Alternating beds of shale and limestone. The shale is ripple-marked, some cross ripples being noticed. Fucoids are numerous, and *Columnaria alveolata* is found	2½

Horizon No. 1 is herein included in the *Bythopora meeki* zone. Near the northern end of the section the *Columnaria* reef becomes much thinner. At this end, also, a bed of limestone occurs about three feet above the water-level, (500) which yields numerous examples of the gastropods, *Lophospira bowdeni* and *Lophospira tropidophora*. *Platystrophia clarkesvillensis*, *Homotrypella hospitalis*, *Hebertella occidentalis*, and *Byssonychia* sp. also occur.

SECTION No. 17.—WEST SIDE OF RIVER, ONE MILE NORTH OF CASTLER'S BRIDGE (495 TO 505)

MEADOWVALE MEMBER:	THICKNESS feet
(3) Alternating beds of limestone, clay shale, and argillaceous sandstone. The following fossils are found: *Columnaria alveolata, Hebertella occidentalis, Platystrophia* cf. *clarkesvillensis, Zygospira modesta, Rafinesquina alternata, Rafinesquina alternata subcircularis, Byssonychia* sp., *Clidophorus fabula, Modiolopsis concentrica, Opisthoptera fissicosta, Pterinea demissa, Whiteavesia pholadiformis, Cyrtolites ornatus*, crinoid columns	7
(2) The *Columnaria* reef with: *Columnaria alveolata, Columnaria calicina, Tetradium approximatum*, and *Stromatocerium huronense*	2
STREETSVILLE MEMBER:	
(1) Alternating beds of soft shale and arenaceous shale, extending to water-level. The arenaceous shale shows beautiful cross ripple marking. *Columnaria alveolata* occurs	1

SECTION No. 18.—EAST SIDE OF RIVER, NORTH OF THE DAVIS FARM (495 TO 530)

This is the most northerly outcrop at which the grey rocks of the marine Richmond can be seen with the exception of a small outcrop of the *Columnaria* reef 200 yards farther to the east on the same side of the river. The contact with the Queenston red shales is not exposed, and it is probable, also, that the uppermost part of the grey beds is covered by drift. In weathered limestone beds in the upper two feet of this section, *Hebertella occidentalis* is very abundant, and the following fossils are also found: *Homotrypella hospitalis*, *Byssonychia* sp., *Modiolopsis* sp., and casts of ramose bryozoans.