CANADA

DEPARTMENT OF MINES

HON. CHARLES STEWART, MINISTER; CHARLES CAMSELL, DEPUTY MINISTER

GEOLOGICAL SURVEY

W. H. COLLINS, DIRECTOR

MEMOIR 154

No.135, GEOLOGICAL SERIES

Geology of Anticosti Island

BY

W. H. Twenhofel

OTTAWA
F. A. ACLAND
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY
1928

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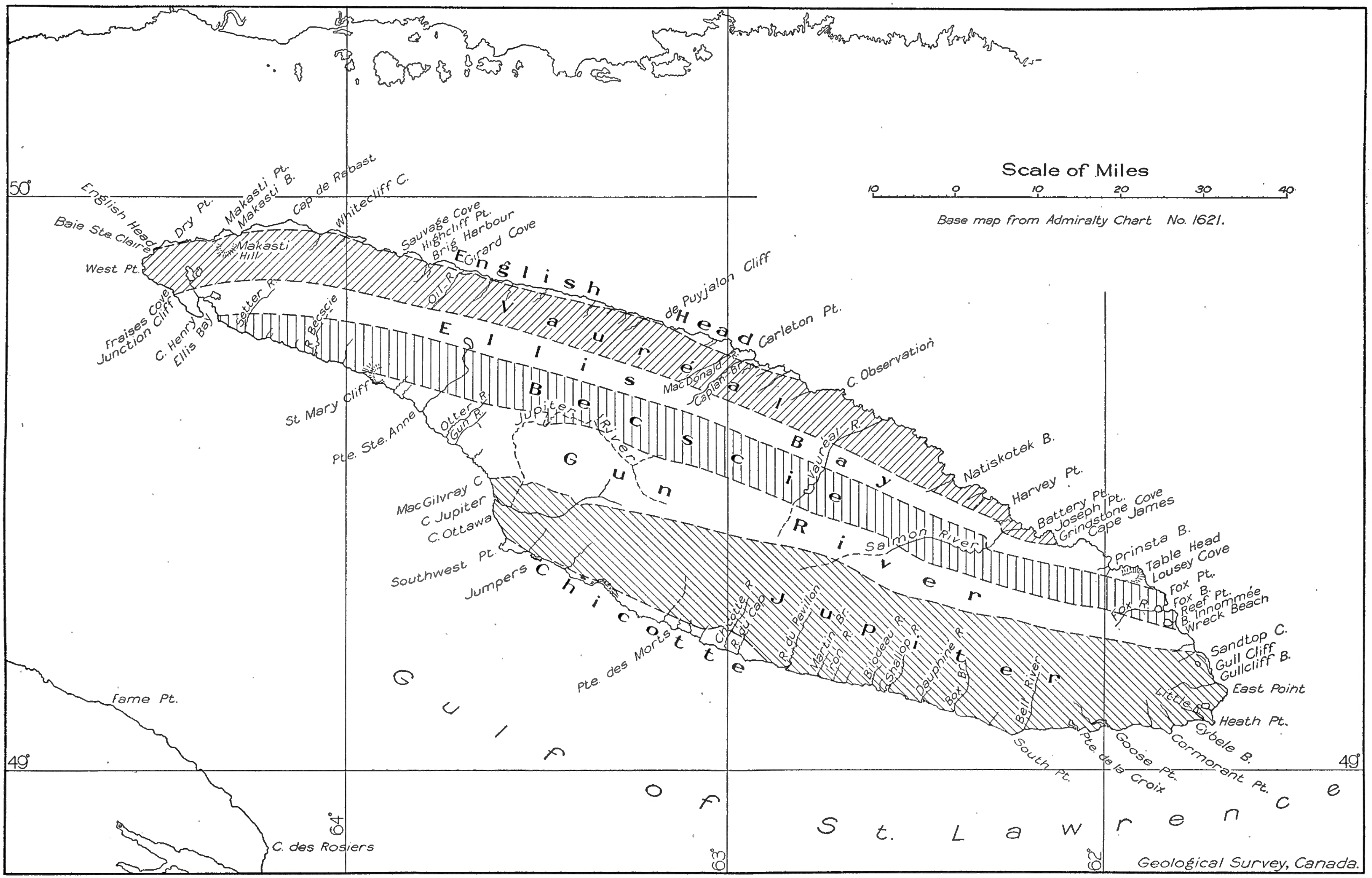

Figure 1. Anticosti Island

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CHAPTER I

INTRODUCTION

Anticosti island is of particular interest to geologists, as it is believed to afford the most extensive sequence of late Ordovician and early Silurian deposits in America. No important collections had been made from its strata for more than fifty years preceding 1908 when Professor Charles Schuchert spent a month there, seeing the top, base, and large parts of the intervening strata as these are exposed on the south coast. The following summer the present writer spent nearly three months in a study of the geology of the island, the entire coast being examined and, where possible, trips made into the interior. The combined collections of both summers amounted to more than three tons of material. The island was again visited by the writer during the summer of 1919 when the entire shoreline was traversed on foot and several rivers were ascended to where exposures ceased.

In pursuance of the work many obligations have been incurred, and this opportunity is taken to thank the authorities of the Peabody Museum of Yale University whose financial assistance made the first expedition possible. Thanks are also due to the late Professor Joseph Barrell, and more especially to Professor Charles Schuchert, for advice and constructive criticism. Deep obligations are felt to the late Mr. Henri Menier, the proprietor of Anticosti, and Messrs. George Martin-Zédé and Albert Malouin, the Governor and the former local Governor, each of whom extended his hospitality and rendered all the assistance possible. Thanks are also due to Messrs. Z. Lemieux, Christopher Hubert, Emil Laprise, and the late Wm. Bradley, the keepers of the lighthouses and telegraph stations, who with kindly hospitality and assistance did much to advance the work. Nor must Mr. Selas Poirer, the owner of the fishing boat, be forgotten, for to his willing service and unfailing good humour is due a great part of whatever success was attained on the writer's first expedition. The writer is also greatly indebted to those of his students, Messrs. C. M. Rieck, Carl Hoppert, W. J. Hamblin, L. L. Pfrang, W. H. Conine, and R. H. Bennett, who were his companions and assistants on the last expedition, since it is due to their loyal efforts that the expedition of 1919 was a success. The co-operation of the Canadian Geological Survey has enabled the writer to complete the study of the faunas.

HISTORY OF ANTICOSTI

The recorded history of Anticosti is nearly as old as that of the gulf of St. Lawrence, for nearly four hundred years ago (1534), Jacques Cartier saw the rugged cliffs of the north coast and called the island, île de l'Assomption. As French fishermen before this had visited Percé on the Gaspe coast, it is probable that the island had been previously seen. It was re-named île de l'Ascension by de Roberval in 1542. In 1680, when it was granted to Louis Joliet, it bore the name of Anticosty[1].

From the time of de Roberval to Joliet, historical record of the island's existence almost fails. In 1690 it was occupied by Sir William Phipps, who destroyed the fort which Joliet had built and took Joliet, his family, and assistants, prisoners. Joliet died some time between 1699 and 1705 and the island was inherited by his two sons and a daughter. One of the sons lived on the island for a time, but there appears to have been no division of the property at his death or the deaths of the other children, and after this generation of Joliets the heirs with other interests lived elsewhere, and the property remained undivided. The owners grew in number with each generation and most of them lived in Europe.

For the one hundred and fifty years from 1725 to 1874 the island was inhabited largely by squatters and temporary residents—the latter coming from the north and south sides of the gulf of St. Lawrence, and from Newfoundland to fish and hunt. Many of the inhabitants were of an adventurous and not too scrupulous temperament, and from among them came the wreckers whose activities gave the island a very unsavoury reputation. In 1870 a company, known as the Anticosti Company, later (1874) called the Forsyth Company, attempted the colonization of the island. Little success attended its efforts.

After having paid little attention to their possession for about a century and a half, several of the heirs in 1895 demanded that the property be liquidated, and on November 16 of that year it was sold, the purchaser being M. Henri Menier of France. Under the present ownership land has been cleared, lakes drained, farming begun on a considerable scale, and a thriving industry in the raising of furs initiated. The owner has erected a school, a church, and a hospital, and maintains a physician. A wharf about three-quarters of a mile in length has been constructed at Ellis Bay. This permits steamers to land and gives them safe anchorage in storms. A railway 30 miles long has been built into the interior in order to develop the timber and an excellent macadam road connects Baie-Ste. Claire with Ellis Bay. An hotel has been built at Ellis Bay and comfortable camps have been erected on the best salmon streams. Deer were introduced on the island in 1897. The environment has been well suited to them, and they are now extremely abundant.

Except for the lighthouse keepers and the game wardens the population is confined to the two villages of Baie-Ste. Claire and Ellis Bay. The latter is the site of the offices of the owner and practically all business is done there. There are about fifty families on the island.

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[1] According to Schmitt, Jos., the name Anticosti is derived from the Spanish, being compounded from *a nte*, before, and *costa*, coast.

CLIMATE

The summers are short and warm, but rarely hot. The winters are long, but not extremely cold. Summer begins in late May and ends in late August, with an occasional frost in early August. Snow falls in October. The cold Labrador current sends some of its water through the strait of Belle Isle, and is responsible for some lowering of the temperature. Dr. Joseph Schmitt made observations at Baie-Ste. Claire from 1897 to 1902 inclusive, which show the highest temperatures to occur in July, the maximum observed being 26 degrees C. (78·8°F.) with the average daily temperature for the last half of May to the close of August around 15 to 16 degrees C. (50°F.). The lowest temperatures observed were in late January and early February, 1898, the minimum being 39 degrees C. below zero (−38·2°F.). The average low temperature is around 20 to 25 degrees C. below zero (−4° to −13°F.). The rainfall during the growing season is about 9 to 12 inches, and the islanders state that the average annual snowfall for the western end of Anticosti is about 3 feet and on the south side of the east end about 2 feet. There is a great deal of fog, particularly on the east end. In 1901 there were three hundred and sixty-four hours of fog observed at the West Point lighthouse, there being four occasions when the fog lasted twenty-four hours at a time. The light-keeper at South point informed the writer that he blew the fog horn on twenty-six days in the month of August, 1909.

FLORA AND FAUNA

The greater part of the island is heavily covered with vegetation, which is mostly not high, but very thick, extensive stretches being almost impenetrable. On the south shore there are large areas where the vegetation consists of moss, with such low shrubbery as blueberries, alders, etc. The timber consists of spruce, Canada balsam, white pine, with occasional patches of American aspen and balsam poplar. Spruce and balsam are the most abundant.

The larger animals include beaver, martin, fox, bear, otter, and rabbit. Deer have been introduced and exist in great numbers. The bird life is like that of the adjacent coasts, and the same is true of the shore fauna.

The greatest present resource of the island is the fish, principally trout and salmon, which throng its waters, both along the coast and inland. Its submerged reefs are the homes of many lobsters which now are little more than touched. Cod are locally very abundant.

Beaver colonies are numerous. The trapping of bear, fox, and martin, all of which are plentiful, furnishes occupation for a number of men during the winter.

The timber resources of Anticosti are extensive so far as timber for pulpwood is concerned, but not of much importance for lumber as the vast majority of the trees are too small.

GEOLOGICAL RESOURCES

The geological resources are largely potential. Anticosti possesses no deposits of metallic minerals. The quantities of structural stone that may be quarried are practically inexhaustible. Only limestone and sandstones are present; none of the varieties has any particular merit over other good average limestones or sandstones and not all of the limestones of the island are suitable for building purposes. The best stone of all is in the Chicotte formation in its exposures from Southwest point to rivière du Pavillon. The lighthouse of Southwest point was made from this stone. Sandstone of fine grain and of a texture easy for trimming may be obtained on the north shore from Grindstone cape to Lousy cove. Blocks of almost any size desired are possible. This sandstone is very porous and would crumble rapidly if exposed to frost. Some layers of the sandstones of the north shore could be utilized for the manufacture of grindstones and perhaps other abrasive tools.

Stone suitable for ornamental purposes occurs in the Chicotte formation. This is about 70 feet thick and is exposed for about 3 miles west of rivière du Pavillon to a little west of Southwest point and in large part is a dense, thick-bedded, crystalline limestone which from a commercial point of view is a marble. Blocks could be quarried up to about 3 feet in thickness and of almost any horizontal dimensions desired. At all localities the rock is filled with stems of fossil crinoids and heads of fossil corals which in most cases differ in colour from the enclosing materials, so that on polished surfaces the pink and white stems of the crinoids, and the honeycomb and chain arrangement of the corals give to the rock a unique beauty. The colours range from grey to flesh-red. This stone closely resembles the well-known Hoburgen marble of the island of Gotland in the Baltic sea, which has been extensively quarried and used in Sweden and other adjacent countries. The two rocks are the same in origin and are not greatly different in characteristics.

Some of the limestones of every Anticosti formation, the Chicotte excepted, may contain the proper percentages of impurities to produce natural cements. Limestone and shale suitable for the manufacture of Portland cement are present at a number of places.

Good clay is not common on Anticosti. Clays of glacial origin of unknown, but probably limited, extent have been observed on Caplan river, and it is probable that such occur elsewhere.

Fine-grained quartz, garnet, and magnetite sands occur quite commonly in the tidal zone of the beach and in a number of places above tide. The places of greatest abundance are on the south side from Cormorant point to rivière du Pavillon. Large quantities are obtainable in the estuary east of pointe de la Croix and between Little river and Box brook. Limestone sands and coarser particles occur on many parts of the beach of both the north and the south shores. On the north shore quartz sand is present in considerable abundance near cape James and Grindstone cliff.

There is no limit to the quantity of gravel that may be obtained, as nearly the whole of the beach above the tidal zone is composed of limestone gravel of various degrees of coarseness; and on many sections of the shore, particularly on the north side, the tidal zone is also floored with gravel.

Some of the lakes contain much shell marl. Marl lake, near baie Ste. Claire, with an area exceeding 100 acres, has its bottom covered with this material to a maximum thickness of 12 feet[1], so that in this single lake

[1] Grant, C. C.: Jour. and Proc. of the Hamilton Association, 1892, p. 141.

there are over 1,000,000 cubic yards of marl. Many other lakes and ponds are partly filled with marl, and the total quantity on Anticosti must be very large. An analysis of marl from Anticosti, which probably came from one of the lakes, was made by Mr. F. D. Adams and showed the presence of 0·0137 per cent tribasic phosphate of lime[1]. In the future, perhaps, these marl deposits may be used for the neutralization of the island's peaty soils.

The peat deposits are very extensive. The maximum thicknesses and better qualities are found on the lower terraces and on the flat, or nearly flat, parts of the higher terraces. The greatest development of the thick deposits extends 80 miles along the eastern end of the south coast. The lowest terrace has there a width of several miles and is covered with peat to a maximum thickness of more than 10 feet[2]. There are numerous other areas of from 100 to more than 1,000 acres, where the peat reaches a thickness as great as 10 feet.

Scattered along the beach of the north shore for about 75 miles eastward of English head are fragments of bituminous black shale. The distribution strongly suggests that the parent rock from which these fragments were derived underlies the channel north of the island and that it can scarcely be more than 100 feet and may be less, below sea-level on the edge of the reef at English head, Makasti point, Carleton point, and intervening headlands. This shale has not been analysed, but it appears to have a high petroleum content.

RÉSUMÉ OF THE LITERATURE

The first geological exploration of Anticosti was undertaken in 1856 by James Richardson. He circumnavigated the island and made very extensive collections of fossils. The published result of Richardson's work was a detailed section, in which the strata of the south shore were grouped into six divisions to which the letters A to F were applied, beginning at the base. Where it was considered possible the strata of the north shore were correlated with these divisions[3].

Richardson's collections were studied by Billings. His conclusions announced in 1857, are as follows:

> "All the facts tend to show that these strata were accumulated in a quiet sea, in uninterrupted succession during that period in which the upper part of the Hudson River group, the Oneida conglomerate, the Medina sandstone, and the Clinton group were in course of being deposited in that part of the palæozoic ocean constituting the state of New York, and some of the countries adjacent. If this view be correct, then the Anticosti rocks become highly interesting, because they give us in great perfection a fauna hitherto unknown to the palæontology of North America. When the great thickness of the rocks between the Hudson River and Clinton groups is considered, it becomes evident that a vast period of time must have passed away during their deposition; and yet as the Oneida conglomerate is unfossiliferous, and the Medina sandstone has yielded but a few inconspicuous species, we have been almost wholly without a means of ascertaining the natural history of the American seas of that epoch. The fossils of the middle portion of the rocks of Anticosti fill this blank exactly, and furnish us with the materials for connecting the Hudson River group with the Clinton, by beds of passage containing some of the characteristic fossils of both formations, associated with many new species that do not occur in either."

[1] Ells, R. W.: Geol. Surv., Canada, Ann. Rept., vol. IV, p. 115 (1891).
[2] Twenhofel, W. H.: "Geologic Bearings of the Anticosti Peat Beds"; Am. Jour. Sci., vol. XXX, pp. 65–71 (1910).
[3] Richardson, James: Geol. Surv., Canada, Rept. of Prog. 1853–1856, pp. 191–245 (1857).

Divisions A and B of Richardson's section Billings considered as belonging to the Hudson River group and perhaps holding beds as low as the Trenton, whereas "The divisions C, D, E, and F constitute a series of deposits to which it is proposed for the present in the arrangement of the measures to give the name of the Anticosti group."[1]

In the paper quoted, Billings described many of the Anticosti species, and further descriptions were given in Decades III and IV of the Geological Survey, Canada (1858), and the Canadian Naturalist and Geologist, beginning in volume IV, 1859, and extending through succeeding volumes to 1865.

In 1861, Hyatt, Verrill, and Shaler visited Anticosti and made collections at a number of localities. These collections were studied by Shaler, who reached conclusions somewhat opposed to those of Billings[2].

An extremely good summary of the Anticosti section with the names of the fossils characterizing each zone was given by Logan in his masterly work on the "Geology of Canada."[3]

In 1865 Shaler published a second paper relating to Anticosti, in which he described or named fifty-six species of Anticosti brachiopods[4].

The year 1862 witnessed the completion of the first volume of Billings' great work on the Palæozoic fossils; the second volume appeared in 1874, and in an intervening year was published his "Catalogue of the Silurian Fossils of Anticosti". Each of the papers contains descriptions of some of the Anticosti species.[5]

No other papers relating to the geology of Anticosti appeared until 1892, when C. C. Grant published two papers bearing the titles: "Geological Notes on Marl Lake, Anticosti," and "Fragments of the Palæozoic Sea Floor from Hamilton, Ontario, and Anticosti". In the former the lake is rather briefly described and a few notes are given on the stratigraphy and chief fossil-bearing horizons of the Anticosti rocks. In the latter reference is made to some of the beautiful slabs in the Anticosti beds, and these are cited as fragments of the Palæozoic sea-floor.[6]

In 1896 there appeared in Paris a paper by Paul Combes, bearing the title: "Exploration de l'Ile d'Anticosti." This paper consists of forty-six pages and a map, and, among other matters, there is given a brief account of the geology. The undulations of the beds are mentioned and ascribed to the influence exercised on deposition by the corals.

In 1900 Reverend Monsieur J. C. K. Laflamme explored the south coast from West point to rivière du Pavillon, and in his brief report he gives considerable data relating to the geology.[7]

The most ambitious paper relating to Anticosti appeared in 1904 and was the work of Dr. Joseph Schmitt, then resident physician on the island. This paper is a compilation of facts relating to the natural history of Anticosti and, in addition, gives much valuable information collected by the doctor during his residence there.[8]

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[1] Billings, E.: Geol. Surv., Canada, Rept. of Prog. 1853–1856, pp. 249–255; (1857).
[2] Shaler, N. S.: Proc. of the Boston Soc. Nat. Hist., vol. 8, pp. 285–287 (1862).
[3] Logan, W. E.: Geol. Surv., Canada, 1863, pp. 220–224, 298–309.
[4] Shaler, N. S.: Bull. Mus. Comp. Zool., vol. 1, pp. 61–70 (1865).
[5] Billings, E.: Geol. Surv., Canada, "Palæozoic Fossils", vol. I (1865). Geol. Surv., Canada, "Catalogue of the Silurian Fossils of the Island of Anticosti", 1866. Geol. Surv., Canada, "Palæozoic Fossils", vol. II (1874).
[6] Grant, C. C.: Hamilton Association, Jour. and Proc., 1892, pp. 141–146, 149–154.
[7] Laflamme, J. C. K.: Geol. Surv., Canada, Ann. Rept., vol. XIV, pt. A, pp. 190–196 (1905); or Sum. Rept. 1901, Sess. Paper No. 26, pp. 188–194.
[8] Schmitt, Jos.: Monographie de l'Ile d'Anticosti, Paris, 1904.

In 1910 Schuchert and Twenhofel published a paper on a geological section beginning on the Quebec shore and extending to the summit of the exposed strata on the southwest point of the island. In this section the characteristic fossils of each zone are named.[1]

Also in 1910, Twenhofel published a short paper describing the peat beds of Anticosti and discussing their geologic bearings[2] and in 1914 he published two short papers, in one of which was given a summary of the facts of Anticosti geology so far as known at the time of publication; and the other contained descriptions of several of the new species of fossils.[3]

A comparatively recent paper by Twenhofel discusses the variations in the sediments and faunas of the Anticosti strata.[4] A later paper by Twenhofel and Conine describes the terraces which are such conspicuous features of the island's surface.[5]

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1 Schuchert, Chas., and Twenhofel, W. H.: Bull. Geol. Soc. Am., vol. 21, pp. 677–716 (1910).
2 Twenhofel, W. H.: Am. Jour. Sci., 1910, pp. 65–71.
3 Twenhofel, W. H.: Geol. Surv., Canada, Mus. Bull. 3, 1914.
4 Twenhofel, W. H.: Geol. Surv., Canada, Mus. Bull. 33, 1921.
5 Twenhofel, W. H., and Conine, W. H.: "The Post-Glacial Terraces of Anticosti Island"; Am. Jour. Sci., ser. V, vol. I, pp. 268–278 (1921).

CHAPTER II

GEOGRAPHY AND PHYSIOGRAPHY

Anticosti island is situated in the northern half of the gulf of St. Lawrence, between latitudes 49° 4′ north and 49° 53′ north and longitudes 61° 45′ west and 64° 35′ west. Its greatest width is near the middle of the island where it is 34·7 miles. Its length is about 125 miles. The area is between 3,750 and 4,000 square miles. The longer axis of the island is about north 65 degrees west. The locality nearest the Quebec shore is cap de Rabast, between which and the mainland at Long point the distance slightly exceeds 20 miles. A little more than 16 miles separates cap de Rabast from Mingan islands. There are about 44 miles between Anticosti and the peninsula of Gaspe, the nearest point of the south mainland, and it is about 125 miles from East point to Newfoundland. There are only two villages on the island, these being situated near the west end on Ellis bay and baie Ste. Claire, the former having a fair harbour.

In its larger physiographic relations Anticosti is a partly submerged cuesta with the inner lowland holding the position of the north channel. As the escarpment faces north, the high land is nearer the north coast.

The general outline of the shore is laid in broad curves, and deep indentations are rare. The only indentations of sufficient depths to serve as harbours are Ellis and Fox bays and these are not landlocked.

The very small indentations owe their origin to erosion by the sea, or erosion by the present streams. Schmitt claims that the broad embayment east of Southwest point was produced by currents impinging on that part of the coast. Such, however, is not likely to have been its manner of origin. The larger re-entrants, such as Ellis and Fox bays, were undoubtedly produced by the drowning of the lower courses of the streams which drain into them, as is indicated by the presence of submerged channels.

An extensive wave-cut terrace exists along most of the coast. This is the "reef" which is so dreaded by the ships which pass Anticosti and which is such a barrier to access to the island. The "reef" is exposed at low tide and is a prominent feature from cap de Rabast to West point, and thence eastward along the south coast to Heath point. Within these limits it varies in width from nothing to about 3 miles, the greatest width being on the south side at the mouth of Dauphiné river. Along the north coast eastward from cap de Rabast it is narrow, and from de Puyjalon cliff to East cliff it is in many places wanting, or of insignificant width, deep water existing at the foot of the high promontories which are characteristic of that part of the coast. At the edge of the "reef", so far as observed, there appears to be a quite abrupt descent into deeper water. The "reef" shows little other than barnacle and sea-weed covered rocks, and there are many places where the rock is polished smooth. Pebbles are as a rule wanting, except at the shore where they are apt to be present in large quantities unless the coastal rocks are not of a character to furnish pebbles.

This reef is thought to have been developed during the present cycle of marine planation, although it is possible that it was partly developed during an earlier period and then brought to its present position by later movement.

Where the reef is absent or narrow, the coast is bold, consisting of high headlands alternating with indentations. Some of the coves and bays are backed by high cliffs; but the surface behind most of them rises gently, the low areas gradually narrowing and disappearing at from 2 to 3 miles from the sea. Locally there are instances where the salients are low, cap de Rabast being a conspicuous example; but, with few exceptions, a high cliff exists a short distance inland from the shore. Where the reef is wide, the coast is low, cliffs being an exceptional feature and existing only where a tongue of higher land has been reached by the cutting of the sea.

There are probably no more impressive features in the physiography of Anticosti island than its terraces and it is thought that twenty-two are determinable. The elevation of the highest exceeds 400 feet. In places a terrace may have a width of a mile or more; in other places it narrows until it disappears, its cliff or front slope merging with those above and below. The terraces of greatest width are about the indentations, those of least width on the salients. Some on the south side are several miles wide. On the north side all are narrow and the highest observed in many places are within a couple of miles of the sea.

In practically every locality studied the terraces truncate the bedrock structure and are with difficulty referred to a structural origin. Most, including the highest measured, bear gravel which appears to be of beach origin. Shell-bored rocks have been found between Ellis bay and baie Ste. Claire up to at least 85 feet above sea-level. In many places the lower terraces are backed by steep slopes and undercut cliffs such as could have been developed only by waves.[1]

During the Ice Age, the island was covered by ice derived from the north mainland, as shown by the character of many of the abundant erratics and by the glacial striæ which have been observed on Vauréal river where the direction is south 24 degrees west, and in two places, at Cormorant point, at one of which the direction is south 20 degrees west, and at the other south 3 degrees west. Schmitt has noted the occurrence at rivière du Cap of striæ which have a direction from northeast to southwest. Till appears to be rather rare, but where found it contains pebbles and boulders of dolomite derived from the Ordovician strata to the north. Unstratified glacial gravel occurs in the bed of Vauréal river up to 12 miles from the sea at an elevation of 322 feet.

Clays and sands containing an abundance of *Saxicava rugosa* and *Mya truncata* have been observed at Ellis bay at an elevation of about 20 feet above sea-level, and have also been seen at Otter river and Jupiter river, at the latter place being estimated to be 30 to 40 feet above sea-level. On the north side of the island they occur on the brook which

[1] *See* paper by Twenhofel and Conine, op. cit.

empties into Petit Makasti bay, and it is probable that similar clays and sands occur at many other places. These marine Champlain deposits are truncated by the terraces.

At many points along the coast and rivers are deposits of stratified sand, gravel, and clay. These were observed up to elevations of 100 feet above sea-level. At Southwest point these deposits are truncated by a 65-foot terrace; at Caplan river an 85-foot terrace is cut across them; and at pointe Ste. Anne a 74-foot terrace truncates them. At the last-named place the many shells of *Mytilus edulis* and *Mya arenaria* occurring throughout the deposit—species now living in abundance along some parts of the shores of the island—show that these deposits are younger than those laid down during the Champlain submergence.

The river valleys are of two types. Nearly all the smaller streams flow in rock-floored, narrow valleys, and most of these streams reach the sea over rapids or falls. These streams are probably largely post-Glacial. Other streams have wide valleys and flow over floors of gravel and sand which cover an older valley floor beneath. The latter type is illustrated by parts of the Caplan, Jupiter, Fox, and Salmon River valleys. Caplan river has a broad flood-plain for such a small stream, and as a general rule the valley slopes are gentle. Near the mouth, however, the valley narrows and the stream reaches the sea between high rock cliffs, which are bordered on the upstream side by cliffs of till and stratified gravel. This suggests that this stream has made a new entrance to the sea, and, as the shore to the west consists of gravel cliffs for fully half a mile, it is probable that the old Caplan valley lies hidden there. These valleys are pre-Glacial, as shown by their aspect of maturity, by the glacial deposits in them, and by the glacial striæ seen on rivière du Cap and Vauréal river. As no Tertiary deposits have been seen in any of them, it is assumed that in pre-Glacial time this region was as high as it is at present.

Wave erosion on Anticosti appears to be very rapid. The rocks on an average are not particularly strong. They are much jointed, and there is much frost wedging. At Heath point, Mr. Christopher Hubert, the light-keeper, pointed out a road which had been moved twice between 1909 and 1919, and the rock at that place, if anything, is somewhat more resistant than the average. The estimated width eroded in the ten years is 20 feet, or a mile in a little over 2,500 years. At this rate, it would have required about 7,500 years to cut the present sea-level terrace at its greatest width. As the average width of this terrace is not much more than a mile, it may be assumed that about 3,000 years were required for its development. On the south side of the island the gradient of the surface is gentle, and the surface low, so that in the cutting of any one of the terraces the quantity of material to be eroded and transported was not great, thus permitting the terraces to develop to great widths. On the north side erosion is just as easy, but the general elevation above sea-level is so much greater that a move of one foot inland required the removal of from five to forty times as much material as is the case for a movement inland of the same distance on the south side. A longer time would, therefore, be required to cut an equal width of terrace on that side, hence their lesser width. If each uplift meant the development on the south side of a terrace with an average width of one mile—probably far too large an assumption, as many of them are known to have reached a width of only a fraction of that figure—the development of the twenty-three terraces would have required a maximum not above 70,000 years. The cliffs show that the last uplifts have been comparatively recent; otherwise these features would have been destroyed under the strong frost action that prevails. The island is reported to be rising at present, the evidence being found in the apparent inaccessibility of former harbours.

Anticosti has no large rivers. None is navigable, all consisting of a succession of falls and rapids. Jupiter river is the largest and the Vauréal second in size. The latter has beautiful falls about 8 miles from the sea. Above the falls the river flows for about half a mile in a crooked, steep-walled channel, lying about 25 feet below the level of what appears to be a wider valley whose slopes, as far as may be determined from the general aspect of the timber-covered country, grade imperceptibly into the upland surface. At the falls there is a drop of 153 feet into a crooked gorge whose almost perpendicular walls rise about 200 feet above the stream. This gorge extends for about 2 miles and then gradually becomes transformed into a steep-sided valley. Of the other streams, the Salmon, MacDonald, Fox, and Chicotte are about the only ones worthy of being called rivers.

The divide between the streams of the north and south shores is north of the middle of the island on both the east and west ends; but it is south of the middle in the central part, where it appears to have been forced southward by a headward growth of Vauréal and Salmon rivers, those two streams apparently having taken drainage areas from both Chicotte and Jupiter rivers.

Lakes occur at all altitudes. Some are former arms of the sea which have been cut off by bars; some have been made by beaver dams; others appear to be rock-floored basins; and still others are shallow pools in basins of vegetable deposits. The largest and best known examples of the first type are Fox, Heath Point, and Salt lakes, the last still connected with the sea. The barriers range in height up to about 20 feet.

Every lake on the island is being rapidly extinguished by growth of vegetation about its borders and deposits of organic and other matter over its bottom. An extinct "marl lake" was seen in section in the sea-cliff about 10 miles west of Shallop creek. The section (descending) is as follows:

	Feet
Black amorphus peat of which the upper part grades into the living vegetation	7
Marl with well-preserved shells of the same species as those living in existing lakes, maximum	2
Blue, grey, and yellow clay, base concealed	3

CHAPTER III

GENERAL GEOLOGY

INTRODUCTION

The work of Richardson[1] led to the division of the Anticosti strata into six formations which were designated, from the base upward, by the letters A to F. Subsequent work has recognized the validity of these divisions, but has divided the fourth into two formations, and in the cases of the third and fourth Schuchert and Twenhofel[2] placed the divisions a little lower than was done by Richardson. To bring the formational designations into harmony with modern usage the same authors gave geographic names to them. Two of the names are slightly modified in this paper in the interests of simplicity. All previous zonal definitions in the formations, so far as they are related to the west end of the south shore, have been based on the section measured by Richardson between English head and Southwest point.

Richardson's collections were very large, and worked up by Billings gave palæontologic definition to Richardson's formations. As some of the fossils collected by Richardson appear to have been incorrectly labelled as to locality, conclusions based on their distribution are likely to contain some error.

Studies of the Anticosti sequence prior to 1919 were almost wholly limited to the exposures of the shore, which, though excellent, are interrupted in many of the indentations and over long stretches are wanting altogether. Such conditions made it almost inevitable that errors of detail should be made in reconstructing the stratigraphical sequence. Furthermore, the lithological differences between the deposits of the north and the south shores made it fairly certain that any correlation of the deposits of the two shores would contain some error so long as the character of the strata in the intermediate territory was unknown. In previous studies it has also been assumed that the structure is quite uniformly monoclinal, but with variations of inclination. The work of the 1919 field season resulted in proving that, though the structure is monoclinal, there are many low anticlines which pitch in the same general direction as the dip of the monocline. These hitherto undetected minor folds have been the cause of errors in the former accounts of the stratigraphy.

On the coast as a rule it is not possible to examine many of the contacts of the various zones, but most of them can be seen in the river sections. On the south side of the island the gradients of the streams approximate the dip of the strata, so that the actual section which can be seen on any one stream is small. On the north shore the streams flow in one direction

[1] Richardson, J.: Geol. Surv., Canada, Rept. of Prog. 1856, p. 191.
[2] Schuchert, Chas., and Twenhofel, W. H.: Bull. Geol. Soc. Am., vol. 21, p. 677 (1910).

and the strata dip in the opposite direction, thus giving ideal conditions for thick exposures. Not every stream of the north side has exposures, but there are enough streams conveniently placed with reference to each other to make possible the satisfactory determination of the lower part of the sequence, the place where the greatest uncertainty has existed.

The strata dip southward at angles ranging from nothing to 5 or 6 degrees with an average of less than 2 degrees. A few reversals of inclination have been noticed. The strike shows a range from north 39 degrees west to north 80 degrees west. In most places it is about north 65 degrees west. A basin structure is indicated by the outcrops of the different formations; the beds of the east and west ends of the island have been slightly warped upward, forming a shallow trough, which, in the middle part of the island, holds the strata of the higher divisions.

Throughout the whole extent of the deposits there are gentle undulations. Most of these show no system whatever in their arrangement and are evidently due to conditions present at the time of deposition of the sediments. Others were formed after the deposition of the strata. The beds dip away from the axes of the latter undulations at angles up to 5 or 6 degrees, and in rare cases with greater inclination. The largest undulation observed is about three-fourths of a mile up MacDonald river where the strata along the banks of the river show a north dip over a distance of about a quarter of a mile, giving an anticline which has an estimated height of 30 to 40 feet. Another relatively large arch occurs at East cliff. Many other undulations are shown by the outcrops of the strata on the reef. In many of the bays of the north shore the strata extend around the sides and back, showing that these exist on anticlines. Such were observed in the bay west of High cliff, Brig harbour, and elsewhere. At the Jumpers on the south shore three such arches occur in succession. These structures pitch southward and southwestward in harmony with the inclination of the strata.

At nearly every locality two systems of joints can be seen. Those of the more prominent system have a direction, ranging from about north 50 degrees west to north 60 degrees west. The joints of the system of lesser prominence range from about north 45 degrees east to north 70 degrees east. As a rule the joint-planes are approximately vertical.

Anticosti does not offer much in the way of faulting; even displacements of a foot or two are rare. Other writers have mentioned the occurrence of faults in three places and the field work of 1909 and 1919 showed the occurrence of several others.

In 1857 Richardson described a fault in the bay just east of Cormorant point, having a downthrow on the east of 45 feet and trending north 37 degrees east.[1] This place was carefully studied in 1919; the fault was found to trend north 40 degrees west (true). The downthrow is between 44 and 54 feet. On the east side of the fault-plane are many joint-planes containing calcite, with the joints trending more or less parallel to the strike of the fault.

Laflamme[2] briefly notes the occurrence of two faults, one just east of Ellis bay and the other crossing Jupiter river just above its mouth

[1] Richardson, J.: Geol. Surv., Canada, Rept. of Prog. 1853-1856, p. 230.
(Richardson does not state whether his directions are true or magnetic.)

[2] Laflamme, J. C. K.: Geol. Surv., Canada, Sum. Rept. 1901, p. 190 A.

and reaching the sea on the east side of Jupiter bay. These two localities were closely examined, the former perhaps better than any other part of the island, and no evidence suggesting faulting was seen.

Several small faults are exposed in the cliffs at the back of Prinsta bay. The first fault on the west has a downthrow of about 6 inches on the west. The fault-plane dips 82 degrees west and trends north 80 degrees west. Calcite deposits occur along the fault-plane in several places. Thirty to forty feet east of this fault is a parallel fracture dipping 66 degrees west. About 70 feet east of the fault is a second fault with trend north 75 degrees west, dipping 62 degrees west with a throw of 7 to 8 feet on the west and a drag of about 6 inches on some of the thin beds. Fifteen feet farther east is a third fault with trend like that of the second. The dip is 72 degrees east and the throw is 7 inches to the east. Fifty feet farther east is a group of six faults in a zone about 4 feet wide with a total throw to the west of about 6 feet. The trend is about north 80 degrees west and the dip is 72 degrees west. Thirty feet farther east are two vertical faults trending north 60 degrees west, the two giving a total drop on the east side of 10 feet. A fault is exposed on the reef just west of White cliff on the northwest of the island; the displacement is only a few feet.

A case of possible faulting occurs about a mile east of South point. On the low and partly gravel-covered shore for a space about 12 feet wide the rocks have a vertical attitude and strike north 49 degrees west. Outside of the 12-foot zone the inclination of the beds rapidly decreases, and within less than 50 feet the strata are again horizontal. The rocks on each side of the disturbed zone are the same in character and fossils, and if a fault exists the throw cannot be great.

At du Puyjalon cliff on the north shore there are two dykes[1] about 2,000 feet apart. Each stands approximately vertical. The west one is between 55 and 60 feet wide; the smaller has a width of about 27 feet. The trend of the west dyke is north 15 degrees east, that of the east, north 20 degrees east. On the shore the dykes form walls, due to the fact that mechanical action dominates over chemical, to the former of which the limestones and shales yield more readily than the dyke rocks. On the wooded cliffs and steep slopes back from the shore the dykes in some places are indicated by depressions. At the contact with the sedimentary rocks the latter are slightly altered, and this alteration appears to be the explanation of the narrow limestone ridge which borders the east dyke where it ascends the cliff. The sedimentary rocks bordering the west dyke are cut by joints which are parallel to the dyke and by other joints which trend south 45 degrees west. Cleavage planes are also present, the strike of the cleavage being parallel to the trend of the dyke, with the cleavage planes from one-quarter to one-half inch apart near the dyke, but progressively farther apart with distance therefrom. There is also a jointing in the west dyke, the joints having the trend of the dyke and dipping west on the west side at an angle of 80 degrees and east on the east side at about the same angle.

[1] Richardson, J.: Geol. Surv., Canada, Rept. of Prog. 1853–1856, p. 208.
Schmitt, J.: Monographie de l'Ile d'Anticosti, 1904, p. 73.
(It is to be noted that Richardson gives different figures of bearing.)

Microscopic examination of thin sections of the dyke rocks shows them to be composed of long labradorite crystals, magnetite, and augite, the last more or less altered to chlorite or serpentine. The texture is that of diabase.

The strata of Mingan islands are separated from those of Anticosti by North channel, forming a geographical break of 19 miles, in which Logan considered that if the "average dip of 90 feet to the mile" were maintained across the channel, 1,700 feet of strata might exist there. This thickness is supposed to represent the Trenton to and perhaps including, the Lorraine, neither of which has yet been definitely recognized in this region. That such a thickness is not too great for these formations is shown by the greatly increased thicknesses that the equivalents of other formations have in the St. Lawrence embayment. If, however, the dip in this geographical break should flatten out, as it is known to do in many places on Anticosti, the thickness would be much reduced.

Above sea-level on the south shore of Anticosti there are represented two systems—the Ordovician and Silurian—with a total thickness of about 2,400 feet. The thickness varies with different sections, but on the whole the aggregate is about the same. The lowest 1,159 feet belong to the Ordovician system, embracing the three formations of English Head, Vauréal, and Ellis Bay. On the south shore the rocks of the Silurian system have a total thickness of 1,205 feet, distributed among the four formations composing the system. As both base and summit of the section are concealed by the sea, the total thickness of these two systems may be much greater than has been measured.

Table of Formations

In the following table, after the formation name, are indicated the corresponding divisions of Richardson's section:

Silurian	Niagaran	Chicotte (F 1–4)	Limestone, 73 feet
		Jupiter (D 9–10, E 1–10)	Limestone and shale followed by limestone, 653 feet
	Anticostian	Gun River (D 2–8)	Alternating limestone and shale, 308 feet
		Becscie (C 12–14, D 1)	Limestone with shale partings, 199 feet
Ordovician	Gamachian	Ellis Bay (C 1–12)	On south shore, shale and limestone; on north shore, sandstone followed by limestone, 200 feet
	Richmondian	Vauréal (B 1–11)	Limestone and shale interbedded, 730 feet
		English Head (A 1–6)	Limestone and shale, 228 feet
	Mohawkian	Macasty	Black shale

CHARACTER OF THE SEDIMENTS

The sediments vary in character throughout the section and the variation is not systematic.

LIMESTONES

The rocks of Anticosti are more than one-half limestones which for convenience may be classified as argillaceous shell, coral-crinoid, compact, and crystalline limestone.

Argillaceous limestones are by far the most common, particularly in the lowest 1,000 feet of the sequence. The upper half of the Gun River formation also contains great thicknesses of this type. As a rule the colour is grey, and the thickness of an individual bed rarely exceeds 6 inches. In most cases the bedding planes are irregular.

Shell limestones and shell breccias occur in limited quantities at many horizons, and nearly every bed of limestone is locally a mass of shells. Limestones of this type are particularly prominent in the upper half of the Becscie formation in which, on the south side of the island, there is a zone more than 50 feet thick locally almost wholly formed of the broken shells of the brachiopod *Virgiana barrandei* and the bryozoan *Phaenopora superba*. Locally parts of the Jupiter formation are almost wholly composed of the shells of *Atrypa*, *Stricklandinia*, and *Pentamerus*, and in places broken crinoid stems make up large parts of the Chicotte formation. Also there is a zone in the Ellis Bay formation almost completely made up of shells of *Parastrophia reversa*.

Coral limestone occurs at many levels, formed of entire or comminuted corals, in some cases to the almost total exclusion of other organic remains. The English Head and Vauréal formations contain large masses of coral and coral heads. The Ellis Bay formation contains the lowest coral reef limestone. This has a thickness of about 5 feet and the coral masses rise like ant-hills on the present wave-cut reef. The common species belong chiefly to the genera—*Clathrodictyon*, *Paleofavosites*, *Lyellia*, and *Halysites*. The northern shore outcrop of this zone is not a reef, but coral abounds, and there is a small reef on Vauréal river. Small reefs are in the Becscie, Gun River, and Jupiter formations, the total thickness of coral in the three formations probably exceeding 50 feet. It is in the Chicotte formation, however, that the corals make their greatest record, and here they occur in association with a great abundance of crinoid fragments. Locally, the entire thickness (73 feet) appears to be a structureless mass of *Favosites*, *Clathrodictyon*, *Halysites*, and other genera, one overgrowing the other and with included fragments of crinoid stems.

Compact limestone is well bedded, light coloured, very compact, extremely fine grained, turns yellowish white on exposure, and has a somewhat conchoidal fracture. This limestone appears to be that which Richardson described as bituminous. This rock contains few fossils, except on the surfaces of the beds, where in some cases they are thickly crowded, although mostly consisting of fragments. The larger part of the lower half of the Becscie, the lower part of the Gun River, much of the upper part of the Jupiter, and considerable parts of the upper third of the Ellis Bay formations are composed of this class of rock, and small thicknesses exist in each of the other formations except the Macasty and Chicotte.

Crystalline limestone is found in the Chicotte formation alone. Parts of this formation are "marble" with almost all fossils destroyed. The rock is compact, of fairly coarse texture, and has probably been diagenetically changed from the organic matter of which it was originally largely composed.

Extensive studies of the Anticosti limestones were made for the writer by Mr. A. W. Weeks, and these have shown that each limestone bed studied has a remarkable degree of individuality in its texture and constituents; and so far as studied no two beds have been found which are alike.

SHALES

The shales grade into the limestones at one extreme and the sandstones at the other. Typically bituminous shales occur at one level only, the Macasty black shales in North channel. These are black and soft, and on being struck with a hammer yield an odour of petroleum; if held to a flame, they burn slowly and give off a similar odour.

The other shales are blue, grey, green, or yellow. Alternating with beds of limestone, they are present in every formation except the Chicotte. The English Head and Vauréal formations contain considerable thicknesses, particularly in the northern exposures. At least half of the Ellis Bay formation on the south side is a calcareous shale, and it contains one thick zone. Other thick zones of shale are found in the upper Vauréal and the Becscie on the north side, and in the basal Jupiter on the south, the last having a known thickness of more than 100 feet with the lower part carrying considerable fine sand. In general, it may be said that shales compose about one-third of the Anticosti rocks.

SANDSTONE

There is little sandstone in the entire sequence, although many of the shales and limestones contain small percentages of angular grains of quartz. The only true sandstone is in the north coast exposures of the Ellis Bay formation, where a thickness of over 100 feet has been measured. These sandstones abruptly succeed the sandy shales of the Vauréal formation. The upper part of the sandstones contains a great deal of calcareous matter and carries many tabulate corals and *Beatricias*, some heads of the former being nearly 2 feet in diameter. Other fossils occur in this upper part, but as a rule they are fragmentary. The sandstones are more or less cross-laminated, and at cape James they contain an erosion channel with a depth of 6 to 8 feet.

CONGLOMERATES

There are three classes of conglomerates. In the Prinsta Bay and Cape Jones exposures of the Ellis Bay formation there are two thin zones of white and transparent quartz pebble conglomerate. The largest pebbles are not more than 10 mm. in diameter and most are less than 5 mm. The quartz particles, as regards character and dimensions, are such as occur in granites, and it is probable that they were derived from the crystalline rocks of Labrador. Associated with the pebbles in one of the zones are many worn shells of gastropods and brachiopods, each of a single species.

The second variety of conglomerate is formed of dolomite, limestone, or shale pebbles and boulders held in a limestone matrix, the fragments generally constituting a small percentage of the rock, but in many instances being crowded together as thickly as is possible. Dolomite and limestone compose the majority of the fragments, the former in the minority. Some of them are rounded, but in many cases they are subangular, thus indicating short transportation. The largest fragments are slabs of limestone or dolomite, many of which exceed a foot in diameter. These occur mostly in the English Head and Vauréal formations where they either are confined to definite horizons or are scattered irregularly and sparsely in the limestone beds. Large fragments are also present in the Ellis Bay formation at cape James and Prinsta bay and in the limestones of the upper part on Vauréal river. Pebbles and boulders also occur very abundantly in the Becscie and Gun River formations, but the dimensions average much smaller than in the Vauréal and English Head formations. Some of the fragments in the lower formations were not derived from rocks now exposed on the island, but came from an older division of the Ordovician, as a few of them are composed of dolomite, and the limestones contain *Plectambonites sericeus* of Middle Ordovician aspect.

The Ellis Bay and higher formations, in which the reef-like masses of coral occur, not uncommonly have conglomerates composed of coral heads and rock fragments which were derived from the coral growths. Such a case occurs at pointe Ste. Anne, where there is a bed about 2 feet thick which is made up almost wholly of spherical corals of 1 to 2 inches diameter belonging to *Lyellia*, *Paleofavosites*, *Favosites*, and *Clathrodictyon*.

In the Gun River formation, and to a less degree in some of the other formations, there are many beds of limestone whose upper surfaces are covered with small pebbles of limestone, shale, or mud. So far nothing has been found suggesting the source of these pebbles.

Intraformational conglomerate beds occur in the English Head and Gun River formations. These consist of what seem to have been fragments of partly consolidated sediments redeposited in heterogeneous arrangement with new sediments heaped among the fragments of the old. Some of the fragments are estimated to weigh as much as 50 pounds, and, standing inclined or vertical, have fine sediments with curved laminæ extending from one block to the other.

ORIGIN OF THE SEDIMENTS

Little doubt can be entertained as to the place of origin of the clastic materials. The coarser character of the sediments of the north coast as contrasted with the south, the greater quantity of shale on the former side, and the increased proportion of limestone on the latter, the relative scarcity of coral reefs on the north shore, the lenticular nature of the beds of the northern exposures of the Vauréal formation, the prominent cross-bedding of the sands at the base of the Ellis Bay formation—all of these prove that the source of the sediments was a northern one.

DEPTH OF THE ANTICOSTI SEAS

That the greater part of the Anticosti sediments, if not all of them, were deposited in shallow waters can hardly be questioned. Only small parts, if any, were deposited in depths beyond the reach of large waves. It is thought that sea-level was gradually, but not constantly, rising and that there were long periods of time when no deposition took place. Evidence of the shallowness of the water is presented in the paragraphs which follow.

Within certain limits, the textural and chemical characters of the sediments are a measure of the depths in which they were deposited. Limestones may exist from the littoral to great depths, and so are not definite in their limitations, though it is probable that most limestones are deposited in fairly shallow water. Muds and shales are more limited in their vertical distribution, but they may be deposited from the shoreline to great depths, depending on the distance of deep water from the shore. The rather abrupt alternation of shales and impure limestones is a better index of depth than is the presence of either rock alone. To the foregoing statements with respect to shales, one exception should perhaps be made—the Macasty black shales with pyrite fossils. The significance of shales of this type has been variously interpreted, and it is not within the scope of the present paper to attempt the solution of the problem of their conditions of deposition, but it is considered established that they develop more abundantly in shallow than in deep waters. Sandstones appear to be more limited in their vertical deposition than are either shales or limestones, most of the sands being said to be deposited within the 100-fathom line. It is conceivable that under certain coastal conditions sands may be swept into deep waters, but there is nothing to indicate that such conditions obtained in the case of the Anticosti sandstones. Conglomerates are thought to be narrowly limited in their vertical distribution, and their presence in marine deposits is considered to denote extreme shallowness of water. The beds of quartz conglomerate about Prinsta bay, however, are so thin that they can be given no great significance. A storm or two would suffice to account for them. The limestone, dolomite, and intraformational conglomerates can indicate nothing other than extremely shallow waters, and the wide distribution of the dolomite and limestone pebbles, boulders, and slabs in the English Head, Vauréal, Ellis Bay, and Becscie formations is interpreted as indicating shallow waters for long times over extensive areas.

Cross-lamination in water deposits results from rapid deposition by currents. So far as known, cross-lamination is developed in moderate depths, probably less than 100 feet for most of it. Extreme variation in directions of inclination and strike suggests very shallow waters.

Lenticular beds of limestone and shale are found in every formation except the Chicotte. For the most part they appear to have developed through redistribution of previously deposited sediments, for which shallow water was necessary.

Symmetrical and asymmetrical ripple-mark occurs from the base of the sequence to the top of the Jupiter formation. The presence of symmetrical ripple-marks places the depths of deposition of the entire sequence within the limits of such activity, which ordinarily is probably not greater than 100 fathoms.

The pebbles and boulders of the conglomerates in the Anticosti sequence reach maximum diameters of about 15 inches and weights of 20 to 30 pounds. To transport these, strong currents were necessary. These currents are thought to have been the undertow developed in great storms and acting in comparatively deep water, since in shallow water the large fragments would have been moved shoreward and kept there.

Intraformational conglomerates have been observed in the English Head and Gun River formations. Their presence is thought to indicate waters, at these times and places, of such extreme shallowness that waves could reach the bottom with sufficient power to tear up the previously deposited and partly consolidated sediments. The depth at which such work may be done surely cannot be great.

Channels were seen at five localities—West point, cape James, cape Observation, Chicotte river, and East cliff—in limestone or sandstone beds, the former containing many corals and the latter composed of quartz sands with corals. At West point they occur on the reef and are sinuous like the small channels of a few inches depth and width such as can be seen on any coast. At cape Observation the channels are exposed in section. One of the beds in the cliff at that place is a broad lens of limestone in which cross-sections of eight V-shaped channels are exposed. Corals are attached to the sides of some of these channels. It is thought that the channels were formed by currents while the sediments composing the beds were yet soft. In the cliff at cape James a cross-section of a channel is shown with a depth of 6 to 8 feet. It is filled with conglomerate, sandstone, and limestone. The channel at the mouth of Chicotte river has about the same magnitude. The channels at East cliff are small. Each of these channels is associated with an abundance of corals. It is thought that each was made beneath water, but it is possible that some were developed during temporary recession of the water.

Many of the beds have undulations which can hardly be ascribed to forces operative after consolidation of the sediments. Some of these undulations pass over the coral masses, whereas others end abruptly against them. The beds containing *Beatricias* have a great development of small undulations, the prostrate trunks seeming to have had about the same effect as a log in drifting snow or sand—stopping the drift until sufficient thickness has accumulated to pass over the obstacle. About such obstacles the sediments would settle, due to compacting, whereas the obstacles would undergo no decrease in volume. This would intensify the initial inclination. It is not likely that features of this character could have been extensively produced in other than shallow water.

The fossils themselves present somewhat contradictory evidence. Rolled and worn gastropods, brachiopods, corals, and other fossils are rather abundant throughout the entire sequence. These have resulted from the grinding action of waves in the shallows. Many zones contain corals which were torn loose by the waves, rolled for some distance, and then dropped with other sediments and fossils without any sorting whatever. One of the best occurrences of this character is that of cape Ste.

Anne. These features occur again and again and perhaps have arisen from storms of extraordinary violence which swept the corals from their places of attachment to deeper waters. Other zones, very abundant and many in close vertical proximity to those just described, contain most exquisite fossils which do not appear to have been disturbed after the death of the animals inhabiting the shells. These conditions are thought to indicate waters of moderate depths.

The present beach contains many shells which were once broken and later healed, and the study of the Anticosti brachiopods has shown many shells which have passed through a like experience. Such are most common in the English Head, Vauréal, Ellis Bay, and Gun River formations, and these fractured shells permit the inference that the habitat was so close to the surface that the waves could tear the shells from their hold and strike them on the rocks with sufficient force to break them, although it is possible that predatory animals with the strength to crush shells were then in existence and the fracturing was so caused.

The dominant forms of life in the Anticosti seas were corals and brachiopods. Living brachiopods are found to great depth, but occur most abundantly in waters within the zone of light. Schuchert concludes "that inarticulate brachiopods when large, thick shelled, and abundant, clearly indicate to the palæontologist animals inhabiting very shallow waters of probably less depths than 100 feet."[1] Living articulate brachiopods have 70 per cent of their species above the 100-fathom line, and 19 per cent live in water of less depth than 15 fathoms;[2] when the heavy shells, the great number of species, and the abundance of individuals of the Anticosti articulates are considered in connexion with the present distribution, it leads to the conclusion that the waters were at no time deep.

The coral reefs infer a depth of water not greater than that to which modern reef-building corals are limited, and "these are effective workers only in depths less than 25 fathoms."[3] The Anticosti reefs may have been in somewhat deeper water, but the association of conglomerates, lenticular beds, and corroded fossils reinforces the evidence that they were near the surface. There also can be seen the deeper channels between the reefs, ranging in depth from 1 foot to 5 and 6 feet in the reefs of East cliffs and greater depths in the reefs of the Chicotte formation.

It is thus seen that all lines of evidence converge to the conclusion that during the times of deposition of the Anticosti sediments the waters in which they accumulated were extremely shallow, and it appears probable that at no time were they deeper than 200 to 300 feet.

TEMPERATURE OF THE ANTICOSTI SEAS

Any conclusion relating to temperature must be based almost wholly on analogy. If the ancient reef-building corals required temperature conditions similar to those which limit the distribution of modern reef-building corals—not colder than 68 degrees F.[4]—it follows that a summer temperature prevailed in the gulf of St. Lawrence throughout the year.

[1] Schuchert, Chas.: Bull. Geol. Soc., Am., vol. 22, 1911, pp. 262, 264.
[2] Schuchert, Chas.: op. cit., p. 265.
[3] Vaughan, T. Wayland: Bull. Geol. Soc., Am., vol. 22, p 248 (1911).
[4] Vaughan, T. Wayland: Bull. Geol. Soc., Am., vol. 22, p. 250 (1911).

If the facts in respect to depth have been correctly interpreted, the above assumption represents in all probability the true condition, for with the corals at the surface of the sea a chilling temperature would probably have resulted in their elimination.

In modern seas there is said to be a close relation between temperature and lime secretion, and "the most favourable conditions for lime-secreting organisms are met with in the warm, equable waters of the ocean......... In the polar areas and in the cold waters of the deep sea there is, as is well known, a feeble development of all carbonate of lime structures in marine organisms."[1] Though it is probable that the above statements do not have as broad application as formerly supposed, yet the vast quantity of calcium carbonate which the organisms of the Anticosti seas extracted from the water, considered in connexion with the great number of species which did the work, strongly favours the view that a warm climate prevailed.

SEQUENCE OF SEDIMENTS

MACASTY BLACK SHALES

The lowest known rocks of Anticosti are the soft, black, highly bituminous shales of which fragments are found in the material composing the beach about the northwest end. At Makasti cliff was found a block weighing fully 500 pounds, from which five species were collected. The occurrence of this rock was first noted by Logan in 1863, who considered it the probable equivalent of the Utica of New York state.

Fragments from this horizon have been found only along the north shore eastward from English head for about 75 miles, and they make their largest contributions to the beach materials adjacent to the southern end of a submerged north-south trending divide which crosses the north channel from near Makasti bay to the western end of Mingan islands, suggesting that the parent formation outcrops on this ridge and possibly lies only a short vertical distance beneath the lowest visible strata of Anticosti. How thick it is, upon what it rests, and its stratigraphic and structural relations to the English Head formation are altogether unknown; but it is considered probable that it is disconformable either to the English Head formation or to one which may lie below the latter.

ENGLISH HEAD FORMATION

So far as known, the black shales are directly followed by the alternating beds of blue, grey, and green shales, and argillaceous and other limestones of the English Head formation. Many of the limestones are made of entire or fragmentary shells, particularly the latter, and intraformational and other conglomerates with pebbles, boulders, and slabs of limestone are marked features of the formation from base to summit. Irregular ripple-marking is present on many surfaces, and many beds are merely lenses of short diameter. Heads of *Paleofavosites prolificus*, some of which attain diameters of 2 feet, occur on almost every level, and *Buthotrephis* impressions are extremely abundant. The topmost bed of the formation

[1] Murray, J.: Nat. Sci., vol. II, pp. 25-27 (1897).

is a fine-grained, subcrystalline limestone covered with cylindrical paired impressions *(Saerichnites abruptus)*, supposed by Billings to be tracks. These are so thick that hardly a square yard can be found that is not marked by them. No other fossils are known to occur in this bed.

The type section for the formation is at English head, the bold promontory on the northwest end of Anticosti. The base of the formation is not exposed. The upper limit, known as the "track bed," has its western terminus in the back of baie Ste. Claire and its eastern extremity passes beneath the sea at the foot of Observation cliff. Here it was seen by Richardson in 1856 and by the writer in 1909 and 1919, and it probably does not appear east of that point. At many points between its most eastern and most western determined limits—White cliff, High cliff, West cliff, Makasti hill, and elsewhere—this bed is well exposed on the reef. On other parts of the coast it is high in the cliffs or inland.

VAURÉAL FORMATION

The Vauréal formation was described by Schuchert and Twenhofel as the Charleton, in the belief that the strata in the cliff at Carleton (Charleton) point belonged to it. This view has been found to be incorrect, making necessary the renaming of the formation. Lithologically the formation is little different from the preceding, save perhaps that corals become more abundant. Some individual heads attain diameters of 2 feet. Ripple-marking is commonly present, and there are many *Buthotrephis* impressions. Shale is thought to make a greater proportion of the thickness on the north coast than on the south, and the purity of the limestones appears to be inversely related to latitude. The formation closes on the north coast with about 100 feet of poorly fossiliferous shale, whose equivalent on the south side consists of grey limestones and sandy shales.

Richardson's section on the south shore gives to the formation a thickness of 730 feet. The Vauréal River section is 541 feet thick with the base concealed, in which it is probable that about 200 feet occur, so that the thicknesses on opposite coasts do not greatly differ.

The type section is that exposed on Vauréal river, where the sequence given on pages 44-46, 48-51 occurs. On the west end of Anticosti the section begins in the back of baie Ste. Claire and extends around West point southeastward to Junction cliff, a distance of about 7 miles. The other extremity forms the coast from Observation cliff to point Joseph, where its summit is placed at the top of a sandy shale exposed on the west side of the headland. Practically every foot of the sequence of the north coast is exposed in broken-down cliffs, and these are supplemented by splendid exposures in the cliffs of Vauréal and MacDonald rivers and rivière à l'Huile. On the western end of the island the exposures are on the reefs and in a number of elevated cliffs about 150 yards from the shore. Plenty of rock is exposed on the reef, but the fossils are usually so worn as to be worthless, and in the old cliffs the overgrowth of vegetation on the talus favours neither the exposure nor preservation of the fossils.

It would be possible to place both this and the English Head formation in a single division, but the rarer occurrence of limestone conglomerates with fragments of large dimension and the greater proportion of shale are features of difference and the presence of the "track bed" gives a convenient place of separation. The faunas merge into each other, but new species appear in the Vauréal formation and some of those of the English Head drop out so that the separation into two formations seems justified.

ELLIS BAY FORMATION

In the coastal exposures of the north shore the Ellis Bay formation contains much sandstone, in some beds of which there is an abundance of *Beatricia* and *Paleofavosites*. In some beds the sands are greatly cross-laminated, and two beds, one of which is a channel filling, consist of quartz pebble conglomerate. On Vauréal river, not over 25 miles to the west, there are no sandstones, but the strata consist of shale and limestone in which are layers containing pebbles of limestone. Limestone pebbles and boulders also occur in the sandstones of cape James. On the south coast the sandstones of the north find their equivalent in highly calcareous shale[1] and thin limestone. Rather exact correlation is possible for all three sections, because of the occurrence in each section of a nodular shale of which the large gastropod *Hormotoma gigantea* is characteristic. On the south side and in the Vauréal River section, the *Hormotoma gigantea* shale is continued upward in a coral reef which is represented in the north coast by impure limestone, shale, and sandstone containing coral heads. Considered as a whole, the rocks of this formation are not markedly calcareous, the limestone as a rule occurring as thin bands separating thicker bands of shale (South coast), or sandstone (North coast). Ripple-marking is not uncommon in all three sections, and some of the ripples are of large dimension.

The formation varies considerably in thickness. It is about 200 feet thick at Ellis bay and vicinity. On Vauréal river 184 feet are assigned to the formation, with the possibility that part of the 200-foot zone below the falls may belong thereto. The thickness of the north shore section is about 300 feet.

On the west end of the island this formation begins with the lowest beds exposed at the base of Junction cliff, the first prominent headland east of West point. The highest beds form the lower part of cape Henry, the west horn of Ellis bay. The indentation of Ellis bay gives a second

[1] An analysis of the calcareous shales of Ellis bay gave the following:

—	1	2
SiO_2	20·700	20·800
Al_2O_3	12·279	7·345
Fe_2O_3	2·771	2·355
CaO	33·200	34·600
MgO	trace	trace
I't'n loss	31·500	32·600
SO_3	0·800	1·300
Total	100·250	100·000

Made at the School of Mines of Paris from specimens taken from White cliff, Ellis bay, and kindly furnished by Mr. George Martin-Zédé.

excellent exposure of the upper six zones of the formation, extending its outcrops to Bear cliff, the east horn of the bay. The northern exposures are best developed about Prinsta bay, but begin at the base of the cross-bedded sandstones of point Joseph and extend southeastward to the east side of Lousy cove, forming Grindstone cliff, cape James, and Table head. The extent of the exposures is about 12 miles. On Vauréal river the formation is thought to form the rock making the upper part of the canyon at the falls, and thence includes nearly all the strata exposed in the upper part of the river.

The line between the Ordovician and Silurian is drawn at the top of this formation. A break in deposition is thought to have occurred, as succeeding deposits begin with conglomerates, and ripple-marks and other features of the surfaces of the strata show that there was a decided shallowing of the water; and if there was not exposure, it seems very probable that the bottom was brought to a depth above the profile of equilibrium for the conditions and was eroded. There were sufficient changes in the environment to bring about the extinction, modification, or migration of most of the Ellis Bay fauna.

BECSCIE FORMATION

On both sides of the island the deposition of compact and granular limestone initiated the Becscie formation, which with progress upward largely becomes a shell breccia, but grades near the top into shales and impure limestones holding many coral heads and masses. Limestone pebble conglomerates enter into the record on both sides of the island, and ripple-marking is common.

The type section of the formation is in Becscie River bay, in the vicinity of which almost the entire section can be seen. Its base and most western exposure are found at Bear cliff and cape Henry whence, with some interruptions due to the appearance of beds of the succeeding formation, it makes the shore to the mouth of Otter river, a total distance of about 25 miles. On the north shore the line of separation between this and the preceding formation is placed just west of Fox point, and its upper limit is placed on the east end of Wreck beach on Innommeé bay. The length of the outcrop is about 12 miles. Concealed areas and inaccessible cliffs do not favour collecting in parts of the formation on the north side of the island. The thickness is around 200 feet.

GUN RIVER FORMATION

An abundance of corals is a prominent feature of the basal Gun River formation at its western extremity. This feature is wanting in the equivalent on the north shore, which is represented by compact limestones with thin shales. The sequence is continued on both sides of the island in alternating beds of shale and limestone, in which are a great number of zones of coral in reef-like masses or isolated heads. This formation has many beds of intraformational and flat pebble conglomerate and near the middle of the formation on the south shore these are rather striking features of the cliff exposures. The roughness and irregularities of the bedding planes suggest very shallow waters.

At the western extremity this formation is excellently exposed in the many low, and a few high, headlands of the coast extending from Ste. Anne cliff to within about 6 miles west of Jupiter river. A large part of the formation can readily be seen in the cliffs in the vicinity of the mouth of Gun river, and for a short distance up the stream there are excellent exposures of the higher beds. The eastern limits of the formation are exposed from Wreck beach on Innommée bay to cape Sandtop. It is not completely known in these exposures because of inaccessibility.

In previous papers by the writer and in the paper by Schuchert and Twenhofel, beds to the west of Jupiter river with a thickness of about 60 feet were assigned to this formation. These beds are characterized by an abundance of fossils, among which are *Bilobites bilobus, Coelospira hemispherica, Triplecia insularis anticostiensis, Clorinda linguifera, Atrypa reticularis,* and others. The strata containing these fossils are unlike those of the other parts of the Gun River formation, but are like those of the overlying Jupiter formation in which are also found the same fossils. For these reasons in this paper the strata have been referred to the Jupiter formation.

JUPITER FORMATION

The basal strata of the Jupiter formation on the south side consist of very fossiliferous shales and limestones, following which in the western exposures there are about 100 feet of nearly unfossiliferous shale. No similar shale zone occurs in the eastern exposures. Above the unfossiliferous shale zone are calcareous shales and soft limestones which are succeeded upward by compact limestones. Locally, these limestones have zones of shell limestone, several of which are composed of the shells of *Stricklandinia* and *Atrypa*.

The type section of this formation is in the high headlands that guard the entrance of Jupiter river to the sea. The western exposures begin about 6 miles west of the mouth of Jupiter river and extend eastward to about 1 mile west of Southwest point. The formation is again exposed at the Jumpers, where a low anticlinal swell brings up the higher beds. The length of the exposures is about 7 miles; they are extremely good, and an abundance of fossils can be collected. On the east end of the island the coast is formed of Jupiter rocks in the 60 odd miles extending from cape Sandtop eastward to East cliff and westward to rivière du Pavillon. There are many exposures, which are separated by an equal number of concealed areas of greater length than the exposures. The strata are quite undulatory and much of the shore is on the strike, so that in following its windings, both ascent and descent are made in the section. Many fossils can be collected in these exposures, and it is no exaggeration to state that a carload of *Atrypa reticularis* could easily be obtained.

CHICOTTE FORMATION

The Chicotte crinoidal and reef limestones in their lithology are rather markedly different from any that have preceded, although there is an even but rapid transition from the limestones of the upper Jupiter. In many places the rock is a pure coral limestone; in others it is formed locally of the broken stems of crinoids. Some parts of the formation are highly crystalline. Much of it is structureless, unless the plastering of *Favosites, Halysites,* and *Clathrodictyon* over each other be considered structure.

This formation has its most western exposures about 1 mile west of Southwest point and with many concealed areas extends eastward almost to rivière du Pavillon, a distance of about 35 miles. Its base has been seen in contact with the beds of the preceding formation at the Jumpers and near rivière du Pavillon, and its upper horizon passes beneath the sea. The beds are extremely undulating, due to causes already described. The best exposed and most continuous section is the type section on Chicotte river. The exposed strata of the formation have a thickness of 73 feet.

CHAPTER IV

THE FAUNAS OF THE ANTICOSTI ROCKS

INTRODUCTION

In general, the Anticosti rocks are filled with fossils in a most excellent state of preservation. Like all other great series of rocks there are barren members where the most careful search reveals nothing. Some shales at one level are crowded with extremely exquisite and delicate forms, and at another level other beds, apparently exactly similar, are empty. Some of the best fossil localities are Ellis, Fox, and Prinsta bays, Heath and Southwest points, and Jupiter river. In the vicinity of each of these localities a large and beautiful collection can be made.

To give an estimate of the number of individuals of a particular species which can be collected in the rocks of Anticosti may be hazardous, but to attempt an approximation of the number of individuals in some of the zones that hold fossils in more than ordinary abundance will give some idea of the abundance of life in these seas. For this purpose a member of the Ellis Bay formation which is exposed at three localities will serve, two in the bay from which the formation takes its name and the third about a mile to the west. The member is about 6 feet thick and fully one-twentieth of the rock is formed of shells of the brachiopod *Parastrophia reversa*. Each average *Parastrophia reversa* occupies a space of a cubic inch and it is estimated that the member over an area of one square mile contains 20,908,800,000 individuals of this single species. Fully one-third of Anticosti is underlain by the Ellis Bay formation, so that the total number of brachiopods of this species is about 1,000 times the above number. To multiply estimates is needless; but it may be stated that the number of *Atrypa reticularis*, *Coelospira hemispherica*, *Hindella umbonata*, and several other species will equal or fall little short of the above number.

The intimate relationship existing between a fauna and its environment is strikingly illustrated by the faunas of the Anticosti seas. The replacing of the deposition of one kind of sediment by that of another is not more marked nor more abrupt than is the entrance and exit of one or another fauna. A repetition, vertically, in the character of the sediments, is in many cases accompanied by the return of members of an older fauna. This is exemplified, for instance, by the return of the *Beatricias* near the middle of the Ellis Bay formation, after having been absent from the deposits through a thickness of fully 200 feet.

Horizontal variations in the character of the rocks are accompanied by corresponding faunal variations, and the marked differences in the character of the rocks of the north and south shores are by no means so striking and decided as the differences in the kinds of animals which inhabited the two different parts of the sea bottom. The Becscie formation of the south side is dominantly limestone, in the middle part of which there is a zone with a thickness of about 60 feet which is literally crammed with *Virgiana barrandei;* whereas on the north shore only a few specimens of this species have ever been found, although the equivalent zones are well exposed. It is thought that this is due to the fact that the deposits of the northern coast contain more clay. The basal zones of the Ellis Bay formation in its southern exposures contain *Atrypa marginalis* and *Orthis laurentina* in great profusion, and the former species continues up into the Chicotte formation, yet neither has been recognized on the north shore, where the equivalent zones of the Ellis Bay formation consist of crossbedded sands, but *Atrypa marginalis* is abundant in the Vauréal River section. Other examples could be adduced, but they are of a species with fewer individuals and so lose in importance. It is considered that variations in the environment are responsible for those differences in the faunas of the north and south shores, and the significance of such differences within short distances in respect to correlation cannot fail to be apparent and should always be appreciated and considered. The mere absence of any particular species should not be taken as deciding evidence that the rocks to which the species is confined are wanting, until it has been well considered whether a habitat is indicated similar to that in which it has elsewhere been found.

Among the Anticosti fossils, the brachiopods dominate numerically in species and individuals; the corals vie with them in the latter respect, but in no way approach them in the former. Taken as a whole, the organic remains in the Anticosti rocks are probably three-fourths brachiopods and corals. In number of individuals the arrangement, in decreasing order, would probably be: brachiopods, coelenterates, bryozoa, gastropods, trilobites, ostracoda, cephalopods, and pelecypods. In number of species the brachiopods lead with the cephalopods, bryozoan, coelenterates, gastropods, trilobites, pelecypods, and ostracoda holding the other places in the order named. There is a total of 543 species and varieties as follows: algæ 10, sponges 5, coelenterates 65, echinoderms 12, annelids 3, bryozoans 72, brachiopods 113, pelecypods 28, gastropods 57, pteropods 7, cephalopods 100, ostracoda 34, trilobites 35, and brachiopods 2.

The brachiopods exist in some zones to the almost total exclusion of other forms, and if the coral zones and a few others be excepted, it is little exaggeration to state that each zone contains more brachiopods than all other forms put together. The chief genera in the Ordovician rocks in the order of their approximate abundance in individuals are: *Plectambonites, Parastrophia, Catazyga, Dinorthis, Zygospira, Hindella, Dinobolus, Atrypa, Leptaena?, Strophomena,* and *Rhynchotrema. Strophomena* and *Plectambonites* are those most commonly found throughout, most of the other genera being confined to more or less limited zones. Other genera which are represented in some zones in great abundance are: *Dalmenalla, Rhipidomella, Orthis,* and *Clitambonites.* Rarer genera are: *Lingula, Crania, Trematis, Protozeuga, Schuchertella, Atrypina, Pseudolingula,* and *Chonetes.* The genera of the Silurian of apparent greatest individual abundance are in somewhat striking contrast. They are: *Atrypa, Virgiana, Camarotoechia, Brachyprion, Coelospira, Hyattidina, Stricklandinia, Pentamerus,* and *Schuchertella.* Other genera occurring in greater or less abundance are: *Hindella*, *Leptaena*, *Plectambonites*, *Rhynchotrema*, *Plagiorhyncha*, *Strophoprion*, *Triplecia*, *Clorinda*, *Lissatrypa*, and *Whitfieldella*. In the entire section there is a total of 113 species and varieties, of which 33 are new.

Vieing with the brachiopods in abundance in individuals are the coelenterates. The important Ordovician genera, in respect to individual abundance, are: *Paleofavosites*, *Lyellia*, *Calapoecia*, *Streptelasma*, and, toward the top, *Halysites* and *Clathrodictyon*. All except *Calapoecia* continue into higher strata, most of them playing a more important rôle with progress upward. Of all the forms of life represented in the Anticosti seas, the coelenterates are the most conservative, one species, *Paleofavosites prolificus*, extending throughout nearly the entire sequence, and *F. gothlandicus* and *Lyellia affinis* have ranges almost as great. Sixty-five species and varieties are represented, of which 12 are new.

Bryozoa are common, but are not extremely abundant except in the Becscie formation, where *Phaenopora superba* is an important contributor to the rocks. The comparative individual absence of *Trepostomata* in the Ordovician rocks is particularly noticeable, since this group of bryozoans is as a rule very common in equivalent strata of the Mississippi valley. There is a total of 72 species of bryozoa, of which 22 are new to science.

Trilobites and ostracoda are generally present in every zone, and at some levels they are very common, but at no time were their contributions to the rocks of any great importance. The most common species of the former are: *Calymene meeki*, *C. niagarensis*, and *Phacops* (*Portlockia*) *orestes*. There are 35 species of trilobites and 34 of ostracods, of which 12 of the former and 12 of the latter are new.

Gastropods occur throughout and are quite abundant on several levels; but their preservation is generally so poor that identification is very difficult. In one zone in the Ellis Bay formation they are especially abundant and large; one form, *Hormotoma gigantea*, attaining a length of from 8 to 10 inches. Fifty-seven species have been identified.

The cephalopods were present in the Anticosti seas in many species and genera, but at no time do they appear to have been the dominant form of life. Only one level has been discovered where they occur in moderate abundance. This is in the middle part of the Jupiter formation, where *Amphicyrtoceras futile* is not uncommon. They are always present, and 100 species have been identified; 69 of these are new to science.

The record of the pelecypoda is not extensive; nor is it well written, due presumably to the nacreous structure of the shells. Few genera are present and of these only three are common: *Pterinea* and *Byssonychia* in the English Head, Vauréal, and Ellis Bay formations, and *Mytilarca* in the calcareous shale of the Jupiter formation, where a thin bed is almost wholly made up of one species of this genus. Identification has been made of 28 species; only 5 of these are new.

FAUNAS OF THE FORMATIONS

An attempt is here made to indicate the chief faunal features of each formation and show some of the faunal differences which each has in relation to the contiguous formations.

MACASTY BLACK SHALE

The great abundance of graptolites in this shale gives to the known, but probably small, fragment of its fauna an aspect not elsewhere seen in the Anticosti section; still the fauna can hardly be called one of graptolites, as only two forms occur, both of the genus *Climacograptus*. A few individuals of the brachiopod, *Leptobolus insignis*, are present, which is likewise true of the single trilobite, *Triarthrus becki macastyensis*. Cephalopods are represented by a few poorly preserved individuals of an *Orthoceras*?. It is probable that could the material be seen in place graptolites would dominate the individuals and species, but this assumption is based on analogy and might fail to materialize.

ENGLISH HEAD FORMATION

The fauna of this formation bears no resemblance to the preceding and, so far as known, there is not a single species common to the two formations. There are present 160 species, of which 89 pass into higher formations and 71 are confined to the English Head formation. The 160 species consist of 7 plants?, 2 sponges?, 7 coelenterates, 7 echinoderms, 19 bryozoa, 25 brachiopods, 25 gastropods, 3 pteropods, 11 pelecypods, 28 cephalopods, 2 annelids, 8 ostracods, 14 trilobites, 1 branchiopod, and 1 track?. Considered as an aggregate, the fauna is not markedly different from the succeeding, the differences largely arising from the introduction of *Beatricia* in the Vauréal formation.

Brachiopods dominate in numbers, but the gastropods have the same number of species. Those which are exceedingly common are: *Catazyga anticostiensis*, *Dalmanella meeki*, *Dinobolus laurentinus*, *Dinorthis carletona*, *Leptaena*? *nitens*, *Plectambonites sericeus*, *Protozeuga anticostiana*, *Strophomena fluctuosa*, *S. hecuba*, *Zygospira recurvirostris aequivalvis*, and *Rhynchotrema perlamellosum*. Rarer species are: *Hebertella maria*, *Lingula forbesi*, *Parastrophia lenticularis*, *Pseudolingula elegantula*, and *Pholidops gamachiana*. Though the gastropods are rather plentiful, they are generally so poorly preserved that identifications in most cases are uncertain. Among those most common are: *Phragmolites pannosus*, *Lophospira modesta*, and *Liospira americana*. The pelecypods have as their most common species: *Byssonychia anticostiana*, *Pterinea prolifica*, *Rhytimya emma*, and *Whitella sigmoidea*. Corals are represented by hundreds of colonies of *Paleofavosites prolificus*. The rugose corals are comparatively rare. Of hydroids, *Mesograptus putillus* occurs in rare specimens.

VAURÉAL FORMATION

Continuity of sedimentation and fauna appears to characterize the passage from the preceding to the Vauréal formation, the chief points of difference shown by the latter being a greater abundance of corals and the introduction of several species not found below. The fauna consists of 139 species, of which 85 were derived from the English Head formation but 54 do not occur below the Vauréal. The 139 species consist of: 3 plants?, 2 sponges, 13 coelenterates, 3 echinoderms, 1 annelid, 24 bryozoans, 30 brachiopods, 11 gastropods, 2 pteropods, 7 pelecypods, 21 cephalopods, 12 ostracods, 1 branchiopod, and 9 trilobites. Among the important introduced species are: *Beatricia nodulosa*, *B. undulata*, *Halysites catenularia*, *Rhipidomella sola*, *Clitambonites diversus*, and *Hyattidina carletona*.

ELLIS BAY FORMATION

The Ellis Bay fauna is somewhat distinct from that which preceded it and markedly so from that which follows. The group of organisms showing the greatest differences is that of the bryozoa. Twenty-one of the Vauréal forms out of a total of 24 do not pass into the Ellis Bay, and of the Ellis Bay bryozoa, 22 of the 25 species make their first appearance in that formation. The fauna is larger than the preceding, not only having inherited nearly 25 per cent of the species of earlier formations, but having in addition 110 new forms; and it is these that differentiate this fauna from those of the two formations below, since many of the new species belong to genera which are not found so early in the geologic column at other places in America. During most of Ellis Bay time the brachiopods appear to have been in control of the sea bottom, existing in an abundance not seen during the time of the deposition of the two preceding formations. Just before the end of Ellis Bay time two species of large gastropods, *Hormotoma gigantea* and *Loxonema rugosa,* became abundant.

The fauna consists of 172 species, of which 59 species came from the lower formations. Several of these inherited species have no significance, as they are such forms as *Hormotoma* cf. *gracilis* and *Sinuites* cf. *bilobatus,* which are placed under these designations for convenience. Eighty-six species are confined to the formation and 142 species—over 70 per cent of the fauna—become extinct therein. The total fauna is made up of 1 plant?, 3 sponges, 22 coelenterates, 2 echinoderms, 2 annelids, 25 bryozoans, 46 brachiopods, 8 pelecypods, 23 gastropods, 23 cephalopods, 2 ostracods, 14 trilobites, and 1 branchiopod.

Important species of the lower beds which do not continue in this formation are: *Catazyga anticostiensis*, *Rhynchotrema perlamellosum*, and *Zygospira recurvirostris aequivalvis;* but nearly all the other brachiopod diagnostic forms hold well into the formation. The new species of brachiopods are extremely prolific in numbers; but, in general, do not have extensive vertical ranges. Among them are: *Atrypa marginalis*, *Atrypina gamachiana*, *Hindella prinstana*, *H. umbonata*, *Leptaena rhomboidalis*, *Orthis laurentina*, *Parastrophia reversa*, *Platystrophia regularis*, and *Schuchertella gamachiana*. Corals are more abundant than ever before. Newly introduced forms are: *Protarea tenuis*, *Lyellia speciosa*, *L. exigua*, *L. affinis*, *Zaphrentis affinis*, and *Cyathophyllum ellisensis;* but the old species, especially *Halysites catenularia*, *Paleofavosites prolificus*, *P. capax*, and the *Beatricias* are of an abundance equal to any of the new forms. The gastropods have as their most important representatives: *Hormotoma giganteus*, *Loxonema? rugosum*, *Cyrtospira notata*, *Liospira helena*, *Oxydiscus giganteus*, and *Lophospira? papillosa*. *Byssonychia anticostiana* is the only common pelecypod.

This is the most easily recognized fauna of the Anticosti section, partly because of the excellent preservation and the abundance of fossils, these being found in almost every zone, but largely because many of the common forms do not occur below or above. The entire fauna holds almost to the topmost zone of the formation, in the upper 50 feet at least 60 per cent of the species become extinct, and less than 20 per cent, mostly corals and bryozoa, of the fauna, appears in higher beds, and many of these drop out in the basal part of the Becscie formation.

BECSCIE FORMATION

This formation records the disappearance or submergence of the forms, corals excepted, which had flourished in the Ellis Bay and lower faunas, and the appearance of a fauna having little in common with those below. A comparison of the number of species shows a striking difference—the Ellis Bay formation with 172 species, the Becscie with 58. Of the 58 forms 25 have come from below; most of these, however, are the long-ranging Anticosti corals and bryozoa, the generally well-known, long-ranging brachiopods, and some forms which rest on doubtful identifications. In general, the lower part of this formation contains a paucity of fossils; although on the upper surfaces of some of the beds they are somewhat abundant, though mostly in a fragmentary condition. The higher beds are abundantly fossiliferous so far as individuals are concerned, but the species are few. Thirty-four species and varieties originate in this formation, of which 4 are clorindoid brachiopods, and these constitute the bulk of the individuals. There is an extinction of 25 species in the formation. The fauna consists of 1 plant?, 13 coelenterates, 1 annelid, 7 bryozoa, 27 brachiopods, 4 pelecypods, 1 gastropod, 1 cephalopod, 2 trilobites, and 1 ostracod. The most diagnostic of the new species are: *Coelospira planoconvexa, Camarotoechia neglecta, Virgiana barrandei,* and *Ptilodictya gladiola.*

GUN RIVER FORMATION

In this formation corals assume greater importance than in any of the preceding, but the abundant species are about the same as those of lower formations. There are 15 species of coelenterates. The Becscie clorindoids are no longer abundant, their places being taken by an abundance of *Camarotoechia, Hyattidina congesta junea,* and early forms of *Pentamerus oblongus.* There is a total of 23 species of brachiopods. Among trilobites, *Phacops (Portlockia) orestes* is the most common. Of the ostracods, *Leperditia anticostiana* is present in considerable abundance. *Diaphorostoma humiles* is the only readily identified species of the 6 gastropods, but there is an abundance of poorly preserved hormotomoid type of shell. A form of uncertain position is *Cyclocrinites intermedius.* Of other groups there are 2 plants, 1 annelid, 9 bryozoa, 1 pteropod, 7 cephalopods, 3 ostracoda, and 6 trilobites. Of the 73 species, 46 occur here for the first time, and 27 came from below. Ten species are confined to this formation.

JUPITER FORMATION

Early Jupiter time provided an environment favouring the development of a trilobite-graptolite fauna, both groups occurring in many individuals, the former in fine specimens of *Phacops (Portlockia) orestes, Calymene niagarensis, C. schucherti,* and *Illaenus grandis,* and the latter in numerous rhabdosomes of *Monograptus clintonensis.* The fauna has 189 species, of which there is a single plant?, 2 sponges, 36 coelenterates, 3 echinoderms, 45 brachiopods, 26 bryozoa, 12 gastropods, 9 pelecypods, 21 cephalopods, 1 annelid, 3 pteropods, 18 ostracoda, and 12 trilobites. One hundred and twenty-two species are introduced in this formation and 157 become extinct. The local extinction of this great number of species has no great significance, it being merely corollary to the introduction of the coral-crinoid fauna which was in complete possession of the sea bottom during the times of deposition of the succeeding Chicotte formation. As in every formation below, the brachiopods are the most abundant in species and individuals. Particularly abundant species are: *Coelospira hemispherica*, *Atrypa reticularis*, *Pentamerus oblongus*, and *Stricklandinia davidsoni*. Of the pelecypods, only four species are worthy of note: *Mytilarca nitida*, *Pterinea emacerata*, *Conocardium elegantulum*, and *Modiolopsis miser*. Gastropods occur sparingly, *Cyclonema percingulata*, *C. bellulum*, *Diaphorostoma humile*, and *D. niagarense* being those most common. Coelenterates are not abundant—though 36 species are present—fewer specimens occurring in this formation than in any other of the Anticosti sequence. A noteworthy event about the middle of Jupiter time was the appearance of the cephalopod, *Amphicyrtoceras futile*, which occurs commonly through a considerable thickness.

CHICOTTE FORMATION

Chicotte time introduced an environment favouring the development of corals and crinoids, whose entrance drove the mud-loving animals of the Jupiter to extinction, or forced them to migrate to other regions. The fauna decreases from 189 species in the Jupiter to 63 in the Chicotte, of which 25 are new. Brachiopods with 13 species give way to the corals with 23. The other 27 forms consist of 2 crinoids, 3 bryozoans, 5 gastropods, 1 pelecypod, 11 cephalopods, and 5 trilobites. The most important of the species occurring for the first time are: *Chonophyllum (Craterophyllum) canadense* and *Cyrtia exporrecta myrtea*.

LONG RANGE OF SPECIES

One of the most striking features of the Anticosti section is the extremely long range of some of the species. Forms which elsewhere are confined to zones only a few feet thick here have ranges which extend through many feet. Is this to be explained on the hypothesis that in this basin the conditions were such as to permit an extremely rapid accumulation of sediments, or did the animals actually live here for a longer time than elsewhere? The hypothesis of very rapid accumulation is not tenable, as the sediments, in general, do not so indicate, but on the contrary, suggest that long periods of time existed during which the bottom was near the base-level of deposition and hence receiving thin or no permanent deposits. The St. Lawrence embayment appears to have been a marine littoral asylum during the very late Ordovician and very early Silurian, wherein the faunas of the Richmond may have lived until displaced by those of the Silurian. The bottom surface is thought to have been above the base-level of deposition at the close of Ellis Bay deposition. The conditions in the St. Lawrence basin appear to have been widely different from those of the interior of the continent, where advancing and receding seas alternately covered the land with water or left it dry. During times of an advancing sea, an army of individuals left the Anticosti or a connected basin and, following the invading waters, spread far inland, existed for a moment of geologic time, and then disappeared from the interior sea. An invasion of this kind carried *Rhynchotrema perlamellosum* and the *Beatricias* as far inland as Manitoba on the north and the Ohio valley on the south, and *Catazyga headi* as far west as the Manitoulin islands and southwestern Ohio. Each species probably had lived in the home embayment long before migration began and probably endured long after it had disappeared from the interior, so that the stratigraphic range of each long-enduring form not only includes the time that the species lived in the interior, but, as well, all the time consumed in the spreading and retreating of the sea.[1]

Some of the most striking of the long-enduring species, with their vertical ranges, are the following:

	Feet
Paleofavosites prolificus	2,473
Favosites forbesi	1,350
Favosites gothlandicus	1,100
Beatricia nodulosa	710
Beatricia undulata	710
Lyellia affinis	1,350
Halysites catenularia and varieties	2,140
Zaphrentis stokesi	600
Atrypa marginalis	1,400
Clitambonites diversus	690
Dinorthis carletona	1,100
Dinorthis anticostiensis	180
Hebertella maria	1,075
Leptæna rhomboidalis	1,400
Orthis flabellites	1,040
Pentamerus oblongus and early form	650
Strophomena fluctuosa	1,140
Byssonychia anticostiana	1,066

DESCRIPTION OF THE FAUNAL ZONES

Introduction

The Anticosti section is one of the most interesting on the North American continent. In it in almost unbroken sequence are recorded the changes of life from the Ordovician to the Silurian, the stratigraphic break between the two having been apparently of brief duration. The table (page 36) shows the chief features of the entire section in synoptical form.

The exposed rocks of Anticosti belong to two systems—the Ordovician and the Silurian—the division being drawn at the top of the Ellis Bay formation. When the faunas were first studied by Billings, he considered that the two divisions, herein defined as the English Head and Vauréal formations, belonged to the "Hudson River" group, apparently considering the rocks equivalent to such members of that group as bore an aspect similar to that exhibited at Cincinnati, Three Rivers, and lake St. John. In terms of the new nomenclature they become the Richmondian.[2] The fauna of the third division—the Ellis Bay formation—is largely composed of species derived from the two lower formations, or indigenous species

[1] The writer does not mean to leave the impression that there was only one Atlantic coast embayment in the times immediately preceding the Silurian. There may have been several; but, if so, they are now submerged, or their records have been destroyed.

[2] Schuchert, Chas.: Bull. Geol. Soc., Am., vol. 20, p. 530 (1909).

belonging to genera usually considered of Ordovician age. In view of these facts it is not considered possible on faunal grounds to refer this formation to the Silurian, and it is included in the Ordovician. As, however, equivalent beds do not appear to have been recognized in other localities where rocks of Richmondian age have been studied, it is hardly possible to refer the Ellis Bay beds to the Richmondian series without amending the term and giving to it a significance which it may not possess in any North American region other than Anticosti. For this reason it has been considered best to separate the Ellis Bay formation—a formation intended to include all strata higher than the Richmondian of the Mississippian sea and below that which can be clearly recognized as of Silurian age—from those preceding and place it in a series co-ordinate with the Richmondian. For this series the name Gamachian has been proposed, the name being derived from a former name of Ellis bay, borne at a time when it was the home of the smuggler chieftain Gamache.

The passage from the Ellis Bay to the Becscie formation is marked by a

System	Series	Formation	Richardson's zones	Zones	Thickness	Faunal zones	Correlations
Silurian	Niagaran	Chicotte	F 3–4	2	Feet 55	Coral and crinoidal limestone	Rochester and basal Lockport
			F 1–2	1	18		
		Jupiter	E 10	10	158	*Stricklandinia* beds	New York Clinton
			E 9	9	87		
			E 8	8	51		
			E 6–7	7	13		
			E 5	6	43	*Amphicyrtoceras futile* beds	
			E 4	5	22		
			E 3	4	80	*Monograptus clintonensis* and upper *Triplecia* beds	
			E 2	3	80		
			E 1	2	27		
			D 9–10	1	92	*Triplecia insularis* beds	
	Anticostian	Gun River	D 7–8	4	65	*Hyattidina congesta junea* beds	Cataract
			D 5–6	3	113		
			D 4	2	60		
			D 2–3	1	70		
		Becscie	D 1	4	60	*Virgiana barrandei* beds	Probably unknown in the United States unless in the Alexandrian of Savage
			C 14	3	35		
			C 13	2	42		
			C 12	1	62		
		Total	....	....	1,233		

System	Series	Formation	Richardson's zones	Zones	Thickness	Faunal zones	Correlations
Ordovician	Gamachian	Ellis Bay	C 12	10	20		Apparently unknown in the United States
			C 11	9	10	Coral reef	
			C 10	8	10	*Schuchertella* zone	
			C 9	7	12	Last *Beatricias*	
			C 8	6	21	*Parastrophia reversa* and *Hindella* beds	
			C 7	5	41		
			C 6	4	20		
			C 5	3	6	*Dinorthis anticostiensis* and *Orthis laurentina* beds	
			C 2–4	2	40		
			C 1	1	20		
	Richmondian	Vauréal	B 11	6	96	*Beatricia* beds	Richmond of the Missisipi valley
			B 7–10	5	344		
			B 6	4	102		
			B 4–5	3	113		
			B 2–3	2	25		
			B 1	1	50		
		English Head	A 6	5	6″	"Track bed"	
			A 4–5	4	149	*Dinobolus laurentinus* beds *Catazyga anticostiensis* and *Rhynchotrema perlamellosum* beds	
			A 3	3	10		
			A 2	2	25		
			A 1	1	44		
		Total	....	....	1,159		
	Mohawkian	Macasty			?	*Climacograptus spiniferus* and *Triarthrus* beds	Utica (Collingwood)

striking faunal change, since more than 70 per cent of the species become extinct. This was probably a biological resultant of physical events occurring elsewhere, which are indicated on Anticosti by the thick zone of sands in the northern exposures of the Ellis Bay formation and the conglomerates which occur both in the upper beds of the Ellis Bay formation and the basal beds of the Becscie formation.

The first three zones of the Becscie formation were included by Richardson in his division C; but as their faunas show an almost total absence of Richmond or Gamachian forms, and, moreover, have a decided Silurian aspect, they can hardly be considered as belonging to the Ordovician, but to the succeeding system.

In 1857, Billings, considering all the beds lying above division B, or the Vauréal formation, as transitional from the Ordovician to the Silurian, proposed for them the group term of Anticosti. The determination of the Ordovician age of most of Richardson's division C and the Clinton age of his division E and possibly F do not permit them to be embraced under that term which, if retained, can only apply to the Becscie and Gun River formations. In an earlier paper[1] the opinion was expressed that the term Niagaran could be extended so as to include these two formations. That view is no longer held by the writer, since it appears that it would give to the term an extension far beyond its original application. For the New York section the term Oswegan was proposed by Clarke and Schuchert[2] to designate the Silurian rocks older than the Clinton, and included the Medina sandstone, the Oneida conglomerate, and Shawangunk grit. The Medina, as then understood, is now known to include strata of Richmond age. The term Albion, introduced by Kindle and Taylor, applies to the upper Medina.[3] Of late years the term Medina has been extensively used to include not only the deposits of the early Silurian, but also the Richmond formations. The writer is not able to admit that the Richmond strata are of Silurian age, and considers the term as thus used objectionable. In southwestern Illinois and eastern Missouri there is an early Silurian section which Savage has described as the Alexandrian series, the term being intended to include all strata between the Ordovician and the Clinton and which in the type region consist of limestone with a thickness of 175 feet and divisible into four formations.[4]

Billings' term, Anticosti, when applied involved a misconception of the position of the Ellis Bay and formations higher than the Gun River. To still employ the term, it would have to be amended so as to include only the Becscie and Gun River formations; and it seems that this should be done, since Billings gave the proper significance to it, but erred in including too much, and also in that the Anticosti section seems to be far more representative of this time than any other on the North American continent. This course has been followed in this paper.

Detailed Description of the Zones

(*Note:* Faunal lists for the individual zones are not given here; such information is obtainable from the tables, pages 83-97.)

ORDOVICIAN SYSTEM, RICHMONDIAN SERIES

English Head Formation

Zone. 1. Grey limestone in beds from 1 to 6 inches thick, interstratified with grey and blue shale which on exposure to the sea water becomes greenish. Fossils are more or less common throughout, but are locally abundant in lens-like patches. Good specimens are rare, due to the fact that the only exposure of the zone is on the reef. Thickness, 44 feet.

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[1] Schuchert and Twenhofel: Bull. Geol. Soc., Am., vol. 21, p. 677 (1910).
[2] Clarke, J. M., and Schuchert, Chas.: Science, vol. X, p. 876 (1899); Am. Geol., vol. XXV, p. 114 (1900).
[3] Kindle, E. M., and Taylor, F. B.: Geologic Folio, No. 190, U.S. Geol. Surv., 1916; Reason for the introduction of the name is given in Science, vol. XXXIX, p. 917 (June 19, 1914). *See also* Schuchert: Bull. Geol. Soc. Am., vol. 25, p. 286 (1914).
[4] Savage, T. E.: Bull. Geol. Soc. Am., vol. 24, p. 351 (1913).

Zone 2. Grey argillaceous limestone interstratified with grey and blue shale and several beds of limestone conglomerate. Some beds have pillow structure. There are also several beds of intraformational conglomerate. The zone forms the lower part of English head. Thickness 25 feet.

Zone 3. Rocks similar to the preceding. Thickness, 10 feet.

Zone 4. Rocks similar to the preceding, but with fewer zones of conglomerate. This zone is one of the most fossiliferous of the island and is exposed at Makasti bay, rivière à l'Huile, Carleton point, etc. Thickness, 149 feet.

Zone 5. One bed, 6 inches thick, of bluish-grey, compact limestone. This is the "track bed," the top of which Richardson made the plane of division between this and the succeeding formation. The only evidence of "organic remains" are the "tracks" to which Billings gave the name of *Saerichnites abruptus.* They are found only on the upper side of the bed whose outcrops have been traced for about 75 miles.

Other measured sections showing the character of the English Head formation are those of rivière à l'Huile, Carleton point, and MacDonald river. The first-named section includes zones 4 and 5 of the English Head formation and zone 1 of the Vauréal formation. The Carleton Point section belongs to zone 4 of the English Head, and on MacDonald river are zones 3 to 5 of the English Head formation and zone 1 of the Vauréal formation. These sections (in descending order) and the faunas of the different divisions are as follows:

Carleton Point Section (Zone 4)

	Feet
(7) Reddish brown limestone with shale partings interbedded with shaly, grey limestone	2
(6) Nodular, brittle, grey limestone with poorly-defined bedding	15
(5) Brownish grey limestone interstratified with grey shales. Bedding well-defined. Many *Rhynchotrema perlamellosum* present	8
(4) Nodular, grey, shaly and compact limestones with shale partings	20
(3) Interbedded, brownish grey limestone and shale. *Subulites richardsoni* occurs in this division	5
(2) Interbedded, nodular, blue shale and greyish brown limestone	4
(1) Massive-bedded, blue and dark grey limestone interbedded with thin layers of blue shale	5

Rivière à l'Huile Section

Vauréal Formation (Zone 1)

(6) Blue and grey shale and compact blue limestone, the latter in beds up to 6 inches thick. Limestone conglomerate with the pebbles and boulders containing *Plectambonites* of Middle Ordovician aspect occur at several levels, with the rock fragments apparently occurring only on the upper surfaces of the beds	100

The fossils collected from this division are:

Cornulites richmondensis
Homotrypa anticostiensis
Ptilodictya whiteavesi
Sceptropora facula
Dinorthis carletona
Leptaena? nitens
Rhynchotrema perlamellosum
Zygospira recurvirostris aequivalvis
Plectambonites sericeus glaber
Clathrospira subconica
Liospira americana
Rhytimya emma
Whitella sigmoidea
Ceraurinus icarus
Ceraurus numitor
Isotelus gigas

		Feet
(5)	Hard, blue limestone with shale partings, beds 2 to 4 inches thick. Some beds are covered with symmetrical interference ripples. *Catazyga anticostiensis* was the only fossil observed	5
(4)	Blue and bluish grey calcareous shale and brittle blue limestone. The beds are from 2 to 8 inches thick	36

The fossils collected from this zone are:

Cornulites richmondensis
Bythopora striata
Ptilodictya whiteavesi
Sceptropora facula
Catazyga anticostiensis
Leptaena? nitens
Plectambonites sericeus glaber
Zygospira recurvirostris aequivalvis
Cyclonema varispirum
Whitella sigmoidea
Ceraurinus icarus
Ceraurus numitor

English Head Formation (Zones 5 and 4)

(3)	"Track bed". Compact blue limestone, covered with "tracks", seaweed markings, and small ripple-marks	1 to 3 inches
(2)	Blue shale with nodular masses of limestone interbedded with blue and bluish grey limestone; beds up to 7 inches thick. Some of the limestone beds are covered with interference ripple-mark	41

The fossils from this division are:

Eridotrypa simulatrix
Homotrypa anticostiensis
Prasopora canadensis
Sceptropora facula
Leptaena? nitens
Pholidops gamachiana
Plectambonites sericeus glaber
Trematis ottawaensis anticostiensis
Liospira americana
Pterotheca anticostiana
Whitella sigmoidea
Billingsites canadensis
Ceraurinus icarus
Isotelus gigas

(1)	Limestone conglomerate. Pebbles and boulders of dark grey limestone in a matrix of light grey limestone. The fragments range in size from sand to boulders 6 inches in diameter. The conglomerate is overlain by 18 inches of light blue, calcareous shale	2

MacDonald River Section

Vauréal Formation (Zone 1) — Feet

(14) Nodular blue shale with occasional thin beds of hard blue limestone...... 100

This division contains:

Cornulites richmondensis
Catazyga anticostiensis
Dalmanella meeki
Dinorthis carletona
Leptaena? nitens
Plectambonites sericeus glaber
Rhynchotrema janeum
Strophomena hecuba
Zygospira recurvirostris aequivalvis
Pterinea prolifica
Rhytimya emma
Ischyrina winchelli

(13) Hard, blue limestone in 3 to 10-inch beds. Fossils are not different from those of 14.. 7

(12) Nodular blue shale with fossils as in 14................................ 6

(11) Nodular blue shale with occasional thin beds of hard, blue limestone, and at the top 6 feet of hard, blue limestone separated by thin layers of blue shale.. 45

The fossils are:

Hebertella maria
Leptaena? nitens
Plectambonites sericeus glaber
Cornulites richmondensis

(10) Mostly concealed. Talus debris indicates nodular grey shale and drab and grey limestone, some of which is composed of shell fragments........ 8

Fossils collected are:

Dalmanella meeki
Plectambonites sericeus glaber
Zygospira recurvirostris aequivalvis
Isotelus gigas

(9) Hard, blue limestone in 2 to 6-inch beds separated by beds of blue shale of equal thickness.. 20

Fossils are abundant on the surface of some of the limestones. Those collected are:

Mesograptus putillus
Leptaena? gracilis
Leptaena? nitens
Plectambonites sericeus glaber
Zygospira recurvirostris aequivalvis
Whitella sigmoidea
Isotelus gigas

English Head Formation (Zones 5 to 3)

(8) Hard, blue limestone separated by thin beds and partings of bluish grey shale. The limestone beds range in thickness from 2 inches to 1 foot. Seaweed impressions are extremely common on some of the limestone beds. The "track bed" is somewhere near the top of this division, as pieces from it were found in the talus slope beneath, but it was not located in place.. 12

The fossils from this division are:

Cornulites richmondensis
Ptilodictya flagella
Sceptropora facula
Dalmanella meeki
Dinorthis carletona
Leptaena? nitens
Plectambonites sericeus glaber
Ceraurinus icarus

(7) Nodular, calcareous, blue shale with several groups of 2 to 6-inch beds of hard, blue limestone at distances of 15 to 25 feet apart, the limestone layers being separated by beds of blue shale of about equal thickness.. 50

The fossils from this division are:

Cornulites richmondensis
Ptilodictya flagella
Sceptropora facula
Catazyga anticostiensis
Dalmanella meeki
Dinorthis carletona
Leptaena? nitens
Leptaena? gracilis
Plectambonites sericeus glaber
Strophomena planocorrugata
Zygospira recurvirostris aequivalvis
Liospira americana
Whitella sigmoidea
Calymene meeki
Ceraurinus icarus

(6) Calcareous, blue shale with limestone nodules.......................... 18

Sceptropora facula is a common fossil. Other fossils are:

Dinorthis carletona
Leptaena? nitens
Plectambonites sericeus glaber
Zygospira recurvirostris aequivalvis

(5) Nodular, grey limestone; hard, blue limestone, with upper bedding surfaces smooth and lower ones irregular; and grey shales. The limestone beds range in thickness from 6 to 18 inches.......................... 6

No fossils were seen in this division.

(4) Thin-bedded, nodular, bluish grey limestone with an occasional layer of hard, blue limestone. At least one bed of limestone conglomerate is present.. 19

The fossils from this division are:

Ptilodictya flagella
Dinorthis carletona
Leptaena? nitens
Plectambonites sericeus glaber
Rhynchotrema perlamellosum
Strophomena fluctuosa
Strophomena planocorrugata
Zygospira recurvirostris aequivalvis
Hormotoma cf. *gracilis*
Liospira americana
Ceraurinus icarus
Chasmops anticostiensis

(3) Concealed.. 5

(2) Thin-bedded, bluish grey limestone. One bed contains rounded limestone pebbles and boulders ranging in diameter up to 4 inches. The rock fragments show no assortment.................................. 16

The fossils are:

Buthotrephis cf. *gracilis*
Bythopora striata
Leptaena? nitens
Strophomena fluctuosa
Isotelus gigas

(1) Nodular, bluish grey limestone with an occasional bed of non-nodular, compact, blue limestone. Some beds contain limestone pebbles...... 20

The fossils from this division are:

Bythopora striata
Ptilodictya flagella
Catazyga anticostiensis
Dalmanella meeki
Dinorthis carletona

Leptaena nitens
Strophomena fluctuosa
Strophomena hecuba
Phragmolites pannosus
Ceraurinus icarus
Isotelus gigas
Proetus alaricus

Vauréal Formation

Zone 1. Argillaceous limestone in beds from 1 to 6 inches thick, interstratified with grey and greenish shale. Limestone conglomerate commonly present. Exposed at High cliff, Observation cape, MacDonald river, etc. Fossils are not common on the south side, but are extremely abundant on the north. Thickness, 50 feet.

Zone 2. Grey and reddish grey limestone in beds about 6 inches thick, interstratified with greenish and grey shale, many beds containing pebbles and boulders of limestone. The zone is exposed between baie Ste. Claire and West point and at High cliff, MacDonald river, etc., on the north shore. Corals are abundant throughout. Thickness, 25 feet.

Zone 3. Grey and bluish grey limestone interstratified with grey and greenish shale and occasional beds of limestone conglomerate. The zone can be seen to good advantage on Vauréal river and the lower part of Harvey point. Thickness, 113 feet.

Zone 4. Grey and reddish grey limestone interstratified with grey and blue shale. Thin beds and lenses of limestone conglomerate occur throughout. At West point the beds are decidedly lenticular and show channelling. At Battery point the latter feature is absent, the former is pronounced. The southern terminus of the zone is exposed about West point. The northern limit has its finest exposure at Battery point, near the mouth of Salmon river. It is also well exposed on Vauréal river. *Beatricias* are the most common fossils, and were described by the early explorers as projecting from the cliff at Battery point like mouths of cannon from a battery. Thickness, 102 feet.

Zone 5. Grey limestone interstratified with grey shale and conglomerate. The southern exposures extend from West point to anse aux Fraises, and on the northern side about 60 feet near the middle of the zone are exposed at Steamer Bow. The exposures on Vauréal river are excellent. Fossils are fairly abundant. Thickness, 344 feet.

Zone 6. On the south shore this zone is concealed, but Richardson states "the shingle on the beach is largely made up of argillo-arenaceous shale of a greenish tinge mingled with worn fragments of grey limestone; from the fact that this arenaceous shale did not occur at other parts of the beach, and from its easily destructible character, it is probable that the beds from which it was derived constitute a considerable part of the measures concealed." Richardson gives the thickness as 96 feet. On the north shore the character of the upper part of the zone is shown by an exposure of 70 feet of sandy shale and impure limestone on the west side of point Joseph. *Paleofavosites aspera* and *Strophomena fluctuosa* are the only fossils which have been seen in these shales. A splendid exposure of grey limestones with thin grey and blue shales and occasional beds of limestone conglomerate occurs in the upper part of Vauréal canyon.

Sections which are illustrative of this formation are those of rivière à l'Huile and MacDonald river given under the description of the English Head formation and those of Vauréal river and the north coast. The Vauréal River section is thought to be about zones 4 to 6 of the formation. The sections (in descending order) follow:

Vauréal River Section

(Descending order)

	Feet
(9) Thin-bedded, nodular, grey limestone and pale blue, calcareous shale with limestone nodules. There are at least two beds of limestone conglomerate with rock fragments throughout the beds and one bed with pebbles on the upper surface. The fragments have spherical and lenticular shapes, show no assortment, and are up to $4\frac{1}{2}$ inches in diameter. This division forms the upper part of Vauréal canyon, and somewhere near the top is the base of the Ellis Bay formation. The thickness is estimated at 200 feet. This may be too great........................	200

Fossils are extremely common in some beds. They are as follows:

Buthotrephis cf. *gracilis*
Clathrodictyon vesiculosum
Columnaria (?) *vaurealensis*
Paleofavosites capax
Paleofavosites prolificus
Cornulites richmondensis
Batostoma billingsi
Bythopora striata
Hallopora cnodis
Homotrypa anticostiensis
Nematopora lineata
Dalmanella meeki
Dinorthis carletona
Leptaena? nitens
Leptaena? *vaurealensis*
Pholidops gamachiana
Plectambonites sericeus glaber
Pseudolingula elegantula
Rhynchotrema janeum
Strophomena fluctuosa
Strophomena hecuba
Strophomena planocorrugata
Hormotoma cf. *gracilis*
Phragmolites pannosus
Sinuites cf. *bilobatus*
Whitella sigmoidea
Isochilina vaurealensis
Ceraurus numitor
Ceraurinus icarus
Chasmops anticostiensis
Encrinurus laurentinus
Isotelus gigas

(8) Thin-bedded, nodular, grey limestone, a little grey shell limestone, and pale blue, calcareous shale with limestone nodules. About two-thirds shale. At least one layer of limestone conglomerate is present. The rock fragments are rounded and up to 4 inches in diameter. The rocks of this division form the cliffs in the lower part of Vauréal canyon. *Beatricia* was collected near the top, and this upper part is thought to correlate with the *Beatricia* zone near West point..............	150

Fossils are abundant in some beds and those identified are:

Beatricia undulata
Mesograptus putillus
Streptelasma angulatum
Nematopora lineata
Ptilodictya flagella
Dalmanella meeki
Dinorthis carletona
Hebertella maria
Leptaena? nitens
Pholidops gamachiana
Plectambonites sericeus glaber
Strophomena hecuba
Strophomena planocorrugata
Byssonychia anticostiana
Hormotoma cf. *gracilis*
Calymene meeki
Ceraurinus icarus

	Feet
(7) Concealed	16
(6) Thin-bedded, greyish blue limestone and blue shale	20

The fossils are:

Zaphrentis vaurealensis
Dalmanella meeki
Leptaena? nitens
Plectambonites sericeus glaber
Cornulites richmondensis

(5) Compact and somewhat nodular grey limestone and bluish grey shale of greater thickness 50

Not very fossiliferous. Those identified are:

Leptaena? nitens
Plectambonites sericeus glaber
Zygospira recurvirostris aequivalvis
Cornulites richmondensis

(4) Concealed 15

(3) Nodular, dark grey limestone with thin beds and partings of grey shale. A few beds of hard, blue limestone are present 28

The fossils are:

Hallopora enodis
Helopora lineopora
Catazyga anticostiensis
Dalmanella meeki
Leptaena? nitens
Plectambonites sericeus glaber
Strophomena hecuba
Chasmops anticostiensis

(2) Concealed 25

(1) Calcareous blue shale with limestone nodules and hard, bluish grey, laminated limestone. Shales predominate in the proportion of about 3 to 1. One bed of limestone about 15 feet from the top contains rounded fragments of limestone up to about 2 inches in diameter. This bed is 4 inches thick, and the rock fragments compose about half of it. The fragments show no assortment **47**

The fossils, which are abundant, are:

Paleofavosites prolificus
Bythopora striata
Homotrypa anticostiensis
Retiocrinus fimbriatus
Cornulites richmondensis
Catazyga anticostiensis
Dinorthis carletona
Hebertella maria
Leptaena? nitens

Plectambonites sericeus glaber
Rhynchotrema perlamellosum
Strophomena hecuba
Zygospira recurvirostris aequivalvis
Ceraurus numitor
Isotelus gigas

North Shore Section

(Descending order)

	Feet
(6) Sandy, blue shale forming the basal part of Grindstone cliff............	10
The fossils are: *Beatricia undulata*, *Paleofavosites capax*, *Paleofavosites prolificus*, *Rhynchotrema janeum*, *Strophomena fluctuosa*	
(5) Light blue shale with thin layers of nodular, grey limestone. The upper beds of point Joseph, west side..................................	30
Very sparingly fossiliferous, *Strophomena fluctuosa* and *Rhynchotrema janeum* being the only fossils identified.	
(4) Dark blue, sandy shales with an occasional calcareous blue flagstone. May overlap 3 a little. Almost without fossils. The basal beds of point Joseph, west side..	25
(3) Sandy, calcareous shale in which are rough-surfaced, calcareous nodules and 1 to 3-inch beds of flaggy, blue limestone. There are also thin beds of sandstone and shell limestone in the shales. These strata are believed to rest directly on 2, but it is possible that this is not the case and that some strata have not been considered. At the land end of point Joseph this division contains a lens of grey sandstone which has a maximum thickness of 2½ feet, but which pinches out northward within 150 feet. These strata also form Steamer Bow......................	40
The fossils are: *Batostoma billingsi*, *Rhynchotrema janeum*, *Strophomena fluctuosa*	
(2) Interbedded nodular and bluish grey limestone with an occasional bed of well-bedded, blue limestone. All beds are thin and are separated by blue shale of about equal thickness. These strata form the upper part of Battery point..	14
The fossils are: *Batostoma billingsi*, *Dicranopora fragilis*, *Ptilodictya flagella*, *Dalmanella meeki*, *Rhynchotrema janeum*, *Isotelus gigas*	
(1) Nodular, thin-bedded, bluish grey limestone with lenticular and undulatory bedding, some of the undulations having a relief of 1 foot. There is much pinching out of beds. The strata form the basal part of Battery point. The most common fossils are *Beatricia undulata* and *B. nodulosa*.	15
Other fossils are: *Batostoma billingsi*, *Hallopora gracilens*, *Paleofavosites capax*, *Dalmanella meeki*, *Rhipidomella sola*, *Rhynchotrema janeum*, *Strophomena fluctuosa*, *Conularia batteryensis*, *Isotelus gigas*	

Across the bay to the west of Battery point is Harvey point, where strata about 100 feet lower are exposed. These consist of interstratified 4 to 6-inch beds of limestone and shale. Near the base of the Harvey Point strata is the lowest occurrence of *Chonetes*.

ORDOVICIAN SYSTEM, GAMACHIAN SERIES

Ellis Bay Formation

In this formation the sections of the north and south shores are quite different in the character of the sediments and the contained faunas, this being particularly true for the lower half. The detailed sections show the differences in lithology and faunas.

Zone 1. On the south shore the strata consist of greenish blue shale with thin limestone and one 6 to 8-inch bed of compact grey limestone about 10 feet above the base. The beds make the lower part of Junction cliff, and are characterized by an abundance of *Dinorthis anticostiensis* in a beautiful state of preservation, and with this species are associated many equally well-preserved *Clitambonites diversus*. The same strata on Vauréal river consist of thin grey limestones and grey shales. On the north shore the equivalent strata are exposed at Grindstone cliff, where they consist of quartz sandstone. Thickness, 20 feet.

Zone 2. On the south shore the basal strata of this zone consist of grey and blue shale interstratified with thin limestone. The upper strata are conchoidally fracturing grey limestone with thin shale partings. The strata of this zone on Vauréal river are largely grey limestone, but on the north shore they consist of quartz sandstone. On the south shore this zone forms the upper part of Junction cliff and the reef at the back of Ellis bay; on the north shore it constitutes the top of Grindstone cliff and the base of cape James. *Orthis laurentina* is the characteristic fossil of the lower part of the zone in its southern exposures, and the compact limestones of the upper half of Junction cliff have an abundance of *Atrypa marginalis*. The former fossil is very rare on the north shore, the latter is not known. *Atrypa marginalis* is abundant in the Vauréal River exposures. Thickness 40 feet.

Zone 3. Ash-grey argillaceous limestone interbedded with thin, grey shale. The zone is exposed on the reef just east of Junction cliff and in a small quarry at the back of Ellis bay. No fossils were seen in this zone. The exposures on the north shore belonging to this zone have not been differentiated, and it does not appear that the fossils are different from those of contiguous zones. Thickness, 6 feet.

Zone 4. On the south shore the zone consists of yellowish grey, and grey, compact limestone interstratified with grey and blue shale. On Vauréal river the strata belonging to this zone consist of grey limestone and grey shales, and on the north shore of quartz sandstones, well exposed in cape James. The southern exposures are well shown in a small, broken-down cliff about 1½ miles east of Junction cliff and in the low cliffs near the head of Ellis bay. Fossils are extremely abundant, coming out in free specimens from the shales, and the surfaces of most of the limestones are thickly covered with them. Thickness, 20 feet.

Zone 5. On the south shore the zone consists of soft, ash-grey, highly calcareous shale forming White cliff on the west side of Ellis bay and a high cliff on the east side of the same bay. On Vauréal river the strata are like those of zone 4. On the north shore the equivalent strata consist of quartz sandstone. Thickness, 41 feet.

Zone 6. Yellow weathering, brownish grey limestone in thin beds. The zone is exposed in a small cliff and on the reef on the east side of Ellis bay. It has been described by Richardson as concealed. This zone is represented on Vauréal river by limestone and limy shale. On the north coast the equivalent strata consist of quartz sandstone and sandy limestone. Thickness, 21 feet.

Zone 7. Nodular, greenish shale with lenses of nodular, grey limestone. This zone is well exposed at point Laframboise and on both sides of Ellis bay. The zone is represented by a very similar lithology on the north coast and on Vauréal river. It is especially characterized by an abundance of *Hormotoma gigantea* and *Beatricia*, the latter seen here for the last time. Thickness, 12 feet.

Zone 8. Bluish and yellowish grey, fine-grained, limestone containing many *Schuchertella gamachiana* and *Rafinesquina ellisensis*, well exposed at Ellis bay. This zone has a thickness of 9 feet. On the north shore the zone has a different lithology, being represented by bluish grey, impure, coarse-grained limestones. On Vauréal river the strata consist of interbedded, thin limestones and shales. The fossils listed in the table are mostly from the exposures of Vauréal river and the north coast. Thickness, 10 feet.

Zone 9. A coral limestone, formed from a reef in place. The mass is almost structureless. Where the formation is exposed on the present wave-cut reef, the coral masses stand up as little hillocks, due to the erosion of the softer material between. The zone is well exposed in Ellis bay and on Vauréal river. Thickness, 10 feet.

Zone 10. On the south shore this zone consists of thin-bedded, grey-weathering, pale blue limestone, some layers of which are covered with many *Dalmanella meeki* and *Leptaena rhomboidalis.* The rock on Vauréal river is similar, but the layers are not covered with the fossils noted. On the north coast the rocks representing this zone are extremely unlike their equivalents of the south coast and Vauréal river. The thickness on the south coast is 20 feet. On Vauréal river there are 87 feet between the top of the Coral zone and the base of the Becscie formation.

Sections which are illustrative of the Ellis Bay formation are those of Ellis bay and vicinity, Vauréal river, and the north coast. The Ellis Bay section is that given in the zonal description. The other two sections follow.

Vauréal River Section

(Descending order)

Becscie Formation

	Feet
(27) Thin-bedded, nodular limestone, and well-bedded bluish grey, granular limestone. Layers of small limestone pebble conglomerate occur throughout. The basal layers contain rounded limestone pebbles and boulders up to 3 inches in diameter, showing no assortment....	12

Very few fossils occur. Those identified are:
Lyellia affinis
Coelospira planoconvexa (found only in a subcrystalline limestone near the top)
Parastrophia lenticularis
Virgiana barrandei

(26) Well-bedded, bluish grey limestone with very little shale. One bed is a limestone conglomerate with the fragments ranging from fine gravel to boulders up to 6 inches in diameter. Some of the pebbles and boulders are heads of *Lyellia affinis*. Basal zone of the Becscie formation.. Feet 25

Ellis Bay Formation

(25) Not well exposed except near the base, where it consists of a pale blue limestone........ 15
The fossils are:
Lyellia affinis
Streptelasma selectum
Phaenopora ensiformis
Leptaena ? nitens
Hormotoma cf. *gracilis*

(24) Bluish grey limestone with thin shale partings........ 16
The fossils are:
Nematopora lineata
Atrypa marginalis
Dalmanella meeki
Strophomena hecuba
Strophomena semiovalis
Cornulites richmondensis
Calymene meeki

(23) Bluish grey limestone........ 12
With:
Paleofavosites capax
Lyellia affinis
Phaenopora ensiformis
Atrypa marginalis
Dalmanella meeki
Hyattidina carletona
Protozeuga anticostiana

(22) Thin-bedded, blue limestone and shale........ 10
Fossils which are common are:
Clathrodictyon vesiculosum
Streptelasma selectum
Eridotrypa simulatrix
Helopora lineopora
Phaenopora ensiformis
Atrypa marginalis
Dalmanella meeki
Hindella umbonata
Leptaena rhomboidalis
Protozeuga anticostiana

(21) Thin-bedded, grey limestone and shale........ 9
The fossils are:
Bythopora striata
Nematopora lineata
Phaenopora ensiformis
Dalmanella meeki
Leptaena rhomboidalis
Strophomena arcuata
Bumastus orbicaudatus
Cyphaspis anticostiensis
Encrinurus laurentinus

	Feet
(20) Thin, irregularly bedded, grey limestone	74

One bed is covered with *Leptaena rhomboidalis*. Other fossils are:

Calapoecia anticostiensis
Paleofavosites capax
Streptelasma selectum
Zaphrentis affinis
Bythopora striata
Eridotrypa simulatrix
Hallopora elegantula prolifica
Helopora lineopora
Nematopora lineata
Phaenopora ensiformis
Dalmanella meeki
Dinorthis carletona
Hindella umbonata
Leptaena? nitens
Leptaena rhomboidalis
Pholidops gamachiana
Plectambonites sericeus glaber
Protozeuga anticostiana
Rhynchotrema janeum
Strophomena arcuata
Strophomena semiovalis
Cornulites richmondensis
Hormotoma gigantea
Hormotoma cf. *gracilis*
Ceraurus numitor
Ceraurinus icarus
Chasmops anticostiensis
Calymene meeki

(19) Concealed	4
(18) Thin-bedded, conchoidally fracturing, dark blue limestone	7
(17) Concealed	6
(16) Nodular and shaly blue limestone	4

Shown in river bed

(15) One bed of laminated, pale blue flagging stone. Resembles rock of *Schuchertella gamachiana* zone at Ellis bay. No fossils seen	0·75
(14) Mostly concealed, but at the top 3 feet of calcareous, blue shale overlain by 4 feet of rough, nodular, shaly limestone	18

Contains *Hindella umbonata* and *Streptelasma selectum* in abundance. Other fossils are:

Dalmanella meeki
Plectambonites sericeus glaber
Platystrophia regularis
Cornulites richmondensis
Isotelus gigas

(13) Reef limestone	4

Grey coralline limestone. Contains an abundance of algal nodules

Clathrodictyon vesiculosum
Paleofavosites prolificus
Lyellia affinis
Columnaria? vaurealensis

Correlated with the coral zone at Ellis bay.

(12) Thin-bedded, pale blue limestone with shale partings. Some beds are limestone conglomerate with the fragments composed of buff, flinty limestone and up to 2 inches in diameter. There is no assortment. *Beatricia nodulosa* up to 6 inches in diameter is present	30

Other fossils are:

Beatricia undulata
Dalmanella meeki

Feet

(11) Thin, and irregularly-bedded, light blue shales, not well exposed........ 25

Contains *Beatricia nodulosa*, *B. undulata*, *Paleofavosites capax*, and *P. prolificus* in abundance. Other fossils are:

Dinorthis carletona
Plectambonites sericeus
Strophomena semiovalis
Byssonychia anticostiana

(10) Nodular, thin-bedded, buff limestone with essentially no shale............. 22

Resembles the rock of the upper part of Junction cliff. Very poorly fossiliferous. Forms the low cliff bordering the river just above Vauréal falls.

The fossils are:

Dinorthis carletona
Hindella umbonata
Leptaena? gracilis
Rhynchotrema janeum

North Shore Section, Grindstone Cliff to Fox Point

(Continues section given under Vauréal formation)

(31) Reddish grey, granular limestone. At least one bed filled with fossils, and some beds contain blue mud pebbles. At the base is a 24-inch bed which is a conglomerate compound of algal nodules and coral heads. There are also layers of fine-grained, nodular limestone, which in places are intensely crumpled, and the crumpled parts immediately overlie limestones of concretionary appearance. One bed is covered with *Leptaena rhomboidalis*, and *Beatricia nodulosa* was collected in the algal and coral conglomerate. Other fossils are:

Phaenopora ensiformis
Dalmanella meeki
Rhipidomella uberis
Schuchertella gamachiana

It is possible that these strata should be referred to the Becscie formation.. 50

(30) Thin-bedded, bluish grey, calcareous? flagstone, the rock in places being greatly crumpled.. 50

The only fossils collected are:

Beatricia undulata
Hindella unbonata

(29) Thin-bedded, bluish grey, flaggy limestone............................ 5

In places the rocks are greatly crumpled, which is thought to have been developed by local slumping of the sediments before they became consolidated. The fossils are not of many species or individuals. Those known to be present are:

Beatricia undulata
Rhipidomella uberis
Hindella umbonata
Platystrophia regularis

(28) Thinly laminated, sandy, grey limestone in 2 to 7-inch beds. No fossils were observed in this zone.. 3

(27) Thin-bedded, flaggy limestone with shale partings...................... 5

The only observed fossils are:

Dalmanella meeki
Schuchertella gamachiana

(26) One thick bed of limy sandstone.. 4

No fossils were observed

(25) Thin-bedded, nodular, flaggy limestone and grey shale.................. 7

No fossils were observed

These strata, 25-29, are exposed from Lousy cove to Fox point.

	Feet
(24) Calcareous sandstone of concretionary appearance. The bed is generally not much more than 1 foot thick, but in places it swells out into large concretionary masses 6 to 7 feet long and 4 feet thick. The zone is exposed both in Prinsta bay and Lousy cove. No fossils were collected from this sandstone	1–7
(23) Nodular limestone and shale and near the middle 2 feet of conglomeratic limestone containing small, quartz pebbles	24

Hindella prinstana was the only fossil collected or observed.

(22) Nodular, thin-bedded, fine-grained, blue limestone and pale blue shale with limestone nodules	20

Some of the limestone beds are very discontinuous. This zone is exposed both in Prinsta bay and in Lousy cove. Fossils collected from the zone are:

Buthotrephis gracilis
Beatricia nodulosa
B. undulata
Lyellia affinis
Paleofavosites capax
Paleofavosites prolificus
Streptelasma rusticum
Retiocrinus fimbriatus
Bythopora striata
Parastrophia reversa
Hindella umbonata
Rhynchotrema prinstanum
Schuchertella gamachiana

(21) Evenly bedded calcite and quartz sandstones. Calcareous nodules and thin beds of grey limestone are in the sandstone. No fossils were observed	8
(20) Nodular, calcareous shale with irregularly shaped limestone nodules	5

About the middle are a few thin beds of smooth-bedded limestone in which are many small *Hindella umbonata*. This is the *Hormotoma gigantea* zone, and it has been observed both at cape James and in Lousy cove. The fossils are:

Beatricia nodulosa
B. undulata
Streptelasma selectum
Dalmanella meeki
Hindella umbonata
Parastrophia reversa
Platystrophia regularis
Hormotoma gigantea

(19) Calcareous grey sandstone with occasional layers of sandy limestone	16

This zone contains an abundance of:

Beatricia nodulosa
B. undulata
Paleofavosites capax
P. prolificus

(18) Nodular, shaly limestone, largely a shale with limestone nodules	4

Contains *Paleofavosites capax* and *P. prolificus* in abundance and rarely *Beatricia undulata* and *B. nodulosa.* No other fossils were noted.

(17) Thin, laminated, grey quartz sandstone with a bed of dark blue, sandy shale near the middle	7

The fossils are:

Clathrodictyon vesiculosum
Paleofavosites prolificus

(16) Nodular, calcareous, and shaly grey sandstone, bedding poor	6

Paleofavosites capax appears to be the only fossil present.

Feet

(15) Reddish grey limestone, subcrystalline, ranges in thickness from nothing to 6 feet. It appears to fill a channel in the underlying strata. This zone contains an abundance of:

Beatricia undulata
Paleofavosites capax
Parastrophia reversa
Rhynchotrema prinstanum
Liospira helena

(14) Cross-laminated, micaceous, grey quartz sandstone. The beds range in thickness from 1 inch to 3 feet. There is great lateral variation, at one place a bed 3 feet thick separating within 30 feet into a score or more of thin beds. Occasional thin shale lenses are present. At one point in the cliff exposures for a space of about 30 feet this zone gives place to a friable, small quartz pebble conglomerate, the pebbles being in a matrix of sand and calcite. This is the basal part of the channel filling described in zone 15. At another place the upper beds have a concretionary or pillow structure with spheroidal lamination, the pillows ranging up to 3 feet long and a foot high. The sandstone contains:

Beatricia undulata
Beatricia nodulosa
Paleofavosites capax

In the conglomerate are:

Rhynchotrema prinstanum
Liospira helena

The thickness averages about.................................... 4·5

(13) Thin-laminated, grey quartz sandstone and thin-laminated, sandy shale, the latter containing small calcareous nodules and occasional thin layers of grey limestone, the limestone being really a conglomerate of fossils.. 10

The bedding is decidedly undulatory, and the beds thicken and thin, and dovetail into each other. The sandstone and shale appear to be without fossils. The thin limestone contains:

Beatricia undulata
Paleofavosites capax
Batostoma billingsi
Strophomena fluctuosa

(12) Massive, grey quartz sandstone with flakes of white mica more or less throughout.. 12

In the sandstone are thin lenses of fossiliferous grey limestone and more rarely lenses of dark shale. The sandstones are greatly cross-laminated, and the limestone and shale lenses parallel the cross-lamination of the containing sandstone. Fossils are rare in the sandstone, but consist of large coral heads of *Paleofavosites capax* and an occasional *Calapoecia anticostiensis.* The limestone lenses are largely composed of *Strophomena fluctuosa*

(11) Thin-bedded sandstone and sandy limestones.......................... 5

Contain many small *Beatricia* of both species. Other fossils are:

Clathrodictyon vesiculosum
Paleofavosites capax
Streptelasma selectum
Orthis laurentina
Strophomena fluctuosa

(10) Somewhat nodular, grey limestone.................................. 14

Occasional limestone boulders up to 8 inches in diameter are present in a layer near the middle. The bedding is irregular and undulatory. The fossils from this zone are:

Beatricia undulata
Columnaria (?) vaurealense
Paleofavosites capax
Streptelasma selectum
Orthis laurentina
Strophomena fluctuosa

The *Beatricias* are mostly young forms

(9) Thinly laminated, grey sandstone with occasional layers of thin, shaly limestone, bedding with many undulations........................	Feet 20
Large heads of *Paleofavosites capax* up to 3 feet in diameter are present, and *Beatricias* of both species cover the surfaces of the beds, resembling logs in fallen timber. The sandstones are greatly cross-laminated and contain occasional pebbles and boulders of limestone up to 6 inches in diameter.	
(8) Grey limestone like that of Grindstone cliff with which the basal part of this zone may overlap..	50
Near the base are many *Beatricia undulata, Columnaria? vaurealensis,* and *Paleofavosites capax* associated with pebbles and boulders of dark grey limestone up to 3 inches in diameter. Occasional heads of *Paleofavosites capax* occur throughout the sandstone. These constitute the basal strata of cape James.	
(7) Fine-grained, thinly laminated, grey quartz sandstone beds up to 3 feet thick..	20
Beyond an occasional *Paleofavosites capax, P. prolificus,* and still rarer *Strophomena fluctuosa* no other fossils were observed. This zone forms the main and upper part of Grindstone cliff.	

The three sections show that the Ellis Bay formation varies greatly in thickness, with the greatest thickness where the sand is the dominating type of material.

SILURIAN SYSTEM, ANTICOSTIAN SERIES

Becscie Formation

This formation is assumed to begin on both sides of the island with the appearance of granular limestones, and where this takes place there is also an abundance of limestone pebbles and boulders in the limestone, and other evidence of very shallow waters. These strata are thought to lie disconformably on those of the Ellis Bay formation. As the pebbles are similar to those in the English Head formation, it may be that they were derived from the same source. On the south side the change in lithic facies from the Ellis Bay to the Becscie formation is followed by the appearance of myriads of *Phaenopora superba* and *Virgiana barrandei.* On the north shore the former is abundant at Reef point and the latter occurs rarely. Also on this shore the upper part of the formation contains a thick shale zone which passes upward into granular limestones.

The fauna is dominated by the abundant occurrence of *Phaenopora superba* and *Virgiana barrandei* and myriads of corals belonging to *Paleofavosites, Favosites, Lyellia,* and *Clathrodictyon.* A very diagnostic fossil which makes its appearance in the basal beds near Ellis bay and on Vauréal river is *Coelospira planoconvexa.* Corals and a few brachiopods excepted, all the species which are so characteristic of the Ellis Bay formation are gone, and the surface selected as the plane of division between the Ellis Bay and Becscie formations witnesses an almost wholesale change of species. This surface has features which strongly suggest it was developed by subaerial erosion.

Sections illustrative of the formation are rather difficult to obtain. The Vauréal River section ends after passing through only a small part of the Becscie formation. The upper part of the North Shore section is nearly inaccessible, and some of it is concealed, whereas on the south shore the exposures are to a large extent on the reef. On the south shore there is a thickness of about 200 feet. The thickness on the north shore is thought to be about the same.

Zone 1. Yellowish grey limestone with thin shale partings, the former being brittle and having a conchoidal fracture. The zone is exposed at cape Henry and the west end of cape Eagle, the two headlands of Ellis bay. On the north shore the zone is represented by very similar strata which are partly exposed in Fox bay. Fossils are not common, being mostly confined to the thin shales, but good specimens may be found on the surfaces of limestone beds. Thickness, 62 feet.

Zone 2. Beds similar to the preceding, but with a greater fossil content. The zone makes the greater part of Bear point. On the north coast it is partly exposed at Reef point. Thickness, 42 feet.

Zone 3. Similar to the preceding, but with the limestones somewhat more granular. The zone forms pointe aux Graines to the east of Bear point. On the north shore it is perhaps represented in the basal part of the dark shales of the Innommée Baie section. Thickness, 95 feet.

Zone 4. At the base this zone consists of thin-bedded, grey to brownish grey, shell limestone with almost no shale partings, but toward the top the shale increases. The zone is well exposed on the shore with some interruptions from pointe aux Graines to Whale cliff, a distance of about 20 miles. On the north coast it consists of dark shales at the base and grey limestones at the top. On the south side it is characterized by an abundance of *Virgiana barrandei*, particularly in the lower half, where the species occurs in the greatest profusion, some of the beds being almost wholly composed of the broken shells of this brachiopod. A single specimen was found in this zone on the north side. The upper 20 to 30 feet have *Phaenopora superba* as their most abundant fossil. Thickness, 60 feet.

Sections illustrative of the Becscie formation follow.

North Shore Section

Becscie Formation

(Descending order)[1]

(Continues the Ellis Bay formation on this shore)

The section on the north coast extends from Fox point to Innommée baie. The lower part consists of limestones forming the top of Fox point and all of Reef point. Near the middle are dark shales, and the top is limestone. This section is directly above that of the Ellis Bay formation of this coast and is as follows:

	Feet
(40) An inaccessible part of the coast follows zone 39, in which there are probably 50 feet of strata. Then follows irregularly bedded, granular, grey limestone..	30

At the top are 5 feet of thin-bedded limestone, in which *Leperditia selwyni* is common. These strata make the cliffs above the falls at Innommée baie. The fossils are:

Cyclocrinites intermedius
Clathrodictyon vesiculosum
Zaphrentis anticostiensis
Z. hannah
Helopora bellula
Ptilodictya gladiola
Dalmanella media
Virgiana barrandei (a single specimen)
Tentaculites ornatus
Amphilichas arenaceus
Encrinurus anticostiensis
Phacops (Portlockia) orestes

	Feet
(39) Conchoidally fracturing, flinty, drab-coloured limestone with shale partings. To the brink of the falls of Innommée baie. The estimated thickness may be slightly excessive	50
Climacograptus atlanticus and an abundance of small *Camarotoechia glacialis* were collected.	
(38) Blue shale with thin limestone lenses	4
(37) Two beds of shaly, impure, grey limestone, the lower 3·5 feet thick, the upper 6 inches. Separated by 1 foot of shale	5
(36) Thin-bedded (1-2 inches), nodular, greyish blue limestone, separated by 2 to 6-inch beds of dark shale	28
Shales flaky, fine-grained, thin-laminated, and contain *Camarotoechia glacialis* in great abundance. Other fossils are: *Camarotoechia fringilla*, *Rhipidomella uberis*, *Whitfieldella* (?) *solitaria*, *Paleofavosites prolificus*	
(35) Thin-bedded (1-2 inches) limestone separated by 2 to 6-inch beds of bluish grey shale	9½
The limestone is either grey shell limestone largely composed of *Camarotoechia glacialis* or dense, laminated, blue limestone without fossils. The fossils are as in 36.	
(34) Concealed area in Innommée baie. A few layers of granular, grey limestone belonging to this division are exposed in Fox river. Not more than 50 feet thick and may be less.	
(33) Nodular, thin-bedded, buff limestone with an occasional bed of granular, bluish grey shell limestone	15
Some beds of the latter contain occasional pebbles of bluish grey, granular limestone. At the base is a bed of limestone conglomerate with the pebbles and boulders of hard, bluish grey or dark grey limestone. The fragments are up to 4 inches in diameter. These strata form Reef point. The fossils consist of: *Cyclocrinites gregarius*, *Clathrodictyon vesiculosum*, *Lyellia affinis*, *Paleofavosites prolificus*, *Zaphrentis anticostiensis*, *Phaenopora superba*, *Rafinesquina ellisensis*, *Rhipidomella uberis*, *Schuchertella gamachiana*, *Virgiana barrandei*	
(32) Thin-bedded, granular, grey and reddish grey limestone with shale partings and beds of limestone conglomerate	10
Contains *Paleofavosites prolificus* and *Rhipidomella uberis*. Base of Becscie formation. Exposed on the top of Fox point.	

Gun River Formation

On the south shore this formation is largely composed of ash grey to yellowish white limestone, in which are many coral heads and one large reef, interstratified with beds of grey shale, the latter in greater proportion toward the top. On the north shore the strata seem to be similar, but they are not readily accessible. The faunas of the two shores do not appear to be greatly different.

Zone 1. Ash grey and yellowish grey, coralline limestone with obscure bedding, much of the zone being a reef limestone with the coral structure preserved. The zone forms the basal parts of Ste. Anne and St. Mary cliffs, and the fauna is pre-eminently one of corals. Thickness, 70 feet.

Zone 2. Pinkish to brownish grey limestone interstratified with grey shale. Reef-like masses of coral occur locally, and there are hundreds of coral heads. Thickness, 60 feet. The beds of this zone form the major part of Hannah cliff, a headland with a length of about 3 miles. The section at this place, from the top downward, is as follows:

	Feet
(4) Brownish to pinkish grey, coarse-grained limestone in beds 2 to 12 inches thick	30
(3) Grey limestone, of which much is a shell breccia. At the base are numerous reef-like masses of coral, and the horizon contains two beds of intraformational conglomerate, each about 2 feet thick	20
(2) Brownish grey limestone and grey shale	10
(1) Brownish grey, compact limestone with conchoidal fracture	25

This horizon is marked by many *Schuchertella alterniradiata* and *Brachyprion anticostiense.*

Zone 3. Beds similar to the preceding, but with a greater proportion of the compact, yellowish, or brownish grey limestone. The zone is well exposed at Gun river, both in the cliffs up the river and along the shore for about a mile on each side of its mouth. Thickness, 113 feet.

Zone 4. Grey and light blue, thin-bedded limestone and shale with many zones of intraformational and flat pebble conglomerate. One of the basal beds of limestone—seen on the west end of cape Cloutier—contains the grooves described by Richardson.[1] Each groove is about 2·5 cm. deep, 2·5 to 5 cm. long, and 6 to 19 mm. wide. Many are parallel; others, if produced, would intersect; and many have a shell at the bottom. They seem to be due to solution. Ripple-marking is common throughout. The zone is exposed at capes Cloutier and MacGilvray and at several intervening points. Fossils are numerous, but are rarely well preserved. Thickness, 100 feet.

Sections illustrative of the Gun River formation follow.

North Shore Section

(Descending order)

On the north coast the general inaccessibility of the strata of this formation makes collecting difficult and the fauna has never been adequately collected. The exposures extend from near East cliff to the falls of Innommée baie, and the section so far as known is as follows:

(45) In Gull Cliff bay to the west of East cliff there are fully 200 feet of strata, which have not been seen except from a distance. Part of these are thought to belong to the Jupiter formation. About 150 feet above the base of these strata a small brook exposes about 5 feet of massive-bedded, granular, grey, crinoidal limestone. At the brook on the west side of Gull Cliff bay are beds consisting of grey limestone. At Sandtop cape, about 150 feet above the sea, some part of the strata contain *Pentamerus oblongus.* These *Pentamerus* strata are thought to belong to the Jupiter formation, but they may be Gun River. Below the *Pentamerus* beds is an estimated thickness of 90 feet of strata, which are believed to be Gun River. It is probable that part of these strata are represented in 44.

[1]Richardson, J.: Geol. Surv., Canada, Rept. of Prog. 1853-1856, p. 221.

(44) Soft, thin-bedded (1 to 4 inches), pale blue limestone with separating blue shale .... Feet 60
Contact with 45 not seen. Contains:
Cyclocrinites intermedius
Favosites forbesi
Lyellia affinis

(43) Thin-bedded (1 to 3 inches), flaggy, soft, blue limestone 20
Contains *Cyclocrinites intermedius*

(42) Concealed interval in Sandtop bay. It is estimated that between 50 and 100 feet of strata are concealed.

(41) Medium-grained, granular, blue limestone in 3 to 6-inch beds. Exposed on the west side of Sandtop bay. Contains: 15
Zaphrentis hannah
Helopora bellula
H. formosa
Ptilodictya gladiola
Dalmanella media
Tentaculites ornatus

SILURIAN SYSTEM, NIAGARAN SERIES

Jupiter Formation

The lithology of this formation suggests somewhat deeper and certainly less agitated waters than those in which the strata of the preceding formations were deposited, the inference being drawn from the absence of conglomerates and the even character of the bedding. The general zonal description applies to the western exposures.

Zone 1. Ash-grey and reddish grey, thin-bedded limestone interstratified with grey shale, the latter making the greater proportion of the zone. The beds are exposed in a number of low cliffs beginning east of cape MacGilvray and extending to about 1 mile west of Jupiter river. Fossils are very abundant, well preserved, and of many species. Thickness, 60 feet.

Zone 2. Concealed in the western exposures, but shown in the East Cliff section and on Jupiter river. Thickness, 27 feet.

Zone 3. Light green, slightly sandy shales. The zone forms the lower part of the west cliff of Jupiter river and was given a thickness of 60 feet by Richardson. *Atrypa reticularis* was seen in a single specimen. The zone is exposed at East cliff and is full of fossils. Thickness, 80 feet.

Zone 4. Light blue and drab, soft, argillaceous limestone or highly calcareous shale, forming the top of the west cliff and the whole of the east cliff of Jupiter river. The slight resistance of the rock and the presence of numerous perpendicular joints facilitate rapid erosion, and the sea is rapidly working inland. The beds hold many fossils, in many cases very poor, but in others beautifully preserved. Thickness, 100 feet.

Zone 5. This zone begins with rock similar to the preceding, which by gradual transitions passes to purer limestones toward the top. The beds of this zone form the cliffs for about 2 miles east of Jupiter river. On the east end of Anticosti the strata are interbedded limestones and shales and form Cormorant point. Thickness, 22 feet.

Zone 6. Ash-grey, thin-bedded limestone with conchoidal fracture. The most common fossil is *Amphicyrtoceras futile*. Thickness, 43 feet.

Zone 7. Beds similar to the preceding. Exposed on the headland immediately west of Southwest point. Several of the beds are composed almost wholly of the shells of *Stricklandinia davidsoni.* Thickness, 13 feet.

Zone 8. Ash-grey and drab, yellow-weathering limestone with thin shale partings, the limestone having a conchoidal fracture. Thickness, 31 feet.

Zone 9. Beds similar to the preceding. Exposed in the bay west of Southwest point, Bell river, etc. Thickness, 87 feet.

Zone 10. Succeeding measures are concealed west of Southwest point, but at the Jumpers, about 3 miles east of that headland, the upper 25 feet are well exposed. Fossils are extremely numerous at the Jumpers and well preserved. The zone is also splendidly exposed on rivière du Pavillon and in a cliff about 3 miles west of the mouth of the river. The strata consist of 2 to 4-inch beds of grey and bluish grey shell limestone and grey and blue shales. Thickness, 100 feet.

Section from East Cliff to rivière du Pavillon

(Descending order)

	Feet
(30) Interbedded *Pentamerus* and other shell limestone, granular, pale blue limestone and bluish grey shale. Rest directly on 29, the contact being visible about half a mile up rivière du Pavillon. Well exposed at the mouth of rivière du Pavillon, and about 3 miles west, at the last-named place being in contact with the overlying Chicotte formation..	30
(29) Dove-coloured limestone of granular texture, grey shell limestone, and subordinate grey shale. Beds of each kind of rock 3 to 6 inches. Contact with zone below not seen. Cliff about half a mile east of rivière du Pavillon..	15
(28) Massive-bedded, nodular, dove-coloured, conchoidally fracturing limestone overlain by 2 feet of limestone of the same character, but in beds 2 to 4 inches thick. Some beds of thin shell limestone. Strata undulatory with variable inclination in a northwesterly direction. Contact with zone below not observed, and some strata may be concealed. Exposed between rivière du Pavillon and Martin brook. Contains many: *Favosites gothlandicus* *Atrypa reticularis* *Orthis flabellites* And other fossils	12
(27) Nodular, pale dove-coloured, conchoidally fracturing limestone and thin-bedded, blue, shaly limestone. Eight feet exposed on the top of the cliffs west of the mouth of Bilodeau river, and at the Iron River cliffs there is an additional 10 feet in which the last-named type of limestone predominates. Contains an abundance of *Atrypa reticularis* and more rarely *Phacops (Portlockia) orestes*..........................	18
(26) Nodular, dove-coloured limestone. Exposed at Shallop creek and a mile farther west at Bilodeau river. Contact with zone below not seen, and there may be a little overlapping and possibly some concealment. Contains many: *Atrypa recticularis* *Brachyprion anticostiense* *Phacops (Portlockia) orestes* *Calymene niagarensis*	20
(25) Irregularly bedded, conchoidally fracturing, dove-coloured limestone with a few beds of granular, grey limestone covered with fossils. Very little shale. About 5 feet above the base, a bed filled with *Stricklandinia salteri* and near the top local colonies of *Hyattidina congesta junea.* Other common fossils are *Atrypa reticularis* and *Pentamerus oblongus.* Cliffs east of Box brook and for about 1¼ miles east..................	20

Feet

(24) Thin-bedded (2 to 4 inches), nodular, blue-grey limestone with shale partings. Some beds contain an abundance of crinoid stems of two types: an annulated type about $\frac{1}{4}$ inch in diameter, the other not annulated and about half the diameter of the former. Exposed at the first cliff west of Box brook. Contains quite commonly: 15

Atrypa reticularis
Pentamerus oblongus
Calymene niagarensis
Phacops (Portlockia) orestes

(23) Light dove-coloured, fine-grained, conchoidally fracturing limestone. Beds 2 to 4 inches, well-defined and regular. Thin, grey, shale partings. Exposed about $1\frac{1}{2}$ miles east of the mouth of Box brook. Contact with 22 not seen. *Atrypa reticularis* common, other fossils rare.......... 15

(22) Thin-bedded, nodular, granular, pale, bluish grey, shell limestone with separating blue shale. At two horizons a blue, sandy shale. Contact with 21 not observed, and strata may be concealed. Forms the small cliff at South point. Common fossils are: 20

Orthis flabellites
Atrypa reticularis
Pentamerus oblongus
Halysites catenularia

(21) Friable shell limestone interbedded with thin, well-cemented shell limestone. Many *Atrypa reticularis*, *Orthis flabellites*, and *Pentamerus oblongus*. Forms the top of the cliff at Bell river.................... 19

(20) Soft, nodular, fine-grained, pale blue limestone, not many fossils........ 3

(19) From Cormorant point to Bell River cliff are thin-bedded, grey limestones overlain at Bell river by granular, bluish grey, shell limestone with abundant: 50

Pentamerus oblongus
Coelospira hemispherica
Orthis flabellites
Zaphrentis stokesi

(18) Thin-bedded, bluish grey limestone, beds 2 to 3 inches, separated by blue shale. At the top 4 to 5 feet of thin, irregularly bedded, grey limestone containing an abundance of:

Cyathophyllum cormorantense
Zaphrentis cf. *stokesi*
Coelospira hemispherica
Pentamerus oblongus

Probably rests directly on zone 17, but the contact is obscure. Constitutes the strata of Cormorant point............................. 12

(17) Lower 3 feet nodular, grey limestone with many *Pentamerus oblongus*, above 2 feet in 2 to 6-inch beds of crystalline, grey limestone, and at the top 4 feet of thick-bedded (1 to 2 feet), subcrystalline, grey limestone. Contains an abundance of:

Pentamerus oblongus
Favosites gothlandicus
Clathrodictyon vesiculosum

Ends at a fault by which zone 17 is brought to the same level with the top of zone 13, giving a throw of 44 to 54 feet, the drop being on the east side.. 9

(16) Massive-bedded, grey limestone, more or less coherent as one bed. Contains many: 5

Pentamerus oblongus
Favosites gothlandicus

(15) Thin and well-bedded, crystalline, grey limestone interbedded with nodular limestone of the same character. All beds with irregular surfaces. Contact with 14 not observed. Many 25

Clathrodictyon vesiculosum
Favosites gothlandicus
Atrypa reticularis
Pentamerus oblongus

	Feet
(14) Nodular, buff and tan-coloured, conchoidally fracturing limestone and subcrystalline, grey limestone. Many: *Petraia pygmea* *Atrypa reticularis* Colonies of *Stricklandinia davidsoni* *Coelospira hemispherica* Exposed in Cybele bay west of Heath point..........................	15
(13) Massive, tan-coloured limestone, coarse-grained, granular limestone, and a little shale. Heath point. About the middle a zone with abundant *Stricklandinia salteri*. Many: *Plagiorhyncha decemplicata* *Atrypa reticularis* *Petraia pygmea* *Huronia persiphonata* (few)	15
(12) Buff-coloured to grey limestone. Beds lenticular. Badly fractured and the fissures filled with vein calcite. Heath point. Many corals.......	10
(11) Concealed. Estimated..	25
(10) Thin-bedded (2 to 4 inches), granular, grey limestone. Very few fossils other than *Atrypa reticularis* and *Salpingostoma orientalis*..............	15
(9) Low cliff on the east side of Heath Point bay. Thin-bedded, dove-coloured limestone with thin shale partings. Beds 1 to 3 inches. Few fossils...	25
(8) Nodular, light grey limestone, poorly defined bedding....................	10
(7) Concealed area of ¼ mile, estimated to contain..........................	25
(6) Thin-bedded, grey limestone with thin shale partings. Many *Atrypa reticularis* in some beds. Top of East cliff..........................	25
(5) Grey limestone and shale in 2 to 4 inch beds. Contains: *Pentamerus oblongus* *Eospirifer radiatus* *Atrypa reticularis* *Calymene niagarensis*	20
(4) Thin-bedded (2 to 4 inches), grey and pale blue limestone, and shale. Contains: *Plagiorhyncha decemplicata* *Eospirifer radiatus* *Coelospira hemispherica*	36
(3) Thin-bedded, soft, pale blue limestone in 1 to 1½-inch beds, separated by soft, laminated blue shale of a little greater thickness. A few thin beds of granular limestone filled with fossils. Many *Plagiorhyncha decemplicata* in colonies..	7
(2) Grey, nodular limestone with undulatory bedding, Arches over the reefs of the zone below. At places are beds of conglomerate with light-coloured limestone pebbles. Thickness ranges from 8 feet between the coral reefs to about 2 feet over the reefs................................	2–8
(1) Coral reef limestone of variable thickness. Limestone of irregular character; coralline; grey, shell limestone with coral heads; limestone conglomerate; fine-grained, blue-grey limestone; and a little shale. Essentially no bedding except between the reefs, where the strata syncline from one reef to the other..	10

The strata of zone 30 are again exposed at the Jumpers through a thickness of 30 feet, consisting of interbedded, granular, shell limestone separated by blue to grey shale in beds slightly thinner than the limestone. Fossils are extremely abundant, consisting of:

Favosites gothlandicus
Favosites favosus
Streptelasma latusculum
Atrypa reticularis
Coelospira hemispherica
Pentamerus oblongus
Stricklandinii brevis and others

Chicotte Formation

The rock of this formation was formed from coral reefs, coral sand, coral mud, and shell fragments, of which the most abundant are those of crinoid stems. The reef limestones are without bedding. The other types of limestone are bedded in synclinal undulations between the reefs. In many instances they are crystalline and constitute diagenetic marbles, which greatly resemble the well-known Hoburgen marbles of Gotland—a rock of identical origin. The formation shows fine examples of slumping of the sediments before their solidification, and wave marks are common everywhere. Fossils other than corals and crinoid stems are generally rare, but small local patches on and between the reefs yield an abundance of good specimens. From such a small colony near pointe des Morts a large collection of over twenty species was obtained from a small place only about a half dozen feet across.

Both rocks and fauna of this formation differ rather markedly from any which have been already described, as may readily be seen by reference to the faunal tables.

Zone 1. Grey and greenish, somewhat granular limestone with thin shale partings, the latter in many places being absent, and then the rock consisting of whole or comminuted corals without a trace of bedding. This zone is most accessible at the Jumpers, where its lower part forms the upper part of the cliff. It is also exposed at Southwest point, point Galiote, and other localities east to about a mile west of riviére du Pavillon. At the last-named place and at the mouth of Chicotte river are great masses of *Clathrodictyon*, *Favosites*, and *Halysites*. The fauna is largely one of corals. Thickness, 18 feet.

Zone 2. White, granular limestone in beds from 6 to 24 or more inches thick, and in many places with no bedding at all. This zone can be seen at several localities from Southwest point to Chicotte river, and wherever seen it consists of a pure limestone or marble composed almost wholly of comminuted coral or crinoid remains. Other fossils are present in pockets between the corals, where splendid specimens can be found in great abundance. Thickness, 55 feet.

COMPARISON WITH OTHER REGIONS

It is assumed that the migrations of marine organisms proceed so rapidly that geologically they are practically instantaneous, and the presence of like faunas in separated regions is considered evidence of contemporaneity of deposition of the containing strata, unless it can be shown as probable that some barrier, either physical or biological, prevented the geologically simultaneous entrance of the faunas into the two regions. If some species are absent from the faunas which are known to have existed elsewhere in deposits of like age, it is assumed that it was either impossible for such to reach that particular region, or what is equally probable, that the environmental conditions made the region unfit for their occupancy. These conditions, upon which the presence or absence of species depends, vary widely from place to place, so that the absence of members from a fauna of one region, which are present in a contemporaneous fauna of another region, should be the rule and not the exception, and this should be true even if the regions are very little removed from each other.

It has already been noted that two systems are present in the rocks of Anticosti. The detailed zonal presentation contains the evidence for the above and for previously made statements relating to this point.[1]

The faunas show connexion with the North American interior and Europe. Throughout the Richmond the connexions were intimate with the former, but slight with Europe, whereas during the Niagaran connexion with each region obtained.

MACASTY BLACK SHALE

The formation from which this shale was derived is of Ordovician age. Throughout eastern Canada, a similar shale has been called Utica or Collingwood, and among its more important fossils are *Ogygites canadensis*, *Triarthrus becki*, *T. spinosus*, *Leptobolus insignis*, and *Climacograptus spiniferus*. The last two have been collected from the Macasty shale and in addition *Climacograptus typicalis magnificus* and *Triarthrus becki macastyensis*, the latter being closely related to *Triarthrus becki*, differing in that the facial sutures do not converge but diverge. It, therefore, appears extremely probable that these shales are to be correlated with those of Ontario and elsewhere in eastern Canada, although the typical *Ogygites canadensis* has not been recognized—its absence, however, being readily explained when the small quantity of material from which the fossils were collected is considered.

ENGLISH HEAD FORMATION

This formation is considered to be of Richmond age, the conclusion being based on the presence of:

Mesograptus putillus
Halysites catenularia
Paleofavosites capax
Paleofavosites prolificus
Streptelasma rusticum
Arthroclema angulare
Dicranopora fragilis
Dicranopora emacerata
Eridotrypa simulatrix
Goniotrypa bilateralis
Phacelopora pertenuis
Ptilodictya canadensis
Ptilodictya whiteavesi
Ptilodictya magnifica
Sceptropora facula
Catazyga anticostiensis
Dalmanella meeki
Dinorthis carletona
Hebertella maria

[1] If the Richmond rocks be referred to the Silurian, as is done by a few writers, it follows that the above statements relating to the presence of two systems have no validity, but with such a reference the writer is not in sympathy. Based upon diastrophic criteria there appears as much ground for the reference of the Richmond beds to the Ordovician as to the Silurian, it being solely a matter of the evaluation of the unconformities known to exist in some localities both above and below these beds—the evaluation varying widely according to the individual—whereas the faunas differ from those of the Ordovician and the Silurian, though they are very much nearer those of the former; so that if all things be considered, their logical position is with the former, unless, following Schuchert, they are placed in a new system. (Schuchert, Chas.: Bull. Geol. Soc. Am., vol. 21, pp. 487, 530 (1910).)

Leptaena? nitens
Plectambonites sericeus glaber
Rhynchotrema anticostiense
Rhynchotrema perlamellosum
Strophomena fluctuosa
Byssonychia anticostiana
Phragmolites pannosus
Billingsites newberryi
Characteroceras hercules
Diestoceras (three species)

Intimations of a still older time are afforded by myriads of a variety of *Zygospira recurvirostris* and many gastropods of an aspect somewhat more ancient than usually is found in rocks of this age, but there is little doubt that these are to be considered as holdover forms. Close Richmond affinity is seen in the abundant presence of *Catazyga anticostiensis* in the lowest zone, a species distinct from the Lorraine *Catazyga erratica* and closely related to the Richmond *Catazyga headi*, a species not known in older strata. *Rhynchotrema perlamellosum* occurs in zones 3 and 4 in abundance, which is in keeping with its distribution in the Ohio region where it is not known in the Arnheim,[1] but occurs in the Waynesville associated with *Streptelasma rusticum*, *Catazyga headi*, and *Byssonychia radiata;* so that a correlation based on the faunas as well as the distribution of some of the species would assign to the English Head formation an equivalence with the Waynesville. There is very little suggesting that the Arnheim is represented in the Anticosti section. On the other hand, it is curious to find that in the Mississippian province *Leptaena rhomboidalis* appeared for the first time in the Arnheim division,[2] yet it has not been recognized in the Anticosti section below the basal zone of the Ellis Bay formation; and from the point of view of the facies there is no apparent environmental reason that it should not have existed in the Anticosti seas during the times of deposition of the English Head and Vauréal formations.

VAURÉAL FORMATION

The fauna of this formation bears the true expression of the higher Richmond, as shown in the presence in great abundance of some of its most typical fossils, as:

Beatricia nodulosa
Beatricia undulata
Calapoecia anticostiensis
Columnaria alveolata
Columnaria? vaurealensis
Mesograptus putillus
Paleofavosites capax
Paleofavosites prolificus
Streptelasma rusticum
Arthroclema angulare
Bythopora striata
Dicranopora emacerata
Dicranopora fragilis
Goniotrypa bilateralis

[1] As aid in definition, the sequence of the strata of the Cincinnati region is here given in order from youngest to oldest—Richmondian: Elkhorn, Whitewater, Saluda, Liberty, Waynesville, Arnheim; Maysvillian: Mount Auburn, Corryville, Bellevue, Fairmount, Mount Hope.
[2] Foerste, A. F.: Am. Geol., vol. XXXVI, p. 244 (1905).

Lioclemella nitida
Pachydictya firma
Pachydictya hexagonalis
Protocrisina exigua
Ptilodictya flagella
Ptilodictya magnifica
Ptilodictya whiteavesi
Sceptropora facula
Catazyga anticostiensis
Clitambonites diversus
Dinorthis carletona
Dalmanella meeki
Hebertella maria
Leptaena? nitens
Plectambonites sericeus glaber
Rhynchotrema anticostiense
Rhynchotrema perlamellosum
Strophomena fluctuosa
Phragmolites pannosus
Byssonychia anticostiana
Billingsites (two species)
Characteroceras hercules
Diestoceras (three species)
Aparchites minutissimus
Beyrichia parallela
Bythocypris cylindrica
Tetradella lunatifera
Tetradella simplex
Vinella nodosa
Ceraurinus icarus
Calymene meeki
Isotelus gigas

These species do not occur elsewhere in association except in the Richmond; and it is further to be noted that the vertical occurrence of many of the species is in close harmony with their occurrence in the type region of the Richmond and elsewhere. *Catazyga headi* and *Rhynchotrema perlamellosum* occur only in the Waynesville, and after these two species have disappeared *Beatricia nodulosa* and *B. undulata* appear in Kentucky in the south and southwest extension of the Liberty bed and in the Saluda of Indiana. This closely agrees with the occurrence of these species in the Anticosti rocks. *Catazyga anticostiensis* and *Rhynchotrema perlamellosum* become extinct in zones 4 and 2 of the Vauréal formation, and the *Beatricias* do not appear until zone 4. Relying, therefore, on these species and on the order of the vertical distribution of some of them, the Vauréal formation is correlated with the Liberty to Elkhorn beds of the Ohio region.

The English Head and Vauréal formations, considered as a whole, are thus correlated with the whole of the Ohio Richmond above the Arnheim, the great number of species common to the two regions and the order of their vertical distribution being considered to render the correlation essentially positive and to prove direct and open communication between the two areas during the times of deposition of at least the upper half of the English Head and the whole of the Vauréal formation. It is possible that some of the species lived earlier in the Anticosti than in the Mississippian region and this appears very probable for *Catazyga anticostiensis* and a few others.

What was the place of origin of the Richmond faunas of Anticosti? Most common English Head and Vauréal species also occur in the interior; but many common Richmond fossils of the interior have not been found in the Anticosti section. Among them may be named: *Dinorthis carleyi, D. retrorsa, Hebertella sinuata, Leptaena rhomboidalis,* members of the genus *Platystrophia, Strophomena sulcata,* and *Zygospira modesta.* Brachiopods migrate passively, depending largely on the currents to carry them. These facts suggest that the Anticosti Richmond faunas are of North Atlantic origin and were in part carried into the Mississippian sea by westward trending currents which prohibited interior species from attaining Anticosti.

The first westward occurrence of species of the Vauréal and English Head faunas west of Anticosti is at lake St. John, 375 miles to the west, where fragments of Ordovician beds have been preserved from erosion by their position in a structural depression. From scattered blocks on Snake island in lake St. John have been collected *Beatricia nodulosa, B. undulata, Streptelasma rusticum,* and *Catazyga headi borealis.*[1] Whether the *Beatricias* occur associated with the other species or not, has not been determined. Farther west at Three Rivers, on St. Lawrence river, *Catazyga headi* has been collected. Still farther west, on Manitoulin islands, lake Huron, about 900 miles west of Anticosti, the faunal and lithic aspect of the strata is more that of Anticosti than of Ohio. Foerste[2] has lately studied this region, and from the lower Richmond or Waynesville beds, consisting of interbedded limestones and shales, among other fossils he has obtained:

Calapoecia huronensis
Columnaria alveolata
Streptelasma rusticum
Catazyga headi
Plectambonites sericeus
Rhynchotrema perlamellosum

The Kagawong beds, or higher Richmond, are marked by several horizons carrying many corals, and here, as on Anticosti, come the *Beatricias. B. undulata* is the only species present, but with it are:

Calapoecia huronensis
Columnaria alveolata
Rhynchotrema perlamellosum

Probably the most striking occurrence of the Vauréal fauna is at Stony mountain, Manitoba, over 1,450 miles west of Anticosti. This outlier, somewhat isolated, forms a hill some 50 feet in height on the west bank of Red river not far from Fort Garry.[3] In its lower part it "consists of limestones, with clayey partings" which toward the summit "pass into rich cream-coloured, yellow or greyish white dolomites," the whole having an horizontal altitude.[4]

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[1] Logan, W. E.: Geol. Surv., Canada, 1863, pp. 217, 220.
[2] Foerste, A. F.: Ohio Naturalist, Dec. 1912, pp. 45–47.
[3] Bell, Robert: Geol. Surv., Canada, 1878–1879 (App. I, pp. 49C-50C).
Whiteaves, J. F.: Pal. Foss., vol. III, pt. II, pp. 111–112 (1895).

These strata, the thickness of which has not been stated, contain a total of fifty-three identified species, of which the following thirty also occur in the Richmond rocks of Anticosti:

Beatricia nodulosa
Beatricia undulata
Paleofavosites aspera
Protarea vetusta
Streptelasma rusticum
Arthroclema angulare
Bythopora striata
Dicranopora emacerata
Dicranopora fragilis
Goniotrypa bilateralis
Pachydictya hexagonalis
Ptilodictya whiteavesi
Sceptropora facula
Semicoscinium pretiosum
Dalmanella testudinaria
Dinorthis proavita (near *D. carletona*)
Leptaena? ceres
Leptaena? nitens
Rhynchotrema anticostiense
Rhynchotrema capax (near *R. perlamellosum*)
Strophomena fluctuosa
Sinuites bilobatus
Hormotoma gracilis
Lophospira modesta
Trochonema umbilicatum
Aparchites minutissimus
Beyrichia parallela
Bythocrypris cylindrica
Primitia lativia
Tetradella lunatifera
Tetradella simplex
Calymene meeki
Ceraurinus icarus

Of these thirty-one species, no less than twenty-two are considered index fossils to the Richmond, and here again, as elsewhere, the *Beatricias* occur only in the higher beds. Such a large percentage of Anticosti species, taken together with their vertical distribution, makes fairly positive the correlation of the Stony Mountain strata with zones 3, 4, and 5 of the Vauréal formation, which contain most of the fossils named above and in the same order of vertical occurrence; and it is extremely probable that more species will be found common to the two series of deposits, when the fossils of both shall have been increased by more extensive collections. These fragments of the Richmond rocks, reaching from Anticosti to Stony mountain, suggest a line of open water and the probable route of migration from the former to the latter place.

A fauna apparently[1] closely allied to that of the lower half of the Vauréal formation occurs at Spring valley, Minnesota, in a series of shales and limestones of unknown thickness, in which, among other fossils, have been collected:

Clitambonites diversus
Dalmanella meeki
Dinorthis proavita

[1] Winchell and Upham: Geol. and Nat. Hist., Surv., Minn., vol. I, p. 301 (1884).
NOTE.—The writer uses the word apparently because this locality was studied so long ago that much revision is probably now necessary.

D. subquadrata
Leptaena? unicostata
Rhynchotrema capax

A similar fauna has been collected at Iron ridge, Wisconsin, in a formation of shales and limestones. The same species also occur at Wilmington, Illinois, with the addition of:

Arthroclema angulare
Pachydictya firma
Protocrisina exigua
Ptilodictya magnifica
Rhynchotrema anticostiense[1]

ELLIS BAY FORMATION

The faunas of this formation are in part derived from, or an outgrowth of, the faunas of the previous formations. Associated with these are species not known elsewhere in America, or at an horizon so low as this. Diagnostic forms are:

Allonema curtum
Aspidopora siluriana
Atactoporella spicata
Ceramopora niagarensis germana
Chasmatopora angulata
Corynotrypa dissimilis
Cyphotrypa bulbosa
Cyphotrypa polygona
Hallopora elegantula
Hallopora elegantula prolifica
Hallopora magnopora
Helopora lineopora
Lichenalia utricula
Nicholsonella parvula
Pachydictya crassa
Phaenopora ensiformis
Phaenopora excellens
Ptilodictya gladiola
Stomatopora siluriana
Atrypa marginalis
Atrypina gamachiana[2]
Hindella prinstana
Hindella umbonata
Leptaena? reticulata
Orthis pyramidalis
Orthis laurentina
Parastrophia reversa
Parastrophia lenticularis
Platystrophia regularis
Platystrophia camerata
Schuchertella gamachiana
Cyrtospira notata
Cyclonema thalia
Hormotoma gigantea
Lophospira? papillosa
Loxonema rugosum
Encrinurus laurentinus
Sphaerocoryphe salteri

[1] The *Rhynchotrema anticostiense* from this locality is in the Yale collection.

[2] Apparently close to *Atrypina similis* Reed from the Keisley limestone of England of high Ordovician age; Q.J.G.S., vol. LIII, p. 72 (1897).

That the faunas of this formation have a decided Richmond aspect is clearly evident, and yet the assemblages are not known in the deposits of the Mississippi region; nor, so far as present knowledge goes, elsewhere on the American continent. If this surmise be correct, every path permitting migration to the interior from this direction was closed at this time, or the interior region was free from marine waters. One of the two possibilities is well shown by the fact that *Atrypa marginalis* did not reach the Mississippi valley until Clinton (Brassfield) time. A strong Silurian cast is given to the Ellis Bay faunas by the presence of such species as:

Hallopora elegantula
H. magnopora
Pachydictya crassa
Phaenopora ensiformis
Atrypa marginalis
Atrypina gamachiana
Chonetes primigenius
Hindella prinstana
H. umbonata
Orthis davidsoni pyramidalis
Schuchertella gamachiana
Encrinurus laurentinus

BECSCIE FORMATION

In North America this formation holds a stratigraphic position paralleling that of the Ellis Bay formation, in that there is little with which it can be considered synchronous. Except for a few long-enduring or cosmopolitan species, like *Pachydictya crassa*, *Ptilodictya gladiola*, *Leptaena rhomboidalis*, and *Paleofavosites prolificus*, those present are of Silurian aspect, though not known elsewhere; but myriads of clorindoids, *Coelospira planoconvexa*, great masses of *Clathrodictyon vesiculosum*, *Favosites gothlandicus*, and members of the *Cyathophylloid rugosa* emphasize the change and the entrance of a new cycle of evolution. In North America there are few faunas with which that of the Becscie may be correlated, the nearest, but apparently much younger, is found in the Cataract formation of southern Ontario at Dundas, Hamilton, Grimsby, and intermediate localities, and in the thin-bedded, arenaceous shales of Evans gully in the Niagara gorge, referred to the Medina, but apparently identical with the Ontario beds 30 miles to the northwest. The strata of all these places are now known to be the Cataract formation of Schuchert, which lies beneath the fossiliferous Medina and above the Richmond and carries the fauna mentioned above. At Cataract Junction on Credit river, the type locality of the formation, the following fossils have been collected, only those specifically identified being named:

Clathrodictyon vesiculosum
Favosites venustus
Zaphrentis bilateralis
Chasmatopora angulata
Hallopora magnopora
Helopora fragilis
Homotrypa? confluens
Pachydictya crassa
Phaenopora explanata

Phaenopora ensiformis
Phaenopora punctata
Rhinopora verrucosa
Atrypa n. sp.[1]
Camarotoechia neglecta
Coelospira planoconvexa
Dalmanella elegantula
Hebertella fausta
Leptaena rhomboidalis
Orthis flabellites
Platystrophia biforata
Plectambonites transversalis[2]
Rhipidomella hybrida
Rhipidomella circulus
Schuchertella cf. *pecten*
Calymene niagarensis
Encrinurus cf. *punctatus*[3]

These species are represented in the Anticosti section by either identical or closely related forms as follows:

Clathrodictyon vesiculosum
Favosites hisingeri
Chasmatopora angulata
Pachydictya crassa
Phaenopora ensiformis
Atrypa marginalis
Camarotoechia neglecta
Coelospira planoconvexa
Dalmanella elegantula
Leptaena rhomboidalis
Orthis flabellites
Platystrophia regularis
Plectambonites transversalis
Rhipidomella uberis
Schuchertella alterniradiata
Schuchertella gamachiana
Calymene niagarensis
Encrinurus anticostiensis

Of these species *Clathrodictyon vesiculosum, Pachydictya crassa, Phaenopora ensiformis, Atrypa marginalis, Leptaena rhomboidalis, Rhipidomella uberis,* and *Calymene niagarensis* are long ranging in the Anticosti section and so afford no light. *Plectambonites transversalis, Schuchertella alterniradiata,* and *Encrinurus punctatus* do not make their appearance until from 300 to 400 feet above the highest beds of the formation. *Camarotoechia neglecta* and *Orthis flabellites* have been collected in zone 4 of this formation, and *Coelospira planoconvexa* has been found in zone 1; *Schuchertella gamachiana* occurs in the Vauréal, Ellis bay, and zones 1 and 2 of this formation; *Chasmatopora angulata* in zone 8 of the Ellis Bay formation; and *Platystrophia regularis* throughout that formation. Hence, if reliance be placed on fossils, the preponderance of evidence indicates that the Becscie fauna is older than the Cataract, and, therefore, any other known Silurian fauna of the Niagara-Ontario region.

[1] A large multistriate form of *Atrypa marginalis*.
[2] Collected at Hamilton.
[3] Parks, W. A.: Twelfth Inter. Geol. Cong, Guide Book No. 5, pp. 11-12 (1912). The list is from Parks, but revised after.
Schuchert: Bull. Geol. Soc., Am., vol. 25, p. 281 (1914). Schuchert gives other species, but as they add nothing to the correlative data they are not listed.

Faunas holding a somewhat similar stratigraphic position to that of the Becscie are those of the Alexandrian series of Illinois and Missouri. This series has a maximum thickness of about 175 feet, and, named in order from the base upwards, consists of the Girardeau limestone, Edgewood limestone, Essex limestone, and Sexton Creek limestone (Brassfield). The sequence is particularly interesting because of the presence of several breaks in deposition within a small thickness.

From the Girardeau limestone Savage[1] has listed twenty-nine species, of which only *Leptaena rhomboidalis* and *Diaphorostoma niagarense* occur in the Anticosti section, neither being of much value for correlation. From the Edgewood limestone there are seventy-five listed, of which the following have representation on Anticosti:

Clathrodictyon vesiculosum
Halysites catenularia
Zaphrentis stokesi
Dalmanella elegantula
Leptaena rhomboidalis
Orthis flabellites
Rhipidomella hybrida
Rhynchotrema janeum
Diaphorostoma niagarense

The common species whose stratigraphic ranges in the Anticosti section do not extend as low as the Becscie River are *Zaphrentis stokesi* and *Diaphorostoma niagarense*, neither of which makes its appearance below the basal zone of the Jupiter formation. Only a single species of limited range, *Rhynchotrema janeum*, occurs in strata older than the Becscie and that species so closely resembles other forms that the identification may be in error. Since, furthermore, the general aspect of both the Girardeau and Edgewood faunas appears younger than the Becscie, it is assumed that they probably find an equivalency in the lower zones of the Gun River or the uppermost zone of the Becscie formation. The matter is by no means clear, however, as the two regions of deposition appear to have been totally disconnected.

The Essex limestone has twenty-nine species, of which the following have representation in the Anticosti rocks:

Halysites catenularia
Atrypa marginalis
Dalmanella elegantula
Rhipidomella hybrida
Mytilarca cf. *mytiliformis*

There is nothing in the list that has close correlative value.

The Sexton Creek or Brassfield limestone has forty-nine species, of which the following are represented in the Anticosti section:

Clathrodictyon vesiculosum
Diphyphyllum caespitosum
Favosites favosus
Halysites catenularia
Atrypa marginalis
A. reticularis
Dalmanella elegantula
Pentamerus oblongus
Plectambonites transversalis (variety)
Stricklandinia tripleciana
Triplecia ortoni
Diaphorostoma niagarense

[1] Savage, T. E.: Illinois Geol. Surv., Bull. 53, pp. 7-124 (1913).

The presence of *Atrypa reticularis*, *Pentamerus oblongus*, and *Plectambonites transversalis* is of great significance, as these three species make their first appearance in the Anticosti section in the upper part of the Gun River formation or the basal part of the Jupiter, and their common presence indicates the probability of a time equivalence for the Sexton Creek limestone with that part of the Anticosti section.

Doctor T. E. Savage very kindly sent to the writer for study several small collections, of which one came from the Mayville limestone of Mayville, Wisconsin, which Savage places at the base of the Sexton Creek formation.[1] This contained fully a dozen specimens of a species of *Virgiana*. Most of the other material came from northeastern Illinois from near Elgin, Oswego, and Channahon at a level about 20 to 25 feet above the zone with the *Virgianas*, a level which Savage places near the middle of the Sexton Creek division. Most of the fossils from this level, which the writer had the privilege of examining, consisted of *Stricklandinias*, some of which resemble *S. davidsoni* very closely; others are of the *S. salteri* and *S. brevis* types. With them are associated a *Triplecia* which resembles *T. insularia anticostiensis*,[2] *Atrypa marginalis*, *Orthis flabellites*, and a large form of *Schuchertella*.

In the Anticosti section the *Stricklandinias* make their first appearance in zones 2 and 3 of the Jupiter formation with two species present, *S. davidsoni* and *S. salteri*, and in zone 1 of the same formation *Triplecia insularis anticostiensis* occurs for the first time; and, as previously noted, *Atrypa reticularis*, *Pentamerus oblongus*, and *Plectambonites transversalis* also appear in the upper part of the Gun River formation or the basal part of the Jupiter. The association and order of appearance, hence, are strikingly similar to that of the Sexton Creek division of northeastern Illinois and lead to the correlation of the latter with the upper part of the Gun River formation and basal part of the Jupiter.

The presence of the *Virgianas*, however, throws a little doubt on the above correlation. In the Anticosti section this genus does not extend higher than zone 2 of the Gun River, a level about 100 feet below zone 4 of the same formation, whereas in Illinois it occurs only 20 to 25 feet below the *Stricklandinias*. There appear to be three possible interpretations of this fact, as follows: (1) The *Virgianas* appeared somewhat later in the Mississippi valley than in the Anticosti embayment; (2) an hiatus exists in the Illinois section between the *Virgiana* and *Stricklandinia* zones; (3) the beds between the two zones represent the 100 feet of the Anticosti section which lie between the *Virgianas* and *Stricklandinias*. Considering these possibilities in reverse order, it has been shown as quite probable that the Silurian limestones below the Sexton Creek division correlate best with the lower zones of the Gun River formation, and this would give to the *Virgiana* zone an equivalency with a higher division of the formation. Savage has very keenly sought for unconformities in the Illinois Silurian and has found none at this level, so that it seems probable that no hiatus is present. The first explanation appears to be the more tenable one. Whether the *Virgianas* entered the interior from

[1] Personal communication.

[2] The interior has not been seen; so nothing is known of the size of the cardinal process, but the exterior is very similar to that of the Anticosti form and not like *T. ortoni* as figured by Meek, or specimens from the Ohio section which the writer has seen.

the St. Lawrence embayment or from the north, remains to be established, but it seems very probable that the migration into the interior did not take place earlier than toward the end of Gun River time. In this way the close stratigraphic relations of the two genera in the Sexton Creek are readily explained, and the explanation does not conflict with the other evidence.

GUN RIVER FORMATION

In the upper part of the Gun River formation Clinton forms appear, attested by the presence of numerous specimens of:

Coelospira hemispherica
Hyattidina congesta junea
Orthis flabellites
Pentamerus oblongus (early form)
Plectambonites transversalis

As the faunas of the succeeding Jupiter formation are unquestionably Clinton and correlate best with the higher New York Clinton, the Williamson shale and Irondequoit limestone, it is thought probable that the lower zones of the New York Clinton, the Sodus shale, Furnaceville ore bed, and the Walcott limestone may find representation in the highest zone of the Gun River formation. It is further thought very probable that the lower two-thirds of the Gun River formation contains the Anticosti equivalent of the Alexandrian series of Illinois, the Brassfield of Ohio, and the Cataract formation of Ontario. A reminder of the Ohio Brassfield is present in zones 1 and 4 of the Jupiter formation in the occurrence of numerous individuals of *Triplecia insularis anticostiensis*, and *Calymene schucherti* (first identified as *C. vogdesi* Foerste) in zone 1 of the Jupiter formation. In a previous paper[1] considerable stress was placed on the appearance of the first of these species, which was considered a variety of *T. ortoni;* but a closer study of the Anticosti form has shown that there are specific differences between it and *T. ortoni*, and that the former is only varietally distinct from the European *T. insularis*, ranging from the Caradoc into the Upper Llandovery, hence little reliance can be placed on these two species for correlating the containing deposits. It is believed, however, that the Ohio Brassfield has a time equivalence with some part of the upper middle portion of the Gun River formation.

JUPITER FORMATION

The fauna of this formation has the true Clinton aspect, as shown by the presence of such diagnostic forms as:

Monograptus clintonensis
Retiolites geinitzianus venosus
Allonema botellus
Palaeocyclus rotuloides
Ascodictyon siluriense
Diploclema sparsum
Vinella multiradiata
V. radiciformis
Cystiphyllum niagarense
Bilobites bilobus
Coelospira hemispherica

[1] Schuchert, Chas., and Twenhofel, W. H.: loc. cit., 1912, p. 712.

Clorinda linguifera
Dalmanella media
Eospirifer radiatus
Hyattidina congesta junea
Orthis flabellites
Pentamerus oblongus
Plectambonites transversalis
Stricklandinias sp., several species
Chilobolbina billingsi
Apatobolbina granifera
Zygobolba decora
Z. anticostiensis
Z. excavata
Z. inflata
Z. inflata recurva
Z. intermedia
Z. rectangula
Z. robusta
Z. twenhofeli
Calymene niagarensis
Encrinurus anticostiensis

and other forms related to those of the Clinton. The formation is considered the much enlarged time equivalent of the Williamson and Irondequoit divisions of the Clinton of western New York. On the basis of the Ostracoda, Ulrich correlated the Jupiter formation with the Sodus shale, but it is considered that the evidence of the entire faunal aggregate is more in harmony with the correlation made above.[1]

According to Dr. Foerste the presence of "*Huronia persiphonata* and *Huronia obliqua* indicates Manistique age" for the containing strata, a correlation which is also supported by the presence of *Discoceras? infelix* and *Megadiscoceras crassimarginatum orientale*. *Eotrimeroceras jupiterense*, *Orchadoceras incertum* and *Protokionoceras anticostiense* are also said by Dr. Foerste to have closely related forms in the Racine of Wisconsin and Illinois. As these horizons have been correlated with the Lockport, the suggestion of the cephalopods is that the Jupiter may be of Lockport age. This suggestion finds no support in the other fossils.

CHICOTTE FORMATION

Corals were great rock builders in the Anticosti seas during the times of Chicotte deposition—great in numbers, but few in species—and as nearly all are long ranging forms, they do not afford much of a basis for correlation. Most of the associated species of the other groups are also found in the upper part of the Jupiter formation. *Huronia vertebralis* belongs definitely to the Manistique formation of northern Michigan; the other cephalopods suggest middle Silurian and not lower Silurian. This correlation is further supported by the dropping out of such characteristic Clinton forms as *Coelospira hemispherica*, *Pentamerus oblongus*, most of the *Stricklandinias*, and the *Heloporas*. The formation is hence correlated with the Rochester and the basal part of the Lockport.

The Silurian portion of the Anticosti section is thus considered to represent deposits of that system to, and perhaps including, a part of the Lockport.

[1]Ulrich, E. O.: "Ostracod Zones of the Silurian"; Maryland Geol. Surv., Silurian vol., p. 347 (1923).

The nearest occurrence of deposits equivalent to those of the Silurian portion of the Anticosti section is just across South channel in Gaspe region. On the south side of Shickshock mountains, two tributaries of Chat river have exposed "50 feet of yellowish white, fine-grained sandstone dipping southward 20 to 25 degrees........overlain by 200 feet of grey sandstone interstratified with some beds of grey shale," the whole resting on the nearly vertical beds of the "Quebec" series. The lower part is fossiliferous and holds, among other fossils:

Atrypa reticularis
Leptaena rhomboidalis
Orthis davidsoni
Schuchertella pecten
Stricklandinia lens (probably *S. davidsoni*)
S. brevis
Strophomena antiquata
Calymene blumenbachi
Phacops (Portlockia) orestes[1]

There is little doubt that this fauna correlates with some part of the Jupiter formation. The knowledge of this Shickshock series of deposits has been little increased since Logan's time, and the facts given do not permit a zonal assignment. Also, on Gaspe peninsula, at the forks of Scaumenac river, from grey limestones and calcareous shales of unknown, but considerable thickness, Ells collected:

Favosites niagarensis (?)
Stromatopora concentrica (?) (probably *Clathrodictyon vesiculosum*)
Atrypa reticularis
Leptaena rhomboidalis
Pentamerus oblongus
Plectambonites transversalis (?)
Diaphorostoma niagarense
Calymene niagarensis
Encrinurus punctatus[2]

This fauna also appears to be of Jupiter age. On the shores of Matapedia lake near the head of the peninsula are Silurian rocks, of which the lowest visible are "whitish sandstones," from loose blocks of which have been collected *Pentamerus oblongus*, and from overlying limestones:

Halysites catenularia
Atrypa reticularis
Leptaena rhomboidalis
Meristella didyma
Stropheodonta varistriata
S. becki (?)
Oriostoma globosum[3]

This fauna also appears to be of Jupiter age.

At Black cape, on Chaleur bay, Clarke has described a 7,000-foot section of Silurian strata, which begins with what appears to be the probable equivalent of the Chicotte, this conclusion being largely based on the presence of myriads of corals of Chicotte aspect and great numbers of *Stricklandinia gaspiensis*, a form somewhat larger than *S. davidsoni*[4] and individuals of which occur in the Chicotte formation.

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[1] Logan, W. E.: "Geology of Canada, 1863," pp. 410–411.
[2] Ells, R. W.: Geol. Surv., Canada, Rept. of Prog. 1882–1884, pt. E, p. 26.
[3] Bailey, L. W., and McInnes, W.: Geol. Surv., Canada, Ann. Rept., vol. III, pt. II, 1887–1888, p. 14 M (1889).
[4] Clarke, J. M.: Twelfth Inter. Geol. Cong., Guide Book No. 1, 1913, pp. 110–112.

About 275 miles south of Anticosti is the Arisaig section of the Silurian,[1] where the order of deposition is quite different from that of Anticosti, providing an entirely different facies and hence a very different faunal assemblage, with the result that few species are common to the two series of deposits. The Arisaig section begins with the Beechhill Cove formation, an arenaceous limestone which has been called Medina, but which there are no reasons for considering older than Clinton. The initial zone is followed by about 800 feet of black and green shales which contain few fossils, due probably to the unfavourable character of the environment, although some beds are crowded with graptolites and pelecypods. This formation has been called the Ross Brook and with the preceding beds is considered the equivalent of the upper Gun River and Jupiter formations, both holding such well-known Clinton species as:

Monograptus clintonensis
Coelospira hemispherica
Dalmanella elegantula submedia (closely related to *D. concavoconvexa*)
Plagiorhyncha decemplicata
Schuchertella pecten
Pterinea emacerata (variety)

One looks in vain in these beds for *Atrypa reticularis*, but finds it in higher levels on the first appearance of limestone at the base of the overlying McAdam formation. Its absence in the Ross Brook formation appears to be due to the fact that the waters were not suited to this ubiquitous world-ranging species. The same thing takes place where the muds of the Jupiter formation replace the limestones of the Gun River.

The Chicotte formation possibly finds its equivalent in the lower zones of the McAdam formation. *Atrypa reticularis* is the only common species, which should cause no surprise when the widely different character of the facies is considered. Above this part of the McAdam formation there follow over 2,000 feet of marine sediments which carry the record nearly, if not entirely, to the base of the Devonian.

CORRELATION WITH THE BRITISH SECTION

Correlation with the British section is not readily made for the formations below the Ellis Bay, as only five species (or close relatives) of these formations are known in England.[2] Of these, *Dalmanella meeki* and *Plectambonites sericeus glaber* are long ranging and so afford no guidance; the English *Clitambonites adscendens* is not close enough to *C. diversus* to be depended on for correlation. *Halysites catenularia*, another long-ranging species, appears in zone 4 of the English Head formation, and in the Llandeilo,[3] so that a correlation based on its first appearances would make the Llandeilo the equivalent of the English Head, which the other members of the two faunas fail to confirm so definitely as to make it fairly certain that little reliance can be placed on this coral. The other species, *Catazyga anticostiensis*, is said to have a representative in the Bala of Ireland. This common occurrence of two related forms suggests

[1] McLearn, F. H.: "Palaeontology of the Silurian Rocks of Arisaig, Nova Scotia"; Geol. Surv., Canada, Mem. 137 (1924).
[2] It is to be noted that Mrs. Gray has identified *Lingula canadensis* Billings from the Llandeilo of Girvan district in the south of Scotland; but it is very possible that this is a mistaken identification. "The Silurian Rocks of Scotland," Peach and Horne, vol. I (1889); 690, Memoirs Geol. Surv. United Kingdom.
[3] Reed: Q.J.G.S., 1897, pp. 53, 93.

a correlation of the containing strata. This suggestion cannot be considered correct. Correlation may, however, be more definitely made with certain well-studied sections.

Through the courtesy of Sir Audrey Strahan, former director of the Geological Survey of England and Wales, and several members of his staff, particularly Mr. John Pringle, the writer was given an opportunity of studying the material of a detailed collection made from the Bala to Wenlock as exposed near Haverfordwest in South Wales.[1]

The upper Bala of this section is represented by the Robeston Wathen and Shoalshook limestones and Red Hill and Slade beds. The Robeston Wathen limestone is at the base and belongs to the Caradocian; the other divisions are referred to the Ashgillian series of Marr.[2] As the lithology is fairly calcareous, the inference is that the environmental conditions during the times of deposition were somewhat similar to those of the Anticosti Sea, and hence, if synchronous, common species may be present.

The Robeston Wathen limestone is a dark blue, fairly pure limestone and contains among other fossils:

Halysites catenularia
Heliolites megastoma
Leptaena rhomboidalis
Platystrophia biforata
Plectambonites sericeus
Triplecia insularis

The succeeding Shoalshook limestone is of a more sandy, muddy character, and has more brachiopods, cystids, and trilobites than the preceding, but fewer corals. The only other additional fossil of any correlative value for the Anticosti section is a poor specimen of what appears to be *Dinorthis porcata*.

The Slade and Red Hill beds exhibit a more clastic lithology, consisting of blue to grey mudstones with interstratified brown to grey, micaceous, and calcareous sandstones. Local lithic variations appear to be not uncommon. Of Anticosti or closely related forms these beds contain:

Dalmanella testudinaria
Dinorthis porcata sladensis Reed
Leptaena rhomboidalis
Platystrophia biforata
Plectambonites sericeus
Strophomena antiquata
Calymene blumenbachi

Additional forms are a small *Zygospira* resembling *Z. recurvirostris aequivalvis* and typical *Triplecia insularis*.

The corals found in parts of this section suggest a comparison with the Vauréal and Ellis Bay formations, but the common species are few. *Triplecia insularis* suggests the Lyckholm of Baltic Russia, which, as will be shown below, correlates fairly definitely with the English Head and Vauréal formations, so that, on the whole, it would appear that the upper Caradocian and Ashgillian series of Haverfordwest district contain the equivalents of the English Head and Vauréal formations. The fauna

[1] This section has been described in "The Geology of the South Wales Coal Field"; Memoirs of the Geol. Surv., England and Wales, No. 228, pt. XI (1914).
[2] Marr, J. E.: Geol. Mag., 1907, p. 59.

of the Ellis Bay formation does not compare with any part of the Haverfordwest section, the absence of *Atrypa marginalis*, *Schuchertella gamachiana*, the *Hindellas*, *Atrypina*, and others rendering very doubtful the possibility that it contains any Ordovician beds as young as the Ellis Bay. That, however, there are beds in Wales which have a time equivalency with those of the Ellis Bay is extremely probable. Through the kindness of Professor E. J. Garwood, of the University of London, the writer was enabled to examine a small collection of fossils collected near Kingston, Herefordshire, some of which appear to have come from Ordovician strata higher than any in the Haverfordwest section. The following forms were recognized:

Halysites catenularia
Heliolites sp.
Paleofavosites prolificus (?)
Streptelasma near *selectum*
Atrypa marginalis
Leptaena rhomboidalis
Rafinesquina cf. *imbrex*
Rhynchotrema cf. *janeum*
Rhynchonella? cf. *nutrix*
Diaphorostoma cf. *humile*

This fauna has an Ellis Bay aspect.

Through the courtesy of Dr. F. C. R. Reed of the Sedgwick Museum, an opportunity was given of examining collections from the Keisley and Chair of Kildare limestones. Species from the latter were also seen in the Museum of Practical Geology.

The Keisley limestone contains the following thirteen species which are closely related to, or identical with, Anticosti Richmondian forms:

Halysites catenularia
Paleofavosites aspera
Atrypina similis
Atrypa near *marginalis*
Dalmanella testudinaria
Dinorthis porcata
Hyattidina portlockiana
Leptaena rhomboidalis
Orthis calligramma
Platystrophia biforata
Plectambonites sericeus
Strophomena antiquata
Calymene blumenbachi[1]

These are only thirteen out of about one hundred and ten species, and although they are few in comparison with the whole, they strongly suggest, and the general aspect of the faunas supports the suggestion, that the Keisley limestone finds a time equivalence with some part of either the upper Vauréal or the lower Ellis Bay formation. Such species as *Atrypina similis*, *Atrypa marginalis*, and *Hyattidina portlockiana* emphasize the suggestion.

The limestones of the Chair of Kildare have as a rule been correlated with the Keisley limestone, and both fauna and lithology of the two series of deposits are very similar. In addition to the Keisley limestone forms which have been named, the Chair of Kildare limestone contains *Catazyga*

[1]Reed, F. C. R.: Quart. Jour. Geol. Soc., London, vol. LII, pp. 409-537 (1896); ibid. vol. LIII, pp. 67-106 (1897).

anglica (very close to *C. anticostiensis*) and *Encrinurus multisegmentatus*, and in the Museum of Practical Geology there is a specimen from the Chair of Kildare limestone which closely resembles, and is as large as, typical *Catazyga headi* (this specimen bears the label, *Atrypa* sp.). This additional evidence adds strength to the probability that the Vauréal and lower Ellis Bay contain strata equivalent to both the Keisley and Chair of Kildare limestone.[1]

On stratigraphic grounds it would appear that the Becscie formation should be assigned to the Lower Llandovery, but there is little in the fauna supporting any such assignment. Here, as before, evidence must be sought in the faunas of higher formations. In the upper Gun River and basal Jupiter formations there appear the following European fossils:

Bilobites bilobus
Coelospira hemispherica
Clorinda linguifera
Pentamerus oblongus
Plectambonites transversalis
Stricklandinia davidsoni
Triplecia insularis

All are species, with the exception of *Bilobites bilobus*, *Plectambonites transversalis*, and *Triplecia insularis*, which appear either in the Lower Llandovery or more typically and in greater abundance in the Upper Llandovery. Using these species as indices leads to the correlation of the highest zone of the Gun River with either the uppermost part of the Lower Llandovery or lowest Upper Llandovery.

In the Haverfordwest area of South Wales the rocks of the Haverford stage (Lower Llandovery) seem to represent the lowest Silurian present. Anticosti or closely related fossils occurring in the rocks of this stage are:

Atrypa marginalis
Atrypa reticularis
Bilobites bilobus
Camarotoechia borealis
Clorinda undata
Cyrtia exporrecta
Dalmanella elegantula
Leptaena rhomboidalis
Orthis calligramma
Pentamerus cf. *oblongus*
Plagiorhyncha decemplicata
Plectambonites sericeus
Rhipidomella cf. *hybrida*
Schuchertella pecten
Stricklandinia lens
Strophomena antiquata
Calymene blumenbachi
Encrinurus punctatus

There is no correlative value to several well-known forms of those species which are common to the two series of deposits; but such species as *Atrypa reticularis*, *Plagiorhyncha decemplicata*, *Cyrtia exporrecta*, *Pentamerus* cf. *oblongus*, and *Stricklandinia lens*, whose Anticosti representatives do not appear until the upper part of the Gun River or the Jupiter, strongly discount any attempt to synchronize the strata of the Becscie formation with any part of the Haverford stage. The beds of the Millan stage follow

[1] *See* Reynolds and Gardner: Quart. Jour. Geol. Soc., vol. LII, pp. 587–605 (1906).

those of the Haverford stage without apparent break and carry practically the same fauna, and, in addition, *Coelospira hemispherica* is said to make its appearance.[1]

All the evidence, therefore, suggests that both the Haverford and Millan stages are to be correlated with the upper divisions of the Gun River and lower divisions of the Jupiter formations.

The greater part of the Jupiter formation is Upper Llandovery, in which are found no less than thirty-seven identical or closely related species—nearly 30 per cent of the total Jupiter fauna. The vertical distribution of some of the species also sustains the correlation. *Triplecia insularis* holds to the Upper Llandovery, and its Anticosti variety appears for the last time in zone 4 of the Jupiter formation. *Pentamerus oblongus* is rare in the Gun River, but abundant in the Jupiter. In England it is rare in the Lower Llandovery, but abundant in the Upper Llandovery. Hence, the above correlation leads to the assignment of the lower Gun River to the Lower Llandovery, and the Becscie perhaps should be referred to that formation, although it may contain earlier Silurian strata than occur in England. Many of the species common to the Jupiter and the English Upper Llandovery are also found in Etage E of Barrande's Bohemian section and the Stricklandinia marl of the Gotland Silurian, so that the Jupiter formation may have a time equivalence with these formations.

Where to assign the Chicotte formation in the English section is difficult. In the English Wenlock a large coral fauna appears; but the mere appearance of a coral fauna in widely separated regions can hardly be made a reason for considering the containing deposits synchronous, even if the species are the same, for species of corals live long; and if the Anticosti section teaches nothing else, it certainly emphasizes the fact that a coral fauna of practically identical species may recur again and again. The English Wenlock, however, carries forty-nine species which are represented also by identical or closely related forms in the Upper Jupiter and the Chicotte. Among brachiopods, two of those most diagnostic are *Homeospira anticostiana* and *Eospirifer radiatus*. The former is close to *H. bouchardi*, and both occur for the first time in the Wenlock. The facts presented make it probable that the Wenlock strata have a time equivalence with the upper beds of the Jupiter and the Chicotte.

CORRELATION WITH THE BALTIC SECTION

In the Baltic region of Esthonia and on the islands of Worms and Dago off its coast, the Richmond is represented by the Lyckholm and Borkholm limestones, the two formations having a thickness of 75 feet. In the former occur:

Calapoecia cribriformis
Halysites catenularia
Paleofavosites aspera
Protaraea vetusta
Streptelasma cf. *corniculum*
Corynotrypa dissimilis
Hallopora elegantula
Stomatopora arachnoidea
Clitambonites verneuili

[1] This specimen was seen by the writer, and there is considerable doubt as to the correctness of the identification.

Platystrophia biforata lynx
Pseudolingula quadrata
Byssonychia radiata
Sinuites cf. *bilobatus*
Calymene stacyi
Encrinurus multisegmentatus
Proetus ramisulcatus

a list of species which can readily be duplicated by the same or closely related upper Vauréal or basal Ellis Bay forms. *Orthis flabellites* and *Triplecia insularis* also make their appearance in the Lyckholm formation, but these two species did not arrive in America until Silurian time.

In the succeeding Borkholm formation occur:

Calapoecia cribriformis
Clathrodictyon vesiculosum
Halysites catenularia
Paleofavosites aspera
Corynotrypa dissimilis
Glauconome strigosum
Hallopora elegantula
Nematopora lineata
Phaenopora ensiformis
Protocrisina exigua
Ptilodictya gladiola
Sceptropora facula
Atrypa marginalis
Clitambonites verneuili
Leptaena rhomboidalis
Platystrophia biforata lynx
Plectambonites sericeus
Byssonychia radiata
Calymene stacyi
Encrinurus multisegmentatus
Proetus ramisulcatus

nearly all of which are represented by identical or closely related species in the Ellis Bay or lower formations, although a few do not extend as high as the Ellis Bay formation. This makes it highly probable that the above limestones of the Baltic region have an identical time equivalence with the upper Vauréal and the Ellis Bay formations.[1] The Silurian strata of the Anticosti section also find time equivalents in the Russian section, but detailed statements relating thereto must await a study of the Russian Silurian faunas. It may fairly safely be said, however, that the Becscie formation finds no equivalent in the Russian section on the Baltic, but that the other divisions are represented.

CORRELATION WITH THE SCANDINAVIAN SECTION

In Sweden the Ellis Bay formation probably finds an equivalence with the Leptaena limestone of Dalecarlia, considered by Reed the equivalent of the Keisley limestone of England and the Kildare of Ireland, of which the latter has been stated by Schmitt to be the equivalent of the Borkholm formation of Baltic Russia, which last has already been shown to be the probable equivalent of a part of the Ellis Bay formation.[2]

[1] Data relating to the Baltic region have been partly derived from Doctor R. S. Bassler's paper, Bull. 77, U.S. Nat. Mus., 1911, and partly from the writer's investigation in that region.
[2] Reed, F. C. R.: Quart. Jour. Geol. Soc., vol. LIII, p. 535 (1897); Schmitt, ibid., vol. XXXVIII, p. 514 (1882). Also quoted by Reed, above citation.

The Silurian of Norway is best developed in Oslo region, where within recent years it has been exhaustively studied by Kiaer. The section extends from the Middle Ordovician to and including the Ludlow of the Silurian, and the latter outcrops in seven separated areas near that city. The Ordovician closes with what has been called Etage 5, with a thickness of about 450 feet. Its lower division (Gastropoden Kalk, 5a) contains a great array of corals which in the upper division *(Meristella crassa* zone, 5b) become aggregated into reefs. The corals of these two divisions belong to such genera as *Lyellia, Protaraea, Columnaria, Favosites,* and *Calapoecia;* genera which play a great role in rock-making in the Ellis Bay and Vauréal formations, making it very probable that Etage 5 corresponds to the upper part of the latter and perhaps the whole of the former.

The Silurian presents three facies, i.e., western, eastern, and northern. The eastern and northern are so dissimilar to any facies existing on Anticosti that they will not be considered. The western facies is best typified in the Ringerika region where the Lower Llandovery or Etage 6 is divided into three zones as follows: (a) zone with *Coelospira hemispherica* (20 metres); (b) zone with *Rhynchonella weaveri* (50 metres); (c) zone with *Plagiorhyncha decemplicata* (45 metres).

The Upper Llandovery or Etage 7 in the same region also has three zones. These are: (a) zone with *Meristella* sp. and *Pentamerus borealis* (10 metres); (b) (ba) zone with *Pentamerus oblongus* (typical) or Pentamerus limestone (25 metres), (bb) lower zone of coral limestone (17 metres); (c) (ca) lower zone of *Crotallocrinus* shales (20 metres), (cb) zone with *Stricklandinia lens* or upper coral limestone (25 metres); (cc) upper zone of *Crotallocrinus* red shale (35 metres).

In the Wenlock or Etage 8 of the same region there are four zones. These are: (a) zone with *Cyrtia exporrecta* (70 metres); (b) zone with *Chonetes* sp. and *Leperditia hisingeri* (typical form) (45 metres); (c) zone with *Rhynchotreta cuneata* (4 to 25 metres); (d) zone of dark, shaly limestone with *Leperditia baltica* (2 to 12 metres).

Since the succeeding Ludlow has no representation in the Anticosti section it need not be considered.

The Silurian of Oslo region has thirty-seven species which are represented by identical or closely related species in the Anticosti rocks.

In this distribution there are several facts which are interesting and suggestive. *Heliolites interstinctus, Alveolites labechi,* and *Cyrtia exporrecta myrtea* appear for the first time in the top of the Jupiter formation or the base of the Chicotte, and in the Upper Llandovery of the Norwegian section. In the middle part of the Jupiter formation, about 100 feet below the top, there is an horizon characterized by an abundance of *Stricklandinia davidsoni* (the American representative of *S. lens)* and just below is a zone filled with *Pentamerus oblongus.* In the upper part of the Norwegian Upper Llandovery is a zone filled with *S. lens,* which is preceded by a zone carrying an abundance of *P. oblongus,* the same vertical distribution as on Anticosti. These facts have led to the correlation of the greater part of the Jupiter formation with Etage 7; and the upper part of the Jupiter and the Chicotte formations and Etage 8 have a common time equivalence. The upper Gun River and basal part of the Jupiter formation are correlated with Etage 6.

Table of Geological Range Showing by Zone Numbers the Vertical Distribution of Species

—	Ordovician																						Silurian																			
	Macasty	English Head					Vauréal						Ellis Bay										Becscie				Gun River				Jupiter										Chicotte	
		1	2	3	4	5	1	2	3	4	5	6	1	2	3	4	5	6	7	8	9	10	1	2	3	4	1	2	3	4	1	2	3	4	5	6	7	8	9	10	1	2
Marine Algæ and Problematica—																																										
Buthotrephis cf. *gracilis*			x	x	x		x	x	x	x	x	x																x	x	x	x	x								x		
Lockeia anticostiana					x																																					
Lycrophycus formosum			x	x																																						
Lycrophycus robustum			x	x																																						
Lycrophycus vagans		x	x	x	x		x	x	x																																	
Rusophycus bilobatum					x				x	x																						x										
Saerichnites abruptus						x																																				
Siphoneae (Calcareous Algæ)—																																										
Cyclocrinites gregarius																								x		x																
Cyclocrinites halli					z?											x	x		x		x																					
Cyclocrinites intermedius																												x	x	x												
Porifera—																																										
Ischadites? insularis																?x																										
Ischadites cf. *koenigi*																															x											
Hindia cf. *fibrosa*					x						x					x		x	x	x																						
Hyalostelia anticostiana																																				x						
Rauffella cf. *filosa*			x	x	x			x	x	x	x			x		x																										
Coelenterata—																																										
Alveolites labechi																																x			x				x	x	x	x
Aulopora ellisensis																x																										
Aulopora cf. *precia*																															x								x	x		
Beatricia nodulosa										x	x	x					x	x	x	x																						
Beatricia undulata										x	x	x					x	x	x	x																						
Calapoecia anticostiensis			x	x	x		x	x	x	x						x	x	x	x		x																					
Chonophyllum canadense																																									x	x
Clathrodictyon variolare																																									x	x
Clathrodictyon vesiculosum												x				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Cladopora anticostiensis																																										x
Climacograptus jupiterensis																																		x								
Climacograptus spiniferus	x																																									
Climacograptus typicalis atlanticus																										x						x										
Climacograptus typicalis magnificus	x																																									

Table of Geological Range Showing by Zone Numbers the Vertical Distribution of Species—Continued

—	Ordovician																						Silurian																			
	Macasty	English Head					Vauréal						Ellis Bay										Becscie				Gun River				Jupiter										Chicotte	
		1	2	3	4	5	1	2	3	4	5	6	1	2	3	4	5	6	7	8	9	10	1	2	3	4	1	2	3	4	1	2	3	4	5	6	7	8	9	10	1	2
Coelenterata—*Continued*																																										
Coenites labrosus																																							x	x	x	x
Coenites lunatus																																									x	
Columnaria alveolata										x			x																													
Columnaria (?) vaurealensis							x	x				x						x		x																						
Cyathophyllum anticostiense																																								x	x	
Cyathophyllum articulatum																																									x	x
Cyathophyllum cormorantense																																		x	x		x	x				x
Cyathophyllum ellisense																x			x		x																					
Cyathophyllum euryone																														x		x						x	x	x		
Cyathophyllum wahlenbergi																										x						x			x							
Cystiphyllum niagarense																														x		x		x	x				x			
Dictyonema insulare																x																										
Dictyonema jupiterense																																		x				x	x	x		
Diphyphyllum caespitosum																										x	x					x			x							
Favosites favosus																													x						x			x	x	x	x	x
Favosites forbesi																x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Favosites gothlandicus																										x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Favosites hisingeri																												x	x	x									x	x	x	x
Halysites catenularia					x													x	x		x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Halysites catenularia micropora																			x		x	x		x								x						x				
Heliolites interstinctus																																							x		x	x
Heliolites megastoma																																								x		
Heliolites subtubulatus																																x			x	x	x	x	x	x	x	x
Lyellia affinis																x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Lyellia americana																																									x	x
Lyellia speciosa														x				x	x		x																					
Lyellia exigua																			x?																			x		x		x
Lyellia nummulosa																x	x	x																								
Lyopora goldfussi					x																																					
Mastigograptus cf. *simplex*																x	x				x																					
Mesograptus putillus			x	x	x		x				x																															
Monograptus clintonensis																																x	x	x								

Paleofavosites capax					x					x	x						x	x	x	x	x	x																				
Paleofavosites prolificus		x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Palaeocyclus rotuloides																																			x							
Petraia pygmea																											x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Plasmopora petalliformis																																								x	x	x
Protarea tenuis													x			x																										
Retiolites geinitzianus venosus																																			x							
Streptelasma angulatum			x	x	x						x																															
Streptelasma latusculum																															x	x	x	x	x	x	x	x	x	x		
Streptelasma cf. *rusticum*			x	x	x					x										x?																						
Streptelasma selectum													x	x		x	x	x	x	x	x	x	x																			
Strombodes diffluens																																x		x			x	x	x		x	x
Syringopora verticillata																										x	x	x	x	x		x	x					x		x		
Zaphrentis affinis																			x		x																					
Zaphrentis anticostiensis																												x	x	x	x	x	x									
Zaphrentis hannah																								x	x	x	x	x	x	x												
Zaphrentis patens																																			x							
Zaphrentis stokesi																															x	x	x	x	x	x	x	x	x	x	x	x
Zaphrentis vaurealensis											x																															
Echinodermata—																																										
Carabocrinus tuberculatus					x																																					
Cupulocrinus latibranchiatus					x			x	x	x			x				x																									
Crotallocrinus? sp																																							x	x	x	x
Dendrocrinus? tener									x?																																	
Dendrocrinus minutus					x																																					
Dimerocrinus elegans																																							x			
Eucalyptocrinus sp																																								x		
Periechocrinus latus																																										x
Hudsonaster rugosus					x																																					
Periglyptocrinus sp				x																																						
Pleurocystites anticostiensis					x																																					
Retiocrinus fimbriatus					x					x									x																							
Annelida—																																										
Cornulites flexuosus					x											x	x	x	x																							
Cornulites richmondensis				x	x		x	x	x	x	x	x	x	x		x	x				x																					
Cornulites serpularius																									x	x				x		x	x	x	x	x	x	x	x	x		
Bryozoa—																																										
Allonema botellus																																x								x		
Allonema curtum																x	x														x											
Arthroclema angulare			x	x	x		x																																			
Ascodictyon siluriense																															x			x	x							
Aspidopora siluriana													x	x		x																										
Atactoporella spicata																x																										
Batostoma billingsi					x		x			x		x																														
Bythopora striata				x	x		x	x	x			x																														
Ceramopora niagarensis germana													x			x															x											
Chasmatopora angulata																	x																									

Table of Geological Range Showing by Zone Numbers the Vertical Distribution of Species—Continued

—	Ordovician																						Silurian																			
	Macasty	English Head					Vauréal						Ellis Bay										Becscie				Gun River				Jupiter										Chicotte	
		1	2	3	4	5	1	2	3	4	5	6	1	2	3	4	5	6	7	8	9	10	1	2	3	4	1	2	3	4	1	2	3	4	5	6	7	8	9	10	1	2
Bryozoa—*Continued*																																										
Chasmatopora granistriata										x																																
Chilotrypa circe																																		x	x	x	x	x	x			
Corynotrypa dissimilis													x			x				x																						
Corynotrypa elongata																															x											
Cyphotrypa bulbosa													x	x		x	x	x	x		x																					
Cyphotrypa polygona													x																													
Dianulites insueta				x																																						
Dianulites globularis																x																										
Dicranopora emacerata					x		x		x																																	
Dicranopora fragilis			x	x	x				x		x			x																												
Diploclema sparsum																																x		x	x	x	x	x	x	x		
Eridotrypa simulatrix				x	x		x		x																																	
Fenestella anticostiensis																																						x		x		x
Fenestella bella																																										x
Fenestella jupiterensis																																					x		x			
Glauconome strigosa										x				x		x	x	x	x	x	x	x																				
Goniotrypa bilateralis					x				x																																	
Hallopora elegantula																															x											
Hallopora elegantula prolifica																x	x	x	x	x	x	x	x																			
Hallopora enodis							x			x	x	x																														
Hallopora gracilens										x	x																															
Hallopora magnopora													x	x	x																											
Helopora armata																																x							x			
Helopora bellula																											x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Helopora concava																					x						x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Helopora formosa																	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Helopora imbricata					x		x																																			
Helopora lineopora																x	x	x	x	x	x	x					x			x	x											
Homotrypa anticostiensis					x		x	x	x	x	x	x																														
Lichenalia utricula													x		x		x																									
Leptotrypa crassa			x																																							
Lioclema varioporum																																			x				x	x		

Lioclemella nitida							x			x																																
Mitoclema minutum									x																																	
Nematopora lineata											x	x		x		x	x	x	x	x	x	x																				
Nicholsonella parvula																x					x																					
Pachydictya crassa													x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Pachydictya firma							x																																			
Pachydictya hexagonalis									x																																	
Phacelopora pertenuis			x																																							
Phaenopora aperta																																	x	x	x	x	x	x	x	x		
Phaenopora ensiformis																				x	x	x		x						x	x	x										
Phaenopora excellens																						x									x											
Phaenopora superba																							x	x	x	x	x	x		x												
Phaenopora twenhofeli																									x																	
Prasopora canadensis					x		x			x																																
Protocrisina exigua										x																																
Ptilodictya canadensis					x																																					
Ptilodictya flagella					x					x	x	x																														
Ptilodictya gladiola														x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Ptilodictya magnifica		x					x	x	x	x	x																															
Ptilodictya sulcata																																x		x						x		
Ptilodictya whiteavesi			x	x	x		x																																			
Rhinidictya nitidula					x																																					
Sceptropora facula		x	x	x	x		x																																			
Semicoscinium pretiosum																													x									x	x			x
Stomatopora arachnoidea																					x																					
Stomatopora siluriana																x	x																									
Thamniscus striatopora																																		x		x						
Trematopora irregularis																																			x			x	x	x		
Vinella multiradiata																																							x			
Vinella radiciformis																															x				x	x	x	x				
Brachiopoda—																																										
Atrypa marginalis														x		x	x	x	x	x	x	x	x	x	x	x															x	x
Atrypa reticularis																															x	x	x	x	x	x	x	x	x	x	x	x
Atrypina gamachiana																				x	x	x																				
Atrypina arenacea																																		x					x			
Bilobites bilobus																																x	x	x								
Brachyprion anticostiense																									x		x	x	x	x	x	x	x	x			x	x	x	x		
Brachyprion elegantulum																																							x	x		
Brachyprion leda																											x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Brachyprion philomena																													x	x	x	x	x	x	x	x	x	x	x	x		
Brachyprion robustum																									x			x	x			x	x									
Camarotoechia? argentea																																x	x						x			
Camarotoechia fringilla																									x	x		x														
Camarotoechia glacialis																								x	x	x			x	x		x		x					x?			
Camarotoechia neglecta																										x			x													
Camarotoechia peneborealis																																x	x						x	x	x	x
Camarotoechia? pyrrha																												x		x												

Table of Geological Range Showing by Zone Numbers the Vertical Distribution of Species—Continued

—	Ordovician																						Silurian																			
	Macasty	English Head					Vauréal						Ellis Bay										Becscie				Gun River				Jupiter										Chicotte	
		1	2	3	4	5	1	2	3	4	5	6	1	2	3	4	5	6	7	8	9	10	1	2	3	4	1	2	3	4	1	2	3	4	5	6	7	8	9	10	1	2
Brachiopoda—*Continued*																																										
Camarotoechia vicina																																									x	x
Catazyga anticostiensis		x	x	x	x		x	x	x	x																																
Chonetes primigenius									x				x												x															x		
Clitambonites diversus										x			x	x		x	x	x	x		x																					
Clorinda becsciensis																							x			x																
Clorinda linguifera																															x	x	x		x	x		x	x	x	x	x
Coelospira hemispherica																													x	x	x	x	x	x	x	x	x	x	x	x		
Coelospira planoconvexa																							x																			
Crania anticostiana					x								x			x	x	x							x							x			x					x		
Cyrtia exporrecta myrtea																																									x	x
Dalmanella concavoconvexa																															x	x	x	x	x	x	x	x	x	x		
Dalmanella media																									x					x	x	x	x	x	x	x	x	x	x	x	x	x
Dalmanella ruida																	x		x				x																			
Dalmanella meeki		x	x	x	x		x	x	x	x	x	x	x	x		x	x	x	x	x	x	x																				
Dinobolus laurentinus			x	x	x			x		x	x																															
Dinobolus laurentinus ellisensis																			x																							
Dinorthis carletona		x	x	x	x		x	x	x	x	x	x				x			x																							
Dinorthis anticostiensis													x	x		x	x	x	x		x																					
Eichwaldia? anticostiensis										x																																
Eospirifer radiatus																															x	x	x	x	x	x	x	x	x	x	x	x
Hebertella maria		x	x	x	x		x	x	x	x	x	x	x	x		x	x	x	x		x																					
Hindella prinstana													x	x		x	x	x	x	x	x	x	x	x																		
Hindella umbonata													x	x		x	x	x	x	x	x	x	x	x																		
Homeospira anticostiana																													x			x		x		x			x			
Hyattidina congesta junea																												x	x	x	x	x	x	x	x	x	x	x	x			
Hyattidina carletona					x															x																						
Leptaena julia																																								x		
Leptaena rhomboidalis													x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Leptaena? gracilis				x	x			x	x	x	x		x																													
Leptaena? nitens		x	x	x	x		x	x	x	x	x	x							x	x		x																				
Leptaena? reticulata																x	x	x																								
Leptaena? vaurealensis					x		x			x	x	x						x																								

Leptaena? ceres				x	x		x	x	x	x	x					x	x	x																								
Leptobolus insignis	x				••																																					
Lingula anticostiensis																									x									x								
Lingula forbesi			x	x	x									x		x			x						x																	
Lingula insularis																	x																									
Lingula? jupiterensis																																		x								
Lingulasma (?) canadense					x																																					
Lissatrypa atheroidea																															x			x	x	x	x					
Orthis davidsoni pyramidalis							x			x	x					x			x		x			x		x																
Orthis (?) flabellites																										x				x			x	x			x	x	x	x	x	x
Orthis (?) lamellosa										x							x																									
Orthis laurentina													x	x		x	x	x	x																							
Parastrophia lenticularis																x			x		x		x	x	x																	
Parastrophia ops																																									x?	
Parastrophia reversa													x	x		x	x	x	x		x																					
Pentamerus oblongus																												x	x	x	x	x	x	x	x	x	x	x	x	x		
Pholidops gamachiana			x	x	x		x				x	x				x			x																							
Pholidops implicata																												x	x	x	x						x	x	x	x		
Plagiorhyncha decemplicata																																x		x					x?			
Platystrophia regularis													x	x		x	x	x	x	x	x																					
Platystrophia regularis globata																x	x	x																								
Platystrophia camerata																x	x	x	x		x																					
Plectambonites sericeus glaber		x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x																				
Plectambonites striatacostatus																														x	x			x		x						
Plectambonites transversalis																														x	x	x	x	x	x	x	x	x	x	x		
Protozeuga anticostiana			x	x	x		x	x					x	x					x	x																						
Pseudolingula elegantula				x	x		x				x		x			x	x	x																								
Rafinesquina ellisensis																			x	x	x	x	x	x	x																	
Rhipidomella sola							x		x	x																																
Rhipidomella uberis									x	x			x	x		x	x	x	x	x	x	x	x		x		x	x	x	x	x	x							x	x		
Rhipidomella uberis rhynchonelliformis														x		x	x																									
Rhynchotrema anticostiense		x	x	x	x		x	x	x	x	x					x			x		x	x																				
Rhynchotrema janeum					x		x		x	x	x	x				x	x	x	x		x																					
Rhynchotrema perlamellosum				x	x		x	x																																		
Rhynchotrema prinstanum																x	x		x		x																					
Rhynchonella? nutrix																x	x		x		x																					
Schizocrania filosa							x		x	x			x																													
Schuchertella alterniradiata																											x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Schuchertella gamachiana										x			x	x		x	x	x	x	x	x	x	x	x																		
Stricklandinia brevis																																								x		
Stricklandinia davidsoni																																x					x	x	x			
Stricklandinia davidsoni striata																																							x	x		
Stricklandinia gaspiensis																																										x
Stricklandinia melissa																																								x		
Stricklandinia salteri																																x	x		x	x	x	x	x	x		
Strophomena? arethusa									x																																	

Table of Geological Range Showing by Zone Numbers the Vertical Distribution of Species—Continued

—	Ordovician																						Silurian																			
	Macasty	English Head					Vauréal						Ellis Bay										Becscie				Gun River				Jupiter										Chicotte	
		1	2	3	4	5	1	2	3	4	5	6	1	2	3	4	5	6	7	8	9	10	1	2	3	4	1	2	3	4	1	2	3	4	5	6	7	8	9	10	1	2
Brachiopoda—*Continued*																																										
Strophomena arcuata																X	X	X			X																					
Strophomena fluctuosa		X	X	X	X		X	X	X	X	X	X	X	X		X	X	X																								
Strophomena hecuba			X	X	X		X	X	X	X	X	X																														
Strophomena planocorrugata			X	X	X		X	X	X	X	X	X																														
Strophomena radiireticulata																															X	X		X		X		X	X	X		
Strophomena semiovalis																X	X		X		X																					
Strophoprion geniculatum																																							X	X		
Trematis ottawaensis anticostiensis					X								X																													
Triplecia insularis anticostiensis																															X			X								
Virgiana barrandei																								X	X	X	X	X														
Virgiana barrandei anticostiensis																							X			X																
Whitfieldella? julia																														X		X			X	X	X	X	X	X		
Whitfieldella? lara																									X	X			X									X	X	X		
Whitfieldella nitida																																										X
Whitfieldella? solitaria																									X	X																
Zygospira jupiterensis																															X											
Zygospira mica																																						X	X			
Zygospira paupera																															X					X	X		X			
Zygospira recurvirostris aequivalvis		X	X	X	X		X	X	X																																	
Pelecypoda—																																										
Byssonychia anticostiana			X	X	X		X	X	X	X	X		X			X	X	X	X		X																					
Clionychia? superba													X			X																										
Conocardium elegantulum																																		X							X	
Ctenodonta cf. *obliqua*					X																																					
Ctenodonta cf. *elliptica*																																X										
Ctenodonta cf. *simulatrix*																	X								X																	
Ctenodonta cf. *socialis*																																								X		
Cuneamya anticostiana																X	X	X																								
Cyrtodonta anticostiensis			X	X	X		X																																			
Cyrtodonta harrietti			X	X	X																																					
Cyrtodonta? insularis					X																																					
Modiolopsis miser																																		X								

Mytilarca cf. *mytiliformis*																																	x									
Mytilarca nitida																																		x	x	x						
Pterinea bellilineata					x		x																																			
Pterinea curiosa																																		x								
Pterinea emacerata																									x	x						x		x				x		x		
Pterinea laurentina																									x	x																
Pterinea prolifica			x	x	x		x	x	x																																	
Pterinea? striata													x												x																	
Pterinea thisbe																															x								x	x		
Pterinea varistriata										x	x		x			x	x		x		x																					
Rhytimya emma			x	x	x		x																																			
Rhytimya prinstana																		x																								
Vanuxemia acutumbona																x																										
Vanuxemia ungulata					x																																					
Whitella sigmoidea			x	x	x		x	x	x			x																														
Whitella plebia					x																																					
Gastropoda—																																										
Archinacella estella				x																																						
Bellerophon? fraternus				x																																						
Bellerophon laurentinus					x																																					
Bellerophon miser					x																																					
Bellerophon solitarius					x																																					
Bucania ellisensis																x			x																							
Clathrospira subconica			x	x	x		x							x		x	x																									
Cyclonema bellulum																									x	x			x	x		x				x			x	x		
Cyclonema decorum																																									x	x
Cyclonema percingulatum																																		x	x	x	x		x	x		
Cyclonema thalia					x			x								x	x	x	x		x	x																				
Cyclonema varians																																									x	x
Cyclonema varispirum					x		x	x	x																																	
Cyrtospira notata																x	x	x	x																							
Diaphorostoma humile																														x	x	x	x	x			x	x	x	x		
Diaphorostoma niagarense																																x	x			x	x	x	x		x	x
Eccyliomphalus nitida														x		x	x																									
Euomphalus? anticostiensis																												x		x												
Hormotoma? aculeata																											x	x	x	x		x	x						x			
Hormotoma? funata																												x	x	x	x	x	x	x	x	x	x	x	x	x		
Hormotoma gigantea																			x																							
Hormotoma cf. *gracilis*		x	x	x	x		x	x	x	x	x	x	x	x		x	x	x	x	x	x	x																				
Hormotoma multivolvis					x						x																															
Hormotoma teretiformis					x		x			x																																
Hormotoma? turricula																																								x		
Holopea mediocris																																			x							
Holopea vaurealensis																					x																					
Liospira americana			x	x	x		x	x	x	x	x					x	x		x		x																					
Liospira helena																	x	x	x																							
Lophospira acutocarinata																x																										

Table of Geological Range Showing by Zone Numbers the Vertical Distribution of Species—Continued

—	Ordovician																						Silurian																			
	Macasty	English Head					Vauréal						Ellis Bay										Becscie				Gun River				Jupiter										Chicotte	
		1	2	3	4	5	1	2	3	4	5	6	1	2	3	4	5	6	7	8	9	10	1	2	3	4	1	2	3	4	1	2	3	4	5	6	7	8	9	10	1	2
Gastropoda—*Continued*																																										
Lophospira? circe				x	x																																					
Lophospira gamachiana																x	x	x	x																							
Lophospira modesta			x	x	x		x	x	x																																	
Lophospira? papillosa														x		x	x																									
Lophospira sybellina														x		x	x		x		x	x																				
Lophospira? varians			x																																							
Loxonema (?) rugosum																			x																							
Metoptoma? alceste			x	x																																						
Oxydiscus giganteus													x			x			x		x																					
Oxydiscus tenuis			x	x																																						
Palaeacmaea anticostiensis																			x																							
Palaeacmaea magnifica					x																																					
Phragmolites desideratus					x												x																									
Phragmolites pannosus			x	x	x		x	x	x	x		x																														
Platyceras niagarense																																									x	x
Raphistoma vaurealense					x				x																																	
Salpingostoma canadense					x											x			x																							
Salpingostoma orientalis																																x	x	x			x	x	x			x
Schizolopha gigantea													x			x	x		x																							
Sinuites cf. *bilobatus*				x	x		x	x	x	x	x	x	x	x		x	x	x	x	x	x																					
Spirorapha? communis																																						x	x	x		
Spirorapha? corrugata																																			x							
Spirorapha? cryptata																												x	x	x				x				x		x		
Subulites ellisensis																x	x		x		x																					
Subulites richardsoni					x																																					
Tetranota cf. *obsoleta*																x	x		x																							
Trochonema cf. *umbilicatum*			x	x																																						
Pteropoda—																																										
Conularia asperata					x																																					
Conularia batteryensis										x																																
Conularia niagarensis																																		x								
Conularia splendida										x																																

Pterotheca anticostiana			x	x	x		x			x																																
Tentaculites cf. *minutus*																															x			x			x	x	x			
Tentaculites ornatus																													x	x	x	x	x	x	x	x	x	x	x	x		
Cephalopoda—																																										
Actinoceras carletonense					x																																					
Actinoceras gamachense																	x																									
Actinoceras serum																																									x	
Actinoceras anticostiense					x					x																																
Amphicyrtoceras gunense																													x?													
Amphicyrtoceras futile																																		x	x	x						
Apsidoceras magnificum												x																														
Apsidoceras magnificum altum																			x	x																						
Apsidoceras magnificum multicameratum																	x																									
Apsidoceras magnificum major					x																																					
Armenoceras chicottense																															x	x	x						x	x		
Armenoceras angustum																																								x		
Armenoceras excentrale																																						x				
Armenoceras medon																																										x
Armenoceras jupiterense																																		x				x				
Armenoceras raptor																															x											
Armenoceras sedgwicki										x																																
Armenoceras sp.					x																																					
Asaphiceras schucherti																																x										
Beloitoceras accultum				x																																						
Beloitoceras? fererectum													x	x	x	x																										
Beloitoceras fragile																	x		x																							
Beloitoceras? jamesense													x	x																												
Beloitoceras magisterium					x		x	x																																		
Beloitoceras obstructum								x																																		
Beloitoceras percurvatum																x	x	x	x																							
Billingsites acutus			x																																							
Billingsites anticostiensis					x			x					x			x	x	x	x																							
Billingsites canadensis					x		x	x	x																																	
Billingsites newberryi					x																																					
Billingsites elongatus																			x																							
Characteroceras hercules					x		x	x	x	x																																
Cyrtoceras sp.					x																																					
Cyrtorizoceras ellisense																			x																							
Diestoceras anticostiense										x																																
Diestoceras arenicolum																x																										
Diestoceras carletonense					x																																					
Diestoceras scalare										x																																
Diestoceras strangulatum							x																																			
Diestoceras vagum					x																																					
Diestoceras obesum					x																																					
Discoceras gunensis																													x													

Table of Geological Range Showing by Zone Numbers the Vertical Distribution of Species—Continued

—	Ordovician																						Silurian																			
	Macasty	English Head					Vauréal						Ellis Bay										Becscie				Gun River				Jupiter										Chicotte	
		1	2	3	4	5	1	2	3	4	5	6	1	2	3	4	5	6	7	8	9	10	1	2	3	4	1	2	3	4	1	2	3	4	5	6	7	8	9	10	1	2
Cephalopoda—*Continued*																																										
Discoceras? infelix																																							X			
Donacoceras bellense																																						X				
Dawsonoceras cf. *americanum*																																					X					
Endoceras fulgur					X																																					
Endoceras sp.													X																													
Eotrimeroceras jupiterense																																		X								
Ephippiorthoceras formosum				X	X																																					
Ephippiorthoceras plicatulum					X																																					
Ephippiorthoceras schucherti														X																												
Ephippiorthoceras sieboldi										X																																
Ephippiorthoceras altocameratum				X	X																																					
Geisonoceras ellisense																			X																							
Goniotrochoceras twenhofeli							X																																			
Hercocyrtoceras amator																																										X
Huronia chicottense																																										X
Huronia obliqua																																			X						X	
Huronia vertebralis																																										X
Huroniella persiphonata																																			X							
Huroniella sp.																											X															
Hyperoceras twenhofeli					X																																					
Kionoceras bellatulum																														X	X	X	X	X	X				X	X		
Kionoceras bellense																																						X				
Kionoceras magnisulcatum					X																																					
Kionoceras cf. *scammoni*																									X	X																
Leuronotoceras anticostiensis				X	X																																					
Megadiscosorus crassisegmentatus orientalis																																								X		
Oncoceras carletonense					X																																					
Oncoceras? curvacameratum													X	X		X																										
Ormoceras ellisense													X																													
Ormoceras morrisi																													X	X												
Ormoceras prinstaense																				X																						

Ormoceras sp.																																	x									
Orthoceras chicottense																																									x	
Orthoceras desideratum																																										x
Orthoceras ferecylindricum																																						x				
Orchadoceras incertum																																						x				
Phragmoceras anticostiense																																									x	
Polygrammoceras chicottense																																				x	x	x			x	
Polygrammoceras ellisense													x	x		x			x	x	x																					
Polygrammoceras latolineatum														x					x																							
Polygrammoceras twenhofeli													x																													
Protokionoceras anticostiense																																x						x		..		x
Sactoceras bucklandi																																								..		x
Sactoceras lyelli										x																																
Schroederoceras? sp.																x																										
Sphyradoceras? anticostiense							x																																			
Sphyradoceras sp.					x																																					
Spyroceras anticostiense			x				x																																			
Spyroceras balteatum					x																																					
Spyroceras chicottense																																										x
Spyroceras crocus							x	x	x	x	x																															
Spyroceras ferum										x						x																										
Spyroceras microcancellatum													x																													
Spyroceras microlineatum					x				x																																	
Spyroceras tenuiclathratum																													x	x												
Spyroceras vaurealense											x																															
Triptoceras xiphias										x	x																															
Uranoceras? sp.					x																																					
Ostracoda—																																										
Aparchites minutissimus							x																																			
Apatobolbina granifera																																								x		
Apatobolbina acuta																																								x		
Beyrichia diffusa																																		x	x	x						
Beyrichia parallela									x																																	
Bolbibollia labrosa																																								x		
Bollia semilunata								x	x	x	x		x	x																										..		
Bythocypris cylindrica									x																																	
Bythocypris lindstroemi			x	x	x		x	x	x	x	x		x	x																												
Bythocypris obtusa			x	x	x			x	x	x																																
Chilobolbina punctata																																x										
Chilobolbina billingsi																													x	x	x	x	x	x								
Ctenobolbina hammelli			x	x																																						
Eurychilina billingsi																											x	x		x	x											
Isochilina vaurealensis												x																														
Krausella anticostiensis			x	x					x	x																																
Leperditia anticostiana																															x		x	x	x	x						
Leperditia frontalis																																								x		
Leperditia selwyni																										x			x	x	x	x	x	x	x	x	x	x	x	x		

40993—7½

Table of Geological Range Showing by Zone Numbers the Vertical Distribution of Species—Continued

—	Ordovician																						Silurian																			
	Macasty	English Head					Vauréal						Ellis Bay										Becscie				Gun River				Jupiter										Chicotte	
		1	2	3	4	5	1	2	3	4	5	6	1	2	3	4	5	6	7	8	9	10	1	2	3	4	1	2	3	4	1	2	3	4	5	6	7	8	9	10	1	2
Ostracoda—*Continued*																																										
Macrocypris subcylindrica			x	x	x																																					
Primitia? lativia					x																																					
Primitiella canadensis									x																																	
Schmidtella sublenticularis				x	x		x																																			
Tetradella lunatifera									x																																	
Tetradella simplex									x																																	
Ulrichia nodosa					x				x																																	
Zygobolba anticostiensis																																x										
Zygobolba decora																																								x		
Zygobolba excavata																																x										
Zygobolba intermedia																																								x		
Zygobolba inflata																																x										
Zygobolba rectangula																																x										
Zygobolba robusta																																								x		
Zygobolba twenhofeli																																x										
Trilobita—																																										
Amphilichas arenaceus																														x												
Amphilichas borealis				x																																						
Amphilichas canadensis																															x		x	x								
Amphilichas shallopensis																																							x			
Brachyaspis alacer					x																																					
Brachyaspis altilis				x			x		x			x																														
Brachyaspis notans			x	x												x																										
Bumastus orbicaudatus				x	x		x			x						x	x				x																					
Calymene meeki				x	x		x	x	x	x	x	x	x	x		x	x	x	x	x	x	x																				
Calymene niagarensis																							x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Calymene schucherti																															x	x	x	x	x	x	x	x	x	x		
Ceraurus numitor				x	x		x	x	x	x	x	x				x	x	x		x																						
Ceraurinus icarus			x	x	x		x	x	x	x	x	x				x	x	x		x																						
Chasmops anticostiensis					x		x					x	x			x	x		x		x																					
Chasmops occidentalis				x	x					x																																
Chasmops cf. *truncato-caudatus*														x																												

Cheirurus nuperus																															x	x							x	x		x
Cyphaspis borealis																x													x													
Cyphaspis cf. *christyi*																																								x		
Cyphaspis anticostiensis																x		x	x				x?																			
Dalmanites caudatus jupiterensis																															x					x						
Encrinurus anticostiensis																													x	x	x	x	x	x	x	x	x	x	x	x		
Encrinurus elegantulus																																								x		
Encrinurus laurentinus					x							x	x			x	x	x	x	x																						
Eoharpes ottawaensis anticostiensis				x	x																																					
Goldius insularis																																									x	
Harpes consuetus																																									x	
Illaenus grandis																														x	x			x	x	x	x	x	x	x	x	x
Isotelus gigas			x	x	x		x	x	x	x	x	x	x			x	x	x	x																							
Phacops (*Portlockia*) *orestes*																													x	x	x	x	x	x	x	x	x	x	x	x		
Proetus alaricus					x											x																										
Proetus? perplexus																																								x		
Pseudosphaerexochus canadensis																																									x	
Sphaerocoryphe salteri													x	x		x	x																									
Triarthrus becki macastyensis	x																																									
Branchiopoda—																																										
Ischyrina winchelli			x	x	x		x																																			
Technophorus plicata																x																										

CHAPTER V

PALÆONTOLOGY

On the following pages are given descriptions of, or comments on, all Anticosti Ordo vician and Silurian species for which there is sufficient material on which to base a description. Species which were first described from other regions are redescribed only in so far as the Anticosti forms show differences from those from elsewhere, unless it be a species whose description is not generally accessible, or one whose occurrence in America is herein noted for the first time.

In the case of the Anticosti species an attempt has been made to have the bibliography complete. Other species have references only to some of the well-known and readily accessible works, as Schuchert's "Catalogue of Fossil Brachiopoda" and Davidson's "Monograph on the British Fossil Brachiopoda".

Many of the species are listed in Miller's "North American Geology and Palæontology." All species described at the time are listed in Bassler's "Index of American Ordovician and Silurian Fossils",[1] and these, with additional descriptions, are listed in the paper by the writer published in 1914[2].

Formation citations are indicated in the case of most of the species by naming the formation or formations, followed in parenthesis by the number or numbers of the zones to which the species is confined. The author's private collection contains examples of nearly all the species, but ordinarily no reference is made thereto. To avoid repetition it is here stated that the National Museum of Canada is at Ottawa, Canada, and contains the collections of the Geological Survey, Canada. The Peabody Museum to which reference is made is that of Yale University. Reference will be made to these merely as Peabody Museum and the National Museum of Canada.

In the initial study of the Anticosti fossils the writer is under great obligations to Professor Charles Schuchert. He suggested many lines of endeavour and made many constructive criticisms. Furthermore, the aid of Professor Schuchert's unrivalled brachiopod collection has been of great assistance in the study of that group. In the study of the graptolites the writer has had the aid of Doctor Rudolph Ruedemann and he has confirmed most of the identifications. Mr. Frank Springer has examined a few of the crinoids and had written the description of the three new species. The descriptions and illustrations of the ostracoda and bryozoa are those of Doctor R. S. Bassler. In the study of the cephalopoda the writer has been fortunate in having the assistance of Dr. A. F. Foerste who prepared the descriptions and illustrations of this group.

[1] "Bibliographic Index of American Ordovician and Silurian Fossils": U.S. Nat. Mus., Bull. 92, 1915.
[2] Twenhofel, W. H.: "The Anticosti Island Faunas"; Geol. Surv., Canada, Mus., Bull. No. 3, 1914, pp. 1–22.

MARINE ALGÆ AND PROBLEMATICA

Buthotrephis cf. *gracilis* Hall

Buthotrephis gracilis Hall, Pal. N.Y., vol. I, p. 62, Pl. XXI, fig. 1 (1847).

Specimens which apparently belong to this species are not uncommon in the Anticosti strata.

Occurrence. Ordovician: English Head (2-4), English head, Caplan river, etc.; Vauréal (1-6), Vauréal river. Silurian: Gun River (2-4), vicinity of Gun river; Jupiter (1-2, 10), west of Jupiter river, East cliff, and Jumpers.

Lockeia anticostiana n. sp.

Plate I, figure 1

This genus was erected by U. P. James[1] for certain problematical bodies found in the Cincinnati region which have a shape like a grain of wheat and were considered by him as probably being the "ovarian capsules" of *Hydrozoa*, and to it are referred similar problematical bodies found in myriads in a single thin layer in the English Head formation. The Anticosti forms are longer and more slender than the forms from the Cincinnati rocks, having a shape more like a grain of rye. Like the Cincinnati examples they "show no signs of organic structure."[2] What these bodies represent the writer does not know, and the reference to *Lockeia* is merely a matter of convenience and carries with it no implication that these bodies are "ovarian capsules" or, for that manner, anything organic.

Occurrence. Ordovician: English Head (4), near High cliff.

The cotypes are in Peabody Museum.

Lycrophycus vagans Billings

Lycrophycus vagans Billings, Cat. Sil. Foss., Anticosti, p. 72, 1866.

Distinguished by the small size of its branches and its somewhat pronounced fan-like method of branching.

Occurrence. Ordovician: English Head (1-4), all exposures; Vauréal (1-3), baie Ste. Claire and north shore.

The cotypes (V 2059) are in the National Museum of Canada.

Lycrophycus formosum Billings

Lycrophycus formosum Billings, Cat. Sil. Foss., Anticosti, p. 72, 1866.

This fucoid differs from *L. vagans* in having its branches less widely diverging.

Occurrence. Ordovician: English Head (2 or 3), English head.

The holotype (2047) is in the National Museum of Canada.

Lycrophycus robustum Billings

Lycrophycus robustum Billings, Cat. Sil. Foss., Anticosti, p. 73, 1866.

Dendritic arrangement, composed of branches about 25 mm. thick and 6 to 10 inches long.

Occurrence. Ordovician: English Head (2 or 3), English head.

The holotype (2053) is in the National Museum of Canada.

[1] The Paleontologist, 1879, p. 17.
[2] Cin. Soc. Nat. Hist., 1884, p. 163.

Rusophycus bilobatum Vanuxem

Fucoides bilobatus Vanuxem, Geol. Rept. N.Y., p. 79, 1842.

Specimens apparently belonging to this Ordovician and Silurian species occur sparingly in the Anticosti rocks.

Occurrence. Ordovician: English Head (4), near North cliff; Vauréal (3-4), West cliff and Girard harbour. Silurian: Jupiter (2), East cliff.

Anticosti plesiotypes are in Peabody Museum.

Saerichnites abruptus Billings

Plate XIII, figure 6

Saerichnites abruptus Billings, Cat. Sil. Foss., Anticosti, p. 73, 1866.

All these markings have a beginning and an end and if made by an animal it must have varied its method of locomotion between walking and swimming. The writer considers it equally probable that they are fucoid impressions. The giant kelp of the North Atlantic is able to make very similar impressions, and such were seen at several localities in the muds of the coast, the central axis making the groove, and the swellings on opposite sides making the pits.

Occurrence. Ordovician: confined to a 6-inch bed in the English Head (zone 5).

The cotypes, No. 2226, are in the National Museum of Canada. Plesiotypes are in Peabody Museum.

CALCAREOUS ALGÆ (?)

Cyclocrinites Eichwald emend Stolley

Cyclocrinites Eichwald, Schichtensystem von Esthland, p. 192, 1840; *Cyclocrinus* Eichwald, *Lethaea rossica*, I, p. 637, 1860; *Pasceolus* Billings, Geol. Surv., Canada, Rept. of Prog. 1853-1856, p. 342 (1857); *Cyclocrinus* Stolley, Archiv. f. Anthropologie u. Geologie Schleswig-Holstein, bd. I, heft 2, pp. 189-218, figs. 8-30 (1896).

The systematic position of the problematical bodies to which the above generic names have been applied is not one upon which palæontologists are generally agreed, and there is hardly a single group of invertebrates of rank lower than the brachiopods to which they have not been assigned. Stolley, who has exhaustively studied these organisms, considers *Cyclocrinites* and *Pasceolus* identical, but distinct from *Nidulites* which he considers identical with *Mastopora* Eichwald, the latter having priority. He refers all of them to the Siphoneae, a group of algæ whose cell substance is impregnated with calcium carbonate. The present writer makes the same reference.

The Anticosti rocks contain three species of these organisms, of which all appear to belong to *Cyclocrinites*. Through the kindness of Doctor R. S. Bassler the writer was permitted to study a specimen in the United States National Museum, identified as *Cyclocrinus spaskii*, from the Ordovician of Reval, Russia. The specimen is a cast and differs from the Anticosti examples of *P. halli* in having a more spherical shape and in not being quite so well preserved. Later, scores of the species in excellent preservation were collected from the type localities of Eichwald's

Cyclocrinites. Examination of these confirmed the reference. It may be that *P. gregarius* and *P. intermedius* should not be referred to *Cyclocrinites* (as was done by Stolley) since examination of hundreds of specimens of the latter species has shown none with dome-shaped elevations and in no instance were cell covers discovered, this being one of the chief characters relied on by Stolley to separate *Cyclocrinites* from *Mastopora*, or *Nidulites*. Supplementary evidence supporting this view is found in a statement by Hinde that *Nidulites favus* occurs on Anticosti. In all probability he was referring to *intermedius* as he is known to have been in the locality where that species is abundant.[1] Except, however, for the fact that cell covers have never been found, all other characters agree with *Cyclocrinites*.

Cyclocrinites halli (Billings)

Pasceolus halli Billings, Geol. Surv., Canada, Rept. of Prog. 1853-1856, p. 342 (1857); Billings, Geol. Surv., Canada, p. 309, fig. 312, fig. only, 1863; Billings, Pal. Foss., vol. I, p. 390, fig. 366 (1865); Niles and Verril, Proc. Boston Soc. Nat. Hist., vol. X, p. 19 (1865); Billings, Cat. Sil. Foss., Anticosti, pp. 9, 72, 1866; Bigsby, *Thesaurus siluricus*, p. 192, 1868; *Cyclocrinus halli* Bigsby, ibid., p. 19, 1868; *P. halli* Kayser, Zeitschr. d.d. geol. Ges., vol. XXVII, p. 779 (1875); Nicholson and Etheridge, Mon. Sil. Foss. Girvan dist., p. 14, fig. 1*a*, 1878; Hinde, Quart. Jour. Geol. Soc., vol. XL, p. 835 (1884); Lesley, Geol. Surv., Penn., P 4, p. 603, one text fig. only, 1889; Stolley, Archiv. f. Anthrop. u. Geol. Schleswig-Holstein, Bd. 1, heft 2, p. 215 (1896).

The convex elevations which cover casts of the interior range in diameter from 1 to 2·25 mm. There is also considerable variation in the shape of the entire specimen, though this is probably largely the result of pressure. The holotype is pear-shaped with a height of 35 mm. and a diameter of 25 mm., almost a circle in section. The elevations supposed by Billings to be apertures probably serve some other purpose, since one specimen in the collections of the National Museum of Canada has three of these elevations of different sizes and heights and Billings mentions one having four. They are probably due to irregularities of growth and in some instances they may have been places of attachment of some commensal, perhaps a *Crania*. In many of the specimens a small bryozoan encrusts the supposed integument. This supposed integument resembles a thin, skin-like covering and may well have been present, since many marine organisms have a thin organic covering over the shell. Its presence in no way conflicts with the views of Stolley.

Occurrence. Ordovician: Ellis Bay (4, 5, 7, 8), Ellis and Prinsta bays. Two specimens referred to this species were collected in zone 4 of the English Head formation, one from about a mile west of de Puyjalon cliff, and one east of rivière à l'Huile. These are smaller than typical *C. halli* and may belong to a distinct species.

The holotype and paratypes, No. 2227, are in the National Museum of Canada. Plesiotypes are in Peabody Museum.

[1] Quart. Jour. Geol. Soc., vol. XI, p. 551 (1884).

Cyclocrinites gregarius (Billings)

Pasceolus gregarius Billings, Cat. Sil. Foss., Anticosti, p. 72, 1866; Bigsby, *Thesaurus siluricus*, p. 192, 1868; Kayser, Zeitscher. d.d. Geol. Ges., vol. XXVII, p. 780 (1875); *Cyclocrinus gregarius* Stolley, Archiv. f. Anthrop. w. Geol. Schleswig-Holstein, bd. 1, heft 2, p. 215, (1896); *Pasceolus gregarius?* Whiteaves, Pal. Foss., vol. III, pt. 3, p. 144 (1897).

The specimens of these species have all the characters of *C. intermedius*, from which they differ only in the average size of the individuals and the size of the plates, there being from four to five plates in 5 mm. instead of about three to five. These differences and the fact that they occur in slightly lower strata should lead to the retention of the species until more is known concerning it.

Occurrence. Silurian: Becscie (2, 4), Reef point and Becscie river.

The cotypes, No. 2230, are in the National Museum of Canada.

Cyclocrinites intermedius (Billings)

Plate I, figure 10

Pasceolus intermedius Billings, Cat. Sil. Foss., Anticosti, p. 72, 1866; Bigsby, *Thesaurus siluricus*, p. 192, 1868; Kayser, Zeitschr. d.d. Geol. Ges., vol. XXVII, p. 780 (1875); *Cyclocrinus intermedius* Stolley, Archiv. f. Anthrop. u. Geol. Schleswig-Holstein, bd. 1, heft 2, p. 215 (1896).

This species is somewhat larger than *C. gregarius* and has more plates for a given space, although the variation in this respect is not great. It is also larger than *C. halli*. The two species, as preserved, differ from *C. halli* in that no cover plates have been found, so that the surfaces present concave depressions instead of dome-like elevations. The shape is globular, about 24 mm. in diameter, and with three to five plates in 5 mm.

Occurrence. Silurian: Gun River (2-4), very abundant in the exposures of the south side, rare on the north.

The cotypes (2338 and 2230) are in the National Museum of Canada. Plesiotypes are in Peabody Museum.

PORIFERA

Ischadites? insularis (Billings)

Plate I, figure 9

Receptaculites insularis Billings, Cat. Sil. Foss., Anticosti, p. 29, 1866; *Receptaculites (?) insularis* Winchell and Schuchert, Pal., Minn., vol. III, pt. 1, p. 61 (1895).

In the same tray with the type specimens of *Cyclocrinites halli* was a fragment which may be the type specimen of this species. This fragment shows a series of spirally arranged triangular or tooth-like imbricating plates. There is also a part of the integument on another specimen, which shows the small, flat canals and the surface covered with the dome-like elevations which made the small, round pits described by Billings. The flat canals are on the interior of the tooth-like plates. There is hardly enough in the two fragments to determine the true generic position of the species, but the characters appear to be more those of the genus *Ischadites* than *Receptaculites*.

Occurrence. Ordovician: Ellis Bay (4?), Ellis bay.

The holotype, No. 2228, is in the National Museum of Canada.

Ischadites cf. *koenigi* Murchison

Ischadites koenigi Hinde, Quart. Jour. Geol. Soc., vol. XI, p. 836, Pl. XXXVI, figs. 1, 1a-o (*See* this paper for a complete bibliography to date of paper) (1884); Etheridge, Brit. Foss., pt. 1, p. 2, 1886.

There was collected a single specimen (Peabody Museum) which appears to belong to this species. It has a diameter of 24 mm., is depressed concave at the summit with an opening about 2 mm. wide in the centre. The base is not preserved. The head plates, arranged in spirals in two directions, are rhomboidal in shape, and appear to imbricate, due to the elevation of the lower corners of the plates. In the peripheral region the head plates have diameters of about 1·5 mm., but near the centre of the summit they are smaller.

The horizontal rays have not been seen, but the vertical rays are plainly visible on a portion where the surface has been broken off. They appear as tubes about 0·5 mm. in diameter and on the under part they can be seen radiating toward the centre, which they nearly reach. In the summit portion the tube-like spicules are of lesser diameter. They are composed of clear calcite, whereas the surrounding substance consists of yellow, calcareous clay; the same kind of clay fills the central cavity.

Occurrence. Silurian: Jupiter (1), west of Jupiter river.

Hindia cf. *fibrosa* (Roemer)

Calamopora fibrosa Roemer, Silurian Fauna W. Tenn., p. 20, Pl. 2, figs. 2 a-b, 1860; *Hindia fibrosa* Hinde, Mon. Brit. Foss. Sponges, Pal. Soc., p. 116, 1888.

The Anticosti specimens (Peabody Museum) referred to this species are not over 14 mm. in diameter, and in those which have been sectioned the central cavity has a width equal to about one-third of the diameter. This cavity is now filled with calcareous matter. The radial canals vary slightly in size. These are about 3 to 1 mm., circular to oval in section, and a few are five to six-sided. There is a slight increase in number from the centre outward and they are almost straight. The separating walls are thin, slightly flexuous, spicular structure not determined.

The characters given are those of *H. fibrosa* and they might also be those of *H. inequalis,* but the inequality of the cells is not sufficiently noticeable to be emphasized.

Occurrence. Ordovician: English Head (4), Carleton point; Vauréal (5), Battery point; Ellis Bay (4, 6, 7, 9), Ellis bay.

Hyalostelia anticostiana n. sp.

Plate 1, figure 2

Two specimens have been collected. They are of oblate spheroidal shape and have siliceous six-rayed spicules. One specimen evidently has been flattened in a direction perpendicular to the vertical axis and what is apparently the upper end is hollowed to a depth equal to half the height. The other specimen is flattened laterally, but also has a hollow on the summit. All the spicules are six-rayed and are about 4 mm. across for the largest, most being of lesser width.

The larger of the two specimens has a height of about 13 mm. and a diameter of about 30 mm. The rays of the spicules are of approximately equal length and are at right angles to each other. The plane of two of the axes always appears to be in the plane of the surface.

Occurrence. Silurian: Jupiter (6), near Jupiter river.

Peabody Museum.

Rauffella cf. *filosa* Ulrich

Rauffella filosa Ulrich, Am. Geol., vol. III, p. 237, figs. 1, 2, 4 (1889); Winchell and Schuchert, Pal., Minn., vol. III, pt. 1, p. 75, Pl. F, figs. 16-18 (1897).

In the English Head and Vauréal formations occur specimens of this supposed sponge, which are different from those of Minnesota only in that the surface markings appear to be slightly stronger.

Occurrence. Ordovician: English Head (2-4), White cliff and other localities of the north coast; Vauréal (2-5), baie Ste. Claire and Battery point; Ellis Bay (2, 4), Ellis bay.

Peabody Museum.

COELENTERATA

Class, *HYDROZOA*

Order, **Stromatoporoidea**

Beatricia Billings (*Auloceras* Plummer)

Aulocera Plummer, Am. Jour. Sci., vol. 44, pp. 293-294 (1843); *Beatricia* Billings, Geol. Surv., Canada, Rept. of Prog. 1853-56, p. 343 (1857); Billings, Can. Jour., N.S. 3, p. 331 ,1858; Hyatt, Am. Jour. Sci. and Arts, vol. XXXIX, pp. 261-266 (1865); Billings, Can. Nat. and Geol., N.S. 2, p. 405, 1865; Linney, Geol. Surv., Ky., Notes on Rocks of Central Ky., p. 14, 1883; Hyatt, Proc. Am. Ass. Adv. Sci. for 1884, p. 492, 1884; Nicholson, Mon. Brit. Stromatoporids,Pal. Soc., pp. 9, 86-90, 1886; James, Jour. Cin. Soc. Nat. Hist., vol. IX, p. 245 (1886); Grant, Jour. and Proc., Hamilton Ass., vol. VI, p. 122 (1890); James, Jour. Cin. Soc. Nat. Hist., vol. XV, pt. 3, p. 94 (1892); Parks, Univ. Toronto Studies, No. 7, pp. 37-43 (1910).

There are two species of *Beatricia* in the Anticosti rocks which appear to differ only in the characters of the surface, and there is one specimen in the author's collection which exhibits the surface characters of both species. Both Nicholson and Parks found that the microscopic structures of *Beatricia nodulosa* and *B. undulata* are identical, and the present writer makes the same observation. The openings of the surface which Nicholson found in one specimen have not been seen on any of the specimens collected.

So far as observed the axial canal was originally hollow with the convex part of each vesicle directed upward or toward the distal end.

The fossils of this organism are among the most interesting of Anticosti. They are characteristic of two horizons—zones 4 to 6 of the Vauréal formation and 5 to 7, and 9 of the Ellis Bay. At West point and Ellis bay the exposures of the *Beatricia* horizons are on the reef which in places has these fossils lying so thickly as to remind one of a woodyard. At Battery point on the north shore the *Beatricia* zone forms a cliff about 25 feet high. Somewhat salient to the general face of the cliff are the hollow trunks of the *Beatricias*, suggesting small cannon projecting from a wall. This appearance led the early explorers to give the cliff its present name. The Ellis Bay *Beatricia* horizons of the north shore are exposed from cape James to Lousy cove, a distance of about 10 miles, with the *Beatricias* so abundant locally as to resemble piles of petrified logs. They are abundant in the same horizons on Vauréal river above the falls. *Paleofavosites prolificus* and *P. capax* in many cases occur attached to the trunks, and in all cases observed this took place after the trunks had fallen.

Most of the *Beatricias* lie prostrate in the strata; an occasional rare specimen occurs in vertical position with the smaller end directed upward, and this appears to have been the position during life. It is not known to what height the organism grew. One example mentioned by Billings was 10 feet 5 inches long with a diameter of 8 inches at the larger end and 6·5 inches at the smaller. The rate of tapering, however, was not uniform, as shown by a specimen 5 inches in diameter terminating in about 4 inches in a short, blunt cone. The rate of tapering thus indicates little as to the actual height of organism. Such growths on the ancient sea bottom must have virtually constituted real submarine forests of stone.

Billings did not name either of these species as the type of his genus, and since the description of *B. nodulosa* precedes, that species is taken as the genotype.

Beatricia (Aulacera) undulata Billings

Aulacera sp. Plummer, Am. Jour. Sci., vol. 44, pp. 293-295 (1843); *Beatricia undulata* Billings, Geol. Surv., Canada, Rept. of Prog. 1853-56, p. 344 (1857); Billings, Can. Jour., N.S., vol. III, p. 332 (1858); Logan, Geol. Surv., Canada, pp. 217, 220, 1863; Hyatt, Am. Jour. Arts and Sci., ser. 2, vol. XXXIX, pp. 261, 266 (1865); Billings, Can. Nat. and Geol., N.S., vol. II, p. 405, text figs. 1, 2 (1865); Billings, Cat. Sil. Foss., Anticosti, pp. 8, 34, 1866; Shaler, Am. Nat., vol. XI, p. 628 (1877); Nicholson, Mon. Brit. Stromatoporids, Pal. Soc., p. 89, 1886; James, Jour. Cin. Soc. Nat. Hist., vol. IX, p. 245 (1886); James, Jour. Cin. Soc. Nat. Hist., vol. 15, pt. 3, p. 95 (1892); Whiteaves, Can. Rec. Sci., vol. VII, p. 133 (1896); Harper and Bassler, Cat. Foss. of Trenton and Cincinnati Periods in Vicinity of Cincinnati, p. 2, 1896; Nickles, Jour. Cin. Soc. Nat. Hist., vol. XX, No. 2, p. 95 (1902); Cumings, 32nd Rept. Dept. Geol. and Nat. Res., Indiana, p. 701, Pl. I, fig. 1, 1908; Foerste, Bull. Dennison Univ., 1909, p. 298, Pl. VIII, fig. 3. *B. undulata cylindrica*, ibid., p. 298, Pl. IX, fig. 7 (has neither nodes nor rings), 1909; *Beatricia undulata* Parks, Univ. Toronto Studies, No. 7, p. 43, Pl. XXV, figs. 1, 6, 7 (1910).

In the young stages the surfaces of the stems are smooth or sulcated by long, quite irregularly spaced, wave-like furrows separated by angular crests. One specimen has a nodulose as well as an undulated surface. With age the crests become rounded and new ones are implanted, so that much irregularity results. In section the specimens resemble the trunks of trees in that the stem is built up by the addition of concentric layers. Very young specimens appear to be smooth. This species appears to differ from *B. nodulosa* only in the character of the surface.

Occurrence. Ordovician: Vauréal, Battery and West points and Vauréal falls; Ellis Bay (5-8), Ellis and Prinsta bays, cape James, Lousy cove, and Vauréal river.

Billings' statement of the occurrence of this species "2 miles east of Gamache bay" is most certainly an error, as there are no *Beatricias* above the Ellis Bay formation and at that locality there are higher exposures only. The Makasti Bay occurrence is also a mistake, as the species does not occur at all in either the English Head formation or the basal zones of the Vauréal.

The cotypes, No. 1969, are in the National Museum of Canada. Plesiotypes are in Peabody Museum.

Beatricia (Aulacera) nodulosa Billings

Beatricia nodulosa Billings, Geol. Surv., Canada, Rept. of Prog. 1853-56, p. 344 (1857); Billings, Can. Jour., N.S., vol. III, p. 322 (1858); Logan, Geol. Surv., Canada, p. 220, 1863; Hyatt, Proc. Boston Soc. Nat. Hist., vol. X, p. 19 (1865); Hyatt, Am. Jour. Sci. and Arts, vol. XXXIX, pp. 262-266 (1865); Billings, Cat. Sil. Foss., Anticosti, p. 8, 1866; Whiteaves, Pal. Foss., vol. III, pt. 3, p. 111 (1895); Nickles, Jour. Cin. Soc. Nat. Hist., vol. 20, No. 2, p. 95 (1902); Cumings, 32nd Rept. Dept. Geol. and Nat. Res., Indiana, p. 700, Pl. 1, figs. 1a-b, 1908; *Beatricia nodulosa* Foerste, Bull. Den. Univ., 1909, p. 300; *Beatricia nodulifera* Foerste, ibid., p. 299, Pl. VII, fig. 13; Pl. VIII, fig. 5. *Beatricia nodulifera-intermedia* Foerste, ibid., p. 300, Pl. VIII, figs. 4a-c; *Beatricia nodulosa* Parks, Univ. Toronto Studies, No. 7, p. 45, Pl. XXV, figs. 2-5, 7-8, 1910.

This species and *B. undulata* differ only in the character of the surface. As in *B. undulata*, young forms may be smooth. From southwestern Ohio and adjacent parts of Kentucky Foerste has described specimens which so far as may be judged from his published descriptions and illustrations belong to this species.

Occurrence. Ordovician: Vauréal (4-6), West point and Vauréal falls; Ellis Bay (5-8), Ellis and Prinsta bays, cape James, Lousy cove, Vauréal river.

No. 2100, The National Museum of Canada, also Peabody Museum and Twenhofel collections.

Clathrodictyon variolare (Von Rosen)

Stromatopora variolaris Von Rosen, Ueber die Natur der Stromatoporen, p. 61, Pl. II, figs. 2-5, 1867; *Clathrodictyon variolare* Nicholson, Ann. Mag. Nat. Hist., ser. 5, vol. XIX, p. 4, Pl. I, figs. 4-6 (1887);

Nicholson, Mon. Brit. Strom., Pal. Soc., p. 150, Pl. XVIII, figs. 1-5, 1892; Whiteaves, Can. Rec. Sci., vol. VII, p. 130 (1897); Parks, Univ. Toronto Studies, Geol. Ser., No. 5, p. 19, Pl. VIII, figs. 1, 9, 1908.

Specimens which apparently belong to this species are abundant in the Chicotte formation where they are associated with the more abundant *C. vesiculosum.* The number of laminæ per mm. is slightly fewer than in the specimens described by Nicholson. The narrow and wide interlamellar spaces and the weathering effects as noted by Parks as characteristic of this species are also present. Mamelons are conspicuously shown on all of the specimens. There are from 5 to 9 laminæ to 1 mm.

Occurrence. Silurian: Chicotte (1-2), all exposures.

Clathrodictyon vesiculosum Nicholson and Murie

Clathrodictyon vesiculosum Nicholson and Murie, Mon. Brit. Strom., p. 147, Pl. XVII, figs. 10-13; Pl. XVIII, fig. 12, 1892; Parks, Univ. of Toronto Studies, Geol. Ser., No. 5, p. 14, Pl. VII, figs. 1-6; Pl. VIII, figs. 2-5 (this paper contains a complete bibliography) (1908).

In this species neither size nor shape appears to be a factor. Some specimens are flat, others are conical, and there are a few from Ste. Anne cliff which are cylindrical and dendroid. It was thought these last were representatives of a new species, but some of the material was sent to Professor Parks and he pronounced it typical *C. vesiculosum.* Some specimens attain a very large size; one example collected at St. Mary cliff is 2 feet in diameter at the base and a little over a foot high. This is probably the fossil which was identified by Billings as *Stromatopora concentrica.*

Occurrence. Clathrodictyon vesiculosum appears in the top of the Vauréal formation and persists to the very top of the Chicotte formation. It is one of the most abundant fossils on the island and in the Chicotte formation there are great banks of limestone composed almost wholly of the remains of this organism.

Order, **Dendroidea**

Dictyonema insulare n.sp.

Plate I, figures 3, 4

Rhabdosome cyathoform, delicate, branches nearly parallel with little in the way of radiation indicated, some of them not straight, only the outer non-cellular side showing. The meshes are about 1 mm. apart and are generally from 0·4 to 0·5 mm. wide, except just before bifurcation where they become 1 mm. wide. Bifurcation takes place in the proximal part of the rhabdosome at intervals of from 10 to 20 mm. and some branches show no bifurcation at all. The meshes are of fairly uniform size throughout, about 2 mm. long, 1 mm. wide, and of rhomboidal outline. The dissepiments are about 2 mm. apart and somewhat narrower than the branches; some are transverse, but many are oblique and curved.

Doctor Ruedemann in commenting on the species states that "this species resembles somewhat *D. gracile* and *D. retiforme.* Its dimensions are about those of the latter species, but *D. gracile* is even less coarse in its proximal portions and has much less and more delicate dissepiments. *D. retiforme* has a similar aspect, but has wider branches and meshes."

Occurrence. Ordovician: The holotype and a paratype were named as above by Billings and bear the locality labels, Ellis bay, and near Junction cliff, corresponding to zone 4 of the Ellis Bay formation. The writer has collected it at a cliff $\frac{3}{4}$ mile east of Junction cliff from zone 4 of the Ellis Bay formation.

The holotype and a paratype are in the National Museum of Canada (Nos. 2254, 2254a). Plesiotypes are in Peabody Museum.

Dictyonema jupiterense n. sp.

Plate I, figure 5

This species has a much finer pattern than *D. insulare.* The meshes are about 1 mm. long and a little less than 0·5 mm. wide. The branches have about the same width as the meshes. The dissepiments are as a rule a little oblique and are almost thread-like, being not more than a fourth or a fifth as wide as the branches. The much finer pattern readily serves to distinguish this form from *D. insulare.*

Occurrence. Silurian: Jupiter (4, 8, 9, 10), cape Jupiter, rivière du Pavillon, Southwest point, and Jumpers.

Twenhofel collection.

Mastigograptus cf. *simplex* (Walcott)

Mastigograptus simplex Ruedemann, N.Y. St. Mus., Mem. 11, pt. 2, p. 218, text fig. 115; Pl. IX, fig. 1; Pl. XII, figs. 3-5 (1908).

Several slabs containing poorly preserved specimens of a species of *Mastigograptus* were collected at Ellis bay in the Ellis Bay formation. They appear to agree best with the above species, an identification confirmed by Doctor Ruedemann.

Occurrence. Ordovician: Ellis Bay (4, 5, 9), Ellis bay.

Peabody Museum.

Order, **Graptoloidea**

Climacograptus jupiterensis n. sp.

Plate II, figures 1, 2

Synrhabdosome not observed. Rhabdosome small; about 0·75 mm. wide; full width attained at second theca; probably attains a length of 20 mm., but most are fragments less than 10 mm. long. Sicula thread-like, not more than 1 mm. long. Interthecal notches narrowly triangular; seven to eight thecæ in 5 mm., overlapping about one-third, about 1 mm. long, and alternate.

Doctor Ruedemann in commenting on some material of this species sent him states that "This species is extremely similar or probably identical with the British *C. brevis* Elles and Wood[1]. It should, however, be compared with British specimens which I do not have.

I have collected the same form in the Canajoharie and Snake Hill shales and believe it reaches far into the Trenton shales, corresponding in range to the *C. brevis* which is found in the Llandeilo flags, the Glenkilm and lower Hartfell shales."

The Anticosti forms differ from *C. brevis* as described by Elles and Wood in a probably greater length (that species reaching a length of 15 mm., but averaging about 10 mm.), slightly more numerous thecæ, and thecæ alternating instead of being "nearly opposite." These differences, coupled with the fact that the Anticosti forms occur in far younger strata, have led to the erection of the new species.

Occurrence. Silurian: Jupiter (4), cape Jupiter.

Peabody Museum.

Climacograptus spiniferus Ruedemann

Climacograptus typicalis Hall mut. *spinifer* Ruedemann, N.Y. St. Mus., Mem. 11, pt. 2, p. 411, text fig. 363; Pl. XXVIII, figs. 8-9 (1908).

In the Macasty shales this species appears to be the most abundant fossil. The specimens have the slender sicular end and the two diverging spines of the *typicalis* group of *Climacograptus* and there are from 10 to 11 thecæ in 10 mm. Doctor Ruedemann, to whom some of the material was sent, states that it differs from the New York specimens of *C. spiniferus* in that it "broadens faster and more, and the thecæ are less closely arranged. I should call it a little coarser variety of our species."

Occurrence. Ordovician: The species has been collected only in the Macasty shales.

Peabody Museum.

Climacograptus typicalis var. *magnificus*

Plate II, figures 3, 4

Climacograptus typicalis var. *magnificus* Twenhofel, Geol. Surv., Canada, Mus. Bull. No. 3, p. 23 (1914).

Associated with *C. spiniferus* is a giant variety of the *C. typicalis* group and to this the above varietal name has been applied. It has the same type of rhabdosome with the rapidly narrowing sicular end and the two sicular spines. The rhabdosome attains a width of at least 4 mm. and an unknown length, but at least 70 mm. There are 11 to 14 thecæ in 10 mm. It differs from *C. typicalis* in being longer and wider.

Occurrence. Ordovician: Macasty shales.

Peabody Museum.

Climacograptus typicalis var. *atlanticus* n. var.

Plate II, figures 5, 6, 7

Synrhabdosome not preserved. The rhabdosome has a maximum width of over 2·5 mm., length not known; thickness between 1 and 1·5

[1] Brit. Graptolites, pt. V, 1906, p. 192.

mm. Median groove only slightly undulating, but quite deep, septum complete within known limits. There are about 12 thecæ in 10 mm. The interthecal notches are approximately horizontal on the lower sides and extend inwards about one-fourth the width.

Some of the material of this variety was sent to Doctor Ruedemann who states that

> "This form turns out to be a variety of *Climacograptus typicalis*, although it appears quite different, being preserved in relief. The thecæ (12 in 10 mm.) are those of *typicalis*, although the apertural excavations are wider ($\frac{1}{3}$ to $\frac{1}{2}$ of apertural margin) probably because compressed. The sicular end is typically that of *typicalis* and so is the section seen in several places.
>
> From the true *typicalis* this form differs in having the rhabdosome a little slenderer, the thecæ less closely arranged (12 in 10 mm.), and also in the sicular portion; and less overlapping, hence probably the wider apertural opening. The deep sutural (median) groove is a marked feature of your type.
>
> Among the British species the *C. medius-rectangularis-tornquisti* group is similar, but these species have a long and distinct virgula."

Occurrence. Silurian: Becscie (4), Wreck beach; Jupiter (2), East cliff. Peabody Museum.

Mesograptus putillus (Hall)

Climacograptus putillus Ruedemann, N.Y. St. Mus., Mem. 11, pt. 2, p. 415, text figs. 368-377; Pl. XXVIII, figs. 14-15 (1908).

Specimens agreeing well with the typical *M. putillus* occur at several localities in the Richmond rocks of Anticosti. The specimens are as a rule not well preserved, but at least two of them show that the thecæ in the earlier part of the rhabdosome are those of *Climacograptus*, whereas in the later part they are of the *Diplograptus* type. It is for graptolites with this structure that the generic name of *Mesograptus* has been proposed by Elles and Wood.[1]

Occurrence. Ordovician: English Head (2-4), English head, Makasti bay, and Carleton point; Vauréal (1, 5), du Puyjalon and High cliffs and zone 9 of Vauréal River section.

Peabody Museum.

Monograptus clintonensis (Hall)

Monograptus clintonensis (Hall) Ruedemann, N.Y. St. Mus., Mem. 11, pt. 2, p. 450, text figs. 426-431; Pl. XXIX, fig. 1 (1908).

The shales near the base of the Jupiter River formation abound in this common Clinton fossil and it occurs rarely in higher strata. The Anticosti specimens present no essential differences from those of other localities.

Occurrence. Silurian: Jupiter (4, 5, 6), Jupiter cliff and Cormorant point.

Peabody Museum.

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[1] Brit. Graptolites, Pal. Soc., pt. V.

Retiolites cf. *geinitzianus venosus* (Hall)

Retiolites geinitzianus var. *venosus* Ruedemann, N.Y. St. Mus., Mem. 11, pt. 2, p. 469, text figures 449-455; Pl. XXIX, figs. 7, 8; Pl. XXXI, figs. 6-8 (1908).

Poorly preserved graptolites which appear to be this species were collected in association with *Monograptus clintonensis*, from a fine-grained sandstone at Cormorant point.

Occurrence. Silurian: Jupiter (5), Cormorant point.

Twenhofel collection.

Class, *ACTINOZOA*

Subclass, **Tetracoralla**

Petraia pygmea Billings

Petraia pygmea Billings, Geol. Surv., Canada, Pal. Foss., vol. I, p. 104, fig. 91 (1862); Billings, Cat. Sil. Foss., Anticosti, p. 33, 1866; *Petraia pygmaea* Lambe, Cont. Can. Pal., vol. IV, pt. 2, p. 106, Pl. VI, figs. 6, 6a-b (1901).

The shape is cylindrical-conical, in some individuals contracted just below the calyx margin; calyx deep, pointed below, apparently reaching to the base. Lambe describes the primary septa as apparently denticulated. Septa radial, at no place reaching the centre, unless it be at the extreme tip. Where the specimens are 2 mm. in diameter, the septæ do not reach more than half-way to the centre. There do not appear to be any tabulæ or dissepiments. On the exterior, septal ridges are only indistinctly shown, but as a rule fine annulations are plain.

Occurrence. Silurian: Gun River (1-4), capes Ste. Anne, MacGilvray, Sandtop, etc.; Jupiter (1-10), Iron river, Heath point, Jumpers, etc.

Types lost; other specimens, the National Museum of Canada (No. 2486), and Peabody Museum.

Streptelasma angulatum (Billings)

Plate III, figure 5

Petraia angulata Billings, Geol. Surv., Canada, Pal. Foss., vol. I, p. 103, figs. 90 a-b (1862); Billings, Cat. Sil. Foss., Anticosti, p. 7, 1866; *Streptelasma angulatum* Miller, Lambe, Cont. Can. Pal., vol. IV, pt. 2, p. 112 (1901).

The angularity does not appear to be confined to the convex side, as some are flat on that side with the angulation on the side. The septa are alternately long and short, the former reaching the centre and becoming twisted together, uniting by twos and threes before so doing. The short septa are inconspicuous. The depth of the calyx is apparently about one-third the height of the corallum; the floor is irregular, slightly elevated in the centre, the septa projecting as ridges or keels. Neither dissepiments nor tabulæ have been seen. The surface, except for annular undulations, is smooth.

Lambe suggests that this species has been founded on young, angular specimens of *Streptelasma selectum* Billings; but in this view the writer does not concur, as that species is decidedly marked by septal ridges which in this are not conspicuous and, also, because in places in which *S. selectum* has been found by the hundreds, not a single angulated example has been seen. It is associated with *S. rusticum*, but is not the young of that species, because not a single adult example has been seen with a flattened or angulated apex.

Occurrence. Ordovician: English Head (2-4); Vauréal (5), zone 8 of Vauréal River section.

The holotype, No. 1984, and a paratype, No. 1984a, are in the National Museum of Canada. Plesiotypes are in Peabody Museum.

Streptelasma latusculum (Billings)

Petraia latuscula Billings, Geol. Surv., Canada, Pal. Foss., vol. 1, p. 104, figs. 92 a-b (1862); Billings, Cat. Sil. Foss., Anticosti, p. 33, 1866; *Streptelasma latusculum* Lambe, Cont. Can. Pal., vol. IV, pt. 2, p. 114, Pl. VI, figs. 9-9a (1901).

The corallum of this species is almost smooth; rugose annulations are present in a few examples; and in unworn specimens small annulæ to the number of 3 or 4 to a mm. band the shell. Septal ridges are present on a few specimens. The height and diameter are nearly equal, with the diameter generally greater. The calyx has steep sides, the depth varies with age, but is generally from two-fifths to three-fifths the height of the corallum, proportionately greater in young specimens, and in individuals about 10 mm. long the calyx extends to the apex. The septa are in two sets; the smaller are very inconspicuous and in some specimens are merely rows of tubercles, the larger decrease in length to the edge of the calyx and bear distinct denticulations on their edges. These extend over the sides of the septa and outwards to the walls of the corallum as small keels about ½ mm. apart. At their union with the wall the septa are somewhat thickened. The longer septa are 28 in number where the diameter is 13 mm., 23 where 8 mm. At the centre they twist together, uniting by twos and threes before so doing.

This species is very apt to be mistaken for *Zaphrentis anticostiensis* which has a similar shape. That species, however, is conspicuously ornamented with septal ridges and has a more acute and tapering tip. *Z. stokesi* is another species for which it may be mistaken, but that form does not have the rapid increase in diameter and lacks the denticulations and keels on the septa. Sections readily show the tabulæ in the two species named. The forms mentioned by Billings as having the longitudinal striæ "distinctly marked" are probably *Z. anticostiensis.*

In the collections of the University of Kansas there are about a dozen unidentified specimens from the Silurian of Visby, Gotland, which appear to belong to this species. If these have been described the writer has not been able to find the description.

Occurrence. Silurian: Jupiter (1-10), all exposures.

The proterotypes have not been found. Plesiotypes are in both the National Museum of Canada and Peabody Museum.

Streptelasma cf. *rusticum* (Billings)

Streptelasma rusticum Lambe, Cont. Can. Pal., vol. IV, pt. 2, p. 110, Pl. VII, figs. 2, 2a, 3 (1901); Cumings, 32nd Rept. Indiana, Dept. Geol. and Nat. Res., p. 708, Pl. II, figs. 2-2b (1908).

This species is sparingly represented in the Anticosti rocks. The largest specimen collected measures 120 mm. long on the convex side and is 60 mm. in diameter at the larger end. Most of the specimens are smaller. An individual 14 mm. in diameter has 35 primary septa and an equal number of secondary, the former reaching the centre and there forming a twisted structure, the latter not extending more than a fourth of the distance. Compared with *S. rusticum* from the Ohio region, the Anticosti forms increase somewhat more rapidly in diameter.

Occurrence. Ordovician: English Head (2-4), English head, Carleton point, White cliff; Vauréal (4), Battery point.

Streptelasma selectum (Billings)

Petraia selecta Billings, Can. Nat., N.S., vol. II, p. 429 (1865); *P. pulchella* Billings, ibid., p. 429 (1865); *P. selecta* Billings, Cat. Sil. Foss., Anticosti, pp. 7, 33, 1866; *P. pulchella* Billings, ibid., p. 33, 1866; *S. selectum* Lambe, Cont. Can. Pal., vol. IV, pt. 2, p. 113, Pl. VI, figs. 8-8a (1901).

This species does not reach a large size, the average large individual attaining a length between 20 and 30 mm.; generally acutely conical at the base, but more rapidly enlarging a short distance above the base to an average diameter of 15 to 20 mm. Some specimens reach a diameter of 25 mm. and a length of 40 mm. Many, but not all specimens, possesss annulations, and when the corallum is not worn the septal ridges are plainly visible. Most specimens are curved, but some are almost straight. The calyx is quite deep, nearly half the length of the corallum. The sides are steep and in the centre is a low pseudo-columella formed by the twisted septa. The septa are variable as to number, 40 where the corallum has a diameter of 15 mm.; 20 where the diameter is 7·5 mm. They are in two sets of which only the larger reach the centre, there uniting by twos and threes and twisting together. At the top of the calyx there is little difference in the size of the septa, but at the bottom the smaller do not reach more than a fourth of the distance to the centre. On their free edges the septa appear to be denticulated, and they are carinated on their sides. The dissepiments are not strong, and they curve upward and inward toward the centre.

The corallum of this species closely resembles that of *Zaphrentis hannah* from Hannah cliff in the Gun River formation, but it is smaller, and is almost always curved, the septal ridges are better developed, and it has a pseudo-columella. Sections readily distinguish the two forms by showing absence of tabulæ in this species.

Occurrence. Throughout the Ellis Bay formation; Becscie (1), cape Henry.

The proterotypes of this species have not been found. Plesiotypes are in both the National Museum of Canada (No. 2243), and Peabody Museum.

Zaphrentis anticostiensis n. sp.

Plate I, figures 6, 7, 8

In shape this species closely resembles *Streptelasma latusculum*, but differs externally in being prominently marked by the septal ridges which plainly show the position of the four primary septa. Typical examples are wider than high, but in some the opposite is true. The exterior is marked by the prominent septal ridges, irregular annulations, and numerous very fine annuli, of which there are from 2 to 3 to a mm. The apex is as a rule acutely pointed and nearly smooth; the increase in diameter for a space of 2 or 3 mm. above the apex is small, following which there is a very rapid expansion. One wide specimen measures 26 mm. in diameter and is not more than 17 mm. long. Another has a diameter of 35 mm. and was probably 25 mm. long; other specimens are proportionately longer.

The calyx is deep, pointed or concave at the base, one-third to one-half the length, the floor crossed by the septal ridges which do not quite reach the centre, cardinal septum in a fossula and quite small, the fossula being apparent only on the margin of the calyx floor. The septa are in two sets, the larger reaching the centre below the bottom of the calyx and slightly twisting together; the tendency to twist, however, is plainly shown even where the septa do not come in contact. The smaller septa are very inconspicuous and in some specimens merely spines or nodes. No denticulations have been seen on any of the septa. Septa number 23 where the diameter is 8 mm. The tabulæ are complete, depressed in the centre and at the margin, 0·75 mm. to 2 mm. apart; dissepiments abundant in the lower part where the tabulæ are few; they trend upward and outward.

The striated exterior, the rapid expansion from the tapering apex, and the perfect development of tabulæ readily separate this species from either *Z. stokesi* or *Streptelasma latusculum*, with both of which it is associated.

Occurrence. Silurian: Gun River (2-4), generally common; Jupiter (1-3), Sand cliff and west of Jupiter river.

Peabody Museum.

Zaphrentis affinis Billings

Zaphrentis affinis Billings, Can. Nat., N.S., vol. II, p. 430 (1865); *Z. bellistriata* Billings, Can. Nat., N.S., vol. II, p. 430 (1865); *Z. affinis* Billings, Cat. Sil. Foss., Anticosti, pp. 7, 34, 1866; *Z. bellistriata* Billings, Cat. Sil. Foss., Anticosti, pp. 8, 34, 1866; *Z. affinis* Lambe, Cont. to Can. Pal., vol. IV, pt. 2, p. 118, Pl. VII, figs. 6-6b (1901).

This species attains a length of more than 200 mm., but there is little or no increase in diameter after attaining a length of about 70 to 100 mm., the upper part being almost straight and cylindrical; the place of greatest diameter is variable. The outer surface is markedly annulated by rugose lines of growth which are generally quite variable as to size and distance apart; in addition there are fine annulations to the number of 3 or 4 to a mm. The septal ridges are about 1 mm. apart. The tabulæ are complete, probably always concave at the centre and turned down at the edges, quite variable as to distance apart, in some places crowded, in other places separated by from 1·5 to 2 mm. They extend to the base. The calyx is about as deep as the length of the diameter, convex or flat on the floor. The septa are in two sets; the larger reach the centre, but unite by twos and threes before so doing, and at the centre they become twisted together. Those of the smaller set do not reach more than one-sixth to one-fifth the distance to the centre. At the smaller end it appears that none of the septa extends to the middle, but to what height this holds has not been ascertained. Young individuals of this species closely resemble those of *Streptelasma selectum*, but there is a more rapid increase in diameter in this species, and tabulæ are, of course, present.

This evidently is a species of considerable variation, the variation obtaining chiefly in the degree of concavity of the tabulæ and the shape. *Z. bellistriata*, described by Billings as a separate species, does not differ enough to be considered even a variety, a fact previously noted by Lambe.

Occurrence. Ordovician: Ellis Bay (7, 9), Ellis bay, Boulder bay, zone 21 of Vauréal River section.

The proterotypes have not been found. Plesiotypes are in both the National Museum of Canada and Peabody Museum.

Zaphrentis hannah n. sp.

Plate II, figures 8, 9

The corallum is acutely conical, nearly straight or only slightly curved. The increase in diameter to the margin of the calyx is nearly constant. A large example has a length of 34 mm. and a diameter at the large end of 20 mm. The calyx is deep, one-fourth to one-third the length of the corallum and proportionately deeper in young examples. It is slightly concave to slightly convex on the floor and ridged by the septa. The exteriors are annulated with low undulations and septal ridges, the latter mostly not well developed. The septa are in two sets, the secondary very small and inconspicuous; the primary reaching the centre, joining by twos and threes before so doing and twisting together. There are 30 primary septa where the diameter is 10·5 mm., 26 in the same individual where the diameter is 6·5 mm. The tabulæ are thin, less than 1 mm. apart, much depressed to slightly concave in the centre and less so, or not at all, on the margin.

This species in shape much resembles the Anticosti forms of *Streptelasma rusticum*, and young individuals are very much like *S. selectum*, though the septal ridges of *Z. hannah* are not so distinct. The species differs from *Z. stokesi* in its smaller size, lesser tapering, and in lacking a decided curvature. It is more slender than *Z. anticostiensis* and lacks the strong development of septal ridges.

Occurrence. Silurian: Becscie (2-4), all exposures; Gun River (1-4), all exposures.

Peabody Museum.

Zaphrentis patens Billings

Zaphrentis patens Billings, Can. Nat., N.S., vol. I, p. 430 (1865); Billings, Cat. Sil. Foss., Anticosti, p. 33, 1866; Lambe, Cont. to Can. Pal., vol. IV, pt. 2, p. 119, Pl. VIII, figs. 2-2a (1901); *Heterolasma patens* Ehlers, Am. Jour. Sci., vol. XLVIII, p. 467 (1919).

The primary septa do not reach the centre; tabulæ are complete, flat, or slightly concave in the centre, bent down at the edges, about 1 mm. apart; the central portion within the septa is about one-third the width of the calyx. No radiciform processes of any kind have been observed.

Occurrence. Silurian: Jupiter (5), Cormorant point.

The holotype, No. 2406, is in the National Museum of Canada. Specimens from Cormorant point which appear to belong to this species are in the writer's collection.

Zaphrentis stokesi Milne-Edwards and Haime

Zaphrentis stokesi Milne-Edwards and Haime, Polyp. Foss. des Terr. Palæoz., p. 330, Pl. III, fig. 9, 1851; Billings, Cat. Sil. Foss., Anticosti, p. 34, 1866; Lambe, Contr. Can. Pal., vol. IV, pt. 2, p. 120, Pl. IX, figs. 1, 1a, 2 (1901).

Somewhat obtusely conical, generally curved, becoming quite large, a specimen with a length of 95 mm. on the convex side having a diameter at the large end of 44 mm. The exterior is marked with low undulations. The septal ridges are as a rule not well developed. The calyx is flat-floored; the sides steep; and both the floor and the sides are ridged by the septa. A fossula exists in the place of the cardinal septum. The tabulæ are well developed, commonly depressed in the centre and at the edges, considerably given to inosculating, and as a rule from 1 to 1·5 mm. apart. Well-preserved specimens show that the tabulæ extend down pretty well to the tip. The septa are numerous, in two sets; the smaller are not more than 1·75 mm. long where the diameter is 23 mm. The longer unite by twos and threes and twist together in the centre. A section 23 mm. in diameter has 46 primary septa, whereas a section from the same individual, where the diameter is 12 mm., has 31 primary septa. They are slightly thickened at their union with the outer walls. Dissepiments are not strongly developed and show only in the outer half of the radius.

The only other Anticosti *Zaphrentis* with which this is likely to be confused is *Z. hannah;* but that species is more slender, straighter, and does not have the tabulæ so strong.

Occurrence. Silurian: The species appears in zone 1 of the Jupiter formation and extends into the Chicotte, occurring in essentially all exposures. It is most abundant near the top of the Jupiter formation.

Both the National Museum of Canada and Peabody Museum contain plesiotypes of this species.

Zaphrentis vaurealensis n. sp.

Plate III, figure 1

Of this species only a single specimen was collected. It is so well preserved, however, that the description is merited.

The corallum is large, being a little over 6 inches long and slightly more than 2 inches in diameter at the top. The increase in diameter is gradual and uniform to about half the length, above which there is little enlargement. The septal ridges are not sharply developed on the exterior, which is annulated by irregular undulations. On one side is a groove from about 8 to 20 mm. wide, which extends from the tip to the top of the calyx following the curvature of the corallum. Its significance is not known, but it certainly existed during the life of the organism.

The lower half of the corallum is without tabulæ, but dissepiments are present. These rise from the centre toward the margin. The upper half has tabulæ of irregular arrangement, which turn down at the margin and are somewhat undulatory across the central part.

The calyx has steep sides and is about 35 mm. deep, with the bottom slightly raised in the middle. The septa are in two sets, of which the larger extend to the centre and twist together; the smaller are not more than 1·5 to 2 mm. long.

This species differs from *Z. affinis* in the absence of tabulæ in the lower half of the corallum and in lacking the strong rugose annulations of the exterior.

Occurrence. Ordovician: Vauréal (5), zone 7 of the Vauréal River section.

The holotype is in the Twenhofel collection.

Cyathophyllum anticostiense Billings

Cyathophyllum anticostiensis Billings, Geol. Surv., Canada, Pal. Foss., vol. I, p. 109 (1862); Billings, Cat. Sil. Foss., Anticosti, p. 32, 1866; Miller, N. Am. Geol. and Pal., p. 181, 1889; Lambe, Cont. Can. Pal., vol. IV, pt. 2, p. 134, Pl. X, figs. 5, 6, 6a, 7, and 8 (1901).

The corallum is apt to be constricted at intervals; 60 mm. is the diameter of the largest observed specimen; the greatest length is 110 mm., but at least half the length of this individual appears to be wanting. There is a very much wrinkled epitheca; the wrinkles are quite steep or re-entrant on the upper side. Additional ornamentation consists of very fine, closely placed annuli and more or less distinct septal ridges. The calyx is shallow, flat on the bottom, sides convex upward, not more than 10 mm. deep where the corallum is 46 mm. wide, 12 mm. wide on the bottom. The tabulate area is 11·5 mm. wide where the corallum is 46 mm. in diameter. The tabulæ are numerous, but not strong. They are slightly elevated, but appear to turn down at the edges. The dissepiments are very numerous, about 1 mm. apart and very thin and weak. They rise from the tabulate area at an angle of about 45 degrees with the axis of the corallum, but near the margin bend outward to meet the sides nearly at right angles. The septa are radial, 118 where the diameter is 46 mm., in two sets, the shorter stopping just before the tabulate area is reached. Many of the longer septa reach the centre, some of these unite, and a slight tendency to twist is shown. All are very strongly developed.

This species differs from *C. cormorantense* in the much closer arrangement of the septa, their greater thinness, and the cylindrical shape. It has a shallower calyx with less steep sides, more strongly developed septa with some reaching the centre. It differs from *C. euryone* in being larger with closer and finer dissepiments and proportionately narrower tabulate area.

Occurrence. Silurian: Jupiter (10), Jumpers; Chicotte (1), Jumpers.

The proterotypes have not been found. Plesiotypes are in both the National Museum of Canada (No. 2493), and Peabody Museum.

Cyathophyllum articulatum (Wahlenberg)

Cyathophyllum articulatum Milne-Edwards and Haime, Mon. Brit. Foss. Corals, Pal. Soc., p. 282, tab. LXVII, figs. 1–1a, 1854; Lambe, Cont. Can. Pal., vol. IV, pt. 2, p. 135, Pl. X, figs. 9–9b (1901).

A coral identical or very closely allied to this species occurs in great abundance in the Chicotte formation. No specimens have been collected free, all are buried in the matrix; but in polished section the young corallites are seen to bud from the parent and rise parallel without union. The corallites are more or less cylindrical in shape, constricted at irregular intervals, the margins of the expansions thin and trending upward. The calyx has not been seen. The tabulæ are thin, quite irregularly placed, inosculate to a considerable extent; tabulate area 6 mm. wide where the specimen is 11 mm. wide. Dissepiments are strongly developed, rising outward about 45 degrees to the corallite axis; the cells elongate-oval in tangential section, directed upward and outward; concavo-convex in radial section. The dissepiments meet the septa at acute angles and are convex outward and downward between them. The septa are radial, 48 in one specimen where 14 mm. wide, in another specimen from the same colony there are 46 where 8·5 mm. wide; in two sets, the shorter stopping at the tabulate area, the longer crossing it. Several of the long septa unite with neighbouring ones, in some cases the next, and again with the second or third therefrom, and as single septum reaches the centre there to unite with one from the opposite side. This last character is not mentioned by Edwards and Haime, but their illustrations show a similar arrangement.

Occurrence. Silurian: Chicotte (1-2), Chicotte river and pointe des Morts.

The specimens on which the description is based are in the Peabody Museum.

Cyathophyllum cormorantense n. sp.

Plate III, figures 2, 3, 4

The shape of the corallum varies from obtusely to acutely conical, the increase in the diameter as a rule not being constant and a few specimens showing irregular constrictions. The length is probably very great. One broken individual, with diameter of 52 mm. at the calyx, has a length of 150 mm. The largest specimen collected has a diameter at the large end of about 60 mm. Worn specimens have the surface strongly reticulated by the meeting of the septa and dissepiments. The cells are more or less square, and there are about 3 in 2 mm. The calyx is very deep, the bottom is flat or slightly convex, 14 mm. deep in a specimen 46 mm. in diameter, 8 mm. wide at the bottom, and 25 mm. at the top. The tabulate area is as wide as the floor of the calyx. The tabulæ vary from slightly concave to slightly convex, in some cases inosculating, 1 mm. to 2 mm. apart. The septa are radial, in two sets (some sections show only one); the larger reach into the tabulate area; the smaller stop where the tabulæ begin; neither is strongly developed. Where the diameter is 22 mm. there are 80 in both sets, and there are 84 in the same specimen where the diameter is 24 mm. The dissepiments are very numerous, thin, and curve upward; convex outward between the septa. Unworn coralla have a thin epitheca which is annulated by closely placed lines to the number of about 4 to a mm. Septal ridges show only faintly. Many specimens are so completely recrystallized as to show no structure.

Occurrence. Silurian: Jupiter (4, 5, 7, 8), Cormorant point, Little river, Jupiter river.

The holotype and paratypes are in Peabody Museum. Paratypes are in the National Museum of Canada.

Cyathophyllum euryone Billings

Cyathophyllum euryone Billings, Geol. Surv., Canada, Pal. Foss, vol. I, p. 110 (1862); Billings, Cat. Sil. Foss., Anticoisti, p. 34, 1866; Lambe, Cont. Can. Pal., vol. IV, pt. 2, p. 136, Pl. XI, figs. 15-16 (1901).

The septa are in two sets, one ending just before the tabulate area is reached, the other extending across the tabulate area, but not reaching the centre. The tabulæ are elevated in the centre and turn up at the intersections with the septa.

The corallum of this species is smaller and more cylindrical than that of *C. cormorantense*, has a more obtusely conical base, and a shallower calyx, in the centre of which there is generally a low cone. It also has a wider tabulate area.

Occurrence. Silurian: Gun River (4), cape MacGilvray; Jupiter (2, 8-10), East cliff, near head of Salmon river, Iron river, Jumpers.

Types lost; other specimens in the National Museum of Canada (No. 2491), and Peabody Museum.

Cyathophyllum ellisense n. sp.

Plate II, figures 10, 11, 12, 13

The corallum of this species is slender, acutely pointed, curved at the tip, and almost cylindrical. The length is not known, but probably is considerable. The diameter of the largest specimen collected is 20 mm. One fragment 42 mm. long has a diameter of 18 mm. at the larger end and 7 mm. at the smaller; but for the upper half of this length the increase in diameter is not great. The exterior is annulated by rugose lines of growth, which are variable as to size and distance apart. There are also very fine annuli to the number of 3 or 4 to a mm. The septal ridges are distinct and from 7 to 8 to a mm. The septa are in two sets, 80 in a section 20 mm. in diameter. The 40 primaries reach the centre, some uniting before so doing, and in the centre they become twisted together. The marginal portion for about a third the length of the radius is vesicular, with the divisions between the vesicles convex outward and downward. In radial section the vesicles do not appear conspicuous, and they end before the ends of the secondary septa are reached. Complete, or imperfectly developed tabulæ cross the central area, arching upward from the margin. In some instances this species underwent calicinal budding, as one specimen from Ellis bay has 7 small corallites arising from the calyx. The tabular central area and outer dissepimental or vesicular area are characters allying the species with the Cyathophyllidæ, whereas the twisting together of the septa in the middle suggests the Zaphrentidæ.

Occurrence. Ordovician: Ellis Bay (4, 7, 9), Ellis bay.

Peabody Museum.

Cyathophyllum wahlenbergi Billings

Cyathophyllum wahlenbergi Billings, Geol. Surv., Canada, Pal. Foss., vol. I, p. 108 (1862); Billings, Cat. Sil. Foss., Anticosti, p. 34, 1866; Lambe, Cont. Can. Pal., vol. IV, pt. 2, p. 136, Pl. XI, figs. 2 to 2b (1901).

The corallites of this species are closely placed and vary in diameter from 6 to 10 mm., most of them being 7 to 8 mm. The septa are in two sets, neither of which reaches the centre. The smaller are about half as long as the larger and extend into the tabulate area. The tabulate area is proportionately wider than in *C. articulatum*, a specimen 9 mm. in diameter having a tabulate area slightly exceeding 5 mm. The dissepiments trend upward and outward, the latter the more numerous. The cells are rectangular in outline.

The species differ from *C. articulatum* in having a smaller corallum, the absence of any union between the septa and the wider tabulate area.

Occurrence. Silurian: Becscie (4), Whale cliff and Otter river; Jupiter (2, 5), East cliff and Cormorant point.

Holotype, No. 2428, the National Museum of Canada, other specimens in Peabody Museum.

Diphyphyllum caespitosum (Hall)

Cyathophyllum pelagicum Billings, Pal. Foss., vol. I, p. 108 (1862); Billings, Cat. Sil. Foss., Anticosti, p. 34, 1866; *Diphyphyllum caespitosum* Lambe, Cont. Can. Pal., vol. IV, pt. 2, p. 158, Pl. XIII, figs. 3-3b (1901).

The corallites are straight for short distances only, and their diameters vary from 2 to 7 mm. The septa are radial, 50 where 7 mm. in diameter, 36 where the diameter is 4 mm. Two walls are simulated, the inner being quite thin and produced by a single series of dissepiments which arch upward and outward. It is about 1 mm. from the outer wall where the corallite is 7 mm. in diameter and in some examples it does not show. The septa are in two sets, the smaller ending at the pseudo inner wall, the longer reaching almost to the centre. The tabulæ are strong, from 0·5 to 1·5 mm. apart, extending between the outer walls in some examples; but generally ending at the inner wall. They are mostly flat in the centre and turned down at the edges.

Occurrence. Silurian: Becscie (4), Becscie river; Gun River (2?), cape Ste. Anne; Jupiter (2, 5), East cliff and Cormorant point.

Peabody Museum and the National Museum of Canada.

Chonophyllum (Craterophyllum) canadense (Billings)

Ptychophyllum canadense Billings, Geol. Surv., Can., Pal. Foss., vol. I, p. 107 (1865); Miller, N. Am. Geol. and Pal., p. 201, 1889; *Chonophyllum canadense* Lambe, Cont. Can. Pal., vol. IV, pt. 2, p. 185, Pl. XV, figs. 1, 1a-c, 2, 3, 3a-b, 4 (1901).

The height is small in proportion to the width, the corallum enlarging from a small, obtusely pointed base[1] into a broad, frill-like expansion on whose upper surface rises the truncated cone forming the calyx area, this

[1]Billings appears to have confused the base and summit.

having a width equal to from one-fifth to one-fourth the diameter and a height above the frill equal to about half the height of the corallum. The height of the corallum probably does not exceed 35 mm. and the diameter is at least 190 mm. The calyx is steep-sided, flat-floored, and about half as deep as wide. The septa are in two sets, the longer reaching the centre where they unite by twos and threes and twist together. The shorter do not extend more than a third the distance to the centre. There is no trace of a columnella. Immediately below the frill where the base is 23 mm. wide there are 42 septa. From the calyx the septa extend over the frill as ridges which broaden as the margin is approached and are separated by narrow and angular depressions. Both surfaces of the frill are marked by concentric wave-like lines of growth,[1] which are a little less than 1 mm. apart. In some cases these are continuous across the septal ridges, and in others they alternate on adjoining ridges, but each septum appears to have the same number. The tabulæ are flat or concave in the centre, elevated just before the margin is reached, and turned down at the margin. Lambe states that tangential and vertical sections show the septa to be formed of superimposed convex layers resembling the septal structure of *C. magnificum* Billings, but more dense.

Occurrence. Silurian: Chicotte (1-2), Chicotte river and Jumpers.

The cotypes, No. 2383, are in the National Museum of Canada. Other examples are in Peabody Museum.

Strombodes diffluens Edwards and Haime

Strombodes diffluens Milne-Edwards and Haime, Mon. Brit. Foss. Corals, Pal. Soc., Sil., p. 294, Pl. LXXI, figs. 2, 2a (1855); Billings, Cat. Sil. Foss., p. 34, 1866; Etheridge, Brit. Foss., pt. 1, p. 24 (1866); *Arachnophyllum diffluens* Lambe, Cont. Can. Pal., vol. IV, pt. 2, p. 183, Pl. XIV, fig. 12 (1901).

The Anticosti specimens differ from those of England in having the calices a little deeper and closer together, and even these characters vary in different specimens and hence can have no great value. The corallum is massive; upper side convex, the lower more or less obtusely conical, ribbed by the corallites, and covered by a thin epitheca. The calyx pits vary from 4 to 8 mm. across, 5 to 9 mm. apart, and 2 to 3 mm. deep. The sides are steep and abrupt, slightly elevated around the margin, and there is a low cone in the centre of each calyx. The septa are very numerous, flexuous, delicate, covered with nodules on the top, apparently perforated by numerous small pores about 0·5 mm. in diameter. They are alternately long and short and confluent with those of neighbouring corallites. At the centre the longer ones unite with each other to form a pseudo-columnella. There are from 36 to 50 at the margin of the calyx depression, and farther out there are more. The inter-corallite spaces and the corallites themselves are filled with vesicular tissue, the vesicles being of unequal size and from ½ to 2 mm. in diameter. A colony is divided by laminæ which cross both corallite and inter-corallite space in a direction parallel to the surface. According to Rominger[2] these laminæ represent periods of growth. No trace of a wall exists between the corallites.

[1] Billings appears to have confused the base and summit.
[2] Geol. Mich. Foss. Corals, 1876, p. 129.

Occurrence. Silurian: Jupiter (2, 4, 7, 8, 9), East cliff, Heath point, east of Bell river; Chicotte (1, 2), pointe des Morts and Jumpers.

The specimens on which the above description is based are in Peabody Museum. The species occurs in the collections of Richardson with the statement of collection from Ellis bay. The probabilities are that it did not come from that locality, and it is not so given in the faunal lists.

Palaeocyclus rotuloides Hall

Cyclolites rotuloides Hall, Pal. New York, vol. II, p. 42, Pl. 17, figs. 4a-e (1852).

A single specimen of this species was collected at Cormorant point. It is about 10 mm. in diameter. There are 20 primary septa and an equal number of secondary septa.

Occurrence. Silurian: Jupiter (5), Cormorant point.

Twenhofel collection.

Columnaria alveolata Goldfuss

Columnaria alveolata Lambe, Cont. Can. Pal., vol. IV, pt. 2, p. 96, Pl. VI, figs. 1, 1a (1901); Cumings, Dept. Geol. and Nat. Res. Indiana, 32nd Ann. Rept., p. 703, Pl. I, figs. 4, 4a (1908).

The Anticosti individuals of this species are irregularly hemispherical in shape, with the polygonal cells ranging in diameter from 2 to 5 mm. The septa are in two sets, the longer 10 to 15 in number reaching nearly to the centre, the smaller not more than one-fifth to one-fourth as long. The tabulæ are complete, generally depressed in the centre and at the edges. There are from 1 to 3 in a mm. The corallite walls are not firmly united as they readily separate on sectioning.

Occurrence. Ordovician: Vauréal (4), baie Ste. Claire and Battery point; Ellis Bay (1), Junction cliff.

Both the National Museum of Canada and Peabody Museum possess Anticosti plesiotypes of this species.

Columnaria (?) (Palaeophyllum) vaurealensis n. sp.

Plate IV, figure 1

This new species occurs in considerable abundance in the Ordovician strata of Anticosti, where it forms colonies several feet in diameter. The corallites are 2·5 to 3 mm. in diameter and are not connected except at the places of origin. Individual corallites are 7 to 10 mm. long. The external surface is ornamented by annular growth lines and septal ridges. The tabulæ are thin, bent downward in the middle, and some bend downward at the margins; but most of them join the walls without any deflexion, although there is a decided approach to horizontality just before the walls are reached. They are about 0·5 mm. distant from each other.

The septa are in two sets, of which the longer set is about 16 in number, reach the centre and unite. Those of the smaller set are about 0·5 mm. long or less. There is no outer dissepimental area of any kind.

This species differs from *C.*? *stokesi* in that the septa unite in the centre and the corallites are more slender. It has been compared with specimens and thin sections of that species from lake Timiskaming. It appears to differ from *C. thomi* in the same respects, but the comparison has been made only with the original drawing of that species in the report of the Mexico-United States Boundary Survey for 1857.

Occurrence. Ordovician: Vauréal (1, 2, 6), zone 12 of MacDonald River section, zone 10, Vauréal River section, and de Puyjalon cliff; Ellis Bay (6, 8), cape James and coral zone of Vauréal River section.

Twenhofel collection.

Cystiphyllum niagarense (Hall)

Conophyllum niagarense Hall, Pal. N.Y., vol. II, p. 114, Pl. 32, figs. 4a-n (1852); *Cystiphyllum huronense* Billings, Cat. Sil. Foss., Anticosti, p. 92, 1866; *C. niagarense* Lambe, Cont. Can. Pal., p. 180, Pl. XVI, fig. 7 (1901); Cf. *Cystiphyllum cylindricum* Lonsdale, Murchison's Silurian System, 1839, p. 691, Pl. 16 bis, figs. 3-3b.

In general, the Anticosti specimens are slightly smaller than those described from the interior of North America, particularly those from Lake Huron region, but some are about the same size as those from New York. The unworn specimens are covered with a very much wrinkled epitheca which is ornamented by fine, closely placed annuli and indistinct septal ridges. Worn specimens have the surface much pitted by the cells. The general outline is cylindrical, or conical-cylindrical, with numerous constrictions at irregular intervals. The expanded parts are in many instances drawn out into thin edges which project upward. The diameter varies up to about 17 mm. In longitudinal section the interior is seen to consist of irregular ovoid cells, directed upward and outward, the upper side of a cell as a rule being more convex than the lower. The sizes of the cells vary, but average about 2 mm. long and 1 mm. wide. In some of the constricted places there are no cells, whether this is an accident of preservation or otherwise is not known. In radial section the cells are of irregular shape, and on the inside of their outer walls, particularly those near the edge of the corallum, are ridges which apparently correspond to the septa of the outer wall, though no septa were seen to cross the cells. The septa are mere lines on the walls. A section 7 mm. in diameter has 42 septal lines.

This species is very close to, if not identical with, *C. cylindricum* Lonsdale, as illustrated in Murchison's Silurian System; but the specimens of that species figured by Edwards and Haime are somewhat more conical and have smaller cells.

Occurrence. Silurian: Gun River (4), cape Sandtop; Jupiter (2, 4, 5, 9), East cliff, Cormorant point, and Jupiter and Iron rivers.

Peabody Museum and Twenhofel collections (rare).

Subclass, **Hexacoralla**

Suborder, TABULATA

Aulopora cf. *precia* Hall

Aulopora precius Hall, N.Y. St. Mus. Nat. Hist., 28th Rept., Doc. ed. (1875); Pl. IX, figs. 5 and 6, (1873); Mus. ed. (1879), Hall, Ind.

Dept. Geol. Nat. Hist., 11th Ann. Rept., p. 227, Pl. VIII, figs. 5 and 6 (1882); Roemer, Leth. Geog., pt. 1, Leth. Pal., p. 521 (1883); Davis, Kentucky Fossil Corals, Geol. Surv., Ky., pt. 2, Pl. 97, fig. 20 (1885).

The Anticosti strata contain specimens of a species of *Aulopora* which closely resembles the above. The corallites are trumpet or funnel-shaped with the calices from 1·25 to 2 mm. in diameter.

Occurrence. Silurian: Jupiter (1, 9, 10), cape Sandtop, East cliff, west of Jupiter river, Iron river, and Jumpers, not common.

Specimens are in Peabody Museum and in the collection of the writer.

Aulopora ellisensis n. sp.

Plate II, figure 14

A single specimen of this species was collected. It differs from *A. precia* in that the upper half of each corallite is bent at almost a right angle from the lower half, so that the former stands erect. The calices are about 1·25 mm. in diameter; the total length of a corallite is 5 to 6 mm. The shapes are tapering conical.

Occurrence. Ordovician: Ellis Bay (4), west side of Ellis bay.

The holotype is in the writer's collection.

Syringopora verticillata Goldfuss

Syringopora verticillata Goldfuss, Petrefacta Germ., vol. I, p. 76, Pl. XXV, figs. 6a-b (1826); Lambe, Cont. Can. Pal., vol. IV, pt. 1, p. 50 (1899).

The mature colony is formed of upright,more or less parallel, cylindrical corallites, the individuals ranging in diameter in the same colony from 2·5 to 4 mm. They are separated from each other by distances which as a rule exceed the width of the corallites. At the base the corallites are prostrate, conical, appearing in weathered specimens like invaginated funnels, and in some ways resembling *Aulopora.* The height attained by an individual colony is not known, but a diameter exceeding 150 mm. was reached. At irregular intervals the corallites are united by horizontal, rod-like appendages, which generally are filled with vesicular tissue. They vary from 2 to 3 mm. in diameter, and as a rule two or three arise from one place. The septa consist of rows of spines, of which there are about 8 rows in 2 mm. The spines are also arranged in circles. The tabulæ commonly are much attenuated downward so as to appear like invaginated funnels and in some instances present the appearance of a continuous central tube. There are from 2 to 3 to a mm.; in many cases they unite and in some instances are prolonged into the connecting rods.

Occurrence. Silurian: Becscie (4), most exposures; Gun River (1-4), most exposures; Jupiter (2, 3, 8, 10), East cliff, Jupiter river, pointe de la Croix.

Peabody Museum.

Halysites catenularia (Linnaeus)

Halysites catenularia Milne-Edwards and Haime, Mon. Brit. Foss., Corals, Pal. Soc., p. 270, Pl. 664, figs. 1-1c (1854); Billings, Cat. Sil. Foss., Anticosti, pp. 7, 32, 1866.

This widely distributed species first appeared in the Anticosti seas in the latter part of English Head time. The common form has the chains about 1 mm. wide with about 4 corallites in 10 mm. The corallites are usually separated by small tubules, but these do not always appear to be present. At cape MacGilvray a specimen was collected in which the corallites form a compact mass in places, so that in such parts the colony has the appearance of a Favosites, whereas elsewhere it is like the common form. The Carleton Point form (Twenhofel collection) has the corallites nearly square with a width and length of about 1 mm. and no tubules. It is uncertain just what value should be given to these variations, and until the genus can be studied in a monographic way it is thought best not to introduce additional names.

Occurrence. Ordovician and Silurian. The species first appears at Carleton point in zone 4 of the English Head formation and extends to the top of the Chicotte, being extremely abundant in some horizons.

Halysites catenularia micropora Whitfield

Halysites catenularia var. *microporus* Whitfield, Geol. Wisconsin, vol. 4, p. 272, Pl. 13, fig. 6 (1882).

This variety differs from other forms in the small dimensions of its corallites. Tubules appear to be occasionally present between the corallites, but apparently not generally so. Along the chain there are about 6 corallites in 5 mm.; the width of a corallite is less than 0·5 mm.

Occurrence. Ordovician: Ellis Bay (7, 9, 10), Ellis bay. Silurian: Becscie (2), Reef point; Jupiter (2, 8), East cliff, Bell river.

Plesiotypes are in Peabody Museum and the National Museum of Canada.

Paleofavosites Twenhofel

Paleofavosites Twenhofel, Geol. Surv., Canada, Mus. Bull. No. 3, p. 24 (1914).

Under the generic name of Paleofavosites it is proposed to include those Favosite corals which have the mural pores in the angles. As thus defined, it is thought that the new genus will include the species *Favosites asper*, *F. prolificus*, and *F. capax*. If *Favosites alveolaris* Goldfuss is distinct from *F. asper*, it should also be included. *F. asper* was originally given as the genotype, this being done in the belief that it and *F. prolificus* are the same species. As there is some doubt in the author's mind that such is the case, it is thought that *F. prolificus* should be taken as the genotype.

Paleofavosites capax (Billings)

Favosites capax Billings, Cat. Sil. Foss., Anticosti, p. 6, 1866; *F. aspera* Lambe, Cont. Can. Pal., vol. IV, pt. 1, p. 4, Pl. I, fig. 2 (1899).

The tabulæ are thin, but well developed. They may be concave, convex, or flat, and at the edges they are depressed to form small marginal pits in the same manner as occur in *Favosites favosus*, which this species greatly resembles. The corallites are 2 to 3 in diameter. The mural pores are small and in the angles. The species is distinguished from *P. prolificus* in the larger dimensions of the corallites.

This species is associated with *P. prolificus*, but unlike that species it is most abundant in strata carrying considerable proportions of mud and sand.

Occurrence. Ordovician: English Head (4), North cliff; Vauréal (4-5), Battery point, Steamer Bow, Vauréal river; Ellis Bay (5–10), cape James, Lousy cove.

Types seem to be lost, specimens in all collections.

Paleofavosites prolificus (Billings)

Favosites prolificus Billings, Can. Nat., 2nd ser., vol. II, p. 429 (1865); Billings, Cat. Sil. Foss., Anticosti, pp. 6, 32, 1866; *F. aspera* Lambe, Cont. Can. Pal., vol. IV, pt. 1, p. 4, Pl. I, fig. 2 (in part), (1899). *Favosites*? *prolificus* Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, p. 696 (1910).

The corallites are from three to ten-sided, but are generally five to six-sided, and from 1 mm. to 1·5 mm. in diameter. The tabulæ are well developed and complete. They may be concave, convex, or flat. Their distances apart are fairly constant in the same individual and are generally less than 1 mm.; but they may be as close as 0·33 mm. and as far apart as 2 mm. Submarginal pits are rarely visible, and where present they are not very distinct. The mural pores are not large, less than 0·25 mm. in diameter, 8 to 9 in 5 mm., always situated in the angles of the corallites, the walls marginal to each pore being arched to make a depression about the pore. Casual examination might readily lead to the assumption that no pores are present, but the study of hundreds of specimens has led to the finding of pores in each. Septal spines are present, but they do not appear to be numerous.

The bases of young and unworn specimens are covered with a wrinkled epitheca which is radially ribbed by the corallites.

This is one of the most common of the Anticosti fossils and the one with the widest range. Making its appearance at almost the very base of the English Head formation, it extends to the base of the Chicotte. In the English Head formation it produced colonies fully 2 feet in diameter. In the Vauréal formation small, reef-like masses appear and small reefs occur in the Ellis Bay.

This species and *P. capax* were assigned by Lambe to *Favosites asper* d'Orbigny, and the present writer has previously made the same reference. It has not been possible to compare with European specimens, and the present conclusion is to retain the names applied to these forms by Billings.

Occurrence. Ordovician and Silurian: Throughout the Anticosti measures.

Favosites favosus (Goldfuss)

Calamopora favosa Goldfuss, Petrefacta Germ., p. 77, tab. 26, figs. 2a-c, 1826; *Favosites favosa* Hall, Pal. N.Y., vol. II, p. 126, Pl. 34a bis, figs. 5a-g (1852); Billings, Cat. Sil. Foss., Anticosti, p. 32, 1866.

The Anticosti forms which have been referred to this species are broad and of discoid or low-dome shape. A specimen 220 mm. in diameter has a thickness of 20 mm., but fragments of other specimens show a thickness of 100 mm. The corallites are large and prismatic, five to seven-sided, 4 to 5 mm. in diameter, and not closely united. The interiors of some of them are longitudinally marked by low ridges which bear slender spines. The exteriors are transversely striated, with from 5 to 6 striations to a mm. Marginal fossulæ are variable in development, some showing plainly, whereas in others they are hardly visible. The mural pores are of moderately large size; commonly circular; usually with a raised margin; arranged either in alternation or opposite; in one or two rows, but as a rule the latter. The tabulæ are numerous, convex, flat, or concave; many are depressed at the edges; some are as much as 3·5 mm. apart, but most are thickly crowded.

Except for the large size of the corallites, the multiplicity of tabulæ, and the readiness with which the corallites separate, this species closely resembles *F. gothlandicus*. By some writers it has been considered identical or a variety of that species, but the writer considers it distinct.

Occurrence. Silurian: Gun River (3), Gun river; Jupiter (5, 8, 9, 10), Cormorant, South, and Southwest points, and Jumpers; Chicotte (1, 2), Southwest point and Jumpers.

Common in all collections.

Favosites forbesi Milne-Edwards and Haime

Favosites forbesi Milne-Edwards and Haime, Mon. Brit. Foss. Corals, Pal. Soc., p. 258, tab. LX, figs. 2a-g, 1855; Etheridge, Brit. Foss., pt. 1, p. 18 (1888).

The corallum is large; upper side hemispheric, the lower conical in the central portion, but depressed on the sides in the fashion of an umbrella. It originates at a point,is never encrusting, and reaches a maximum diameter of around 200 mm. Young and unworn examples have the base covered with a wrinkled epitheca, which is annulated by fine, concentric lines to the number of 4 to 6 to a mm. In addition it is radially ribbed by the corallites. The calices of the corallites are very unequal in size, the large ones scattered among the smaller. On the surface most of them appear to be circular, this being particularly true of the larger; but in section they are seen to have from three to twelve sides, the larger cells having the greater number. The large corallites have diameters of about 3 mm., most of the smaller from 1·5 to 2 mm., though some are less than 1 mm. The walls of the cells are thin, generally without septal arrangements of any kind, though a few show spines. The exteriors are ringed by fine lines to the number of 3 to 6 to a mm. The tabulæ are horizontal, commonly about 1 mm. apart, thin, and have from 1 to 2 marginal fossulæ to a side. The mural pores are about 0·25 mm. in diameter, about 1 mm. apart in the row, and in one or two rows, depending on the width of the side. If there is only a single row it is as a rule near the middle; if two rows, each is placed near the middle of the half. Each is encircled by a raised ring, and they are arranged both in alternation and opposite in the same specimen.

This species differs from the other Anticosti forms of the genus in the pronounced variability in the size of the corallites and the general conical aspect of the lower side. Its differences from *F. gothlandicus* are noted under that species.

Occurrence. Ordovician and Silurian. The species appears in zone 4 of the Ellis Bay formation and persists to the top of the Jupiter formation. It is particularly abundant in the Jupiter formation. The mural pores have been seen in only a single specimen of those from the Ellis Bay formation, hence it is not wholly certain that all of the specimens from that formation which are referred to this species belong thereto.

The specimens on which the description is based are in Peabody Museum.

Favosites gothlandicus (Lamarck)

Favosites gothlandica Milne-Edwards and Haime, Mon. Brit. Foss. Corals, Pal. Soc., p. 256, tab. LX, figs. 1, 1a, 1855; Billings, Cat. Sil. Foss., Anticosti, p. 32, 1866; Lambe, Cont. Can. Pal., vol. IV, pt. 1, p. 3, Pl. I, fig. 1 (1899).

Corallum large, forming hemispheric, discoid, or irregular masses, in some instances growing from a point and in others from a surface. Where preserved, the base is covered with a concentrically wrinkled epitheca which is also marked by fine, concentric striæ and radially ribbed by the corallites. Corallites of several sizes, but not departing much from a mean in any corallum, generally from 2·5 to 3 mm. in diameter. New ones reach full size in from 3 to 5 mm. Tabulæ are numerous; commonly slightly concave, but they may be flat or slightly convex; about 2 to a mm., margins are marked by fossulæ which vary greatly in their degree of development in the same corallum. In some examples they reach nearly to the middle of the calyx and in others they are hardly visible. Several young examples show the last tabula to be pitted by a crater-like depression which does not appear to extend through it. Mural pores (small), in one, two, or three rows, generally two, arranged in alternation, and margined by a raised ring. An occasional pore occurs in angular position. The septal spines are short, set very close together, and with very little system in their arrangement.

This species differs from *Paleofavosites prolificus* with which it is associated, in the greater diameter of the corallites and in having the mural pores at the sides instead of on the angles. The first character does not hold when applied to *P. capax*. It is also associated with *F. forbesi*, from which it is readily separated by the greater equality in the size of the cells, the general absence of a definite shape, and in section by the closeness of its tabulæ and the more rapid growth of its cells to full size.

Comparison of the Anticosti forms has been made with those of Gotland, and the differences are not greater than may be found among those of Anticosti, and some examples show essentially identical features.

Occurrence. Silurian. The species appears in zone 4 of the Becscie formation and persists to the top of the Chicotte.

Favosites hisingeri Milne-Edwards and Haime

Favosites hisingeri Milne-Edwards and Haime, Mon. Brit. Foss. Corals, Pal. Soc., p. 259, tab. LXI, figs. 1, 1a, 1b, 1855; Lambe, Cont. Can. Pal., vol. IV, pt. 1, p. 6 (1899).

Corallum massive, of varied shape, generally showing lamination, a character, however, not peculiar to this species; reaching a diameter exceeding 200 mm. Cells small, apt to be curved in their ascent, never more than 1 mm. in diameter; walls comparatively thick, four to seven-sided. Tabulæ numerous, 1 to 3 in 1 mm., parallel or otherwise, flat, concave, or convex, thinner than the cell walls, in places much crowded, giving rise to pseudo-lamination. Mural pores large, circular, in one or two rows, and if the latter, the rows are very close and the pores alternate. Septal spines well developed, one or two rows to a side, apparently situated just above a mural pore. They project upward, and some extend nearly to the centre.

The decided development of septal spines in this species led Hall in 1852 to propose for its reception the genus *Astrocerium;* but, as already pointed out by Milne-Edwards and Haime, this character varies enormously in the same specimen from cells showing spines only slightly developed to those highly developed, so that the character does not appear to have generic value. He described what appears to have been this species as *A. venustum.*

Occurrence. Silurian: Gun River (2-4), all exposures; Jupiter (9, 10), Cormorant point, South point, Jumpers; Chicotte (1-2), all exposures.

The specimens on which the description is based are in Peabody Museum.

Calapoecia anticostiensis Billings

Calapoecia anticostiensis, Can. Nat., N.S., vol. II, p. 426 (1865); Billings, Cat. Sil. Foss., Anticosti, p. 32, figs. 15a-b, 1866; *C. canadensis* Lambe, Cont. Can. Pal., vol. IV, pt. 1, p. 43, Pl. I, figs. 6, 6a, 7 (in part) (1899).

Corallum of irregular shape, free or encrusting. The corallites are circular or polygonal, both forms existing in the same corallum; in contact or separated from each other up to a distance of 3 mm. The size of the corallum varies, the largest specimen in the Yale collection has a diameter of 290 mm. and a height of 130 mm. In any individual corallum the corallites are nearly the same in width and abundance, the diameters ranging from 1·5 to 2·25 mm. The walls of the cells are comparatively thick, reticulated by rectangular or ovoidal mural pores which are about one-third mm. in diameter and separated by an equal or lesser width. The pores are arranged in regular longitudinal and more or less circular rows, the walls of the cells in this way being reduced to a series of annular and vertical ridges, the latter being generally the stronger and in section appearing as longitudinal keels both on the inside and outside of the walls, and when the corallites are close together those of adjacent corallites unite. The number varies from 18 to 25 and in nearly, if not all, cases, they extend about 0·5 mm. beyond the corallite walls. The septa consist of spines with stout bases and acute apices, either in horizontal position or pointing upwards. They arise at the intersection of the annulæ and vertical ridges which form the walls and are about one-third as long as the radius. The calyx is generally round, encircled by a raised ring, on which are ridges connecting the vertical ridges of the interior with similar ridges of the exterior. Where the corallites are not in contact there is an annular depression around each calyx which is separated from adjacent similar depressions by a flat, sharp, or concave topped ridge ornamented with knobs. The tabulæ are complete, flat, concave, or convex, many dividing and forming 2. There are from 2 to 3 to a mm. The intercorallite space, if any, is filled with similar tabulæ.

Billings differentiated this species from *C. canadensis* and *C. huronensis,* chiefly on the size and distance apart of the corallites. A large collection of specimens from Anticosti suggests that these differences have little if any specific value, and that they can hardly be considered a basis for specific separation, a fact previously noted by Lambe. As opportunity for studying *C. canadensis* has not been had, the reference is made to *C. anticostiensis.*

C. cribriformis, a closely related form, occurs in the Lower Richmond of the Cincinnati region and has been identified by Kiaer in the Upper Ordovician (Etage 5) and Silurian of Norway. Through the kindness of Professor Kiaer the writer was able to obtain specimens of the Norway forms, and the differences from *C. anticostiensis* do not appear to be more than varietal.

Occurrence. Ordovician: English Head (2-4), English head and Makasti cliff; Vauréal (1-4), White cliff and baie Ste. Claire; Ellis Bay (4-7, 9), Ellis and Prinsta bays and Vauréal river.

The cotypes of *C. anticostiensis,* No. 2234, are in the National Museum of Canada. Plesiotypes are in Peabody Museum.

Cladopora anticostiensis n. sp.

Plate IV, figure 2

This coral occurs as expansions which have a thickness of about 2 mm. The corallites are oblique to the surface and funnel-shaped. Their diameters from the lower to the upper margins vary from 3 to 3·5 mm., and from side to side the diameters are about 2·5 mm. The corallites are so arranged that the side walls of any two join the corallite above at about the middle. Tabulæ have not been observed; mural pores have been observed on the lower and lateral margins, but not on the upper margin.

Occurrence. Silurian: Chicotte (2), pointe des Morts.

The holotype is in the collection of the writer.

Alveolites labechi Milne-Edwards and Haime

Alveolites labechi Edwards and Haime, Mon. Brit. Foss. Corals, Pal. Soc., p. 262, Pl. 61, fig. 6 to 6b, 1855; Billings, Cat. Sil. Foss., Anticosti, p. 33, 1866; Lambe, Cont. to Can. Pal., vol. IV, pt. 1, p. 21 (1899).

The corallum of the Anticosti specimen is low, spreading, rises from a basal central attachment, and apparently attains a great diameter. The base is covered with a thin, much wrinkled epitheca. The corallites have thin walls, are much compressed and oblique to the surface. The calices are of irregular shape; one axis has a diameter of from 0·5 to 1 mm., the other is usually not more than a third as great. The tabulæ are generally oblique. There are about 2 to a mm., inosculating or complete. Septal spines appear to be present; but their number has not been determined, as they are not well preserved. Pores occur at the angular edges of the corallites.

Occurrence. Silurian: Jupiter (2, 5, 9, 10), East cliff, Cormorant and South points, and Jumpers; Chicotte (1, 2), Jumpers and pointe des Morts.

Peabody Museum and the National Museum of Canada.

Coenites labrosus Milne-Edwards and Haime

Coenites labrosus Milne-Edwards and Haime, Pal. Foss. des Terr. Pal., Archiv., du Mus., vol. V, p. 302 (1851); Edwards and Haime, Mon. Brit. Foss. Corals, Pal. Soc., p. 277, Pl. 65, figs. 6, 6a, 1854; Etheridge, Brit. Foss., pt. 1, p. 16 (1888).

The Anticosti specimens referred to this species appear to be identical with those from Dudley, England. All the corallites appear to be turned in one direction, and all reach the surface at acute angles. The corallum does not have a thickness of more than 1 to 1·5 mm. The upper surface appears to be smooth.

This species differs from *C. lunatus* in that the lunate cells are larger and not perpendicular to the surface as they are in that species.

Occurrence. Silurian: Jupiter (9, 10), South point, Jumpers, near head of Salmon river; Chicotte (1-2), Jumpers, pointe des Morts, Chicotte river.

The above description is based on a few specimens in both the National Museum of Canada and Peabody Museum.

Coenites lunatus Nicholson and Hinde

Coenites lunata Nicholson and Hinde, Can. Jour., N. S., vol. XIV, p. 151, figs. 2a-c (1873); Lambe, Cont. Can. Pal., vol. IV, pt. 1, p. 28 (1899).

The writer has not seen this species in any of the collections from Anticosti, but it has been identified by Lambe.

Occurrence. Silurian: Chicotte (1), Jumpers.

Octocoralla

Heliolites interstinctus (Linnaeus)

Heliolites interstinctus Etheridge, Brit. Foss., pt. 1, p. 20 (1888); Lambe, Cont. Can. Pal., vol. IV, pt. 1, p. 79, Pl. II, figs. 6-6a (1889).

The corallites of this species are about 1·5 mm. in diameter, from 1 to 2·5 mm. apart, and are separated by 2 to 8 tubules. There are from 2 to 6 tabulæ to 1 mm. in the tubules, and from 2 to 4 to a mm. in the corallites. Very delicate septal ridges are present in most of the specimens, but a single example from Southwest point has the septa reaching nearly to the centre, where in many calices they form what Nicholson and Etheridge[1] have called a "loose and irregular trabecular axis or pseudocolumnella."

[1] Mon. Sil. Foss., Girvan Dist., pt. 1, p. 254 (1880).

Occurrence. Silurian: Jupiter (9), South point; Chicotte (1-2), all exposures.

Anticosti plesiotypes are in both the National Museum of Canada and Peabody Museum.

Heliolites megastoma McCoy

Heliolites megastoma McCoy, Sil. Foss. Ireland, p. 62, Pl. IV, fig. 19 (1846); Edwards and Haime, Mon. Brit. Corals, Pal. Soc., p. 251, tab. LVII, figs. 2, 2a-d, 1855.

A single specimen has been collected which appears to belong to this species. It consists of an hemispheric corallum with a convex upper surface and a concave lower surface, the latter very rough and once covered by an epitheca, as shown by small patches still present. The corallum apparently was attached by a single point, from which the corallites radiated. These are about 2 mm. in diameter and are generally less than 1 mm. apart. The septa are little developed and apparently extend outside the corallite walls. The cells are separated by 2 to 8 tubules. The tabulæ of the corallites are concave, with 2 to 4 to a mm. The corallites are about one and a half times as wide in the tubules.

The large size of the cells of this species readily premits its separation from others of the Anticosti *Heliolitidae.* It may be mistaken for *Lyellia speciosa,* but a section will readily demonstrate the non-vesicular character of the tubule structure.

Occurrence. Silurian: Jupiter (10), Jumpers.

The only specimen collected is in Peabody Museum.

Heliolites subtubulatus (McCoy)

Heleolites subtubulata Etheridge, Brit. Foss., pt. 1, p. 20 (1888); Lambe, Cont. Can. Pal., vol. IV, pt. 1, p. 80, Pl. II, figs. 7–7a (1899).

The corallum is of almost any shape. Young examples as a rule are spherical or hemispherical. The upper surface is convex, and in the Anticosti examples the lower is unknown. The corallites are from 0·75 to 1 mm. in diameter, and the distances apart vary from contact to 3·5 mm., but are mostly about 1·5 to 2 mm. The intercorallite tubules are polygonal in section and of three, four, or five sides. The walls are commonly thin and are crossed by horizontal tabulæ, of which those of any tubule appear to have no connexion with those of the adjoining tubules, but are placed a little lower or higher, so that any series of tabulæ zigzags across a section. These tabulæ are stronger than the vertical walls, and there are from 3 to 5 to a mm. The septa of the cells are thin, not always well preserved, and none is longer than one-third the radius of the corallite. The calices are slightly exsert and are margined by a thin rim on which are seen the twelve septa. The tabulæ of the corallites are slightly concave, and there are from 2 to 4 in a mm.

The small size of the corallites and their distances apart readily distinguish this species from the other Anticosti *Heliolites.*

Occurrence. Silurian: Jupiter (2, 5–10), all exposures; Chicotte (1–2), Southwest point and pointe des Morts.

Anticosti plesiotypes are in both the National Museum of Canada and the Peabody Museum.

Plasmopora petalliformis (Lonsdale)

Heliolites sparsus Billings, Can. Nat., N.S., vol. II, p. 428 (1865); Billings, Cat. Sil. Foss., Anticosti, p. 31, 1866; *Plasmopora petalliformis* Lambe, Cont. Can. Pal., vol. IV, pt. 1, p. 83, Pl. II, figs. 9, 9a (1899).

The corallum varies from a flat, cake-like form to hemispheric, grows to a considerable size, and has a lamellar structure. It is attached either by a point or encrusts another substance, one of the specimens in the Yale collections having overgrown a *Stricklandinia*. The corallites in shape resemble an ionic column, are about 1·5 mm. in diameter, and from 1 to 3·5 mm. apart. They grow perpendicular to all surfaces. The calices are a little exsert, petalliform with twelve oval cells arranged around each. The tubules are prismatic, three to six-sided, and there are from 2 to 10 between the corallites. The 12 septa are thickened at their bases; in some instances they reach nearly to the centre, in other cells they appear to be reduced to a series of upward projecting spines. The tabulæ of the corallites are very concave, inosculating or complete, and from 3 to 4 to a mm. In the tubules the tabulæ are somewhat more numerous, are strongly developed, and in most places they disturb the regularity of the tubule walls.

Occurrence. Silurian: Jupiter (10), Jumpers; Chicotte (1–2), Southwest point, Chicotte river, pointe des Morts.

The cotypes of *Heliolites sparsus*, No. 2478, are in the National Museum of Canada. Other specimens are in Peabody Museum.

Lyellia affinis (Billings)

Heliolites affinis Billings, Can. Nat., N.S., vol. II, p. 427 (1865); Billings, Cat. Sil. Foss., Anticosti, pp. 5, 30, fig. 12, 1866; *Propora affinis* Kiaer, Videnskabs-Selskabets Skrifter, I, Math-Naturs. Klasse, No. 3, p. 69 (1897); *Lyellia affinis* Lambe, Cont. Can. Pal., vol. IV, pt. 1, p. 84, Pl. V, figs. 1–1a (1899); *Propora affinis*, Kiaer, ibid., No. 10, pp. 11, 12, 53 (1903); Kiaer, ibid., bd. II, p. 584 (1908).

Some specimens have the septa well developed, whereas in others they are hardly visible; but some vestiges as a rule are present. The corallites in some cases are almost in contact, but more commonly they are separated by distances equal to about half their diameters. These variations occur together and are confined to no particular horizon. Had extremes only been collected there is little doubt but that at least two species would be considered to be present.

The shape may be anything, varying from spherical to forms widely explanate. The coral zone of the Ellis Bay formation has individuals of pear-like shape.

Occurrence. Ordovician and Silurian. This species appears in zone 4 of the Ellis Bay formation and persists to the top of the Chicotte, and there are few zones in which it cannot be collected abundantly.

The proterotypes have not been found. Plesiotypes are in both the National Museum of Canada and Peabody Museum.

Lyellia americana Milne-Edwards and Haime

Lyellia americana Milne-Edwards and Haime, Polyp. Foss. des Pal., p. 226, Pl. 14, figs. 3, 3a, 1851; Rominger, Geol. Surv., Mich., Foss. Corals, p. 14, Pl. II, figs. 1, 2, 1876; Lambe (partim), Cont. Can. Pal., vol. IV, pt. 1, p. 85, Pl. V, figs. 2, 2a (1899).

The Anticosti examples of this species are rather widely explanate, reaching a great diameter with the thickness not greatly exceeding 1 inch. The corallites are from 2 to 2·5 mm. in diameter and are distant from each other from 1·5 to 5 mm.; but mostly about 3 mm. In some instances the corallites are in contact. They are circular, perpendicular to the surface and slightly exsert. There are 12 septa, consisting of keels carrying short spines which reach fully half-way to the centre. On the upper margin of the slightly exsert calices the septa are expressed as twelve rounded tubercles, and on well-preserved specimens similar tubercles are present on the surface between the corallites. The exteriors of the corallites are crenulated by ridges, which in some instances correspond to the septa and in others appear to be independent. The intercorallite space is composed of a vesicular structure made of convex plates which enclose irregularly lenticular spaces with widths varying from very small to the distances between corallites; but mostly they are not more than 1 mm. wide in the direction parallel to the long axes. On some of the plates forming the vesicles are convex elevations projecting upward, but not reaching the plate above. These appear to be a part of the plates, though in some instances the colour is slightly different. It may be that they are sections of pyramidal crystals of introduced calcite. The tabulæ are numerous, 1 to 3 to a mm., and in the Anticosti examples they are as a rule concave upward; but in forms from other localities they are stated to be horizontal.

Occurrence. Silurian: Chicotte (1–2), Jumpers.

The Anticosti plesiotypes are in Peabody Museum.

Lyellia exigua (Billings)

Heliolites exiguus Billings, Can. Nat. and Geol., N.S., vol. II, p. 428 (1865); Billings, Cat. Sil. Foss., Anticosti, p. 31, fig. 14, 1866; *Lyellia exigua* Rominger, Geol. Surv., Mich., Fossil Corals, p. 16, 1876; Nicholson and Etheridge, Mon. Sil. Foss., Girvan dist., p. 250, 1880; *Heliolites exiguus* Roemer, Leth. Geog., pt. 1, Leth. Pal., p. 508 (1883); *Lyellia exigua* Lambe, Cont. Can. Pal., vol. IV, pt. 2, p. 86, Pl. V, figs. 3, 3a (1899).

The corallum is hemispheric when free, but it is also encrusting. The size attained is not known, but the largest free specimen is 62 mm. in diameter and 35 mm. thick. The corallites are very small, cover the entire surface except the point of attachment, about 0·5 mm. in diameter and from 1 to 2 mm. apart. The calices are exsert; the margins are thin and are probably ornamented with 12 nodules, though this is not well shown. The septa are faintly developed. The tabulæ are horizontal and there are about 2 to a mm. The intercorallite space is filled with the vesicular tissue characteristic of the genus; the cells are from 0·25 to 1 mm. wide and from 0·25 to 0·35 mm. high.

This species is readily separated from the other members of the genus by the small size of the corallites and their relatively great distances from each other.

Occurrence. Ordovician: Ellis Bay (7), Ellis bay (Billings). Silurian: Jupiter (8, 10), Goose point and Jumpers.

Holotype, No. 2239, the National Museum of Canada, specimens in Peabody Museum, and Twenhofel collections.

Lyellia speciosa (Billings)

Heliolites speciosus Billings, Can. Nat., N. S., vol. II, p. 426 (1865); Billings, Cat. Sil. Foss., Anticosti, p. 30, fig. 13, 1866; *Lyellia americana* Lambe (partim), Cont. Can. Pal., vol. IV, pt. 1, p. 85 (1899); *Propora speciosa* Kiaer, Revision der Mittelsilurischen Heliolitiden Videnskabs-Selskabets Skrifter, Math-Natur, Klasse, pp. 11, 12, and 53, 1903; Kiaer, ibid., p. 584, 1908.

The corallites are about 2·5 mm. in diameter, and they are commonly from 0·25 to 1 mm. apart, but may be as much as 2 mm. The septa consist of twelve vertical ridges. The intercorallite space is filled with vesicular tissue formed of plates which are convex upward, the vesicles being from 0·5 to 1 mm. in diameter and about 0·5 mm. high.

This species was considered by Lambe as identical with *L. americana* with which, however, it appears not to have a great deal in common, other than general structure and large size of cells. Its corallites are closer, its vesicles smaller, its septa more faintly developed, and the general shape is quite different. It also occurs in much younger strata.

Occurrence. Ordovician: Ellis Bay (2, 6, 7, 9), Junction cliff and Ellis bay.

The proterotypes have not been found. Plesiotypes are in the National Museum of Canada and Peabody Museum.

Lyellia nummulosa n. sp.

Plate V, figures 1, 2, 3, 4, 5

Corallum coin-shaped, with an observed maximum diameter of 25 mm., but with the average large specimen about 20 mm. in diameter. The thickness is not over 2 to 3 mm. The upper side is convex, the lower concave, and covered with a concentrically striated and wrinkled epitheca. The calices are surrounded by a single row of vesicles, but not more than one row is between adjacent calices. The calices are arranged in definite rows, which cross each other in three directions, so that any four constitute an equilateral rhomboid and any seven a regular hexagon. Young examples of about 1 mm. thickness have only a single tabula, with small tabulæ crossing the intervening spaces. When the thickness reaches about 3 mm., two to three tabulæ are present. Coralla with a thickness of about 2 to 2·5 mm. are apt to show some irregularities in the arrangement of the corallites due to the irregular development of new corallites. The walls of a corallite are crenulated or bent alternately inward and outward so that there are 12 infolds, which at the margin of the calices appear as small nodes.

Nicholson and Etheridge described coin-shaped forms of a coral from the Silurian shales of Mullock Hill, Girvan, as *Pinnacopora grayi*[1], and mentioned having "seen specimens in the collections of George Jennings Hinde of a species of coral from the Junction beds of Anticosti, which is undoubtedly congeneric with *Pinnacopora grayi*.[2]"

The first studies of these forms made by the writer led him to the conclusion that they are the young of *Lyellia affinis*, although it was observed that the calices are larger. The fact, however, that they seem to occur only in the Ellis Bay formation shows that this conclusion is not probable. The similarity of the structure to that of the other species of *Lyellia* leads to their retention in that genus, although the shape is so distinctive that it is possible that they ought to be referred to a different genus.

Occurrence. Ordovician: Ellis Bay (4-6), Junction cliff, Ellis bay.

The holotype is in the Twenhofel collection.

Protarea tenuis (Billings)

Plate III, figure 6

Heliolites tenuis Billings, Can. Nat., N.S., vol. II, p. 428 (1865); Billings, Cat. Sil. Foss., Anticosti, 32, 1866; Nicholson and Etheridge, Mon. Sil. Foss., Girvan dist., p. 247, 1880; Roemer, Leth. Geog., pt. 1, Leth. Pal., p. 508 (1883); *Protarea vetusta* Lambe (partim), Cont. Can. Pal., vol. IV, pt. 1, p. 90, Pl. V, figs. 8, 8a (1899).

Protarea tenuis is a form of very variable areal expansion. It is little more than 1 mm. thick. The calices are shallow, 1 to 1·5 mm. in diameter, in contact to 1·5 mm. apart, the intervening spaces being filled with small depressions or pits. Each corallite has 12 stout septa which apparently unite to form a pseudocolumnella. The intercorallite tubules are crossed by horizontal tabulæ to the number of 2 to 3 in a mm. The spaces between the septa of the corallites are crossed by transverse dissepiments which are not of the nature of true tabulæ.

Lambe referred this species to *P. vetusta;* but it appears to the writer that this position is not well taken, since *P. vetusta*, as described by Hall, is stated to have the corallites in contact and not separated by tubules. *P. richmondensis* also does not have tubules separating the corallites. It would seem, therefore, that *P. tenuis* is distinct, since in every corallum there are very few cells in actual contact.

Occurrence. Ordovician: Ellis Bay (1, 4), Junction cliff and Ellis bay.

The cotypes, No. 2236, are in the National Museum of Canada. Other specimens are in Peabody Museum.

Lyopora goldfussi (Billings)

Columnaria goldfussi Billings, Rept. of Prog. 1857, Geol. Surv., Canada, p. 166 (1858); Billings, Can. Nat. and Geol., vol. III, p. 420 (1858); *Lyopora goldfussi* Lambe, Cont. Can. Pal., vol. IV, pt. 1, p. 88, Pl. V, figs. 6, 6a, 7 (1899).

[1]Mon. Sil. Foss., Girvan district, Ayrshire, 1878, p. 52.
[2]Op. cit., p. 57.

This species has been identified by Lambe among the fossils collected by Richardson, but the writer has not recognized it in other collections and has not been able to find the Canadian specimens.

Occurrence. Ordovician: English Head (4?), Schooner point.

ECHINODERMATA

Class, *CRINOIDEA*

Order, **Camerata**

Cupulocrinus latibranchiatus (Billings)

Dendrocrinus latibranchiatus Billings, Geol. Surv., Canada, Rept. of Prog. 1853-56, p. 270 (1857); Billings, Can. Organic Remains, Dec. IV, p. 39, Pl. III, figs. 5a-c (1858); Billings, Cat. Sil. Foss., Anticosti, p. 9, 1866; *Cupulocrinus latibranchiatus* Springer, Geol. Surv., Canada, Mem. No. 15-P, pp. 28, 33 (1911).

This species differs chiefly from *Cupulocrinus humilis* in having the base of the calyx strongly rounded to the stem (Springer, 1911). One of the specimens in the Yale collection has the stem attached. This is round and small; 1·35 mm. in diameter on a specimen whose diameter at the top of the radials is 6 mm. and height to the same point 5·5 mm. That it grew to a larger size is assumed from finding similar stems with a diameter of 1·5 mm.

Occurrence. Ordovician: calices have been collected in zone 4 of the English Head formation, and stems thought to be of this species have been found in zones 2 to 4 of the Vauréal and zones 1 and 5 of the Ellis Bay.

The cotypes, No. 1992, are in the National Museum of Canada. Peabody Museum contains about half a dozen specimens.

Dendrocrinus ? *tener* Billings

Dendrocrinus tener Billings, Cat. Sil. Foss., Anticosti, p. 9, 1866.

The type and only known example of this species (No. 1990, Geol. Surv., Canada) is embedded in limestone and is so worn that hardly anything can be made out. The column is 1·25 mm. wide; the calyx 6 mm. wide, and probably 4 mm. high. The arms are broken off about 30 mm. above the top of the calyx, and some of them branch twice. The stem is stated to be pentagonal, but this cannot be determined from the specimen.

Occurrence. Ordovician: either from the English Head or Vauréal formations.

Dendrocrinus minutus n. sp.

Plate IV, figure 6

The description was prepared by Dr. Frank Springer.

This name is given to a minute specimen which has the general characters of the genus, but of which little more can be said beyond what is shown by the trebly enlarged figure. The anal side is not exposed. The entire crown is only about 9 mm. in length, and with stem attached about

12 mm. The only other Silurian species, *Dendrocrinus longidactylus* Hall from the Rochester shale at Lockport, bears little resemblance to this.

Occurrence. Ordovician: English Head (4), Carleton point.

A single specimen, Twenhofel collection.

Dimerocrinus elegans n. sp.

Plate IV, figure 3

The description was prepared by Dr. Frank Springer.

This unique type is a nearly complete crown, in excellent preservation except that the greater part of the infrabasals is lacking. It is small and of graceful contour. Calyx dicyclic, elongate conical in outline with obscure radial ridges leading to the arms. Anal interradius very distinct, composed of one large plate resting on the posterior basal, followed by three small ones abreast, and these by others passing towards the tegmen. Arms two to the ray, biserial, slender, with a profusion of delicate pinnules, closely packed. Stem not preserved. Height of calyx 9 mm., width 8 mm.; total length of crown 40 mm.

In number of arms and general proportions this form resembles *Dimerocrinus (Glyptaster) brachiatus* Hall, from the Rochester shale of Lockport, New York, but is of smaller size and has more delicate lines than typical examples of that species, and less prominent radial ridges and other surface markings upon the calyx.

Occurrence. Silurian: Jupiter (9), Iron river.

A single specimen, Twenhofel collection.

Periechocrinus latus n. sp.

Plate IV, figures 4, 5

The description was prepared by Dr. Frank Springer.

Represented only by the calyx below the arm bases; this is of large size, relatively low and broad, expanding widely from the base, with sides slightly curving like a bowl. Narrow ridges follow the median line of the radial series, not well preserved in the specimen. Height of calyx to arm bases 22 mm., width at that level 35 mm., width of base at column facet 8 mm. There is some irregularity in the size of the radial plates, and the first anal plate, in line with them, is much larger.

In form and proportions this species is wholly unlike the well-known Silurian species from the Rochester and Waldron shales, and the Wenlock of England, which are characteristically elongate, being usually once and a half higher than wide, instead of the reverse proportion. It is more like the Lower Carboniferous forms that have been referred to this genus, such as *P. whitei* Hall, of the Burlington limestone. But the broad, bowl-shaped calyx of our species is represented in the Silurian by an undescribed form from the Brownsport limestone of the late Niagaran of Decatur county, Tennessee, of which I have several specimens that will probably have to take the name here proposed.

Occurrence. Silurian: Chicotte (2), Southwest point.

Holotype, Twenhofel collection.

Retiocrinus fimbriatus Billings

Retiocrinus? fimbriatus Billings, Geol. Surv., Canada, Can. Org. Remains, Dec. IV, p. 65, Pl. IX, figs. 3a-c (1858); *Retiocrinus fimbriatus* Billings, Cat. Sil. Foss., Anticosti, p. 8, 1866; Wachmuch and Springer, Mem. Mus. Comp. Zool., vol. XX, p. 179 (1897).

Occurrence. Ordovician: English Head (4), Carleton point; Vauréal (4), Vauréal river; Ellis Bay (7), cape James.

Holotype, 1994, The National Museum of Canada.

Crotallocrinus? sp.

In the limestones of the Chicotte formation there is an abundance of crinoidal remains, many of which are very large stems, some beds being formed mainly from them. The stems attain diameters of 18 mm., and the longest collected has a length of 125 mm. The surfaces of the plates are deeply carved by radiating grooves, and the interiors are traversed by radiating canals whose openings appear on the outer surface as pores. The central canal is pentagonal in section. There are two fragments of calices, which may be related to the stems. The better specimen shows 2 small infrabasals and 5 hexagonal basals. The general appearance of the stems suggests relationship to *Crotallocrinus.* During the time of the Chicotte sea *Crotallocrinus,* or some other species, must have existed by myriads, as the evidence of its presence exists in great masses of limestone.

Occurrence. Silurian. Specimens have been collected from zone 9 of the Jupiter formation to the top of the Chicotte.

Periglyptocrinus sp.

A single specimen of this genus was collected, but in a condition hardly good enough to describe specifically. It can not be referred to either of the two described species of this genus, being much larger than *P. priscus* (Billings) and lacking the surface ornamentation of *P. billingsi* Wachsmuth and Springer.

The calyx is 16 mm. in diameter and has about the same height. The arms attain a length of at least 33 mm. and are decidedly biserial. The column is like that of *P. billingsi,* consisting of alternating plates of large and small diameter.

Occurrence. Ordovician: English Head (3), English head.

The specimen is in Peabody Museum.

Eucalyptocrinus sp.

A single specimen of this genus was collected. It consists of a portion of the calyx to which are still attached parts of 4 pairs of arms. The radial plates are triangular, with the basal angles truncate; the distichals are irregularly six-sided and are much larger than the radials. The palmers are five-sided, smaller than the distichals. The first series of brachials is of trapezoidal shape and of almost the same size as the radials; the following four series of brachials consist of short, rectangular plates; the following plates of the arms are in decided biserial arrangement with each plate wedged more than half the radius past the centre. The interdistichals which support half of the vertical partitions are little more than half as large as the interbrachials which support the other half. They are angular and four-sided in the lower part, but taper upward. No base of the divided interbrachial partition supports is preserved. They were probably of the same shape as the interdistichal supports, but somewhat larger. The vertical partitions widen upward.

The species appears to be new and resembles *E. coelatus* Hall, but has a smooth surface. It differs from the variety *laevis* Grabau and Shimer *(E. decorus* of American authors) in not having truncate bases to the interdistichals which support the partitions. *E. crassus* Hall is far larger, has the partitions narrowing above, and the interdistichals have truncate instead of pointed bases.

Occurrence. Silurian: Jupiter (10), Jumpers.

The specimen is in the Peabody Museum.

Order, **Inadunata**

Suborder, FISTULATA

Carabocrinus (?) tuberculatus Billings

Carabocrinus (?) tuberculatus Billings, Can. Org. Remains, Dec. IV, p. 33, Pl. X, figs. 2a–c (1858); Billings, Cat. Sil. Foss., Anticosti, p. 9, 1866.

Occurrence. The type and only known specimen (No. 1991, the National Museum of Canada) came from Carleton point, zone 4 of the English Head formation.

Class, *CYSTOIDEA*

Order, **Rhombifera**

Pleurocystites anticostiensis Billings

Pleurocystites anticostiensis Billings, Geol. Surv., Canada, Rept. of Prog. 1853-1856, p. 288 (1857); Billings, Geol. Surv., Canada, Can. Org. Remains, Dec. III, p. 52, Pl. I, fig. 3 (1858); Billings, Cat. Sil. Foss., Anticosti, p. 8, 1866.

Three pore rhombs are known to be present, one entire, and halves of two others. The lowest is 5 mm. long, the other two about 1 mm. longer. The margins of the rhombs are elevated above the general surface, with the pore canals extending all the way across the rhomb. The rhombs are of rhomboidal shape with one angle about 45 degrees and the other the supplement. The plates are large, 12 mm. in diameter, and of hexagonal shape. The stem tapers below, is 12 mm. long, and composed of 15 plates; it is 6 mm. in diameter at the top and 3 mm. at the base. This species has large plates like *P. filatexta*, but is smooth like *P. squamosa*.

Occurrence. Ordovician: English Head (4), Carleton point.

Type and only specimen, No. 1993, the National Museum of Canada.

Class, *ASTEROIDEA*

Hudsonaster rugosus (Billings)

Plate IV, figure 7

Palasterina rugosa Billings, Geol. Surv., Canada, Rept. of Prog. 1853–1856, p. 291 (1857); Billings, Geol. Surv., Canada, Can. Org. Remains, Dec. III, p. 77, Pl. IX, figs. 2a–c (1858); Chapman, Can. Jour., N.S., vol. VI, p. 517 (1861); Wright, Mon. Brit. Foss. Echinod. Oolitic, vol. II, pt. 1 (Pal. Soc. for 1861), p. 27 (1861); Billings, Cat. Sil. Foss., Anticosti, p. 9, 1866; *Hudsonaster rugosus* Sturtz, Verh. naturh. Ver. preuss. Rheinl., etc., LVI, pp. 206, 218, 224, 225 (1899); Schuchert, Bull. 88, U. S. Nat. Mus., 1915, pp. 64–65, Pl. 3, fig. 1.

There are three rows of dorsal plates, of which those in the outer rows are slightly larger than those in the middle; each plate has a diameter of from 1·25 to 1·5 mm. The supero-marginals are in a single row on each side, the plates are slightly larger than those in the dorsal rows. A single row of infero-marginals, composed of plates which are not more than 1 mm. wide, bounds the ambulacral furrows. In addition to the ornamentation described by Billings, the plates are papillose, but are without spines of any kind. A specimen collected at a cliff near Caplan river shows the under side of two arms and the upper side of a single arm. At each angle between the ambulacra are two elongated plates parallel to each other and with radial orientation. Sturtz[1] states the "Die Form gehört zu den Phanerozonia und steht weder zu Palasterina noch mit recenten Asterinidae in einem verwandtschaftlichen Verhaltnis." He selects this starfish as the type species of his genus *Hudsonaster*. Schuchert states that this species is closely related to *H. incomptus*.

Occurrence. Ordovician: English Head (4), Carleton point and cliff east of Caplan river.

The holotype and a single paratype, No. 1999, are in the National Museum of Canada. There are parts of two individuals in the collection of the writer.

ANNELIDA

Suborder, TUBICULA

Cornulites flexuosus (Hall)

Tentaculites? flexuosus Hall, Pal. N.Y., vol. I, p. 92, Pl. XXIX, figs. 6a–d, p. 284, Pl. LXXVIII, figs. 2a–b (1847); Hall, Pal. N.Y., vol. V, pt. 2, p. 156 (1879); *Cornulites flexuosus* Hall, 28th Rept., N.Y. State Mus. Nat. Hist., p. 184 (1879); Hall, Pal. N.Y., Sup. to vol. V, pt. 2, p. 18, Pl. CXV, figs. 41–42 (1888).

Specimens which appear to belong to this species are present in the lower beds of the Anticosti section. In a single instance they were found attached to a shell, and two specimens were found attached to each other.

[1] Loc. cit.

Occurrence. Ordovician: English Head (4), Makasti cliff; Ellis Bay (4–7), Ellis bay.

The Anticosti plesiotypes are in Peabody Museum.

Cornulites richmondensis (Miller)

Tentaculites richmondensis Miller, Cin. Jour. Sci., vol. I, p. 235, fig. 28 (1874); Hall, Pal. N.Y., vol. V, pt. 2, pp. 157, 162 (1879); Hall, Pal. N.Y., vol. VII, Sup. to vol. V, pt. 2, pp. 10, 12, 18, Pl. CXV, figs. 28–30, 33–39 (1888); *Cornulites richmondensis* Schuchert and Twenhofel, Bull. Geol. Am., vol. XXI, p. 703 (1910).

The annulations are sharp, about 1·5 mm. wide, wanting or obscure, near the apex 20 to 25 to an individual; interspaces about 1 mm. wide at the large end; average length about 12 mm. Longitudinal striæ cover the entire surface in unworn specimens. None has been observed attached, but all have curved tips.

Occurrence. Ordovician: English Head (3, 4), all exposures; Vauréal (1–6), all exposures; Ellis Bay (1, 2, 4, 5, 9), Ellis and Prinsta bays.

The Anticosti plesiotypes are in Peabody Museum.

Cornulites serpularius Schlotheim

Cornulites serpularius Sowerby, Murchison's Silurian System, p. 627, Pl. 26, figs. 5–8, 1839; McCoy, Brit. Pal. Rocks and Foss., p. 63, 1855; Etheridge, Pal. Foss., pt. 1, p. 34 (1888).

This species is the largest of those occurring in the Anticosti rocks; the largest specimen, of which the tip is missing, has a length of 22 mm. with the probability that it was 10 mm. longer. This specimen is 5 mm. wide at the aperture. The annuli are more abrupt on the apertural side, are from 1·5 to 2 mm. apart where the diameter is 5 mm., and very sharp on the apices. In an example 3 mm. in diameter the annuli are 1 mm. apart. The surface is further marked by strong, longitudinal striæ. The cones are always curved, some were found attached to shells, and apparently little choice was exercised, as the collections show them fastened to *Coelospira hemispherica*, *Atrypa reticularis*, *Camarotoechia glacialis*, *Brachyprion*, and *Illaenus grandis*.

This species differs from *C. flexuosus* in being less flexuous and more slender. It presents no essential differences from the European *C. serpularius*, unless it is slightly smaller, although the fragments of large specimens prove that great dimensions were attained.

Occurrence. Silurian: Becscie (3–4), Wreck beach; Gun River (4), Jupiter river; Jupiter (2–10), all exposures.

Anticosti plesiotypes are in the collections of Peabody Museum and that of the writer.

BRYOZOA

By R. S. Bassler

Order, **Ctenostomata**

Vinella radiciformis (Vine)

Ascodictyon radians Vine (in part), Quart. Jour. Geol. Soc. London, vol. 37, p. 619 (1881); *A. radiciforme* Vine, ibid., vol. 38, p. 53, figs. 1, 3 (1882); Vine, Ann. and Mag. Nat. Hist. ser. 5, vol XIV, p. 83, figs. 1–5 (1884); Vine, Proc. Yorkshire Geol. and Polyt. Soc., vol. IX, pp. 183–4, Pl. 12, fig. 5 (1887); Vine, ibid., vol. XII, p. 87 (1892); *Vinella radiciformis* Ulrich, Geol. and Nat. Hist. Surv., Minnesota, Final Rept., vol. 3, pt. 1, p. 113 (1893); Ulrich and Bassler, Smith. Misc. Coll. (Quart. Issue), vol. 45, p. 275, Pl. 68, fig. 7 (1904); Bassler, U.S. Geol. Surv., Bull. No. 292, p. 12, Pl. 4, figs. 2, 3 (1906).

Several fragmentary but well-preserved colonies of this widespread Silurian species were found in the Jupiter formation usually attached to brachiopod shells, associated with other delicate encrusting bryozoa such as *Allonema botellus, Ascodictyon siluriense, Corynotrypa dissimilis,* and *C. elongata,* all of which were originally described by Vine from the Wenlock shales. *V. radiciformis* may be distinguished from all associated bryozoa by the fact that its parasitic zoarium consists of very slender tubular threads or stolons arranged more or less distinctly in a radial manner. At the points of radiation the threads unite to form indistinct nuclei.

In the present species the rather widely separated nuclei and the extreme tenuity of the radiating threads are especially characteristic. Near the centres the radii are slightly swollen, but their average thickness elsewhere lies between 0·03 and 0·04 mm. In some cases the threads seem to bifurcate or to wander about without much order, and in many others the nuclei are difficult to distinguish from the points where the threads merely cross.

Occurrence. Silurian: Jupiter (1, 5–8), near Jupiter river.

Vinella multiradiata Ulrich and Bassler

Vinella? multiradiata Ulrich and Bassler, Smith. Misc. Coll. (Quart. Issue), vol. 45, p. 276, Pl. 68, fig. 8 (1904); Bassler, U.S. Geol. Surv., Bull. No. 292, p. 13, Pl. 4, fig. 1 (1906).

An example of this species consists of a closely interwoven mat of threads radiating from a number of well-marked nuclei. The Anticosti specimen presents all of the characters of the type save that it consists of a single nucleus with its numerous radiating threads. The microscopic structure of this latter specimen is better preserved than in the type and shows the organism to be of the same nature as the other thread-like bryozoa referred to the Ctenostomata.

Occurrence. Silurian: Jupiter (9), Shallop creek.

Allonema botellus (Vine)

Rhopalonaria botellus Vine, Ann. and Mag. Nat. Hist., ser. 5, vol. XIV, p. 85, fig. IV, 3 (1884); Proc. Yorkshire Geol. and Polyt. Soc., vol. IX, p. 185; Pl. 12, fig. 11 (?12) (1887).

Several imperfect although apparently typical specimens of this species, which has hitherto been known only from the Silurian of England and Scotland, were identified in the Jupiter River beds. In this genus the internodes form strings of sausage-shaped links and the specific characters are founded mainly upon the dimensions of these links. In *A. botellus* the links average about 0·5 mm. in length, and their width varies from 0·1 to 0·15 mm. Growth is usually upon some brachiopod shell, although crinoid columns and other objects may be encrusted by these delicate bryozoa. The only other bryozoan with which the present species need be compared is *A. curtum* described below, which is more delicate in all respects.

Occurrence. Silurian: Jupiter (2,10), East cliff and rivière du Pavillon.

Allonema curtum n. sp.

Plate VI, figure 1

This neat new species, although closely allied to the foregoing, may readily be distinguished by its more delicate growth and shorter internodes. In *A. botellus* the average internode is 0·5 mm. in length, whereas in *A. curtum* the internodes are seldom over 0·3 mm. long.

Occurrence. Ordovician: Ellis Bay (4, 5), Ellis bay. Silurian: Jupiter (1), Jupiter river.

Ascodictyon siluriense Vine

Ascodictyon stellatum Vine, Quart. Jour. Geol. Soc., London, vol. 37, p. 618 (Not Nicholson and Etheridge) (1881); *A. s.* var. *siluriense,* Vine, ibid., vol. 38, p. 52, figs. 1, 2 (1882): Vine, Ann. and Mag. Nat. Hist., ser. 5, vol. 14, p. 81, fig. 7 (1884); Vine, Proc. Yorkshire Geol. and Polyt. Soc., vol. 9, p. 184, Pl. 12, fig. 6 (1887); *Ascodictyon siluriense,* Vine, ibid., vol. 12, p. 88, Pl. 2, fig. 1 (1892); Ulrich and Bassler, Smith. Misc. Coll. (Quart. Issue), vol. 45, p. 286, Pl. 68, figs. 11, 12 (1904); Bassler, U.S. Geol. Surv., Bull. No. 292, p. 14, Pl. IV, figs. 6-8 (1906).

The pyriform radially arranged vesicles and the delicate connecting threads of this cosmopolitan Silurian species form a zoarium so different from associated bryozoa that comparison is unnecessary.

Occurrence. Silurian: Jupiter (1, 4, 5), cape Ottawa.

Order, **Cyclostomata**

Stomatopora siluriana n. sp.

Plate VI, figure 2; Plate V, figure 6

This new species in general form and method of growth is closely related to the very abundant Trenton and Cincinnatian bryozoan *S. arachnoidea* Hall, but differs in two conspicuous features. These are:

first, the more robust zoarium and generally larger proportions; and, second, the presence of fine, transverse wrinkles or striations on the zooecia. The latter feature is interesting in that such striations are present on most of the simple encrusting cyclostomata of the Silurian and are absent entirely on all known Ordovician forms.

The type specimen, of which a part is shown in the illustrations, encrusts a small cup coral and presents the following additional features. The zoarium branches dichotomously at frequent intervals; the apertures are circular, somewhat elevated, and slightly contracted with a well-marked peristome when perfect; about six apertures occur in 3 mm.

Occurrence. Ordovician: Ellis Bay (4, 5), Ellis bay, rare.

Stomatopora arachnoidea (Hall)

Aulopora arachnoidea Hall, Pal. New York, vol. I, p. 76, Pl. XXVI, figs. 6a-c, and woodcut on p. 76 (1847); Nicholson, Pal. Ohio, vol. II, p. 216, Pl. XXIII, figs. 1, 1b (1875); Nicholson, Rept. 44th Meeting Brit. Assoc. Adv. Sci., Notes and Abstracts, p. 90 (1875); Emmons, Am. Geol., vol. I, pt. II, p. 230, text fig. 83, Pl. 7, fig. 6 (1855); Chamberlin, Geol. Wisconsin, vol. I, p. 173, fig. (1883); *Stomatopora arachnoidea* Nickles and Bassler, U.S. Geol. Surv., Bull. No. 173, p. 419 (1900); Cummings, Dept. Geol. and Nat. Res. Indiana, 32nd Ann. Rept., p. 885, Pl. 32, figs. 2-2c (1908); Bassler, U.S. Nat. Mus., Bull. No. 77, pp. 60, 61, text fig. 7 (1911).

Among the encrusting bryozoa of the Ellis Bay formation is a small Stomatopora which differs in no appreciable manner from the long-ranging and widely-distributed *S. arachnoidea* Hall. The same formation holds quite a distinct species of Stomatopora, here described as *S. siluriana*, which differs conspicuously in having a transversely annulated, more robust zoarium and larger zooecial apertures.

Occurrence. Ordovician: Ellis Bay (9), Ellis bay.

Corynotrypa dissimilis (Vine)

Aulopora sp. Hall, Nat. Hist. New York, Pal., vol. I, Pl. 50, figs. 27, 29 (1852); *Stomatopora dissimilis* Vine, Quart. Jour. Geol. Soc. London, vol. 37, pp. 615, 616, figs. 1-8 (1881); Vine, Quart. Jour. Geol. Soc. London, vol. 38, p. 50 (1882); Bassler, U.S. Geol. Surv., Bull. No. 292, pp. 15, 16, Pl. 4, figs. 15-19 (1906); *Corynotrypa dissimilis* Bassler, Proc. U.S. Nat. Mus., vol. 39, p. 523, text figs. 23, 24 (1911); Bassler, U.S. Nat. Mus., Bull. No. 77, pp. 68, 69, text fig. 14 (1911); *Stomatopora recta* Ringueberg, Bull. Buffalo Soc. Nat. Sciences, vol. V, p. 20, Pl. 2, figs. 15, 15a (1886).

This parasitic bryozoan occurs on the surfaces of brachiopods of the horizons noted. Its club-shaped zooecia are about 0·1 mm. in diameter at the small end, and about 0·35 mm. at the distal end. The zooecia are characterized by fine, transverse wrinkles.

Occurrence. Ordovician: Ellis Bay (1, 4, 8), Junction cliff and Ellis bay. Silurian: Jupiter (1), Jupiter river.

Corynotrypa elongata (Vine)

Stomatopora dissimilis var. *elongata* Vine, Quart. Jour. Geol. Soc. London, vol. XXXVIII, p. 50 (1882); *S. elongata* Vine, Ann. and Mag. Nat. Hist., ser. 5, vol. XIV, p. 85, fig. IV, 2 (1884); Bassler, U.S. Geol. Surv., Bull. No. 292, pp. 14, 15, Pl. 4, figs. (1906); *S. parva* Ringueberg, Bull. Buffalo Soc. Nat. Sciences, vol. V, p. 20, Pl. 2, fig. 16 (1886); *Corynotrypa elongata* Bassler, Proc. U.S. Nat. Mus., vol. 39, p. 510, text fig. 9 (1911).

Associated with the largest known species of *Corynotrypa*, *C. dissimilis*, is frequently found a more minute form which was described by Vine as *Stomatopora dissimilis* var. *elongata*. Several colonies of this minute form occur in the collections from the Gun River formation. The species has been described by the present writer as follows:

Zoarium encrusting foreign objects, the smooth epitheca of corals or bryozoa being most favoured in the American examples. Zooecia uniserial, branching at irregular intervals, slender, fusiform, increasing slowly in size from a diameter of 0·03 to 0·04 mm. at the proximal end to one of 0·15 to 0·18 mm. at the distal or anterior end, which, although normally rounded, is in some cases slightly drawn out. An average zooecium is 0·60 mm. in length; when arranged in a straight line, seven zooecia may be counted in the space of 4 mm. Aperture small, rounded, subterminal, with a slightly elevated border and less than half the greatest width of the zooecium in diameter. Surface of the zooecia smooth, probably finely porous.

The very much larger and relatively shorter, transversely wrinkled zooecia of the associated *C. dissimilis* are so different that comparisons are unnecessary.

Occurrence. Silurian: Jupiter (1), Jupiter river.

Phacelopora pertenuis Ulrich

Phacelopora pertenuis Ulrich, Geol. Surv., Illinois, vol. VIII, p. 406, Pl. XXIX, figs. 1-1c (1890); Keyes, Geol. Surv., Missouri, vol. V, p. 13, Pl. XXXIII, fig. 3 (1894); Simpson, State Geol., New York, for 1894, 14th Ann. Rept., p. 600, figs. 207-208 (1897); Grabau and Shimer, N.A. Index Fossils, vol. I (11), p. 121, fig. 178 (1907).

The discovery of this very interesting and unique bryozoan on the island of Anticosti is fair evidence of the wide distribution of these delicate organisms. The species is so different from all other bryozoa that comparisons are not necessary. Careful search upon slabs of limestone is required, otherwise its thread-like zoarium will be easily overlooked.

Occurrence. Ordovician: English Head (2), English head.

Protocrisina exigua Ulrich

Protocrisina exigua Ulrich, Geol. Surv., Illinois, vol. VIII, p. 405, Pl. XXIX, figs. 4-4c, Pl. LIII, figs. 11, 11e (1890); Ulrich, Zittel's Textb. Pal. (Eng. ed.), fig. 417 (p. 262), 1896; Cumings, Am. Jour. Sci., ser. 4, vol. XX, Pl. 7, fig. 53 (1905); Bassler, U.S. Nat. Mus., Bull. 77, p. 73, text fig. 17 (1911); *Crisinella exigua* Wiman, Bull. Geol. Univ., Upsala, vol. 5, pt. 2, p. 181, Pl. 6, figs. 12-16 (1902).

The narrow bifurcating branches celluliferous on one side only and with small accessory pores distributed irregularly on both faces of the zoarium, distinguish this from all associated bryozoa.

Occurrence. Ordovician: Vauréal (4), Battery point.

Diploclema sparsum (Hall)

Trematopora sparsa Hall, Nat. Hist., New York, Pal. II, p. 155, Pl. 40A, figs. 12a-d (1852); *Diploclema sparsa* Ulrich, Geol. Surv., Illinois, vol. VIII, p. 368, Pl. 53, fig. 10 (1890); Grabau, New York State Mus. Nat. Hist., Bull. No. 45, p. 162, fig. 57 (1901); Bassler, U.S. Geol. Surv., Bull. No. 292, p. 17, Pl. V, figs. 6, 7; Pl. XXIII, figs. 4-6 (1906).

The widely separated rounded apertures and the small branches, celluliferous on all sides, readily distinguish this neat species.

The Anticosti specimens referred to the species vary in no way apparently from the type form.

Occurrence. Silurian: Jupiter (2, 4-10), East cliff, Jupiter river, Jumpers, etc.

Mitoclema (?) minutum n. sp.

Plate V, figure 7

This minute bryozoan has been known to the Cincinnati palæontologists for some years as a very abundant fossil in the lower part of the Richmond group of Ohio and Indiana. These specimens are in so much better state of preservation than the Anticosti examples that the Ohio examples have been chosen for illustration. The zoarium is of very small, somewhat flattened branches, 0·30 to 0·35 mm. in diameter, with the zooecia tubular, projecting outward, 3 or 4 in 2 mm., and arranged in ascending spiral series.

The affinities of this species are with *M. ? mundulum* Ulrich from the Black River shales of Minnesota, but the slightly flattened branches and especially the less number of zooecia in a given space are sufficient points of difference. The generic relationships of both *M. mundulum* and *M. minutum* are uncertain, and it is possible both belong to the genus *Diploclema*.

Occurrence. Ordovician: Vauréal (3), cape Henry.

Ceramopora niagarensis var. *germana* n. var.

Plate V, figure 8; Plate VI, figures 3, 4

Ceramopora niagarensis Bassler, U.S. Geol. Surv., Bull. No. 292, pp. 19, 20, Pl. 6, figs. 11-13 (1906).

The specimens upon which this new variety is founded are lamellate expansions with a smooth, celluliferous surface and epithecated underside, differing from *C. niagarensis*, first, in that the zooecia are larger and more regularly arranged, and, second, that the lunarium is less distinct. Another point of difference is in the manner of growth, *C. niagarensis* being usually encrusting and the present variety lamellate.

Although this new variety and *C. niagarensis* are at present believed to be closely related, it is possible that more extended collections will show both to be good species. The external aspect of the two is quite different, the regularity of arrangement of the zooecial apertures in the variety being quite in contrast with the regular arrangement in *C. niagarensis*.

Occurrence. Ordovician: Ellis Bay (1, 4), Ellis bay. Silurian: Jupiter (1), west of Jupiter river.

Chilotrypa circe (Billings)

Plate VI, figures 12, 13; Plate XI, figures 10, 11

Helopora circe Billings, Cat. Sil. Foss., Anticosti, p. 39, 1866.

The type specimen of *Helopora circe* has apparently been lost, but there is no difficulty in identifying this form as a species of *Chilotrypa* not uncommon in the Jupiter formation. Although closely related to the very abundant *Chilotrypa ostiolata* (Hall) of the Rochester shale, *C. circe* may be distinguished by its slightly smaller zooecia and less-developed lunaria.

Occurrence. Silurian: Jupiter (4-9), most exposures.

Order, **Trepostomata**

Atactoporella spicata n. sp.

Plate V, figures 9, 10; Plate VI, figures 5, 6, 7

Zoarium, a thin crust about 1 mm. in thickness over shells and other foreign objects. Surface comparatively smooth with the maculæ about 3 mm. distant from each other and seldom rising into low, broad monticules. Under a hand lens the surface is seen to be hirsute on account of the development of numerous large acanthopores. Zooecial apertures irregularly angular in the most mature stage with thick walls much inflected by the acanthopores. In the younger stages the zooecia are less angular and a few mesopores may be noted. Seven zooecia may be counted in the space of 2 mm. Acanthopores of large size situated usually at the zooecial angles. Besides the acanthopores the walls, especially in thin sections, exhibit numerous large granules. The internal characters are illustrated on Plate VI and show the present species to be closely allied to *A. schucherti* Ulrich from the Richmond of Ohio and Indiana. *A. spicata* differs, however, in having larger zooecia, thicker walls, and more strongly developed granules. The species is typical of the genus and is interesting in being the youngest known form.

Occurrence. Ordovician: Ellis Bay (4), Ellis bay, rare.

Homotrypa anticostiensis n. sp.

Plate VI, figure 8; Plate VII, figures 1, 2, 3

Zoarium of subcylindrical branches, averaging about 7 mm. in diameter, and frequently dividing. Surface smooth and exhibiting well-marked, solid, maculæ, 4 mm. apart, composed entirely of mesopores.

Zooecial apertures angular, thin-walled, with many more mesopores than are usual in the genus; 8 to 9 zooecia in 2 mm.; acanthopores very small or entirely wanting; mesopores rather numerous among the zooecia.

The internal structure shows this species to be closely related to *H. ? intercalaris* from the Black River shales of Minnesota. Indeed, there can be little doubt that *H. anticostiensis* is a direct descendant of this peculiar form, which on account of its numerous tabulated mesopores cannot be considered a typical species of *Homotrypa*. Compared with other ramose bryozoa of the Anticosti rocks *H. anticostiensis* can be distinguished at once by the numerous cystiphragms lining the zooecial tubes. *Prasopora canadensis* also has cystiphragms, but its growth is quite different and the zooecia are angular and in contact.

Occurrence. Ordovician: English Head (4), Carleton point, High cliff, and rivière à l'Huile; Vauréal (1-6), Vauréal river, rivière à l'Huile, and Girard cove.

Prasopora canadensis n. sp.

Plate VIII, figures 1, 2, 3

This new species is closely related to *Prasopora (Monticulipora) grandis* Ulrich from the Black River shales of Minnesota and like it has a zoarium that is irregularly massive, tending to become lobate or subramose. The zooecial structure and the tabulation are also very similar, but one decided difference between the two lies in the smaller apertures of *Prasopora canadensis*. In *P. grandis* 6 to 7 zooecia may be counted in a distance of 2 mm., whereas in *P. canadensis* 8 to 9 occur in the same distance. The internal characters of the present species are illustrated on Plate VIII fully enough not to require more detailed description.

Occurrence. Ordovician: English Head (4), Makasti cliff and rivière à l'Huile; Vauréal (1, 4), White cliff and Battery point.

Aspidopora siluriana n. sp.

Plate VII, figure 4; Plate VIII, figures 4, 5

Zoarium, a thin concavo-convex expansion 1 to 2 centimetres in diameter, and a mm. or more in thickness. Undersurface concave, with a concentrically marked epithecal membrane; upper surface smooth, convex, celluliferous. Zooecial apertures rounded to angular, according to the number of mesopores which vary in different parts of the zoarium; about 6 zooecia in 2 mm., acanthopores present but indistinct, both at the surface and in thin sections; maculæ rather inconspicuous, but consisting of the usual groups of larger zooecia.

The internal characters illustrated on Plate VIII show this to be a typical species of *Aspidopora* closely allied both in internal and external features with the lower Cincinnation forms of the genus. There is no species in the Anticosti formations with which it need be compared.

Occurrence. Ordovician: Ellis Bay (1, 2, 4), Junction cliff and Ellis bay, rare.

Leptotrypa crassa n. sp.

Plate VI, figures 9, 10, 11; Plate VII, figure 5

Stenopora papillata (McCoy) Billings, Cat. Sil. Foss., Anticosti, p. 7, 1866.

The type and only known specimen (Geol. Surv., Canada), consisting of a single zoarial layer encrusting an Orthoceras, was identified by Billings with the frequently quoted but little known *Stenopora or Nebulipora papillata* McCoy. Even at the present time the characters of McCoy's species are unknown, so that his species has no standing. Externally Billings' specimen closely resembles the monticulated species of *Spatiopora* from the Richmond group, but an examination of its surface with a hand lens shows it to belong to *Leptotrypa*, differing from all other of the genus by its thick-walled zooecia with numerous large acanthopores and by the elongated tubercules of the surface, of which there are three in a space of 12 mm. The monticules are composed almost entirely of small, mesopore-like cells with greatly thickened walls. Elsewhere mesopores are absent. The true zooecia are angular and are bounded by thick walls, between which there is a well-defined, clear area. Larger and clean-cut acanthopores are developed at the junction angles of the zooecia. Thin sections reveal the structure characteristic of *Leptotrypa*. Diaphragms are few, occurring only at the base of the mature zone. In the intermacular areas about 8 zooecia may be counted in a distance of 2 mm.

Occurrence. Ordovician: English Head (2), English head.

Type, National Museum of Canada.

Cyphotrypa bulbosa (Billings)

Plate VII, figure 18; Plate VIII, figures 8, 9

Stenopora bulbosa Billings, Can. Nat., N.S., vol. II, p. 429; Cat. Sil. Foss., Anticosti, p. 32, 1866.

Billings' description of this species is insufficient for its recognition, but the type specimen fortunately has been preserved and the name can be retained. The specimen is a typical *Cyphotrypa* found abundantly in all zones of the Ellis Bay formation at practically all its southern exposures. The zoarium is a smooth, globular mass as a rule 2 to 3 cm. in diameter, although some grow to a width of 6 cm., composed of polygonal thin-walled zooecia, of which 7 occur in 2 mm. Mesopores are absent; acanthopores although present are so small as to be detected only in thin sections. Maculæ composed of slightly larger zooecia are, as usual, present at regular intervals, but they are an inconspicuous feature of the surface. Diaphragms are not so abundant as in certain other species of the genus, but in the mature zone they occur at intervals of a tube diameter.

Although closely resembling certain undescribed species of *Cyphotrypa*, *C. bulbosa* is too different from other Anticosti bryozoa to require comparison. *Cyphotrypa polygona*, the next species, differs in its conspicuously larger and regularly polygonal zooecia.

Occurrence. Ordovician: Ellis Bay (1, 2, 4-7, 9), Junction cliff and Ellis bay.

Cyphotrypa polygona n. sp.

Plate VII, figure 6; Plate VIII, figures 6, 7

This species forms a globular zoarium quite similar in size and other external characteristics to the preceding *C. bulbosa*, but may be distinguished at once with a hand lens by its larger and very regular, polygonal, usually hexagonal zooecia with well-marked clusters or maculæ of considerably larger cells. In vertical sections or in fractures the differences are even more marked. Here, numerous slightly curved diaphragms may be noted, averaging about 1 to a tube diameter in the immature zone and about 3 in the same space in the mature region. Undoubted acanthopores have not been detected, although certain slight thickenings at the zooecial junction angles are probably of this nature. Of the smaller intermacular zooecia 5 to 6 may be counted in 2 mm., but the larger macular zooecia number only 4 in the same length.

Occurrence. Ordovician: Ellis Bay (1), Junction cliff.

Nicholsonella parvula n. sp.

Plate VII, figure 7; Plate IX, figures 1, 2

Several specimens of a small explanate species of *Nicholsonella* were found in the Ellis Bay formation, apparently closely allied to *N. ringuebergi* Bassler of the Rochester shale of New York. Comparisons and the study of thin sections showed that the present species differs conspicuously from the New York form in its larger mesopores, wider zooecial interspaces, and smaller granular acanthopores. The method of growth and size of zooecia are much alike in the two species. The small floriform apertures, many acanthopores, explanate growth, and the smaller granular acanthopores, externally, and internally the general granular structure, will readily distinguish *Nicholsonella parvula* from other Anticosti bryozoa.

Occurrence. Ordovician: Ellis Bay (4, 9), east of Junction cliff and Ellis bay.

Dianulites insueta n. sp.

Plate VII, figure 8; Plate IX, figures 3, 4, 5

Zoarium, a lobate mass, the type specimen being 6 mm. in diameter at the base and 8 mm. high. Celluliferous surface smooth with the inconspicuous maculæ composed of slightly larger zooecia. Granular acanthopores present, but seldom visible at the surface. Zooecial walls with the granular structure characteristic of *Nicholsonella* and *Dianulites*. Diaphragms average a tube diameter apart in the immature zone and about 3 in the same distance in the mature region. Zooecia regularly polygonal, usually hexagonal, 3 to 4 in 2 mm. In thin sections the characteristic features are the general granular structure of the zooecial walls and the granular acanthopores situated at the angles.

This species is a typical *Dianulites* and differs from the common Ordovician form, *D. petropolitana*, in its lobate growth, slightly larger zooecia, greater development of diaphragms, and particularly in the presence of acanthopores.

Occurrence. Ordovician: English Head (3), English head.

Dianulites globularis n. sp.

Plate IX, figures 6, 7, 8

The specimens upon which this species is founded exhibit all the characters of typical *Dianulites* and are closely related to the preceding form *D. insueta.* They differ, however, in having a globular zoarium, slightly smaller zooecia (4 to $4\frac{1}{2}$ in 2 mm.), thinner walls, and fewer diaphragms. As many of the mesopores are closed before the surface is reached, the exterior of the species is quite similar to the preceding. Mesopores are present, but are to be noted mainly in thin sections. Tangential sections are particularly interesting in showing the large, granular acanthopores and the numerous smaller granules of which the zooecial walls are largely composed. The diaphragms marked with radial rows of granules and characteristic of this and other genera of the Constellaridae are best seen in such sections.

Occurrence. Ordovician: Ellis Bay (4), Ellis bay.

Bythopora striata Ulrich

Bythopora striata Ulrich, Cont. Micro-Pal. Cambro-Sil., pt. 2, p. 36 (1889); Whiteaves, Pal. Foss., vol. III, Geol. Surv., Canada, p. 116 (1895); Cumings, Dept. Geol. and Nat. Res., Indiana, 32nd Ann. Rept., p. 784, Pl. 27, fig. 4 (1908).

The very slender, in many cases bifurcating, branches and the long-drawn out zooecial apertures, giving a longitudinally striated appearance to the zoarial surface, cause this species to be easy of recognition.

Occurrence. Ordovician: English Head (3, 4), MacDonald river and rivière à l'Huile; Vauréal (1–3, 6), MacDonald river and rivière à l'Huile.

Eridotrypa simulatrix (Ulrich)

Batostomelle simulatrix Ulrich, Geol. Surv., Illinois, vol. VIII, p. 432, Pl. XXXV, figs. 1, 1g (1890); *Eridotrypa simulatrix* Ulrich, Geol. Minnesota, vol. III, p. 265 (1893); *Monticulipora simulatrix,* J. F. James, Jour. Cincinnati Soc. Nat. Hist., vol. XVI, p. 194 (1894); *Eridotrypa simulatrix* Cumings, Dept. Geol. Nat. Res., Indiana, 32nd Ann. Rept., p. 828, Pl. 16, figs. 4, 4b; Pl. 29, figs. 5, 5a (1907).

This species is represented in the Anticosti strata by specimens identical with those of the Cincinnati region.

Occurrence. Ordovician: English Head (3, 4), English head and Carleton point; Vauréal (1, 3), High cliff and cape Henry.

Lioclemella nitida (Ulrich)

Trematopora nitida Ulrich, Geol. Surv., Illinois, vol. VIII, p. 419, Pl. XXXIV, figs. 2, 2f (1890); *Lioclemella nitida* Foerste, Geol. Surv., Ohio, vol. VII, p. 600 (1895).

Since the original description of this species was written the author of the species collected numerous specimens, showing that the base of the branches was pointed and that the zoarium was jointed at regular intervals.

This character alone is sufficient to distinguish it from associated trepostomatous bryozoa in the rocks of Anticosti.

Occurrence. Ordovician: Vauréal (1, 4), White brook and Battery point.

Lioclema variporum (Billings)

Plate VIII, figures 10, 11; Plate IX, figures 12, 13

Helopora varipora Billings, Cat. Sil. Foss., Anticosti, p. 40, 1866.

The type specimen of this species was found associated with *Trematopora* (*Helopora*) *irregularis* Billings, and proved to be a crushed example of a ramose *Lioclema* found very abundantly in the Jupiter formation. Although the type being crushed suggested that the zoarium was hollow as stated by Billings, it is solid, in reality, as indicated by other specimens.

The zooecia are small, thin-walled, angular, with very few acanthopores. The mesopores in many cases equal the zooecia in size, and are so numerous as to completely separate them. Six to 7 zooecia occur in 2 mm. The internal structure is that of a usual ramose *Lioclema*.

Occurrence. Silurian: Jupiter (5, 9, 10), probably all exposures.

Hallopora elegantula (Hall)

Callopora elegantula Hall, Pal. New York, vol. II, p. 144, Pl. XL, figs. 1a-m (1852); Bassler, U.S. Geol. Surv., Bull. No. 292, p. 41, Pl. 17, figs. 11–15; Pl. 26, fig. 12 (1906).

Contrary to its usual occurrence only a few examples of the widespread *H. elegantula* were found in the Anticosti rocks. Externally and in thin sections, these present the usual specific characters which are noted below.

Zoarium ramose, of frequently branching stems 3 to 5 mm. in diameter; surface smooth, the maculæ distinguished by the presence of zooecia slightly larger than the average and of mesopores more abundant than usual. Zooecia thin-walled, rounded, 4 to 5 in 2 mm., separated by a variable number of angular, thin-walled mesopores, many of which are numerous enough to isolate the zooecial tubes. Zooecial apertures closed in the perfect state by ornamented covers or opercula, having a central circular perforation with a diameter about two-fifths that of the zooecia. Six to 8 well-marked ridges distributed at equal distances from each other radiate from the central opening to the margin.

Occurrence. Silurian: Jupiter (1), west of Jupiter river.

Hallopora elegantula prolifica n. var.

Plate X, figures 1, 2

Although the characteristic Silurian bryozoan *H. elegantula* Hall is present on the island of Anticosti, this species is more abundantly represented by a variety which differs from the typical form in its more robust zoarium and more numerous diaphragms. The average specimens of the variety, for which the new name *prolifica* is suggested, are 7 mm. in diameter, whereas the species itself is seldom over 4. The tabulation of the mesopores is very similar to *H. elegantula*, but in the zooecia the diaphragms are closely crowded as shown on plate.

Occurrence. Ordovician: Ellis Bay (4–10), Ellis bay. Silurian: Becscie (1), Fox bay.

Hallopora magnopora (Foerste)

Callopora magnopora Foerste, Bull. Sci. Lab. Denison Univ., vol. II, p. 173, vol. III, Pl. XVI, fig. 5 (1887); Foerste, Geol. Surv., Ohio, vol. VII, p. 600, Pl. XXIX, fig. 5 (1895); Bassler, U.S. Geol. Surv., Bull. No. 292, pp. 42, 43, Pl. 15, figs. 1–8; Pl. 26, fig. 3 (1906).

Zoarium more or less irregularly ramose, the branches in some cases being subcylindrical and regularly dividing, but many consisting of gnarled stems irregular in shape; diameter of branches varying from 5 to 12 mm. or more, but averaging 7 or 8 mm. Surface smooth, maculæ of larger zooecia than those of the intermacular spaces, but not conspicuous. Zooecia larger than is usual in species of this genus, with subangular apertures and moderately thin walls, an average of 4 in 2 mm. Mesopores usually small and comparatively few at the surface, larger and more abundant at deeper zones in the zoarium. Opercula closing the zooecia not observed at the surface, but detected in tangential sections.

Specimens poorly preserved externally, but exhibiting the characters of this species in thin sections, were noted in the collections from the Ellis Bay formation. The zoarium and zooecia of *H. magnopora* are larger than other Silurian species of the genus, but in addition to this the species may be identified by the scarcity of diaphragms in the zooecial tubes.

Occurrence. Ordovician: Ellis Bay (1–3), Grindstone cliff.

Hallopora enodis n. sp.

Plate VII, figure 9; Plate X, figures 3, 4, 5

This new species is allied to the preceding *H. magnopora* Foerste, and differs more especially in its internal structure. The zoarial features and the size and shape of the zooecia are about the same in both species, but *H. enodis* exhibits more numerous mesopores at the surface and internally has very few diaphragms in the zooecial tubes and more distantly spaced diaphragms in the mesopores. In *H. magnopora* about 2 diaphragms may be counted in the diameter of a mesopore, but in *H. enodis* only 1 occurs on an average in the same space.

Occurrence. Ordovician: Vauréal (1, 4–6), White cliff, West point, and Vauréal river.

Hallopora gracilens n. sp.

Plate VII, figures 10, 11; Plate X, figures 6, 7, 8

Zoarium in this neat little species is of small, frequently dividing, smooth branches, averaging 2 mm. in diameter. In all of the numerous specimens seen the surface is without monticules, but the characteristic clusters of zooecia larger than the average are present. The zooecial apertures are angular and rather large, with comparatively few mesopores; 4 to 5 zooecia in 2 mm. measuring lengthwise.

Internally the distribution of the diaphragms is quite similar to many other species of *Hallopora*, differing most in that few are developed in the zooecial tubes. The large, angular zooecia, comparatively few mesopores, and few zooecial diaphragms, and the slender, smooth branches, are the diagnostic features of the species.

H. gracilens belongs to the typical or *H. elegantula* section of the genus, and indeed is closely related to the genotype. *H. elegantula* differs, however, in its larger proportions both in the zooecia and zoaria.

Occurrence. Ordovician: Vauréal (4, 5), Battery and West points.

Trematopora irregularis (Billings)

Plate VI, figures 14, 15

Helopora irregularis Billings, Cat. Sil. Foss., Anticosti, p. 39, 1866.

The type of *Helopora irregularis* proves to be a small species of *Trematopora* with a solid, ramose zoarium, the branches of which average a millimetre in diameter. The surface is smooth and shows no conspicuous maculæ. The zooecia are oval and are usually separated by small mesopores, many closed at the surface. Numerous, minute, granular acanthopores surround the zooecia. The internal structure is that of a typical *Trematopora*. The bulbous enlargements noted by Billings are simply fortuitous growths.

Occurrence. Silurian: Jupiter (5, 8-10), all exposures.

Batostoma billingsi n. sp.

Plate VII, figures 12, 13; Plate XI, figures 1, 2

Stenopora fibrosa Billings, Cat. Sil. Foss., Anticosti, p. 32, 1866.

The specimens which were identified by Billings as *Stenopora fibrosa* prove to belong to a fine, new species of *Batostoma* characterized by its symmetrical, regularly dividing, smooth branches, with conspicuous maculæ of larger cells in place of the usual monticules. The zooecial apertures are quite angular, usually hexagonal, and mesopores are seldom developed. Counting from the middle of the maculæ 4 zooecia are found in 2 mm., but of the ordinary intermacular zooecia 5 are found in the same space. The maculæ are placed 6 mm. apart, measuring from centre to centre. Although a few mesopores are seen in a few cases among the ordinary zooecia they are usually limited to the macular areas.

The internal structure of this species is that of a typical *Batostoma* with a minimum of mesopores. In tangential sections the dark line separating the adjoining zooecia, their angular shape, the scarcity of mesopores and small acanthopores developed usually at the angles, are the main features. Vertical sections show the usual crinkling of the walls in the immature zone, numerous tabulæ in the few mesopores that occur in the mature region, and from 2 to 3 diaphragms in the tube diameter in the zooecial tubes themselves.

The smooth zoarium, conspicuous maculæ, large angular zooecia, few mesopores, and slightly developed acanthopores are the characteristic features of this fine, abundant species.

Occurrence. Ordovician: English Head (4), Nid de Corbeau; Vauréal (1, 4, 6), White cliff, Battery point, and Vauréal river.

Order, **Cryptostomata**

Chasmatopora angulata (Hall)

Retepora angulata Hall, Pal. New York, vol. II, p. 49, Pl. XIX, figs. 3a-h (1852); Hall and Whitfield, Pal. Ohio, vol. II, p. 111, Pl. V, figs. 2-4 (1875); Geol. and Nat. Hist. Surv., Indiana, 12th Ann. Rept., p. 269, Pl. XIV, figs. 1-2 (1882); Lesley, Geol. Surv., Pennsylvania, Rept. P4, p. 861, text figs. (1889). *Phylloporina angulata* Foerste, Bull. Sci. Lab. Dennison Univ., vol. II, p. 151 (1887); ibid., vol. III, Pl. XV, fig. 1 (1888); Geol. Surv., Ohio, vol. VII, p. 600, Pl. XXVIII, fig. 1 (1895); *Subretepora angulata; Retepora daytonensis* Hall and Whitfield, Geol. Surv., Ohio, Pal., vol. II, p. 111 (1875) (proposed at end of description).

A single specimen of this species which is quite abundant in the Clinton formation of New York and in the Brassfield of Ohio, was found in the Anticosti collections. It agrees so well with the original types that there is little doubt in its identification as *C. angulata.*

Occurrence. Ordovician: Ellis Bay (5), Ellis bay.

Chasmatopora granistriata (Ulrich)

Phylloporina granistriata Ulrich, Geol. Surv., Illinois, vol. VIII, p. 639, Pl. XXIX, figs. 3, 3a (1890).

This species is extremely rare in the Anticosti section, and also in the Girardeau limestone of Illinois from which it was described.

Occurrence. Ordovician: Vauréal (4), Battery point.

Fenestella bella n. sp.

Plate XII, figures 1, 2

The fine specimen upon which this species is based was studied by Billings, who recognized it as a new species, but failed to note it in his catalogue of fossils from Anticosti. The type (No. 2494, Geol. Surv., Canada) shows only the non-celluliferous side, but thin sections of another specimen enclosed in rock indicate the species to be a typical *Fenestella.* As will be noted from the figure on Plate XII, the fenestrules are elongate oval and 4 occur in 5 mm. measuring longitudinally, whereas 8 to 9 may be measured in the same space transversely. The non-celluliferous surface is faintly striated, but the size of the fenestrules will distinguish this from all other Silurian species of *Fenestella.*

Occurrence. Silurian: Chicotte (2), Chicotte river and Southwest point.

Fenestella anticostiensis n. sp.

Plate XI, figure 13; Plate XIII, figure 1

The rather large fenestrules, their quadrangular shape, and the considerable width of the branches are the diagnostic features of this fine species. Measuring lengthwise 3 fenestrules occur in 3 mm. and 4 in the same space transversely. As will be noted from the figure, the branches are in many cases as broad as the fenestrules, but the dissepiments are quite narrow. The carina is well developed but plain; 3 to 4 zooecia occur to a fenestrule.

Occurrence. Silurian: Jupiter (8, 10), Little river and Jumpers; Chicotte (2), pointe des Morts.

Fenestella jupiterensis n. sp.

Plate XI, figure 14; Plate XIII, figures 2, 3

This new species is quite similar to several early Silurian species, but differs from all the valid described forms in its measurements. Measured lengthwise 4 to 5 fenestrules occur in 3 mm., and 6 in the same space measured transversely. The carina is developed, but is without ornament. Three zooecia occur to a fenestrule.

F. anticostiensis, another Jupiter species, is somewhat similar, but differs in its greater dimensions.

Occurrence. Silurian: Jupiter (7, 9), Box brook, cape Ottawa, and rivière du Pavillon.

Semicoscinium pretiosum n. sp.

Plate XI, figure 12; Plate XIII, figures 4, 5

Although closely related to the two described Middle Silurian species, *S. acmeum* and *S. tenuiceps* (Hall), the specimens for which the above new name is proposed differ in having distinctly larger fenestrules. In this new species 3 fenestrules may be measured in 3 mm. longitudinally, whereas in the other species mentioned, the number in the same space is not less than 4. As in other Silurian species of *Semicoscinium* the fenestrules of *S. pretiosum* are much as in *Fenestella*, leaving the sharp, prominent carina as the most characteristic feature. The subrhomboidal or rounded fenestrules of typical *Semicoscinium* are not developed until the early Devonian.

The figured types were found in the Gun River formation, zone 3, at the cliffs up Gun river.

Occurrence. Silurian: Gun River (3), Gun River cliffs; Jupiter (8, 9), Bell and Iron rivers; Chicotte (2), Death point.

Thamniscus striatoporus (Billings)

Plate XIV, figures 16, 17

Helopora striatopora Billings, Cat. Sil. Foss., Anticosti, 1866, p. 39; *Nematopora striatopora* Ulrich, Geol. Surv., Illinois, vol. VIII, p. 645 (1890); *Nematopora? striatopora* Ulrich, Am. Geol., vol. I, p. 232, footnote (1888).

The type specimen described by Billings proves to be a species of *Thamniscus* so embedded in the rock that at the lower end a few zooecia of the celluliferous side are shown, and the remaining part of the zoarium exposes only the striated non-celluliferous side. The species is closely allied to *Thamniscus dichotomus* (Hall) from the Rochester shale of New York and Ontario, but may be distinguished at once by its less frequent bifurcation. The pore-like striations of the non-celluliferous side from which the specific name was taken are well developed in *T. striatopora,* although this feature is common to most of the species of the genus. The zooecial structure in both of the species mentioned is very similar, and until more specimens of *T. striatopora* are available the more frequent branching must be relied upon to distinguish the two.

Occurrence. Silurian: Jupiter (4, 6), cape Jupiter and Cormorant point.

Helopora formosa Billings

Plate XIV, figures 1, 2, 3

Helopora formosa Billings, Cat. Sil. Foss., Anticosti, p. 37, 1866; *Nematopora formosa* Ulrich, Geol. Surv., Illinois, vol. VIII, p. 645 (1890); *Helopora nodosa* Billings, Cat. Sil. Foss., Anticosti, p. 38, 1866.

The type specimen of *H. formosa* (No. 2356, Geol. Surv., Canada) represents a species of *Helopora* occurring at numerous localities on the island of Anticosti in all the formations from the Ellis Bay to, and including, the Jupiter. The type of *H. nodosa* is missing, but this species seems to be founded upon simply a variation of *H. formosa.*

The type is from the Jupiter formation, East point, Anticosti.

Occurrence. Ordovician: Ellis Bay (5–10). Silurian: Becscie (1–4); Gun River (1–4); Jupiter (1–10). Common throughout.

Helopora concava Billings

Plate XIV, figure 7

Helopora concava Billings, Cat. Sil. Foss., Anticosti, p. 37, 1866.

Although closely resembling young stages of the associated *H. formosa*, *H. concava* is a more delicate species and may be distinguished by its regular 4-sided zoarium, the depression at the anterior end of the zooecia, and the slight development of granules along the ridge separating the rows of apertures.

The type (Cat. No. 2355, Geol. Surv., Canada) was found in the Jupiter formation 2 miles east of Jupiter river.

Occurrence. Ordovician: Ellis Bay (9), Lousy cove. Silurian: Gun River (1–4), most exposures; Jupiter (1–10), most exposures.

Helopora armata Billings

Plate XI, figure 5

Helopora armata Billings, Cat. Sil. Foss., Anticosti, p. 38, 1866.

The type of the species has been lost, and no other specimens identical with the detailed description given above have been found in the collections from East point. However, in the Jupiter formation a small *Helopora* or possible *Arthroclema* agreeing well in all particulars with the description of *Helopora armata* is found somewhat rarely. None of these specimens is perfect enough to determine the exact generic placement and until better material is obtained it is thought best to leave this species under *Helopora.*

Occurrence. Silurian: Jupiter (2, 9), East point and Iron river.

Helopora lineopora Billings

Plate X, figures 14, 15, 16

Helopora lineopora Billings, Cat. Sil. Foss., Anticosti, p. 38, 1866; *Nematopora? lineopora* Ulrich, Geol. Surv., Illinois, vol. VIII, p. 645 (1890).

The type of this species proved to be the basal segment of a *Helopora* closely allied to *H. fragilis*. As usual the basal segments of these jointed bryozoa do not preserve the true zooecial characters, the ordinary cells being covered by a growth of sclerenchyma in which the original openings are represented by elongate pores. The zooecia are elongate, irregularly oval, 8 in 2 mm. measuring lengthways, and separated from each other by elongate mesopores varying considerably in outline.

Although closely related to *H. fragilis*, the type of the genus, *H. lineopora* is held as distinct until comparisons can be made with well-preserved specimens of the genotype.

Occurrence. Ordovician: Ellis Bay (4–10), Ellis bay. Silurian: Gun River (1, 4), St. Mary cliff and cape MacGilvray; Jupiter (1), west of Jupiter river.

Type specimen (Cat. No. 2433 Geol. Surv., Canada) came from zone 9 of the Jupiter formation, 2 miles west of Jupiter river.

Helopora imbricata Ulrich

Helopora imbricata Ulrich, Geol. Surv., Illinois, vol. VIII, p. 644, Pl. XXIX, fig. 5 (1890).

Although this species has been regarded as possibly representing the tertiary segments of *Arthroclema angulare* Ulrich with which it is associated both in Illinois and Anticosti, it is here recognized as valid until more complete collections can establish its relationship.

Occurrence. Ordovician: English Head (4), English head; Vauréal (1), White cliff.

Helopora bellula Billings

Plate XIV, figures 4, 5, 6

Helopora bellula Billings, Cat. Sil. Foss., Anticosti, pp. 38, 39, 1866.

The only character that is missing in the very good description by Billings is the fact that the zoarium in this species is composed of segments pointed at the lower end for articulation in sockets at the upper end of the preceding segment. The small joints of *H. bellula*, with the prominent spine at the head of the aperture, the distinct longitudinal groove between the zooecia, and their very regular arrangement, make this one of the most easily recognized bryozoa.

Occurrence. Silurian: Gun River (1–4); Jupiter (1–10). Common in all exposures.

The type specimen (Cat. No. 2434, Geol. Surv., Canada) was found in zone 5 of the Jupiter formation, 2 miles east of Jupiter river.

Sceptropora facula Ulrich

Sceptropora facula Ulrich, Am. Geol., vol. I, p. 229, fig. 1 (1888); Ulrich, Cont. Micro-Pal. Cambro-Sil., pt. II, p. 46, fig. 2 (1889); Ulrich, Geol. Surv., Illinois, vol. VIII, p. 401, fig. 15 (1890); Whiteaves, Pal. Foss., vol. III, Geol. Surv., Canada, pt. 2, p. 117 (1895); Simpson, State Geol. New York, for 1894, 14th Ann. Rept., p. 549, fig. 116 (1897); Bassler, U.S. Nat. Mus., Bull. 77, p. 153, text fig. 74 (1911).

This unique bryozoan of wide geographical range has been found to be one of the abundant fossils of the English Head and Vauréal formations whose thin-bedded limestones in many places exhibit numerous disjointed segments. Specimens showing the segments still joined together are rare, but have been noted in several instances. No other American bryozoan approaches this species in growth or in any other feature, so that its discrimination is quite easy.

Occurrence. Ordovician: English Head (1–4), all exposures; Vauréal (1), High cliff and rivière à l'Huile.

Arthroclema angulare Ulrich

Arthroclema angulare Ulrich, Cont. Micro–Pal. Cambro–Sil., pt. II, p. 45 (1889); Ulrich, Geol. Surv., Illinois, vol. VIII, p. 641, Pl. XXIX, figs. 6, 6b (1890); Whiteaves, Pal. Foss., vol. III, Geol. Surv., Canada, p. 117 (1895).

The Anticosti specimens are similar to those of Illinois and Manitoba. The species is not common.

Occurrence. Ordovician: English Head (2–4), English head and Nid de Corbeau; Vauréal (1), White cliff.

Nematopora lineata (Billings)

Plate VII, figures 20, 21

Helopora lineata Billings, Cat. Sil. Foss., Anticosti, p. 36, 1866; *Nematopora lineata* Ulrich, Am. Geol., vol. I, p. 232, footnote (1888); Ulrich, Geol. Surv., Illinois, vol. VIII, pp. 646, Pl. XXIX, figs. 7, 7e (1890); Bassler, U.S. Nat. Mus., Bull. 77, pp. 158, 159, text fig. 79 (1911).

The type of *Helopora lineata* proves to belong to a fine, abundant species of *Nematopora* differing from all other species of the genus in its oval zooecial apertures bounded by well-marked peristomes ornamented with granules, arranged in linear series between straight, sharp ridges which are likewise quite granulose. Measured longitudinally 6 apertures may be counted in 2 mm. There is no associated species with which this will be confused save *Glauconome strigosa*, which has similarly arranged, although much larger and more widely separated, apertures on its celluliferous side. The latter species, however, has one side non-celluliferous, whereas in *N. lineata* all sides bear apertures.

Occurrence. Ordovician: Vauréal (5, 6), Vauréal river; Ellis Bay (2, 4-10), most exposures.

The type specimen (Cat. No. 2251, Geol. Surv., Canada) was found in the Ellis Bay formation at Junction cliff.

Glauconome strigosa (Billings)

Plate XIV, figures 8, 9

Helopora strigosa Billings, Cat. Sil. Foss., Anticosti, p. 37, 1866; *Nematopora* (?) *strigosa* Ulrich, Am. Geol., vol. I, p. 232, footnote (1888); *Nematopora strigosa* Ulrich, Geol. Surv., Illinois, vol. VIII, p. 645 (1890); Species No. 1, Wiman, Bull. Geol. Inst. Univ. Upsala, vol. 5, pt. 2, No. 10, p. 181, Pl. 6, figs. 29–33 (1902); *Glauconome strigosa* Bassler, U.S. Nat. Mus., Bull. 77, pp. 161, 162, text fig. 81 (1911).

Although the type of this species appears to be lost, there is no difficulty in recognizing the form from Billings' careful description. This author, however, did not definitely mention that one side of the branch is non-striated, this character alone readily distinguishing it from the associated *Nematopora lineata*, which otherwise is quite similar. Another point of difference between the two species lies in the fact that the zooecia of *G. strigosa* are situated from each other from one to two times their own length.

Occurrence. Ordovician: Vauréal (4), Battery point; Ellis Bay (2-10), Junction cliff and Ellis bay.

Ptilodictya flagella Nicholson

Ptilodictya flagellum Nicholson, Ann. Mag. Nat. Hist., ser. 4, vol. XV, p. 179, Pl. XIV, figs. 3, 3b (1875); Nicholson, Pal. Ohio, vol. II, p. 262, Pl. XXV, figs. 4, 4b (1875); Lesley, Geol. Surv., Pennsylvania, Rept. P4, p. 827, text figs. (1889).

Associated with *Ptilodictya magnifica* in the English Head formation is a narrow, branched species of the same genus which is apparently identical with *P. flagella* described by Nicholson from the Richmond group of Ohio. The subquadrate zooecia with suboval apertures arranged in distinct longitudinal series, and the elongate, narrow, bifoliate zoarium, pointed at the lower end for articulation, will distinguish the present species from associated forms. *P. gladiola* is a quite similar, narrow, branched species, but differs most in having still narrower zoaria and larger zooecia, 9 occurring in a length of 3 mm., whereas 11 may be counted in the same space in *P. flagella*.

Occurrence. Ordovician: English Head (4), Carleton point and English head; Vauréal (4-6), Battery point and Vauréal river.

Ptilodictya canadensis Billings

Plate VII, figure 19; Plate IX, figure 9

Ptilodictya canadensis Billings, Cat. Sil. Foss., Anticosti, pp. 9, 10, 1866.

Zoarium fan-shaped, expanding from a point to 12 mm. in a length of 80 to 90 mm. The zooecia are oblong, arranged in longitudinal and transverse rows. The type specimen (2005, Geol. Surv., Canada) shows that measuring lengthwise 8 zooecia occur in a length of 3 mm.

Occurrence. Ordovician: English Head (4), Carleton point.

Ptilodictya sulcata Billings

Plate X, figures 9, 10, 11

Ptilodictya sulcata Billings, Cat. Sil. Foss., Anticosti, p. 35, 1866.

The narrow, unbranched zoarium, and the nearly square zooecia, of which there are 11 in 3 mm., measuring both longitudinally and transversely, are the two important features of this fine species. The wall-like projection or imperfect septum projecting from the side in the zooecial cavity is not observable in all specimens, but in some examples several projections of this sort may be noted in the same aperture. These projections are undoubtedly only a modification of the spines which are to be noted in most species of *Ptilodictya* and *Phaenopora* and related genera.

Occurrence. Silurian: Jupiter (2, 4, 10), East cliff, cape Jupiter, and rivière du Pavillon.

Cat. Nos. 2496 and 2501, Geol. Surv., Canada. The two type specimens described by Billings are from zone 10 of the Jupiter formation at the Jumpers.

Ptilodictya gladiola Billings

Plate X, figures 12, 13

Ptilodictya gladiola Billings, Cat. Sil. Foss., Anticosti, p. 10 (1866).

The specimen selected by Billings as the type of *P. gladiola* (No. 2353, Geol. Surv., Canada), proves to be a true species of *Ptilodictya* distinguished from all others by its exceedingly narrow zoarium and by the measurements of its zooecia. *P. flagella*, the most closely related species, differs in having a slightly broader and less regular zoarium, but especially in the size of its zooecia, 11 occurring lengthwise in 3 mm., whereas in *P. gladiola* only 9 occupy the same space.

Occurrence. Ordovician: Ellis Bay (2, 4–10). Silurian: Becscie (1-4); Gun River (1-4); Jupiter (1-10). Common in most exposures.

The type is from the Jupiter formation at East cliff (2).

Ptilodictya whiteavesi Ulrich

Ptilodictya whiteavesii Ulrich, Cont. Micro-Pal. Cambro-Sil., pt. 1, p. 44, Pl. VIII, figs. 1, 1e (1889); Whiteaves, Pal. Foss., vol. III, Geol. Surv., Canada, p. 118 (1895).

Although there are several associated species of *Ptilodictya* on the island of Anticosti, *P. whiteavesi* should readily be distinguished by its short, comparatively broad zoarium and smooth surface, but especially by the subquadrate zooecia arranged longitudinally on the median ridge with less regularly arranged hexagonal zooecia on either side. The latter areas exhibit well-marked maculæ composed of conspicuously larger zooecia.

Occurrence. Ordovician: English Head (2-4), English head and Nid de Corbeau; Vauréal (1), White brook.

Ptilodictya magnifica Miller

Stenopora mammulata Billings, Cat. Sil. Foss., Anticosti, p. 7 (not *Monticulipora mammulate* d'Orb.) 1866; *Ptilodictya magnifica* Miller, Jour. Cincinnati Soc. Nat. Hist., vol. 1, p. 100, Pl. III, fig. 1, 1a (1878); Miller, North Am. Geol. and Pal., fig. 503 (p. 318), 1889; Ulrich, Geol. Surv., Illinois, vol. VIII, fig. 11a-c (p. 391) (1890).

This splendid species, which is represented by numerous specimens at various localities in Anticosti exposures in English Head and Vauréal formations, may be readily distinguished from all associated bryozoa by its broad, bifoliate zoarium pointed at the lower end for articulation with a spreading base, and by the surface elevated at regular intervals into small, conical monticules. The zooecia are hexagonal or rhomboidal in shape and many (especially in tangential sections) exhibit the spine-like indentations of the walls, characteristic of the genus.

As indicated in the synonymy above a specimen of this species was listed by Billings as *Stenopora mammulata*, but the specimen so identified is quite different from D'Orbigny's well-known species of Monticulipora.

Occurrence. Ordovician: English Head (1), English head; Vauréal (1-5), White cliff, baie Ste. Claire, and anse aux Fraises.

Phaenopora excellens (Billings)

Plate XIV, figures 10, 11

Ptilodictya excellens Billings, Cat. Sil. Foss., Anticosti, p. 34, 1866; *Stictoporella? excellens* Ulrich, Jour. Cincinnati Soc. Nat. Hist., vol. V, p. 169 (1882).

The type specimen belongs to the genus *Phaenopora*, as may well be determined from the descriptions by Billings, and differs from other species of the genus in its narrow, branching zoarium, rather small zooecia (6 to 7 in 2 mm. measuring longitudinally), and inconspicuous mesopores. *P. aperta*, new species, is closely allied, but differs in having stronger ridges between the rows of apertures, large conspicuous mesopores, and larger zooecia of which there are 4½ to 5½ in 2 mm.

Occurrence. Ordovician: Ellis Bay (10), Ellis bay. Silurian: Jupiter (1), East cliff (Billings).

The type specimen (Cat. No. 2248, Geol. Surv., Canada) was obtained in zone 10 of the Ellis Bay formation at point Laframboise, Anticosti.

Phaenopora ensiformis Hall

Phaenopora ensiformis Hall, Pal. New York, vol. II, p. 48, Pl. XVIII, figs. 8a-c (1852); Nicholson and Hinde, Can. Jour., N. S., vol. XIV, p. 142 (1874); Nicholson, Pal. Province Ontario, 1875, p. 45, fig. 19, figs. 2, 2a; *Ptilodictya ensiformis* Ulrich, Jour. Cincinnati Soc. Nat. Hist., vol. V, p. 172 (1882); *Phaenopora ensiformis* Foerste, Geol. Surv., Ohio, vol. VII, p. 598 (1895); Bassler, U.S. Geol. Surv., No. 292, p. 55, Pl. 27, figs. 8, 9 (1906); Bassler, U.S. Nat. Mus., Bull. 77, p. 118, text fig. 45 (1911).

Numerous specimens of a narrow, unbranched species of Phaenopora occur in the Ellis Bay and Gun River formations, and agree in all respects with the abundant Clinton form *Phaenopora ensiformis*. The zoarium in all of these specimens is bifoliate and pointed at the base for articulation. It averages 25 mm. in length and 2 mm. in width; each face bears from 7 to 11 parallel rows of zooecia with 6 zooecia in 2 mm. measuring longitudinally; apertures in linear series between slightly raised longitudinal lines, quadrangular, measuring about 0·18 mm. to 0·30 mm., but in marginal series, oval, slightly oblique, and larger than in the middle ridges. The narrow, sword-shaped zoarium and the characteristic mesopores at the ends of the zooecia are features which will cause this species to be easily recognized.

Occurrence. Ordovician: Ellis Bay (8-10). Silurian: Becscie (2); Gun River (4); Jupiter (1, 2). Common everywhere.

Phaenopora superba (Billings)

Plate IX, figures 10, 11; Plate XI, figures 6, 7, 8, 9

Ptilodictya superba Billings, Cat. Sil. Foss., Anticosti, p. 35, 1866; *Phaenopora superba* Ulrich, Geol. Minnesota, vol. III, p. 174 (1893).

The type specimen of *Ptilodictya superba* Billings proves, as indicated by the original description, to be a well-marked species of *Phaenopora*, differing from all the known forms in its broad, strongly monticulated zoarium and in the unusually large number of mesopores separating the zooecia. In the young stages of growth, the zooecia are arranged in longitudinal rows and are separated by the usual two small mesopores. In older growths this arrangement is lost and mesopores are developed so numerously that the zooecia become polygonal and separated entirely from each other by them. The type and most specimens as broken out of the rock in the field are split along the mesial lamina and thus fail to exhibit the strong surface monticules. One specimen obtained is preserved on the surface of a limestone layer and thus exhibits the monticules which upon close examination are found to consist largely of mesopores. Measured longitudinally 7 zooecia may be counted in 2 mm.; transversely 9 to 10 occur in the same distance.

Compared with other species of the genus *P. superba* differs conspicuously in the great development of the mesopores, and the broad, monticulated zoarium. *P. expansa*, with which *P. superba* has been confused in previous identifications of the Anticosti bryozoa, is similar only in having a broad, monticulated zoarium.

The specimen marked as the type (Cat. No. 2352, Geol. Surv., Canada) was found at Walls cove, Anticosti.

Occurrence. Silurian: Becscie (1-4), all limestone exposures; Gun River (1, 2, 4), St. Mary cliff and cape Cloutier.

Phaenopora twenhofeli n. sp.

Plate VII, figures 14, 15; Plate XI, figures 3, 4

Zoarium, a broad bifoliate frond with a striated base pointed for articulation. The type specimen, although incomplete, is about 4 cm.

in height and width. Surface with well-developed, rounded monticules 4 mm. apart. Zooecia regularly arranged in longitudinal and diagonally intersecting rows, measuring lengthwise $5\frac{1}{2}$ may be counted in 2 mm., and transversely 8 in the same distance. Mesopores few in number when compared with other broad species of the genus and located as usual at the ends of the zooecia.

The essential characters of this fine, new species are: (1) the broad zoarium with the surface raised into prominent monticules; and (2) the comparative scarcity of mesopores.

Occurrence. Silurian: Becscie (3), Wreck beach.

Phaenopora aperta n. sp.

Plate XII, figure 3

This neat little branching bryozoan differs from all known species of *Phaenopora* in the unusually large size of the characteristic two mesopores separating adjoining zooecia. The zoarium is bifoliate, parallel-edged, usually about 3 mm. wide and branching at intervals of 10 or more mm. Surface smooth, with the zooecia arranged in regular, longitudinal rows, separated by strong, ridge-like walls; 7 zooecia occur in 2 mm. measured longitudinally, and 9 in the same length, transversely. The mesopores are always 2 in number and located at the ends of the zooecia, but their size may vary from that shown in the figure on Plate XII to about one-half of this diameter.

Occurrence. Silurian: Jupiter (3-10), all exposures.

Rhinidictya nitidula (Billings)

Plate XIV, figures 14, 15

Ptilodictya nitidula Billings, Cat. Sil. Foss., Anticosti, 1866, p. 9.

Because this species was compared by its author with *Ptilodictya fragilis*, now *Dicranopora fragilis*, it has hitherto been believed that it belonged to the genus *Dicranopora;* but the type specimens show *P. nitidula* to be a typical species of *Rhinidictya*, differing from the few other early Silurian forms in its measurements and unornamented zooecial apertures. Measuring lengthwise, 6 apertures may be counted in 2 mm.

Occurrence. Ordovician: English Head (4), Carleton point.

Goniotrypa bilateralis Ulrich

Goniotrypa bilateralis Ulrich, Cont. Micro-Pal. Cambro-Sil., pt. 2, p. 41, figs. 1-3, Pl. IX, fig. 1 (1889); Whiteaves, Pal. Foss., vol. III, Geol. Surv., Canada, p. 118 (1895).

Specimens of this species, agreeing well with the original descriptions, are not uncommon in the horizons noted.

Occurrence. Ordovician: English Head (4), Carleton point and Nid de Corbeau; Vauréal (3), cape Henry.

Dicranopora emacerata (Nicholson)

Ptilodictya emacerata Nicholson, Ann. Mag. Nat. Hist., ser. 4, vol. XV, p. 179, Pl. XIV, figs. 3, 3b (1875); Nicholson, Pal. Ohio, vol. II, p. 261, Pl. XXV, figs. 5, 5b (1875). *Dicranopora emacerata* Ulrich, Cont. Micro-Pal. Cambro-Sil., pt. II, p. 40 (1889); Whiteaves, Pal. Foss., vol. III, p. 118 (1895); *Ptilodictya emacerata* Lesley, Geol. Surv., Pennsylvania, Rept. P4, p. 826, text figs. (1889); *Dicranopora emacerata* Cumings, Dept. Geol. and Nat. Res., Indiana, 32nd Ann. Rept., p. 827, Pl. 32, figs. 13, 13b (1908).

Several examples of a species of *Dicranopora*, agreeing well with Nicholson's species as described from Cincinnati, Ohio, were noted in the Anticosti collections. *Dicranopora emacerata* is a much smaller species than the associated *D. fragilis* and for that reason alone can readily be distinguished. The characteristic upper and lower terminations of the segments for articulation are plainly shown in many specimens.

Occurrence. Ordovician: English Head (4), Carleton point; Vauréal (1, 3), White brook and cape Henry.

Dicranopora fragilis (Billings)

Plate XIV, figures 12, 13

Ptilodictya fragilis Billings, Cat. Sil. Foss., Anticosti, p. 9, 1866; *Stictopora fragilis* Whitfield, Geol. Surv., Wisconsin, vol. IV, p. 253, Pl. XI, fig. 24 (1882); *Dicranopora fragilis* Ulrich, Cont. Micro-Pal. Cambro-Sil., pt. II, p. 40 (1889); Whiteaves, Pal. Foss., vol. III, p. 118 (1895).

The original description contains most of the characters of this species except the main feature of the genus, namely, that the zoarium consists of segments pointed at the lower end for articulation with the distal end of the preceding segment. The type specimen shows that this is the well-known Richmond form, which has been identified in many parts of the United States and Canada.

Occurrence. Ordovician: English Head (2-4), all exposures; Vauréal (3, 5), cape Henry and anse aux Fraises; Ellis Bay (2), Junction cliff.

The type was found in zone 2 of the Ellis Bay formation at Junction cliff (Cat. No. 2249, Geol. Surv., Canada).

Pachydictya hexagonalis Ulrich

Pachydictya hexagonalis Ulrich, Cont. Micro-Pal. Cambro-Sil., pt. II, p. 42, Pl. IX, figs. 2, 2c (1889); Whiteaves, Pal. Foss., vol. III, Geol. Surv., Canada, p. 118 (1895).

The broad zoarium and large zooecia of a rather regular hexagonal shape are characteristics by which *P. hexagonalis* can readily be recognized.

Occurrence. Ordovician: Vauréal (3), baie Ste. Claire.

Pachydictya firma Ulrich

Pachydictya firma Ulrich, Geol. Surv., Illinois, vol. VIII, p. 525, Pl. XXXI, figs. 2, 2f (1890).

A single specimen agreeing in all respects with this abundant species was found in the Anticosti collections from the Vauréal formation. *P. hexagonalis*, the only other species of *Pachydictya* discovered in this formation, differs decidedly in its zooecial features.

Occurrence. Ordovician: Vauréal (1), Sauvage cove.

Pachydictya crassa (Hall)

Stictopora crassa Hall, Pal. New York, vol. II, p. 45, Pl. XVIII, figs. 4a-c (1852); *Ptilodictya crassa* Nicholson and Hinde, Can. Jour., N.S., vol. XIV, p. 142 (1874); Nicholson, Pal. Province Ontario, p. 45, 1875; Ulrich, Geol. Minnesota, vol. III, p. 147 (1893); *Ptilodictya rustica* Billings, Cat. Sil. Foss., Anticosti, p. 36, 1866; *Pachydictya rustica* Ulrich, Geol. Minnesota, vol. III, p. 146 (1893); *Ptilodictya arguta* Billings, Cat. Sil. Foss., Anticosti, p. 36, 1866; *Pachydictya arguta* Ulrich, Geol. Minnesota, vol. III, p. 146 (1893); *Stictopora scitula* Hall and Simpson, Pal. New York, vol. VI, Pl. LXI, figs. 24 and 25 (1887); *Pachydictya scitula* Ulrich, Geol. Minnesota, vol. III, p. 147 (1893); *Ptilodictya farctus* Foerste, Proc. Boston Soc. Nat. Hist., vol. XXIV, p. 328, Pl. VI, fig. 31 (1889); *Pachydictya farctus* Foerste, Geol. Soc., Ohio, vol. VII, p. 599, Pl. XXXI, fig. 31 (1895); *Ptilodictya rudis* Foerste, Proc. Boston Soc. Nat. Hist., vol. XXIV, p. 329, Pl. VI, fig. 33 (1889); *Pachydictya (Rhinidictya) rudis* Foerste, Geol. Soc., Ohio, vol. VII, p. 599, Pl. XXXI, figs. 32, 33 (1895); *Pachydictya crassa* Nickles and Bassler, U.S. Geol. Surv., Bull. No. 173, p. 338 (1900); Bassler, U.S. Geol. Surv., Bull. No. 292, p. 57, Pl. 18, figs. 11, 12; Pl. 21, figs. 14-16 (1906); Grabau and Shimer, N.A. Index Fossils, vol. I, p. 160 (1909); *Ptilodictya alcyone* Billings, Cat. Sil. Foss., Anticosti, p. 36, 1866; *P. tenera* Billings, Cat. Sil. Foss., Anticosti, p. 36, 1866.

The type specimens upon which Billings founded the four species referred to above, proved upon examination to represent various phases of the very abundant and widely distributed form first described by Hall as *Stictopora crassa*. *Ptilodictya rustica* was based upon a well-developed, normal example of *Pachydictya crassa* from the Jupiter formation. The type of *P. arguta* is a narrow branch of the same species from the Gun River formation; the type of *P. alcyone* from the Chicotte formation differs in no other way from *P. rustica* than as mentioned by Billings in size and shape of the zooecia. These differences are slight, and as shown by typical examples from the same formation and locality are only individual.

A fourth species described by Billings as *Ptilodictya tenera* is known only from the original description, as the type has been lost. As this description indicates, *Ptilodictya tenera* is in all probability based on only another form of *Pachydictya crassa*.

The essential features of *Pachydictya crassa* are: (1), the zoarium consists of a narrow, dichotomously dividing frond with sharp, parallel edges with branches elliptical in cross-section, and having narrow non-celluliferous margins marked by faint striæ; and (2), the zooecial apertures are oval, arranged in parallel longitudinal rows separated by linear ridges and measuring 4 in 2 mm., lengthwise.

Occurrence. Ordovician: Ellis Bay (1, 2, 4-10). Silurian: Becscie (1-4); Gun River (1-4); Jupiter (1-10); Chicotte (1, 2). Common in all exposures.

Lichenalia utricula n. sp.

Plate VII, figures 16, 17

The two interesting specimens upon which this new species is founded were studied by Billings, who applied to them a new generic and specific designation without ever publishing the names. An examination of their internal structure has shown these specimens to be typical examples of *Lichenalia* conspicuously distinguished from the type and only other known valid form of the genus by the utricular or sack-shape method of growth. A further distinction between the two is that in *L. utricula* the zooecia are considerably smaller, about 4 occurring in the distance of 2 mm., whereas in *L. concentrica* only 2 or 3 may be noted in the same space.

The utricular method of growth will give a clue as to this species at first sight, and on account of the ease with which the zoarial layer splits from the matrix, casts of the interior showing the basal laminæ are in most cases all to be found; but when the surface of the zoarium is seen the characteristic meandering canals are conspicuous. Aside from size and number of zooecia in a given distance, the internal structure is otherwise precisely as in the genotype.

Occurrence. Ordovician: Ellis Bay (1, 4, 5), Ellis bay and Junction cliff.

The figured examples were found in zone 1 of the Ellis Bay formation at Junction cliff (Cat. No. 2247, Geol. Surv., Canada).

BRACHIOPODA

Order, **Atremata**

Dinobolus laurentinus n. sp.

Plate XII, figures 4, 5, 6, 7

Dinobolus n. sp., Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. 21, p. 696 (1910).

The shell is below the medium size for the genus, almost equivalved, trigonal, anterior angles rounded, form very broadly rounded; posterior half of shell with the cardinal slopes straight or slightly convex, meeting at an angle of about 90 degrees; except for concentric striæ the surface is smooth; length of an average individual 21 mm., width about the same, depth of both valves 8 mm. The more prominent beak is on the ventral valve.

The platform of each valve is low, probably less than 0·5 mm. high, no crescent observed in either valve. In the ventral valve a triangular buttress extends anteriorly from the cardinal margin, becoming a low, median septum about 1 mm. from its origin. The umbonal chambers are low, and more wide than deep. The platform in the ventral valve has the margin slightly elevated, and it is divided by a median septum; the outline is elongate oval, widest nearest the front; 9 mm. long, 7·5 mm. wide; no platform vaults.

In the brachial valve the platform is slightly elevated at the margin and on both sides of the middle; elongate oval in outline, widest in front of the middle; 11 mm. long, of which about 2 mm. belong to an anterior club-shaped prolongation (the median plate of Davidson and King)[1], toward which the anterior margin becomes concave; width 7·5 mm.

In size, lowness of platforms, and apparent absence of a crescent this new species of *Dinobolus* appears to have its closest relationships with *D. parva* Whitfield from the Galena of Wisconsin and Minnesota, United States, and lake Winnipeg, Canada; but differs in having a greater depth of umbonal vaults, a stronger cardinal buttress, and the total absence of a groove extending from the anterior end of the platform of the ventral valve to the front margin. It differs from *D. parva* Winchell and Schuchert in having the muscular scar elongate instead of subquadrate and in a somewhat greater length to the median plate.

Occurrence. Ordovician: English Head (2–4), English head and North cliff; Vauréal (2, 4, 5), baie Ste. Claire.

The holotype, paratypes, and plesiotypes are in Peabody Museum.

Dinobolus laurentinus var. *ellisensis* n. var.

Plate XII, figure 8

Of this shell only casts of the interior of the dorsal valve have been collected, but to one of these a fragment of the shell is attached. It differs from *D. laurentinus* in being about twice as large; in having a relatively wider, but not excavated, platform; a slightly more extended anterior prolongation or median plate; and a somewhat sharper depression in the centre of the post-median and subumbonal scars. In other features the shells are apparently not different.

A crescent has not been observed. The largest example is 27 mm. long and 28 mm. wide.

Occurrence. Ordovician: Ellis Bay (7), Ellis bay.

The holotype and paratypes are in Peabody Museum.

Leptobolus insignis Hall

Leptobolus insignis Schuchert, U.S. Geol. Surv., Bull. 87, p. 242 (1897); Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. 21, p. 694 (1910).

The Anticosti specimens of this species are apparently identical with those from the Utica black shales of Ottawa and New York.

Occurrence. Ordovician: Macasty shale.

Peabody Museum.

[1] Quart. Jour. Geol. Soc., pp. 124–173, 1874.

Lingula anticostiensis n. sp.

Plate XII, figure 9

Shell apparently very thin, slightly convex, longitudinally ovate, length 14 mm., greatest width about 4 mm. from the front margin where it is 10 mm. Anterior angles and front fairly uniformly rounded; sides for about half the length nearly parallel; beak acute, the cardinal slopes meeting at an angle of 60 to 70 degrees. The surface is marked by numerous concentric lines, 8 to 10 to 1 mm., and occasional coarse, lamellose lines or undulations, in every instance more prominent at the margin than near the middle of the shell.

The only other Anticosti *Lingula* likely to be mistaken for this species is *L. forbesi*, from which it can be distinguished by the quadrate outline of the anterior half. *L. gibbosa* Hall from the Niagara of Indiana has much the same shape, but the cardinal slopes are shorter and the beak less acute. *L. lamellata* Hall from the Niagara of New York and Ontario is similar in size and shape, but differs in the beak and cardinal slopes and has a different surface. *L. oblata* Hall from the Clinton of Walcott and Sodus, New York, has a similar surface, but differs in outline.

Occurrence. Silurian: Becscie (3), Wreck beach; Jupiter (4), capes Jupiter and Ottawa.

The holotype and paratypes are in Peabody Museum.

Lingula forbesi Billings

Plate XII, figure 13

Lingula forbesi Billings, Geol. Surv., Canada, Pal. Foss., vol. I, p. 115, fig. 96 (1865); Shaler, Bull. Mus. Comp. Zool., vol. I, No. 4, p. 61 (1865); Billings, Cat. Sil. Foss., Anticosti, pp. 10, 40, 1866; Schuchert, U.S. Geol. Surv., Bull. 87, p. 247 (1897).

The small size, oval shape, greater width anteriorly, and rapidly decreasing width posteriorly readily serve to distinguish this species from any other Anticosti *Lingula*. Exfoliated examples show a few radial striæ. Of the interior nothing is known.

Occurrence. Ordovician: English Head (2–4), baie Ste. Claire and Carleton point; Ellis Bay (2, 4, 7), Junction cliff and Ellis bay. Silurian: Becscie (3), Wreck beach (rare).

Holotype, No. 2257, the National Museum of Canada, other specimens in Peabody Museum.

Lingula insularis Billings

Lingula insularis Billings, Cat. Sil. Foss., Anticosti, p. 40, 1866; Schuchert, U.S. Geol. Surv., Bull. 87, p. 248 (1897).

Occurrence. Ordovician: Ellis Bay (5).

The holotype and all other specimens of this species have been lost, and it has not been recognized in later collections.

Lingula? *jupiterensis* n. sp.

Plate XII, figure 10

Lingula canadensis excepted, the surface of this shell is unlike that of any other Anticosti *Lingula*. Two English *Lingulas*—*L. granulata* and *L. tenuigranulata*—have similar papillose surfaces. *Lingulasma schucherti* Ulrich has a somewhat similar surface, but is thick-shelled with decided internal platforms.

The best specimen is 9 mm. long and 5 mm. wide, but a fragment of another shell shows that it grew to a larger size. The outline is oval, broadly rounded at the sides and front, with the anterior angles sharply rounded. The posterior angles are moderately rounded; cardinal slopes straight, meeting at an angle a little less than 90 degrees. The surface is uniformly convex, apparently without three slopes, and ornamented by numerous concentric and radial lines. The latter diverge from the axis of the shell. In a few instances new radial lines originate between two others, but most take their origin on the axis of the shell, and through their divergence produce a feather-like appearance. In the larger fragment the papillæ can be seen with the eye, but a lens is necessary for the smaller specimen. The shell is very thin and fragile.

The species differs from *Lingulasma canadensis* in having the papillæ much smaller, more numerous, the concentric lines closer together, shell far thinner, absence of three slopes, and an oval instead of a quadrate or subpentagonal outline. *L. tenuigranulata* from the Bala of England has a surface almost identically similar, but is far larger (said to be as large as *L. quadrata*), has a surface of three slopes, and does not have its radial lines diverge from the axis.

Occurrence. Silurian: Jupiter (4), cape Jupiter.

The holotype and a paratype are in Peabody Museum.

Lingulasma? *canadense* (Billings)

Lingula canadensis Billings, Geol. Surv., Canada, Pal. Foss., vol. I, p. 114 fig. 95 (1862); Billings, Cat. Sil. Foss., Anticosti, p. 10, 1866; *Lingula? canadensis* Schuchert, U.S. Geol. Surv., Bull. 87, p. 245 (1897).

The holotype and all others of this species studied by Billings have been lost. There is a fragment in the Yale collection and parts of three shells in the collection of the writer. The shell reaches fully 1 inch in length and ¾ inch in width. The shape appears to be quadrate. Its internal structure is not known, and it does not appear to be determinable in the known specimens. The ornamentation is almost identical with that of *Lingulasma schucherti*, and, as in that species, the papillæ on the central part of the shell are conical with circular bases, but elongated parallel to the concentric striæ on the sides. Its close external resemblance to *L. schucherti* has led to its reference to that genus, a reference suggested by Ulrich.[1] The resemblance to *Lingula granulata* Phillips and *L. tenuigranulata* McCoy is very close, and it appears to hold a somewhat intermediate position in that the longitudinal striæ and granules are far more

[1] Ulrich, E. O.: Am. Geol., vol. 3, p. 384 (1889). *See also* Hall and Clarke, Pal. N.Y., vol. VIII, pt. 1, p. 27 (1892).

plain the former than in this species, whereas the opposite is true for the latter.

Occurrence. Ordovician: English Head (4), Nid de Corbeau, Black point, and rivière à l'Huile.

Pseudolingula elegantula (Shaler)

Plate XII, figure 14

Lingula elegantula Shaler, Bull. Mus. Comp. Zool., vol. I, No. 4, p. 61 (1865); *L. quadrata* Billings, Cat. Sil. Foss., Anticosti, p. 10, 1866; *L. rectilateralis* Schuchert (partim), U.S. Geol. Surv., Bull. 87, p. 253 (1897).

This species was identified by Billings as *L. quadrata* Eichwald, to which it bears considerable resemblance; but comparison with specimens of this species in the Yale collections shows that the latter is much wider in proportion to its length and is hardly so convex. A strong medium septum is present. *Lingula quadrata* Hall and *L. quadrata* Billings were considered by Winchell and Schuchert identical with *L. rectilateralis* Emmons. *Pseudolingula elegantula* differs from the last in showing no radial striæ. It resembles *L. iowaensis* Owen, but is far more convex, has its sides more nearly parallel, and the striated hinge area of that species has not been seen in the Anticosti form. *L. cincinnatiensis* Hall and Whitfield is another very similar species, but has much finer concentric striæ. Although it is not certain that *L. elegantula* should be referred to this genus, its strong resemblance to *Pseudolingula quadrata* makes such a reference more than probable.

Occurrence. Ordovician: English Head (3, 4), English head, Carleton point, and Caplan river; Vauréal (1, 4), Vauréal and MacDonald rivers; Ellis Bay (1, 5), Junction cliff and Ellis bay.

Types, Mus. Comp. Zool. Other specimens in The National Museum of Canada and Peabody Museum.

Order, **Neotremata**

Trematis ottawaensis var. *anticostiensis* n. var.

Plate XII, figures, 11, 12

Trematis ottawaensis Billings, Geol. Surv., Canada, Pal. Foss., vol. I, p. 53, fig. 58 (1862); Billings, Cat. Sil. Foss., Anticosti, p. 11, 1866; Miller, N. Am. Geol. and Pal., p. 385, 1889; Schuchert, U.S. Geol. Surv., Bull. 87, p. 452 (1897).

Some specimens have greater dimensions than those given by Billings, the width reaching 35 mm. and the length 37 mm., but the writer has seen similarly large specimens in the Ottawa strata. Compared with the Ottawa forms, the Anticosti examples have larger pits and fewer radial lines. It may be that this species is the same as *T. cancellata*, but not having seen that species or any illustration, no opinion is expressed.

Occurrence. Ordovician: English Head (4), most exposures, but rare; Ellis Bay (1), Junction cliff.

Type, No. 2008, the National Museum of Canada, other specimens in Peabody Museum.

Schizocrania filosa (Hall)

Schizocrania filosa Schuchert, U.S. Geol. Surv., Bull. 87, p. 375 (1897).

Specimens identified as this species, which exhibit no important differences from those of southwestern Ohio, occur rarely in the lower Anticosti rocks.

Occurrence. Ordovician: Vauréal (1, 3, 4), High cliff, Vauréal river, and Battery point; Ellis Bay (1), Junction cliff.

The Anticosti plesiotypes are in Peabody Museum.

Crania anticostiana n. sp.

Plate XV, figures 1, 2

This species resembles *C. siluriana* Hall from the Niagara of Waldron, Indiana, in that both have essentially the same surface features, the ventral valve merely a ring, the beak slightly bent toward the posterior end, and the same variation in the development of the concentric growth lines. It differs in having the ventral ring less high, in having a thinner shell (though some are nearly as thick), and in reproducing the surface of the host. Specimens from Sand cliff have a finely annulated cephalopod for a host, and the *Cranias* show the same striations; those on brachiopods of the Ellis Bay formation reproduce the plications or striations of the hosts.

The shell is nearly circular; depressed conical; apex excentric, curved dorsally; slopes asymmetrical, steeper toward the posterior side, apex about one-third the diameter of the shell from the posterior border; cardinal border concave or straight; surface of the upper valve ornamented with concentric lines of growth; length of largest example 12·5 mm., width 14·5 mm., height 5 mm.

Occurrence. Ordovician: English Head (4), Carleton point; Ellis Bay (1,4,5,6), Junction cliff and Ellis bay. Silurian: Becscie (3), Wreck beach; Jupiter (2, 5, 10), East and Sand cliffs and Jumpers.

Types, Peabody Museum, other specimens Twenhofel collection.

Pholidops gamachiana n. sp.

Plate XV, figure 3

Shell longitudinally ovate, apex very excentric, nearest the cardinal border and situated at from one-fourth to one-sixth the length of the shell; 10 lamellose growth-lines shown on the largest specimen, which is 4·5 mm. long, 3·25 mm. wide, depth of both valves 1·25 mm.; most of the specimens are a little smaller.

The Anticosti forms are related to at least three American and two foreign species. They are about the same size as *P. squamiformis* (Hall) from the Niagara of New York, but are thinner shelled and have a more excentric apex. They are more elongated than *P. ovalis* (Hall) from the Niagara of Waldron, Indiana, and have the apex far more excentric. *P. cincinnatiensis* (Hall) of the Lorraine of the Cincinnati region is more coarsely lamellose. *P. implicata* (Sowerby) of the English Upper Llandovery, Wenlock, and Ludlow is smaller, more circular, and has a less excentric apex; and *P. antiquata* (Schlotheim) from Gotland appears more finely lamellose and the cardinal edge is as a rule slightly concave, giving to it a heart-shaped appearance. Although the differences which have been mentioned appear trivial, they are fully as great as those existing between the species to which reference has been made.

Occurrence. Ordovician: English Head (2-4), all exposures; Vauréal[1] (1, 5, 6), all exposures; Ellis bay (4, 7), Ellis bay and Vauréal river.

Peabody Museum.

Pholidops implicata (Sowerby)

Plate XV, figure 16

Crania implicata Davidson, Mon. Brit. Foss. Brach. Sil., vol. III, pt. 7, p. 80, Pl. VII, figs. 13-17 (1871).

This species in specimens essentially identical with those illustrated by Davidson is wonderfully abundant at certain levels in the Anticosti Silurian. The species is not more than half as large as *P. gamachiana*, has a more central apex, and a more finely lamellose structure. As in the English form the shape is slightly variable.

Occurrence. Silurian: Gun River (2-4), Gun river and vicinity; Jupiter (1, 7-10), Jupiter river and Southwest point.

Peabody Museum.

Order, **Protremata**

Orthis davidsoni var. *pyramidalis* n. var.

Plate XV, figures 4, 5, 6

Orthis davidsoni Schuchert (partim), U.S. Geol. Surv., Bull. 87, p. 285 (1897); Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. 21, p. 703 (1910).

An average shell is 12 mm. long, 18 mm. wide at the hinge-line (the greatest width), and 8 mm. thick. Outline semi-elliptical, about 32 plications to each valve; these are rounded with the interspaces of equal or a little greater width and all reach the umbo. The ventral valve is pyramidal, with the beak the highest point and projecting about 1·5 mm. above the hinge; not at all or only slightly incurved. From the beak to the anterior border the slope is practically a straight line. The ventral area is as long as the hinge (6·5 mm. wide in the specimen with the dimensions given above), cuts the plane of the lateral margins almost at right angles, and is longitudinally striated. Fissure triangular, 3 mm. wide at the base, 6 mm. high. The dorsal valve is flat, or only slightly convex, with a broad median depression from the sides of which the surface slopes uniformly to the lateral margins. The dorsal area is 2 mm. wide, longitudinally striated, and meets the ventral area at an angle of about 100 degrees.

The Anticosti forms of this species differ from those of Gotland in having the beak not at all incurved, the area of each valve about twice as wide, the beak the highest point of the ventral valve, and in being more transverse. These differences furnish the basis for the introduction of the varietal name. The shell bears some resemblance to *O. laurentina;* but the total absence of an incurved beak, the wider areas, and absence of deltidium readily distinguish it.

Occurrence. Ordovician: Vauréal (1, 4, 5), White cliff and West point; Ellis Bay (4, 7, 9), cape James, Prinsta bay, Table hill, and Lousy cove. Silurian: Becscie (2, 4), Reef point and Setter river.

Peabody Museum.

Orthis ? flabellites Foerste

Orthis alata Shaler, Bull. Mus. Comp. Zool., vol. I, No. 4, p. 66 (1865); *O. davidsoni* Billings, Cat. Sil. Foss., Anticosti, p. 41, 1866; *O. flabellites* Schuchert, U.S. Geol. Surv., Bull. 87, p. 286 (1897); Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. 21, p. 709 (not p. 702) (1910).

Shell resupinate; all plications are gently rounded on top and extend to the beak; the ventral valve pyramidal and deeper, but the dorsal contains the more space; beak of the dorsal valve slightly incurved, ventral not at all; dorsal cardinal area triangular, less than 1 mm. wide in a mature shell, and equal to the length of the hinge-line. The ventral area 4 mm. wide in a mature shell and also equal to the length of the hinge-line. An average shell is 21 mm. long, hinge-line 22 mm. wide, width of shell across the middle 27 mm. Ventral muscular impression circular, the anterior margin reentrant. Between the ribs there are from 5 to 7 very fine radial striæ, and the whole shell is crossed by exceedingly fine, concentric striæ, about 20 to 1 mm., producing in the interspaces a minute reticulation. Neither set of striæ is shown on weathered specimens.

The fact that this is a resupinate shell would seem to mitigate against its retention in the genus *Orthis;* but as its other characters are in harmony with that reference it has as a rule been so placed. It appears to occupy a position intermediate between the genera *Orthis* and *Dinorthis.* This fact has been recognized in the title of the description.

Occurrence. Silurian: Becscie (4), Becscie river and Whale cliff: Gun River (4), near Gun river; Jupiter (3, 4, 7-10), most exposures, abundant in zones 9-10; Chicotte (1, 2), Southwest point, pointe des Morts, point Galiote, and Jumpers.

The National Museum of Canada and Peabody Museum.

Orthis ? lamellosa Twenhofel

Plate XV, figures 7, 8, 9

Orthis ? lamellosa Twenhofel, Geol. Surv., Canada, Mus. Bull. No. 3, p. 24, Pl. I, figs. 1-3 (1914).

Outline semi-elliptical, greatest width about half-way from beak to border. A specimen from Ellis bay is 8 mm. wide at its greatest width; 7 mm. wide at the hinge-line; thickness 4 mm.; length 6 mm. Another specimen from the Beatricia zone at Battery point is 13 mm. wide. Sides of the shell nearly straight and almost parallel with a slight convergence to the cardinal margin, gently and uniformly curving around the anterior lateral margins; anterior margin for about half the width almost straight. Dorsal valve shallow with a broad mesial sinus, in which the depressions between striations are a little wider than on any other part of the shell; beak slightly incurved. Ventral valve pyramidal, beak highest part, not incurved; no fold to correspond to the dorsal sinus; surface slopes uniformly from the beak to the anterior and lateral margins. The cardinal area is as long as the hinge-line, 2·5 mm. wide in the Ellis Bay specimens, and in the same plane as the lateral margins. Surface ornamented by small plications of which there are 18 on the Battery Point specimen, narrowly rounded on top. Depressions about twice as wide as ridges. Concentric lamellose striæ about 5 in 2 mm. complete the ornamentation. These are slightly turned up on the free margins. Foramen narrow, about 0·25 mm. wide, sides almost parallel; extends to the beak and finds its other continuation in the dorsal valve. Wetting of the ventral area shows that narrow side plates are annexed to the sides of the foramen; these are supposed to be continuous with the teeth, as in *O. bouchardi*, the nearest related species. These plates simulate deltidial plates, with which, however, they are probably in no way homologous. The interior is not known.

O. ? lamellosa finds its nearest relative in *O. bouchardi* Davidson from the Wenlock of England and Gotland, from which it differs in having no ventral sinus, the sides of the foramen almost parallel instead of converging to the beak, the ventral area making a right instead of an acute angle with the plane of the lateral margins, no longitudinal striations on the area such as exist in that species, and in being more finely plicate with all the plications reaching the beak. That species also has the ventral area curved and the beak incurved. Another species which appears to be related is *O. ? rugiplicata* Whitfield from the Niagara of Louisville, Kentucky.

Occurrence. Ordovician: Vauréal (4), Battery point; Ellis Bay (5), Ellis bay.

The holotype is in Peabody Museum. A cotype is in the collection of the writer.

Orthis laurentina Billings

Plate XV, figures 17, 18

Orthis laurentina Billings, Geol. Surv., Canada, Rept. of Prog. 1853-1856, p. 297 (1857); Billings, Geol. Surv., Canada, Pal. Foss., vol. I, pp. 138-139, figs. 115a-c (1862); Shaler, Bull. Mus. Comp. Zool., vol. I, No. 4, p. 60 (1865); *Billingsella ? laurentina* Schuchert, U.S. Geol. Surv., Bull 87, p. 159, 1897; *Orthis laurentina* Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. 21, p. 702 (1910).

Hall and Clarke[1] state that this is "a shell with the interior characters, and the exterior expression of *Orthis calligramma*, differing only in the presence of deltidia upon both valves, and in this respect resembling *Billingsella* and *Clitambonites*." The fact that the shell is so essentially an *Orthis* in every respect save the presence of deltidia leads the writer to consider that this feature, although commonly of the greatest classificatory value, in this species is a matter of secondary importance and is probably to be considered the return of an old character. The deltidium readily distinguishes this species from all others of the genus *Orthis*.

Occurrence. Ordovician: Ellis Bay (1-2, 4-7), Ellis bay and vicinity (abundant), Prinsta bay (rare).

Plesiotypes of the species are in both the National Museum of Canada (No. 2275) and Peabody Museum.

[1] Pal. N.Y., vol. VIII, pt. 1, p. 231 (1892).

Hebertella maria (Billings)

Orthis maria Billings, Pal. Foss., vol. I, p. 137, figs. 114 a-c (1862); Billings, Cat. Sil. Foss., Anticosti, p. 41, 1866; *Hebertella maria* Schuchert, U.S. Geol Surv., Bull. 87, p. 229 (1897); Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. 21, p. 696 (1910).

The dimensions of an average specimen are somewhat greater than those given by Billings. The greatest width is at about one-third the distance from beak to border where an average individual measures 23 mm.; width at the hinge-line 20 mm.; length 17·5 mm. There are about 16 striations to 1 mm. and new striations arise by implantation and bifurcation.

Occurrence. Ordovician: English Head (1–4); Vauréal (1–6); Ellis Bay (1, 2, 4–7, 9), generally common, but not present in the Ellis Bay sandstones.

A paratype, No. 2271a, is in the National Museum of Canada. Numerous plesiotypes are in the collections of Peabody Museum.

Platystrophia regularis Shaler

Plate XVI, figures 19, 20

Platystrophia regularis Shaler, Bull. Mus. Comp. Zool., vol. I, No. 4, p. 67 (1865); *Orthis lynx* Billings, Cat. Sil. Foss., Anticosti, pp. 12, 41, 1866; *O. biforata* Davidson (partim), Mon. Brit. Foss. Brach., vol. III, pt. 7, Pl. XXXVIII, fig. 11, only (1871); *Platystrophia dentata* Cumings, Am. Jour. Sci., vol. XV, pp. 18, 44, 45 (1903); *P. biforata* Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, p. 702 (1910).

An average example, and almost all are such, for the absence of variation is distinctive, is 15 mm. long, 24 mm. wide at the hinge-line which is a little longer than the average width, 14 mm. thick; top width of sinus at the anterior margin 10 mm., bottom width 6 mm. At the beak the ventral sinus contains a single plication which at a distance of about 1 mm. divides to form 2. At the beak the dorsal fold appears to have 2 plications, with a third implanted between them at a distance of from 1·5 to 2 mm., the only implanted plication on any part of the shell.

It differs from *P. dentata*, to which it has been compared, in being larger and far more regular in shape and ornamentation.

Occurrence: Ordovician: Ellis Bay (1, 2, 4–9). Silurian: in zone 4 of the western exposures of the Gun River formation and in zone 2 of the Jupiter formation at East cliff were collected a few specimens which are not separable from those below. Billings states its occurrence at Carleton point, but this is very doubtful.

Numerous Anticosti plesiotypes are in both the Peabody Museum and the National Museum of Canada.

Platystrophia regularis var. *globata* n. var.

Plate XV, figures 10, 11, 12

This is an inflated form with short hinge-line, spherical outline, and rhynchonelloid aspect. An average example measures 10·5 mm. on the hinge; width half-way forward 18 mm.; length 16·5 mm.; thickness 14 mm.; top of sinus 8 mm. wide; base 5 mm. There are 3 plications in the sinus and 4 on the fold and not more than 7 plications on either side of the fold and sinus. On the fold, there appears at first to be a single plication which almost at once bifurcates, each of these dividing to form two others at a distance of from 5 to 7 mm. from the beak. In the sinus there is at first a single plication, beside which two others are implanted at a distance of from 4 to 5 mm. from the beak. Except at the lateral margins no other plications arise.

Occurrence. Ordovician: Ellis Bay (4–6), Prinsta bay.

Peabody Museum.

Platystrophia camerata n. sp.

Plate XV, figures 13, 14, 15

The shape of this species is very similar to *P. regularis*, but it is larger and more inflated. Its characteristic feature, however, is the bifurcation of its plications. The initial single plication of the sinus becomes 5 or 6 at the anterior margin, and the initial 2 of the fold reach the same number. Length of the hinge-line of an average example 17 mm.; width at mid-length 29 mm.; length 19 mm.; thickness 16 mm.; top width of sinus at anterior margin 12 mm.; base 7 mm. One large example has a length of 24 mm.; width 32 mm.; width at hinge-line 24 mm.; thickness 22 mm. The interior is not known.

In the sinus there is at first a single plication which almost at once bifurcates forming two. At about 7 mm. from the beak two others are implanted, one on each side the initial one, between which at about half-way to the front margin one or two others are implanted. On the fold there appear at first two plications, between which a third is implanted, at a distance of about 2 mm. from the beak. About 5 or 6 mm. from the beak each outer one bifurcates, and about half-way to the front margin one or two others are implanted by the side of the middle one. Similarly, on the sides many of the plications bifurcate, and others are implanted, but the increase in number takes place at a later stage than is the case on the fold and sinus. On the margins the plications have a bundle effect. The shell bears a great resemblance to *P. fissicostata* McCoy from the Bala of England.

Occurrence. Ordovician: Ellis Bay (4–7, 9), sandy strata of Ellis and Prinsta bays.

Peabody Museum.

Dalmanella meeki (Miller)

Dalmanella testudinaria meeki Schuchert, U.S. Geol. Surv., Bull. 87, p. 205 (1897); Cumings, Dept. Geol. and Nat. Res., 32nd Ann. Rept., p. 899, Pl. XXXIII, figs. 6–6g (1908); *D. meeki* Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, p. 696 (1910).

The Anticosti forms of this species are most nearly like the variety *meeki*. An average example is 11·5 mm. long, width across the middle 14·5 mm., thickness 4 mm. There are about 70 to 75 striations to each valve; new ones arise both by bifurcation and implantation; not more than one-fifth reach the umbo. At several localities occur very small examples identified by Billings as *Orthis parva ?* Pander. This identification is in error. Compared with Cincinnati examples from the Richmond, those of Anticosti are, as a rule, somewhat smaller and a shade more finely plicated. The interiors are essentially similar. The differences are not considered to be of sufficient importance to be given varietal value. Some of the Ellis Bay examples are extremely robust and more finely plicated than the average.

Occurrence. Ordovician: English Head (1–4); Vauréal (1–6); Ellis Bay (1, 2, 4–10). Generally present in every exposure.

Dalmanella concavoconvexa n. sp.

Plate XVI, figures 1, 2, 3

This *Dalmanella* in shape, contour, fineness of striæ, and concavity of the dorsal valve is much like the European *D. wisbyensis* (Lindstrom), from which it differs in being much smaller, having a more concave dorsal valve with a deeper sinus, and lacking the small, ventral fold and the angulation at the middle of the front margin. It has the dimensions and shape of *D. wisbyensis nana* McLearn, of the Arisaig section, but differs in having a more prominent median septum in the dorsal valve.

The ventral valve is very convex; of *D. elegantula* aspect; umbo prominent and rising above the hinge-line a distance equal to about one-fifth the length of the shell; beak small, very much incurved, and in some specimens in contact with the dorsal valve. Area of both valves small; ventral about 1 mm. wide, almost in the plane of the lateral margins; dorsal area not more than half as wide as the ventral and meeting it at an angle of about 90 degrees.

Dorsal valve concave, closely applied to the ventral at the anterior and lateral margins for from one-fourth to one-third the length of the shell; convex only at the cardinal angles; divided by a sinus which is relatively narrow and deep at the beak, but broad and shallow at the anterior margin.

The surface of both valves is ornamented with fine striæ which increase chiefly by implantation, and these are crossed by very fine concentric lines. The number of striæ is about 65 on an average sized specimen. An average example is 6·5 mm. wide at the hinge-line, 9 mm. wide at one-third the distance from beak to border; length 9·5 mm.; depth of both valves 4 mm.

Occurrence. Silurian: Jupiter (1-10). Confined to shaly strata and not common.

Peabody Museum.

Dalmanella media (Shaler)

Orthis media Shaler, Bull. Mus. Comp. Zool., vol. I, No. 4, p. 65 (1865); Billings, Cat. Sil. Foss., Anticosti, p. 41, 1866; *Rhipidomella media* Schuchert, U.S. Geol. Surv., Bull. 87, p. 349 (1897).

Outline circular; an average example is 20 mm. long, 20 mm. wide, hinge-line 11 mm. long, depth of both valves about 8·5 mm., of which about seven-eighths belong to the ventral valve. About 100 or more striæ to each valve; new ones arise by bifurcation and implantation; about one-fourth reach the umbo, and all except those on the axis curve outward.

Ventral valve very convex, but not humped as in the typical *D. elegantula;* teeth large and diverging with lateral excavation; ventral areas about 2 mm. wide; dorsal less than half as wide; areas almost in contact in old individuals; ventral scar in shell with above dimensions is 4 mm. wide, 5·5 mm. long, and divided by a low, concave topped ridge about 1 mm. wide. The muscle scar is bounded by a well-defined ridge, the continuation of the dental plates which become parallel toward the end and merge into the anterior surface.

Dorsal valve slightly convex, divided into two lobes by a shallow sinus which originates at the beak and widens toward the front. The cardinal process is small, trilobed, not over 0·5 mm. long, the base continued forward as a low ridge for more than two-thirds the length of the shell, separated from the crura by depressions which converge forward. The crura are comparatively large, 2 to 3 mm. long, diverging at an angle of from 60 to 70 degrees. Some of the shells have wart-like growths on the inner faces of the crura, which almost obliterate the mesial ridge. The muscle scars are bounded by low ridges—the continuation of the crural plates—which are almost parallel for about one-quarter the length of the shell and merge into the surface.

The large size, fine striation, and convexity of the dorsal valve readily serve to distinguish this species from other Anticosti forms of the same genus. *D. lovena* (Lindstrom), from the Silurian of Gotland, is of similar size and shape with equally fine striation, but differs interiorly in the form of the crura and cardinal process.

Occurrence. Silurian: Becscie (3), Wreck beach; Gun River (4), capes MacGilvray and Sandtop; Jupiter (1-10), all exposures; Chicotte (1-2), Southwest point and Jumpers.

Specimens which are perhaps the cotypes of this form are in the Museum of Comparative Zoology. Other examples are in Peabody Museum and the National Museum of Canada.

Dalmanella ruida (Billings)

Plate XVI, figures 21, 22

Orthis ruida Billings, Cat. Sil. Foss., Anticosti, p. 42, 1866; *Orthis? ruida* Schuchert, U.S. Geol. Surv., Bull. 87, p. 292 (1897).

Superficially this shell has the aspect of *Atrypa marginalis*, with which, of course, it has no connexion. The ventral area has a width of about 1·25 mm. in the middle, but becomes linear at the angles. It is slightly curved and longitudinally striate and makes an angle of 155 to 160 degrees with the plane of the lateral margins. The dorsal area is less than 0·5 mm. wide. The foramen is 2 mm. wide, triangular, and extends to the beak. The ribs are coarse and divide two or three times before reaching the margin, forming bundles. Numerous, somewhat rugose concentric striæ complete the ornamentation. The shell structure is strongly minutely punctate.

Occurrence. Ordovician: Ellis Bay (5·7), Ellis bay. Silurian: Becscie (1), Bear cliff.

The holotype, No. 2273, is in the National Musuem of Canada. Other examples are in Peabody Museum.

Rhipidomella sola (Billings)

Plate XVII, figures 10, 11

Orthis sola Billings, Cat. Sil. Foss., Anticosti, p. 12, 1866; *Orthis? sola* Schuchert, U.S. Geol. Surv., Bull. 87, p. 292 (1897).

The coarseness of striation of this shell, with its biconvexity and short hinge-line, places it in an intermediate position between the genera *Dalmanella* and *Rhipidomella.* It is more coarsely striated than any species of the latter genus from the Ordovician or Silurian. In the absence of interiors it is impossible to certainly place it, but its general appearance allies it more closely to *Rhipidomella.* It differs from *R. uberis* in being slightly smaller, more coarsely striated, having the beaks farther apart and neither so strongly incurved.

Occurrence. Ordovician: Vauréal (1, 3, 4), de Puyjalon cliff, Vauréal bay, and Battery point.

The holotype, No. 8134, is in the National Museum of Canada. Plesiotypes are in Peabody Museum.

Rhipidomella uberis (Billings)

Plate XVII, figures 12, 13, 14, 15

Orthis aequivalva Shaler (not Hall, 1847), Bull. Mus. Comp. Zool., vol. I, No. 4, p. 66 (1865); *O. uberis* Billings, Cat. Sil. Foss., Anticosti, p. 42, 1866; *Rhipidomella uberis* Schuchert, U.S. Geol. Surv., Bull. 87, p. 352 (1897).

The average shell is 14 mm. long, 15 mm. wide, hinge-line 9 mm. wide, depth of both valves variable, ranging from 3 to 6 mm. Ventral muscular scar elongate, little flabellate, bounded by a ridge on all sides; 5 mm. long, 4 mm. wide in a shell 11·5 mm. wide. A low, median ridge with a longitudinal depression separates it into two halves and produces a notch at the anterior end of the scar. Dorsal scar oval, bounded by a low ridge; 3·5 mm. wide in a shell 11 mm. wide; slightly longer than wide; cardinal process small, continued forward as a low ridge; crura small, divergent at an angle of about 60 degrees, transversely flattened.

In zone 3 of the Gun River formation at Wreck beach a thin layer is characterized by a great abundance of small *Rhipidomellas* which, except for size, do not differ from the larger examples. It has not been thought well to give these a distinct name, considering them either the young of *R. uberis,* or dwarfed by reason of the muddy character of the water.

It is larger than *R. hybrida* (Sowerby) and has a longer hinge-line. From *R. circula,* its nearest representative in American strata, it differs in being smaller, having the beaks farther apart with larger areas, in lacking the ventral sinus, and in having finer striations.

Occurrence. Ordovician: Vauréal (3-4), Battery point and cape James; Ellis Bay (1, 2, 4-10), Ellis bay and Junction cliff. Silurian: Becscie

(1, 3), Bear cliff and Wreck beach; Gun River (1-4), all exposures; Jupiter (1-2, 9-10), most exposures.

The cotypes, No. 2272, are in the National Museum of Canada. Other specimens are in Peabody Museum.

Rhipidomella uberis var. *rhynchonelliformis* (Shaler)

Orthis rhynchonelliformis Shaler, Bull. Mus. Comp. Zool., vol. I, No. 4, p. 66 (1865); *Rhipidomella rhynchonelliformis* Schuchert, U.S. Geol. Surv., Bull. 87, p. 351 (1897).

This is a variety of *R. uberis* differing in having a broad, shallow ventral sinus, larger size, and greater proportional width. An average example is 16 mm. long, 17·5 mm. wide at mid-length, and 9 mm. thick. The features of difference between this form and *R. uberis* are so few that it is doubtful if it should be given even varietal rank. It is probable that the reference by Shaler to baie Innommée is in error.

Occurrence. Ordovician: Ellis Bay (2, 4, 5), Ellis bay.

The cotypes are in the Museum of Comparative Zoology. Other specimens are in the National Museum of Canada, and Peabody Museum.

Bilobites bilobus (Linnaeus)

Orthis biloba Davidson, Mon. Brit. Foss. Brach., vol. III, pt. 7, p. 206, Pl. XXVI, figs. 10-15 (1871); *Bilobites biloba* Schuchert, U.S. Geol. Surv., Bull. 87, p. 160 (1897); Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, p. 710 (1910).

This widely distributed species is present in the Anticosti strata at three localities, but is very rare.

Occurrence. Silurian: Jupiter (2-4), East cliff and capes Ottawa and Jupiter.

Peabody Museum.

Dinorthis carletona n. sp.

Plate XVI, figures 4, 5, 6, 7, 8

Orthis subquadrata Billings, Geol. of Can., 1863, p. 165, fig. 146; Billings, Cat. Sil. Foss., Anticosti, p. 12, 1866; *Dinorthis subquadrata* Schuchert (partim), U.S. Geol. Surv., Bull. 87, p. 217 (1897); Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, p. 698 (1910).

This species differs from *D. subquadrata* Hall in having the anterior angles broadly rounded; in the absence of straight sides, the two valves of about the same size instead of the dorsal nearly twice as deep as the ventral; in possessing a smaller cardinal process, weaker crura, and in being more coarsely plicated, a shell 28 mm. wide having 32 to 40 plications instead of 60. In the Cincinnati species a triangular, flat-floored depression bounds and separates the process from the crura, rising slightly toward the process. In the Anticosti species, the triangular bounding area is not flat-floored, but concave, and deepens immediate to the process.

Additional characters of *D. carletona* are: the areas of both valves are narrow, the ventral area about 2 mm. wide, the dorsal about half as wide; the dorsal muscular scar is very weak with the boundaries hardly indicated; the ventral scar is heart-shaped, wider than long, 6 mm. long in a shell 15 mm. wide; new plications arise on each valve by implantation and bifurcation.

D. carletona is not closely related to *D. anticostiensis*, the other Anticosti species of this genus, differing in being far more coarsely plicated, less tumid, in having valves almost equal, and in having a sinus on the dorsal valve.

Occurrence. Ordovician: English Head (1-4), most exposures; Vauréal (1-6), most exposures; Ellis Bay (4, 7), about a mile east of Junction cliff and zone 21, Vauréal River section.

The holotype and paratypes are in Peabody Museum.

Dinorthis anticostiensis (Shaler)

Plate XVIII, figures 15, 16

Orthis porcata Billings, Pal. Foss., vol. I, p. 135, figs. 111a-b (1862); *O. anticostiensis* Shaler, Bull. Mus. Comp. Zool., vol. I, No. 4, p. 66 (1865); *O. porcata* Billings, Cat. Sil. Foss., Anticosti, p. 41, 1866; *O. anticostiensis* Shaler, Mems. Geol. Surv., Kentucky, Mem. 3, vol. I, p. 19, tab. 10, p. 33, Pl. 6 (1876); *Dinorthis porcata* Schuchert, U.S. Geol. Surv., Bull. 87, p. 216 (1897); Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. 21, p. 701 (1910).

Cardinal process short, continued anteriorly as a low ridge separating the adductor scars. The crura are blunt, separated from the process by depressions, shallowly excavated on the upper inner angles, transversely flattened, diverging at an angle a little less than 90 degrees. The ventral valve gently convex in the posterior half with a broad, shallow depression in the middle of the anterior half. New plications arise on the dorsal valve through bifurcation and interpolation, chiefly the latter; on the ventral valve bifurcation is the more common.

Compared with the Cincinnati forms of *D. subquadrata*, *D. anticostiensis* has deeper ventral muscular scars, the ventral septal ridge is wider and more blunt and rounded, the cardinal process more elongated, the sockets deeper, the shell more tumid, the ventral valve far more convex and the plications finer. It is larger, more tumid, and far more finely plicated than *D. carletona*. The species further differs from both those mentioned in the total absence of either a fold or a true sinus.

Compared with the British *D. porcata* the Anticosti specimens have the ventral muscular scars slightly more prolonged, with the anterior re-entrant a little deeper, the ventral valve somewhat more convex, and there is not the bundled appearance of the striæ such as appears to exist in the British examples. In these all the new striations apparently arise through bifurcation of the old, whereas in the Anticosti forms the greater number of striations originate near the umbo, the new ones of the dorsal valve being chiefly produced by interpolation, although some arise through bifurcation, those on the ventral valve by bifurcation. The English species is also larger and far more coarsely plicated. These differences have led to the retention of Shaler's name.

Occurrence. Ordovician: Ellis Bay (1, 2, 4-7, 9), common at Ellis bay and Junction cliff, rare at Prinsta and Big Boulder bays.

The cotypes are in the Museum of Comparative Zoology. Plesiotypes are in Peabody Museum and the National Museum of Canada.

Leptaena julia (Billings)

Plate XXII, figures 1, 2

Strophomena julia Billings, Pal. Foss., vol. I, p. 127, figs. 105a-b (1862); *Leptaena julia* Shaler, Bull. Mus. Comp. Zool., vol. I, No. 4, p. 65 (1865); *Strophomena julia* Billings, Cat. Sil. Foss., Anticosti, p. 40, 1866; *Strophomena*? *julia* Schuchert, U.S. Geol. Surv., Bull. 87, p. 432 (1897).

This species differs from *L. rhomboidalis* largely in the character of the dorsal interior, in that the ridges from the crura do not curve outward to enclose a pair of ovate, muscular scars; but diverge at an angle of about 120 degrees and have between them the flabellate adductor scars, the flabellation being produced by ridges radiating from the cardinal process. The striated and greatly wrinkled exterior is another point of difference. The resemblance to *L. loveni* is not striking, the only common specific features being the small size of the cardinal process and the wrinkled visceral area.

Occurrence. Silurian: Jupiter (10), Jumpers.

The cotypes, No. 2506a, are in the National Museum of Canada. Other specimens are in Peabody Museum.

Leptaena rhomboidalis (Wilckins)

Leptaena quadrilatera Shaler, Bull. Mus. Comp. Zool., vol. I, No. 4, p. 65 (1865); *Strophomena rhomboidalis* Billings, Cat. Sil. Foss., Anticosti, p. 41, 1866; Davidson, Mon. Brit. Foss. Brach., vol. III, pt. VII, p. 281, Pl. XXXIX, figs. 1-21; Pl. XLIV, fig. 1, 1871; Miller, N. Am. Geol. and Pal., p. 383, 1889; *Leptaena rhomboidalis* Schuchert, Bull. 87, U.S. Geol. Surv., p. 240, 1897; Cumings, Dept. Geol. and Nat. Res., Indiana, 32nd Ann. Rept., p. 809, Pl. XXXIV, figs. 5 a-d (1908); Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, p. 702 (1910).

The Anticosti forms have the general shape and characters of the species for this horizon, but vary considerably in size, alation, and geniculation. In the Ellis Bay formation the specimens are commonly small, but a few are large. The largest examples occur in the basal Jupiter formation, where there are individuals with a width of 44 mm. on the hinge-line, of which about 7 mm. on each side belong to the wing. In these specimens the length to the knee is 20 mm.; the shell below the knee is 11 mm. longer. These individuals are also ornamented by about a dozen strongly developed striæ in the axial portion of the ventral valve. In the upper Jupiter formation occur small forms in which the hinge has a length of about 8 mm., with the width at mid-length about 1 mm. greater. The length of these shells is about 8 mm., of which 3 mm. is below the knee. Radial markings do not appear to be common on specimens from the North American interior, but occur on Gotland forms of this species.

Occurrence. Ordovician: Ellis Bay (1, 2, 4-10). Silurian: Becscie (1-4); Gun River (1-4); Jupiter (1-10); Chicotte (1,2), most exposures.

Numerous specimens of this species are in the collections of both the Peabody Museum and the National Museum of Canada.

Additional Species Referred to Leptaena Dalman

There is a strophomenoid stock which in its general expression is reminiscent of *Rafinesquina*, but the fact that the specimens are more or less geniculate and transverse throws doubt on such a generic reference. On the other hand they appear to be related to *Leptaena;* but as some of the species lack the geniculation, are considerably depressed, and are about as long as wide, hesitation is felt in referring them to that genus. The interiors of this group are quite unlike those of *Rafinesquina alternata*, but fall in line with those of *Leptaena? unicostata*. This fact has led to the reference of many of the Anticosti strophomenoids with *Rafinesquina* expression to the genus *Leptaena* rather than *Rafinesquina*, since their interiors suggest that they are more nearly related to the former genus. Shells having these generic characters are *L.? ceres, L.? gamachiana, L.? vaurealensis, L? gracilis, L.? nitens, and L.? reticulata*. That these species, however, are not *Leptaena sensu stricto* is expressed by the mark of interrogation. The introduction of a new generic term to embrace these forms would probably be a much better mode of procedure; but hesitation is felt in doing this until a monographic study of the Ordovician and Silurian strophomenoids has been made.

Leptaena? ceres (Billings)

Plate XVII, figures 16, 17, 18

Strophomena ceres Billings, Can. Nat. and Geol., vol. 5, p. 54 (1860); Pal. Foss., vol. I, p. 119 (1862); Billings, Cat. Sil. Foss., Anticosti, p. 11, 1866; *Rafinesquina ceres* Whiteaves, Pal. Foss., vol. III, pt. 2, p. 120 (1895); Schuchert, U.S. Geol. Surv., Bull. 87, p. 338 (1897).

This shell closely resembles *L.? nitens*, but is not nearly so geniculate and is longer and more circular in outline. The specimen supposed to be the holotype is 26 mm. wide at the hinge, length 21 mm., depth of the ventral valve 11 mm. Pedicle opening practically obsolete. The specimen identified by Billings from East point probably belongs to *Brachyprion robusta*.

Occurrence. Ordovician: English Head (3-4), English head and MacDonald river: Vauréal (1-5), most exposures; Ellis Bay (4-6), Ellis bay and Vauréal river.

The holotype, No. 2018, is in the National Museum of Canada, other specimens are in Peabody Museum.

Leptaena? gracilis n. sp.

Plate XVI, figure 9

This species is related to the *Leptaena? nitens* stock; but it is smaller, less convex, and far more delicate in its structure than any of the Anticosti forms referred to that grouping. An average shell is about 10 mm. wide at the hinge-line and about 7 mm. long. Some specimens are slightly alate. The ventral valve is fairly evenly convex, in many specimens nearly flat, and commonly less than 2 mm. deep. The dorsal valve is concave and closely fits into the ventral valve. The surfaces of both valves are covered with very fine striations; those which extend to the beak are somewhat larger and between them the new ones arise through bifurcation and implantation. Without a lens these latter are scarcely visible. On the axis of the ventral valve is a single striation which is somewhat larger than any other. The entire surface is crossed by almost microscopic concentric lines. In the ventral valve there is a faint, almost circular muscular impression which is embraced by very faint prolongations of the dental lamellæ. The dorsal interior has not been seen. It was at first thought that these might be the young of *L.? nitens*, but their delicate structure and general flatness of shell led to a separate reference.

Occurrence. Ordovician: English Head (3, 4), most exposures; Vauréal (2-5), Whitecliff, Vauréal river, and West point; Ellis Bay (1), Vauréal river.

Peabody Museum.

Leptaena? nitens (Billings)

Plate XVII, figure 19; Plate XVIII, figures 13, 14

Strophomena nitens Billings, Can. Nat. and Geol., vol. V, p. 53, fig. 1 (1860); Billings, Pal. Foss., vol. I, p. 118, fig. 97 (1862); Billings, Geol. of Can., 1863, p. 209, fig. 208; Billings, Cat. Sil. Foss., Anticosti, p. 11, 1866; *Leptaena nitens* Whiteaves, Pal. Foss., vol. III, pt. 2, p. 120 (1895); *Rafinesquina nitens* Schuchert, U.S. Geol. Surv., Bull. 87, p. 339 (1897); *Leptaena nitens* Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. 21, p. 696 (1910).

L.? nitens is closely related to *L.? unicostata* Meek and Worthen, differing internally in that the visceral area of the ventral valve is more convex, the geniculation not so abrupt, and the mid-striation not so prominent except in the young stages. The ventral interiors are very much the same except that the muscular scar of *L.? unicostata* has its sides a little more diverging and it is rougher. In the dorsal valve *L.? nitens* lacks the crest at the line of geniculation. Associated with the larger examples of *L. nitens* are smaller, nearly smooth, greatly geniculated forms with the part below the geniculation as long as that over the visceral disk. For the present these are not differentiated. They occur in association with the larger forms in the English Head and Vauréal formations, but have not been seen in the Ellis Bay formation.

Occurrence. Ordovician: English Head (1-4), commonly present; Vauréal (1-6), commonly present; Ellis Bay (7, 8, 10), cape James and Ellis bay.

The holotype, No. 2019, is in the National Museum of Canada. Peabody Museum has many examples.

Leptaena? vaurealensis n. sp.

Plate XVI, figures 10, 11

Strophomena imbrex Billings (not Pander), Pal. Foss., vol. I, p. 128, fig. 106 (1862); *S. imbrex* Billings, Cat. Sil. Foss., Anticosti, p. 11, 1866; Miller, N. Am. Geol. and Pal., p. 382, 1889; *Rafinesquina imbrex* Schuchert, U.S. Geol. Surv., Bull. 87, p. 338 (1897).

Ventral valve highly convex and rounded, geniculated, with numerous, fine, radiating striæ of two sizes, 2 to 5 smaller ones being between 2 of the larger, and the latter are the only ones reaching the beak. The central plication is higher and larger than any other. Also ornamented by numerous, fine, concentric lines and a few larger obscure undulations. The beak is small, very slightly overhanging the area; ventral area almost in the plane of the lateral margin, about 1 mm. wide. Foramen small, closed at the apex. Dorsal area linear, the bilobed process projecting and small. Sides straight, almost parallel, front and anterior angles uniformly rounded; visceral surface gently convex, rather abruptly curved about mid-length. The cardinal angles almost rectangular, not sharp, slightly deflected ventralward. Width 30 to 40 mm., length, following curve, 30 to 35 mm., depth of ventral valve 10 to 15 mm. Differs from *L.? reticulata* in lacking the undulated visceral disk.

This species was identified by Billings as *Strophomena imbrex* Pander, and in his supposed type material associated with this identification there were also specimens of *Strophomena hecuba,* which it much resembles. *S. imbrex* was described from the Ordovician rocks of Russia and is a geniculated shell. Davidson described a variety from the Wenlock as *S. semiglobosa,* and his illustrations show that it has a denticulated hinge-margin, the denticulations extending about two-thirds the length. *L.? vaurealensis* has no hinge denticulations, is roughly geniculated, and is distinct from either.

Occurrence. Ordovician: English Head (4), Carleton point; Vauréal (1, 4, 5, 6), Battery point and Vauréal river; Ellis Bay (6), Ellis bay.

The holotype, No. 2015, is in the National Museum of Canada. Plesiotypes are also in Peabody Museum.

Leptaena? reticulata (Shaler)

Plate XXII, figure 19

Strophomena reticulata Shaler, Bull. Mus. Comp. Zool., vol. I, No. 4, p. 62 (1865); *Strophomena? reticulata* Schuchert, U.S. Geol. Surv., Bull. 87, p. 434 (1897).

In the tray containing Shaler's type specimens of this species in the Museum of Comparative Zoology were found two specimens, one a *Strophomena,* the other a *Leptaena?* As the latter is more in accord with the above description it is considered the holotype. The visceral disk is gently convex and markedly reticulated. At about half the length the shell is rather sharply deflected and thence gently convex to the anterior margin. The cardinal areas of both valves are narrow and meet at an acute angle. The greatest width is at the hinge-line where it is 35 to 40 mm. wide; 30 to 40 mm. long, depth about 20 mm. On exfoliation the surface has a decidedly silky lustre. The interior surface of the valves is markedly granulose, with all the granules or papillæ pointing toward the anterior margin; the cardinal process is bifid, completely covered by an extremely large chilidium. The process is continued forward by two ridges which finally unite into a single ridge, which at its distal extremity bifurcates in fish-tail fashion. These ridges enclose the prominent, but narrow, muscle scars. The reticulate visceral surface is something like that of *L. rhomboidalis;* but there all similarity ends, as this species is about as long as broad, not sharply geniculate, and has an entirely different expression.

Occurrence. Ordovician: Ellis Bay (4–6), Ellis bay.

The holotype is in the Museum of Comparative Zoology. Other specimens are in Peabody Museum.

Brachyprion anticostiense (Shaler)

Plate XXII, figures 15, 16, 17, 18

Strophomena anticostiensis Shaler, Bull. Mus. Comp. Zool., vol. I, No. 4, p. 62 (1865); *Rafinesquina alternata* Schuchert (partim), U.S. Geol. Surv., Bull. 87, p. 337 (1897).

The cardinal areas of this species are very narrow, the dorsal being almost linear, the ventral a little wider. The hinge-margin for about half the distance from the beak to the cardinal angles is denticulated.

This species is a flat form of Brachyprion, which has an external aspect very like that of *Rafinesquina alternata.* The denticulated hinge-margin and the slight development of the muscular impressions readily serve to differentiate it from that species.

Occurrence. Silurian: Becscie (3), Wreck beach; Gun River (1–4), all exposures; Jupiter (1-4, 7–10), most exposures.

The holotype is in the Museum of Comparative Zoology. Other specimens are in Peabody Museum.

Brachyprion leda (Billings)

Plate XXII, figures 10, 11

Strophomena leda Billings, Pal. Foss., vol. I, p. 120, figs. 98–99 (1862); Geol. of Can., 1863, p. 311, fig. 316; Billings, Cat. Sil. Foss., Anticosti, p. 40, 1866; *Stropheodonta? leda* Schuchert, U.S. Geol. Surv., Bull. 87, p. 423 (1897); *Brachyprion leda* Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. 21, p. 713 (1910).

Billings appears to have included in his *Strophomena leda* three forms: i.e., a small, nearly circular, almost flat form, which is associated with and considered the young of *B. anticostiensis;* a small, somewhat convex, and alate form of greater width than length; and a larger form of the same shape as number two, but with a heavier and more coarsely striated shell. The second is taken as *Brachyprion leda;* the third is described as *B. robustum.* The three forms are associated, but appear to be distinct.

As amended, *B. leda* has a length of 14 to 16 mm. and a width of about 20 mm. A few have been noted with the length exceeding the width. The shells are rather uniformly convex from beak to border. The ornamentation consists of faintly developed radial striæ. The hinge-line is alate. The shape and ornamentations are very like those of *Leptaena? nitens,* but the interiors are different, and the strong mid-striation of that species is wanting. It may be a descendant of it.

Occurrence. Silurian: Gun River (1–4); Jupiter (1–10). Common in most exposures.

The electotype, No. 2442, is in the National Museum of Canada. Peabody Museum contains an abundance of material.

Brachyprion philomena (Billings)

Plate XXII, figure 14; Plate XXIII, figures 8, 9, 10

Strophomena philomena Billings, Can. Nat. and Geol., vol. V, p. 56 (1860); Billings, Pal. Foss., vol. I, p. 122, figs. 100–101 (1862); Billings, Geol. of Can., 1863, p. 311, fig. 317; *Brachyprion ventricosum* Shaler, Bull. Mus. Comp. Zool., vol. I, No. 4, p. 63 (1865); *Strophomena philomena* Billings, Cat. Sil. Foss., Anticosti, p. 40, 1866; *S. philomena* Schuchert, U.S. Geol. Surv., Bull. 87, p. 433 (1897); *Stropheodonta? ventricosa* Schuchert, ibid., p. 427, 1897.

B. philomena has the surface characters of *Rafinesquina alternata*, but differs in being strongly alate with the ears lobe-like. It is usually linguate, has a narrow cardinal area, denticulations on the hinge-margin for a distance of 5 to 7 mm. on each side of the beak, and is sharply deflected at the margin of the visceral disk. The foramen of each valve is closed, and the cardinal process is deeply bifid. The species is readily separable from the other Anticosti *Brachyprions* by its large size, linguate anterior margin, and great convexity.

Occurrence. Silurian: Gun River (3–4), Gun river and cliffs east; Jupiter (1–10), most exposures, abundant at Iron river and Sand cliff.

A plesiotype, No. 2443, is in the National Museum of Canada. Other specimens are in Peabody Museum.

Brachyprion elegantulum n. sp.

Plate XVI, figure 18

Plectambonites arca Shaler, Bull. Mus. Comp. Zool., 1863, p. 63.

This is the smallest of the Anticosti examples of the genus. The shape and dimensions are much like those of the associated *Plectambonites*, but the shell is somewhat more convex, and the prolongations at the cardinal angles are very different. A large individual is not over 12 mm. wide, and most are not over 10 mm., of which from 1 to 1·5 mm. on each side belong to the alations. The length of the shell is about 6 mm. It is uniformly and rather strongly convex from beak to anterior border. The surface is smooth, but with faint indications of striæ on some individuals. The interior of the ventral valve has the muscular impressions weakly developed. Some individuals have a low, round-topped ridge extending from the beak to within about 2 mm. of the anterior border. In other individuals the ridge is wanting. The interior of the valve is not strongly papillose as in *Plectambonites*, but small papillæ are present. The delthyrium is triangular and small, the width at the base not exceeding 1 mm. The sides of the delthyrium are not supported by plates extending to the floor of the shell as they are in the associated *Plectambonites*. The cardinal area varies from one-third to one-half mm. wide, and extending on each side of the beak along the inner margin of the cardinal area for one-third to one-half the distance to the end are small teeth to the number of 7 to 11. The dorsal valve fits closely in the central valve, but has less curvature than the latter. The muscular markings are faintly developed. The cardinal area is linear. The cardinal process is bilobed, and its base is continued anteriorly for about half the length of the shell as a small ridge; and two diverging ridges extend outward from its base, the ridges making angles of about 60 degrees with the axis of the shell.

The collections of Shaler contained some individuals of this species bearing the label *Plectambonites arca.* With one exception the description of Shaler applies, and the locality from which his specimens were collected is that where they are now found most abundantly. It is thus assumed that Shaler based his description largely on this small Brachyprion, although the reference to striæ of two dimensions suggests that he also had specimens of the associated *Plectambonites,* which have such striæ, but also have strongly developed muscle scars.

Occurrence. Silurian: Jupiter (9, 10), Jumpers, head of Salmon river, etc.

Brachyprion robustum n. sp.

Plate XVI, figures 12, 13, 14, 15

Strophomena ceres Billings (? partim), Can. Nat. and Geol., vol. V, p. 54 (1860); *S. leda* Billings (? partim), Pal. Foss., vol. I, p. 120 (1862).

This form bears some resemblance to *Leptaena? ceres,* and in part it appears to have been so identified by Billings. He also appears to have partly included it in his *Strophomena leda.* The shell is heavier and larger than the latter and shorter than *L. ? ceres,* and also bears denticulations on the hinge-line. An average example is 12 mm. long and 22 mm. wide. It is as a rule somewhat alate, and a few specimens have been collected which have very long wings.

Occurrence. Silurian: Becscie (3), Wreck beach and near Becscie river; Gun River (2, 3), Gun river and vicinity; Jupiter (2, 3), East cliff and near Heath point.

Peabody Museum.

Plectambonites sericeus var. *glaber* Shaler

Plectambonites glabra Shaler, Bull. Mus. Comp. Zool., vol. I, No. 4, p. 64 (1865); *Leptaena sericea* Billings, Cat. Sil. Foss., Anticosti, p. 12, 1866; *Plectambonites glaber* Shaler, Mem. Geol. Surv., Kentucky, vol. I, p. 29 (1876); *Leptaena glabra* Foerste, Proc. Boston Soc. Nat. Hist., vol. XXIV, p. 294 (1889); *Plectambonites sericeus* Schuchert (partim), U.S. Geol. Surv., Bull. 87, p. 310 (1897); Schuchert and Twenhofel, Bull. Geol. Am., vol. 21, p. 703 (1910).

Compared with specimens from the Richmond of the interior of North America, the Anticosti individuals do not show sufficiently constant differences to justify more than varietal separation. There is much variation from horizon to horizon, the variations being in dimensions, slight differences in the muscular impressions, and development of striations. As there must have been young individuals this accounts for the variations in dimensions, and as many of the shells underwent transportation, the variations in striæ are accounted for. Specimens of the three Ordovician formations are essentially similar. The striæ of both valves are of two sizes, 28 to 30 of the larger to an average shell, and between 2 of the larger there are from 2 to 8 very much smaller ones. An average example is 16 to 18 mm. wide on the hinge-line, 8 to 19 mm. long, and 4 to 5 mm. thick; the dorsal muscle scar has a length of 5 to 6 mm. and a width of 6 mm. A number of specimens were noted with the hinge-margin denticulated.

Occurrence. Ordovician: English Head (1-4); Vauréal (1-6); Ellis Bay (1-10). Common in every exposure of calcareous strata.

Plesiotypes are in both the National Museum of Canada and Peabody Museum.

Plectambonites striatacostatus n. sp.

Plate XVI, figures 16, 17

Outline, semi-elliptical; greatest width at the hinge-line; ventral valve very convex; highest near the middle, curving pretty uniformly both to the beak and the anterior margin, concave to the cardinal angles; surface with from 5 to 9, generally 7, large, subangular ridges, of which two near the middle are much larger than the others. These two originate at the beak. Between them at a distance of about 1 mm. from the beak a ridge is implanted, which does not reach a dimension equal to the others until about half the length of the shell. The entire surface is covered with fine, punctate striæ exactly similar to those of *P. transversalis;* but that on the summit of each ridge is larger, angular, and somewhat like the larger striations of that species. Beak small, incurved, with the umbo rising above the hinge-line for about one-sixth the length of the shell. Ventral area small, about one-half mm. wide, curved, hinge-margin denticulated. An average specimen is 6 mm. long, 9 to 10 mm. wide, 2·3 mm. thick.

Dorsal valve concave, fitting closely into the ventral, inner surface strongly papillose. Inner boundaries of the muscular scars very high, more than one-half mm. in a shell 9 mm. wide, close together for about half their lengths, and then slightly diverging, abruptly rounded to nearly flat on top. Laterally there is at least one, and there may be two, parallel ridges, which are not more than half as long as the inner ones. The dorsal exterior has at least five ribs like those of the ventral surface.

This species resembles *P. quinquicostata* (McCoy) of the English Caradoc, on which the normal number of ribs is 5 instead of 7, and they are not elevated on ridges. *P. segmentum* (Angelin) of the English Wenlock is another species to which it bears resemblance, but the beak of the Wenlock form appears far more incurved, and the stronger striæ do not appear to be elevated on ridges. In the Yale collections are 5 specimens from the Niagara of Osgood, Indiana, labelled *P. quinquicostata* (they are not that species), which externally are very nearly the same as the Anticosti forms, but there are slight differences in the configuration of the muscular scar of the dorsal valve. Foerste[1] has briefly described a form which has 5 conspicuous striæ from the Niagara of western Tennessee, as *P. tennesseensis*, but nothing is said of ridges.

The prominent ridges adequately serve to distinguish this species from any other Anticosti *Plectambonites.*

Occurrence. Silurian: Gun River (4), Gun river; Jupiter (4, 6), about a mile west of Jupiter river and Sand cliff.

The holotypes and paratypes are in Peabody Museum.

[1] Jour. Geol., vol. XI, p. 708 (1903).

Plectambonites transversalis (Wahlenburg)

Plectambonites tenera Shaler, Bull. Mus. Comp. Zool., vol. I, No. 4, p. 64 (1865); *Leptaena transversalis* Billings, Cat. Sil. Foss., Anticosti, p. 41, 1866; *Plectambonites transversalis* Schuchert, U.S. Geol. Surv., Bull. 87, p. 311 (1897); Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. 21, p. 714 (1910).

The exteriors of the Anticosti examples of this species are very similar to those of northern Europe. They have from 14 to 16 riblets, which are about 1 mm. apart on the anterior margin, and between them are 4 to 9 very fine striæ. There are some slight differences—the Anticosti forms having the ventral area a little narrower and the beak less incurved. *P. transversalis* from the Niagara of Osgood, Indiana, appears to be practically identical. At the Jumpers occur some rather short, transverse forms, which are somewhat smaller than the norm. This is probably Shaler's *P. tenera*. Similar forms are present in the Gotland beds. An average example is 11 mm. wide at the hinge-line (the greatest width) and 8 mm. long. The hinge-margin is denticulated.

Occurrence. Silurian: Gun River (4), Gun river; Jupiter (1-10), most exposures.

Plesiotypes are in both the National Museum of Canada and Peabody Museum.

Strophomena radiireticulata n. sp.

Plate XVII, figures 1, 2, 3

Strophomena antiquata Billings, Pal. Foss., vol. I, p. 129, fig. 107 (1862); Billings, Cat. Sil. Foss., Anticosti, p. 41, 1866; *Strophomena ? antiquata* Schuchert, U.S. Geol. Surv., Bull. 87, p. 429 (1897).

This species is related to *S. antiquata*, but the Anticosti forms are less rugose than the typical European *S. antiquata*, and the muscular impressions of the ventral valve are different.

Occurrence. Silurian: Jupiter (1, 2, 4, 6, 8-10), East cliff, Bell river, Iron river, Jumpers, etc. Not common.

Plesiotypes of this species are present in both the National Museum of Canada and Peabody Museum.

Strophomena? arethusa Billings

Strophomena arethusa Billings, Pal. Foss., vol. I, p. 132 (1862); Billings, Cat. Sil. Foss., Anticosti, p. 11, 1866; *Strophomena? arethusa* Schuchert, U.S. Geol. Surv., Bull. 87, p. 429 (1897).

The type specimens on which this species is founded consist of three valves on a slab. Two are dorsal and one ventral, and their flattened, fractured, and distorted condition makes it impossible to determine whether they are resupinate or otherwise. On the slab there is also a small part of the beak of another specimen, which appears to be rafinesquinoid.

Occurrence. Ordovician: Vauréal (3), Observation cliff.

The supposed cotypes, No. 2024, are in the National Museum of Canada.

Strophomena fluctuosa Billings

Plate XXII, figures 3, 4, 5

Strophomena fluctuosa Billings, Can. Nat. and Geol., p. 57, fig. 6, 1860; Billings, Pal. Foss., vol. I, p. 123, fig. 102 a-b (1862); Billings, Geol. of Can., 1863, p. 209, fig. 207; Billings, Cat. Sil. Foss., Anticosti, p. 11, 1866; Hall and Clarke, Pal. N.Y., vol. VIII, pt.1, p. 251, Pl. XI A, figs. 4-5 (1892); Winchell and Schuchert, Pal. Minn., vol. III, pt. 1, p. 395, Pl. XXXI, figs. 14-17 (1893); Whiteaves, Pal. Foss., vol. III, pt. 2, p. 119 (1895); Schuchert, U.S. Geol. Surv., Bull. 87, p. 431 (1897); Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, p. 696 (1910).

The prominent features of this species are the much wrinkled visceral surfaces of both valves, and the marked alation. In the Anticosti section it may be mistaken for *S. hecuba;* but that species is more uniformly convex, has finer striations, lacks the wrinkling, and is generally larger. From *S. planocorrugata* it is distinguished by its greater convexity and by having wrinkles all over the visceral disk, instead of just at the cardinal margin.

Occurrence. Ordovician: English Head (1-4); Vauréal (1-6); Ellis Bay (1, 2, 4-6). Generally common.

Plesiotypes are in both the National Museum of Canada (No. 2017), and Peabody Museum.

Strophomena arcuata Shaler

Plate XXIII, figures 6, 7

Strophomena arcuata Shaler, Bull. Mus. Comp. Zool., vol. I, p. 62 (1865).

The striations give the impression of marked irregularity and are of two sizes, 1 to 2 of the smaller between 2 of the larger. The new striations arise largely by implantation. The visceral disk of the dorsal valve varies from slightly convex to slightly concave. The deflexion is abrupt, and the anterior axial portion is humped or nasuate on a mature individual. A full-grown individual is 34 mm. wide on the hinge-line, 27 mm. long, and about 11 mm. thick. The shell of each valve is thick. Cardinal areas of both valves are narrow, that of the ventral about 2·5 mm. wide, and that of the dorsal not more than half as wide. The area of the dorsal valve is almost in the plane of the lateral margin and makes an angle of about 45 degrees with the area of the ventral valve.

The type of *S. arcuata* appears to have been lost, and what purports to be the holotype appears to be *S. semiovalis.* The specimens on which the above description is based were collected at the type locality of Shaler's material and fit the description of Shaler.

Occurrence. Ordovician: Ellis Bay (4-6, 9), Junction cliff and Ellis bay, and zone 21, Vauréal River section.

The electotype is in the writer's collection. Other specimens are in the collections of Peabody Museum.

Strophomena hecuba Billings

Plate XXIII, figures 1, 2, 3

Strophomena hecuba Billings, Can. Nat. and Geol., vol. V, p. 60, fig. 7 (1860); Billings, Pal. Foss., vol. I, p. 126, fig. 104 (1862); Billings, Geol. of Can., 1863, p. 209, fig. 206; Billings, Cat. Sil. Foss., Anticosti, p. 11, 1866; Hall and Clarke, Pal. N.Y., vol. VIII, pt. 1, p. 252 (1892); Schuchert, U.S. Geol. Surv., Bull. 87, p. 431 (1897).

The young of this species strongly resemble mature individuals of the *S. neglecta* type. It is very apt to be mistaken for *Leptaena? vaurealensis,* as the surface is similar, and both are nearly uniformly convex from beak to border. No *L.? vaurealensis,* however, has been seen with a linguiform extension, so that this character may generally be relied on for separation if the areas can not be seen. The visceral disk is so little flattened that the shell is readily mistaken for a *Rafinesquina.* Its descendant in the Ellis Bay formation is thought to be *S. semiovalis.*

Occurrence. Ordovician: English Head (2-4); Vauréal (1-6). Not common, but present as a rule.

The holotype and paratypes, No. 2016 a-f, are in the National Museum of Canada. Plesiotypes are in Peabody Museum.

Strophomena planocorrugata n. sp.

Plate XVII, figures 4, 5, 6

Strophomena subtenta Billings (not Conrad), Pal. Foss., vol. I, p. 132, fig. 109 (1862); Billings, Cat. Sil. Foss., Anticosti, p. 11, 1866.

From *S. subtenta* Conrad, this species differs in being larger, less convex, having stronger striations, and more prominent cardinal wrinkles, which are also more nearly perpendicular to the hinge-line. The interiors are much alike. Except for the cardinal wrinkles, the aspect is much like that of the genus *Rafinesquina,* the resupination taking place at a very young stage. The striations are of the *R. alternata* type. Some specimens are linguate, and nearly all exhibit a tendency toward anterior elongation. An average example is 30 mm. wide at the hinge-line (the greatest width) and the length is about the same. The very slight convexity and the cardinal wrinkles render this species readily separable from the other Anticosti *Strophomenas.*

Occurrence. Ordovician: English Head (2-4); Vauréal (1-6), present in most exposures.

The holotype and paratypes are in Peabody Museum. Other specimens are in the National Museum of Canada.

Strophomena semiovalis Shaler

Plate XXIII, figures 4, 5

Strophomena semiovalis Shaler, Bull. Mus. Comp. Zool., vol. I, No. 4, p. 61 (1865); *S. arcuata* Shaler, ibid., p. 62; *Strophomena? semiovalis* Schuchert, U.S. Geol. Surv., Bull. 87, p. 435; *Strophomena? arcuata* Schuchert, ibid., p. 429, 1897.

The amended description which follows is based on Shaler's specimens and others in the writer's collection.

Shell more or less trigonal, cardinal angles elongate, width from one-third to one-fourth greater than the length. Hinge straight, sides gently converging from the cardinal angles to a little beyond the middle, thence rapidly converging; the front margin in some specimens linguate.

Dorsal valve slightly concave over the visceral disk, which occupies from one-half to two-thirds the distance from beak to border and is abruptly deflected at the edge; depth of valve equal to about one-third the length. Ventral valve the opposite of the dorsal, but convex over the visceral area. Surface of both valves covered with close-set, irregular, radial striæ of several sizes in irregular alternation and crossed by very fine concentric lines; near the hinge are several irregular undulations, which may or may not extend to the middle of the valve. Area of dorsal valve narrow, almost linear, interrupted by a small cardinal process, which is channelled on the summit by a narrow groove. Area of ventral valve about twice as wide as that of the dorsal, the narrow foramen covered with a V-shaped deltidium. Width of the best-preserved example 42 mm., length 30 mm., depth 13 mm. The shell is thin.

This species is closely related to *S. hecuba*, but has a more concave visceral disk and is more wrinkled. It differs from *S. arcuata* in being larger and far more finely striate.

Occurrence. Ordovician: Ellis Bay (4, 5, 7, 9), Ellis bay and vicinity.

The holotype is in the Museum of Comparative Zoology. Other specimens are in Peabody Museum.

Strophoprion geniculatum (Shaler)

Brachyprion geniculatum Shaler, Bull. Mus. Comp. Zool., vol. 1, No. 4, p. 63 (1865); *Stropheodonta ? geniculata* Schuchert, U.S. Geol. Surv., Bull. 87, p. 422 (1897); *Strophonella geniculata* Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, p. 714 (1910). Not *Strophonella geniculata* Hall, 1859.

Shell resupinate; minute, but sharply-defined denticulations extend for about one-fourth the distance from the beak to the cardinal angles, the number not exceeding a dozen. An average example is 27 mm. wide at the hinge-line, which is slightly alate; the length is 14 mm.

Occurrence. Silurian: Jupiter (9–10), Jumpers, Southwest point, and head of Salmon river.

The cotypes are in the Museum of Comparative Zoology. Plesiotypes are in both the National Museum of Canada and Peabody Museum.

Rafinesquina ellisensis n. sp.

Plate XVII, figures 7, 8

Schuchertella pecten (partim) Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, p. 702 (1910); Twenhofel, Geol. Surv., Canada, Bull. No. 3, p. 10 (1914).

Shell thin, margin semicircular, essentially uniformly convex from the anterior part to just in front of the cardinal angles where it becomes concave; cardinal extremities prolonged into small wings. The surface of the ventral valve is gently and uniformly convex, the depth of the valve being about 1 mm. The surface of both valves is ornamented with fine striations of about three sizes, one of the second size between two of the largest and separated therefrom by from one to three of the smallest size. There are 10 striæ in 3 mm. at the anterior margin. Not more than a fifth to a sixth of the striæ reach to the beak. Concentric growth-lines and very fine, concentric lines complete the ornamentation. Under a lens the bases of the depressions between the radial striæ are shown to be dotted with small pits. The ventral valve is nearly flat, the depth of the concavity being little more than 0·5 mm.

The cardinal area of the ventral valve is not more than 0·5 mm. wide, and that of the dorsal is less than 0·25 mm. wide. The delthyrium of the ventral valve is about 1 mm. wide at the base and nearly filled with the cardinal process, which has a small groove on its summit. No other portion of the interior has been seen.

A mature shell is about 30 mm. wide on the hinge-line, about 26 mm. wide near the middle of the shell, and 24 mm. long. The two valves in contact are not over 1·5 mm. thick.

This shell greatly resembles *Brachyprion anticostiensis*, but is thinner and more fragile, appears to have no denticulations on the hinge-line, and with the exception of the specimen collected in the shale at Wreck beach it is confined to fine-grained limestones with no associated shales.

Occurrence. Ordovician: Ellis Bay (7–10), Ellis bay (abundant), and Vauréal river (rare). Silurian: Becscie (1, 2, 3), Reef point, Wreck beach, and near Bear cliff.

Twenhofel collection.

Schuchertella alterniradiata Shaler

Plate XXII, figures 6, 7, 8, 9

Strophomena alterniradiata Shaler, Bull. Mus. Comp. Zool., vol. 1, No. 4, p. 63 (1865); *S. pecten* Billings, Cat. Sil. Foss., Anticosti, p. 55, 1866; *Strophomena ? alterniradiata* Schuchert, U.S. Geol. Surv., Bull. 87, p. 429 (1897); *Schuchertella pecten* Schuchert and Twenhofel (partim), Bull. Geol. Soc. Am., vol. XXI, p. 702 (1910); Twenhofel, Geol. Surv., Canada, Mus. Bull. No. 3, pp. 31, 14, 16; *S. alterniradiata* Twenhofel, ibid., p. 80, 1914.

The shell has a semi-elliptical outline, is wider than long, has the greatest length at the hinge-line, and some specimens are slightly alate. Ventral valve nearly flat, except at the beak, where it is slightly concave. Dorsal valve slightly convex about the beak, concave adjacent to the margin. Anterior and lateral margins gently and almost uniformly rounded, becoming concave toward the cardinal angles. Cardinal process small, bifid, continued by a low, rounded septum, which at its origin is united with the crural plates. These are erect, diverging at an angle of about 90 degrees, and about 2·5 mm. long. Ventral muscular scar 4 mm. wide, 5 mm. long, plainly indicated; diductor scar oval, far back near the foramen. Surface covered with rounded, annulated striations, which increase by implantation; at the anterior margin there are about 7 of these to 3 mm. Concentric striæ are responsible for the annulations. An average example is about 28 mm. wide, 18 mm. long, and 2·5 to 3 mm. thick.

In dimensions, outline, surface, and interior the Anticosti form is identical with some of the forms included in the European *S. pecten*, comparison having been made with original material from several localities. As the form also appeared in the Anticosti strata at the same time as other forms common to the European strata, it appears certain that there is identity with some of the European forms included under that name. It is much smaller than most of the examples figured by Davidson. Compared with the American *S. subplana*, there are few essential differences which can be pointed out, but it is shorter than many of the forms included in that species. For the present, it is considered best to retain Shaler's term.

Occurrence. Silurian: Gun River (1–4), Ste. Anne cliff and Gun river (rare); Jupiter (1–10), generally common.

The holotype is in the Museum of Comparative Zoology. Plesiotypes are in the National Museum of Canada and Peabody Museum.

Schuchertella gamachiana n. sp.

Plate XVII, figure 9

Schuchertella pecten Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, pp. 7, 10 (1910); Twenhofel, Geol. Surv., Canada, Bull. No. 3, pp. 10, 31 (1914).

Outline semicircular to just in front of the cardinal angles and in some individuals to the cardinal angles. Most individuals have the margins concave on one or both sides for about 1 cm. adjacent to the cardinal angles. The ventral valve is convex at the beak, but it becomes concave when about one-third grown. The dorsal valve is flat for a small space about the beak, but the flatness is not conspicuous, and the shell has the appearance of uniform convexity from beak to anterior border. The surface of each valve is ornamented by fine striations. These are of two sizes, of which about one-fourth reach the beak, the others being implanted at various distances from it. The striations reaching the beak are the largest. There are 12 to 13 in 10 mm. on the anterior border of a mature shell. Small, concentric striæ give an annulated aspect to the striations. The cardinal areas meet at an acute angle, and that of the dorsal valve is nearly in the plane of the lateral margin. The ventral area is slightly triangular and has a large delthyrium at its centre, which has a width of 6·5 mm. at the base. This is partly closed by the large deltidium which meets the margins of the delthyrium in depressions. This cardinal area is not over 1 mm. wide. There is a small opening in the beak of this valve. The dorsal area is nearly as wide as the ventral and has a large, conical chilidium in the middle, and on the posterior slope of the chilidium is a small groove.

A large example is 26 mm. wide on the hinge-line, 21 mm. long, and about 3·5 mm. thick. An average individual is 23 to 24 mm. wide, 20 mm. long, and 3 mm. thick. Not much is known of the interiors, as only a single specimen showing a ventral interior was collected. This does not show the muscle scars. The edges of the delthyrium are extended into the shell and are supported by plates extending to the floor of the shell, between which plates and the cardinal areas are small cavities.

This species differs from *S. alterniradiata* of higher strata in being relatively longer, having a different deltidium and chilidium, being more coarsely striated and relatively thicker, and in having the cardinal area of the dorsal valve nearly equal to that of the ventral.

Occurrence. Ordovician: Vauréal (4), Battery point; Ellis Bay (1-10), Junction cliff, Ellis bay, cape James, Lousy cove, Vauréal falls. Silurian: Becscie (1, 2), Reef point.

Twenhofel collection.

Triplecia insularis var. *anticostiensis* Twenhofel

Plate XVIII, figures 1, 2, 3, 4, 5

Orthis insularis Davidson, Mon. Brit. Foss. Brach., vol. III, pt. 7, p. 273, Pl. XXXVII, figs. 8-15 (1871); *Triplecia ortoni* Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, p. 710 (1910); *T. insularis anticostiensis* Twenhofel, Geol. Surv., Canada, Mus. Bull. No. 3, p. 27 (1914).

Shell rectangular in outline, wider than long, greatest width about the middle, hinge-line about seven-tenths the width, greatest thickness about one-third the distance from beak to anterior border. The largest specimen is 28 mm. long, 36 mm. wide, and 25 mm. thick. In smaller specimens the ratios are about the same. Cardinal angles rounded angular at about 135 degrees. Except for concentric lines of growth the shell is smooth; growth-lines markedly visible, particularly near the margin. Ventral valve the less convex, about one-third as deep as the dorsal, flattened at the cardinal margins. The ventral sinus extends to the umbo, is flat on the base, half as wide as the shell at the anterior margin, near which it is abruptly deflected so as to cut the plane of the lateral margins almost at right angles. Ventral beak small and slightly incurved over the area. Ventral area triangular, making a 45 degree angle with the plane of the lateral margins, 3 mm. wide in the largest specimen. Delthyrium triangular, not more than 1·5 mm. wide, covered with an arched deltidium.

Dorsal valve very convex, except at the cardinal angles where it is concave, deepest near the middle of the valve; marked by a low, triangular fold, which is not over 3·5 mm. high and is flat on top. The junction of the fold and sinus forms almost a right angle. Umbo decidedly prominent, in the largest specimen rising fully 9 mm. above the hinge-line and projecting 2 mm. across the hinge; area linear.

Compared with *T. ortoni* of the United States, this species has a greater proportional width; the fold and sinus form a re-entrant at the anterior margin instead of a convexity; the area is longitudinally striated; there is an almost total absence of auriculation at the cardinal angles which are rounded instead of pointed; the sinus is deeper and flat on the bottom; the fold is not nearly so much like a keel; the umbo is far more prominent and projects about twice as far above the hinge-line; and the forked cardinal process is far more slender. Compared with the Old World *T. insularis*, the Anticosti variety is larger, has the beak of the dorsal valve far more incurved, and the ventral sinus deeper.

Occurrence. Silurian: Jupiter (1, 4), Jupiter river and vicinity.

The holotype and paratypes are in Peabody Museum.

Chonetes (Eodevonaria) primigenius Twenhofel

Plate XVIII, figures 6, 7, 8

Chonetes (Eodevonaria) primigenius Twenhofel, Geol. Surv., Canada, Mus. Bull. No. 3, p. 26, Pl. I, figs. 4, 5 (1914).

The shell resembles *Leptaena? nitens* and was at first mistaken for that species. Hinge-line greatest width, average 9 to 12 mm.; average length 6 to 8 mm. Ventral valve moderately convex, but not nearly so much as in *Plectambonites.* In the Ellis Bay formation specimens were found attached by the dorsal valve to *Dinorthis anticostiensis* and *Clitambonites diversus,* but whether this has any significance or not cannot be said. There are four small spines on each side of the beak. The surface of each valve is covered with numerous, fine striæ—about 150 to each valve—and in the centre of the ventral valve is a single striation very much stronger than any other, such as occurs on *Leptaena? gracilis* and *Leptaena? nitens,* and the ventral interior and the size and shape also are very much as in the latter shell. The hinge-area is striated as in *Brachyprion leda.* The dorsal interior is not known. The size and shape are about the same as *C. tenuistriatus* from the Arisaig Silurian, but that shell does not appear to have the prominent mid-striation and is less finely striate, there being not more than 100 striæ at the margin. It is not nearly so large as *C. novascoticus* and is far more finely striate and larger than *C. cornutus* from the New York Clinton. Compared with the Old World species it is not nearly so large as *C. striatella* Dalman and more finely striate; far larger than *C. ? minima* Sowerby; and *C. lepisma* Sowerby is smooth.

This and a species in England are the earliest known forms of this genus, and from its decided resemblance to *Leptaena? nitens* and *L. ? gracilis* it is possible that both came from the same stock; viz., a small *leptaenoid?* with a narrow muscle scar, finely plicated with a single central plication of large size.

Occurrence. Ordovician: Vauréal (3), Harvey point (cape James); Ellis Bay (1), Junction cliff and Vauréal river. Silurian: Becscie (3), Wreck beach; Jupiter (10), Jumpers.

The holotype and paratypes are in Peabody Museum.

Eichwaldia? anticostiensis Billings

Eichwaldia anticostiensis Billings, Cat. Sil. Foss., Anticosti, p. 10, 1866; *Dictyonella anticostiensis* Schuchert, U.S. Geol. Surv., Bull. 87, p. 211 (1897).

In one of Billings' original manuscripts, now in the possession of the Geological Survey, Canada, the horizon of this species is placed 300 feet above the "track bed," which would put it in zone 4 of the Vauréal formation. Billings' original type material appears to have been lost, and nothing which can be referred to the genus *Eichwaldia* has been recognized in later collections.

Clitambonites diversus (Shaler)

Plate XXIII, figures 11, 12, 13, 14

Orthisina diversa Shaler, Bull. Mus. Comp. Zool., vol. I, No. 4, p. 67 (1865); *Orthisina verneuili* Billings, Cat. Sil. Foss., Anticosti, pp. 43, 71, 1866; *Clitambonites diversus* Schuchert, U.S. Geol. Surv., Bull. 87, p. 183 (1897); Schuchert and Twenhofel, Bull. Geol. Soc. Am., p. 683, 1910.

An average example of this species has a length of 26 mm.; width 27 mm.; depth of both valves 11 mm.; cardinal area of ventral valve 9 mm. wide; dorsal area linear. The dorsal valve is almost flat or only slightly convex; process short, elongated longitudinally, united to the chilidium which is continued into the crura and these diverge at an angle of about 110 degrees; shell excavated between them and the process. Muscular scar 8 mm. wide in a shell 22 mm. wide; divided into two halves by a rounded, septal ridge about 1·5 mm. wide; each half oval in outline, narrowing anteriorly and separated into three parts by transverse elevations. In the ventral valve the spondylium is 7 mm. wide and 6 mm. long in a shell 21 mm. wide, pointed anteriorly, and the apex continued forward as a median septum.

In Europe this species finds its nearest representative in *C. verneuili* (Eichwald) from the Lyckholm and Borkholm beds of the Baltic Ordovician. *C. adscendens* (Pander) is another related species, but differs in having a flat area which is much wider than long and a more convex dorsal valve. Comparison has been made with specimens in the Yale collections.

Occurrence. Ordovician: Vauréal (4), West point; Ellis Bay (1, 2, 4-7, 9), Junction cliff and Ellis bay, not seen on the north side.

Cotypes, Mus. Comp. Zool., common in other collections.

Parastrophia lenticularis (Billings)

Camarella lenticularis Billings, Cat. Sil. Foss., Anticosti, p. 45, 1866; Schuchert, U.S. Geol. Surv., Bull. 87, p. 161 (1897).

Both beaks are small, incurved, the ventral resting on the dorsal; umbones not at all prominent. Ventral valve a little the larger. Ribs obscure, but mostly better developed than Billings' description appears to warrant and reaching nearly to the umbo. A single valve of this species from English head is 27 mm. long and 32 mm. wide; whereas the average from that locality is not more than 19 mm. long and 22 mm. wide.

This species is readily distinguished from the closely related *P. reversa* by the almost equal size of the valves, the slight prominence of the fold and sinus, the decided elliptical shape, and the less prominent ribs. The young of that species have the shape of this.

Occurrence. Ordovician: Ellis Bay (4, 7, 9). Silurian: Becscie (1, 2, 3).

The cotypes, No. 2280, are in the National Museum of Canada. Plesiotypes are in Peabody Museum.

Parastrophia ops (Billings)

Camarella ops Billings, Pal. Foss., vol. I, p. 128, figs. 128 a-b (1862); Shaler, Bull. Mus. Comp. Zool., vol. I, No. 4, p. 70 (1865); Billings, Cat. Sil. Foss., Anticosti, p. 45, 1866; *Parastrophia ops* Schuchert, U.S. Geol. Surv., Bull. 87, p. 301 (1897).

This species apparently differs from *P. reversa* only in that the radial plications are not well developed except in front, becoming obscure less than a cm. from the margin; but many specimens of that species are similar. The holotype (possibly authentic) is 21 mm. wide and 15 mm. long. In Billings' description the terms dorsal and ventral should be interchanged.

The writer is very uncertain as to the validity of this species. The resemblance of the holotype to *P. reversa* is extremely close, and the shell has the general lithic appearance of others derived from Ellis bay; it is, therefore, very possible that the type came from that locality. In the Canadian collections, among some unassorted material of the Chicotte formation was found a second specimen which is much smaller than the holotype and has the lenticular shape of young specimens of *P. reversa* of the same size; and the growth stages of both specimens show that the young were biconvex smooth forms. The lithology of this second shell indicates that it may have come from the Chicotte formation. It is necessary to await the collection of further material before deciding the validity of this species.

Occurrence. Silurian: Chicotte (1), Jumpers.

The holotype, No. 2515, is in the National Museum of Canada.

Parastrophia reversa (Billings)

Pentamerus reversus Billings, Geol. Surv., Canada, Rept. of Prog. 1856, p. 295 (1857); *Brachymerus reversus* Shaler, Bull. Mus. Comp. Zool., vol. I, No. 4, p. 69 (1865); *Camarella reversa* Billings, Cat. Sil. Foss., Anticosti, p. 45, 1866; *Parastrophia reversa* Schuchert, U.S. Geol. Surv., Bull. 87, p. 301 (1897); Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, p. 702 (1910); Wilson, Geol. Surv., Canada, Mus. Bull. No. 2, p. 135, Pl. IV, figs. 35-39 (1914).

Billings at one time stated that this is a large form of *P. hemiplicata* Hall; but it is absolutely distinct from that species, lacking its rhynchonelloid aspect, not being angular at the beak, and having longer plications. It is also larger, proportionately wider, and has a more pronounced fold and sinus.

Occurrence. Ordovician: Ellis Bay (1, 2, 4-7, 9), abundant at Ellis bay and vicinity, rare at Prinsta bay and cape James.

The cotypes, No. 2281, are in the National Museum of Canada. Plesiotypes are in Peabody Museum.

Stricklandinia brevis Billings

Plate XXIII, figures 15, 16, 17

Stricklandinia brevis Billings, Can. Nat. and Geol., vol. IV, p. 135 (1859); Billings, Cat. Sil. Foss., Anticosti, p. 46, 1866; Billings, Pal. Foss., vol. II, pt. I, p. 85, Pl. 6, figs. 2 a-c (1874); Schuchert, U.S. Geol. Surv., Bull. 87, p. 415 (1897).

Compared with the other Anticosti members of the genus, this is characterized by being broader than long, in this respect resembling *S. salteri* and *S. lirata*, differing from the former in having a fold and sinus, and from the latter in not being strongly plicated.

Occurrence. Silurian: Jupiter (10), Jumpers.

The holotype, No. 2512, is in the National Museum of Canada, plesiotypes are in Peabody Museum.

Stricklandinia davidsoni Billings

Plate XXI, figure 2

Stricklandinia lens Billings, Cat. Sil. Foss., Anticosti, p. 45, 1866; *S. Davidsoni* Billings, Pal. Foss., vol. II, pt. 1, p. 80, text figs. 46, 47; p. 86, Pl. VI, figs. 1 a-d (1874); Schuchert, U.S. Geol. Surv., Bull. 87, p. 416 (1897); *S. lens* Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, p. 711 (1910).

There is much variation in the form and contour of this shell; typical specimens are elongate oval, many are almost cylindrical, some are linguiform and more or less trilobed, others are circular-lenticular, and a few are almost globular with a flattening at the posterior end. Were no transitional forms present, there is little doubt that varieties, or even species, would be erected. This species differs from *S. gaspiensis* in the character of the ribbing, which feathers out from the axis and does not originate at the beak.

Occurrence. Silurian: Jupiter (2, 7-9), East cliff, Heath point, and near Southwest point.

The proterotypes have not been found. Plesiotypes are in both the National Museum of Canada (No. 2513) and Peabody Museum.

Stricklandinia davidsoni var. *striata* n. var.

Plate XVIII, figure 9

This variety is founded on the specimen figured by Billings in Pal. Foss., vol. II, pt. VII, fig. 3. It is more coarsely striate than *S. davidsoni*. Down the middle of the dorsal valve there are about half a dozen, distinct, irregular ribs, from which the lateral ribs feather out. The greatest width is near the middle, where it is 50 mm., length 63 mm., thickness does not exceed 12 mm. Another specimen has a width of 57 mm. and a length of 60 mm.

The coarse ribbing separates this species from *S. davidsoni*, with which, however, the feather-like character of the lateral ribs readily allies it.

Occurrence. Silurian: Jupiter (9, 10), Southwest point.

The holotype with a single paratype is in the National Museum of Canada. The writer has an additional specimen.

Stricklandinia gaspiensis Billings

Stricklandinia gaspiensis Billings, Can. Nat. and Geol., vol. 4, p. 134 (1859).

The plications are low and rounded; the ventral valve has a well-defined area; and there is a shallow, ventral sinus and a low, dorsal fold. The ventral area is 2 mm. wide in a shell 40 mm. long. The hinge-line is straight; and the ventral beak projects over the area. A large example is 130 mm. long and about the same width. The average is 50 mm. long and 62 mm. wide.

The decided difference between this species and *S. davidsoni* lies in the character of the plications, which radiate from the beak in the former and feather out from the axis in the latter. Associated with the mature individuals are small ones, which are nearly smooth, and an occasional one of these shows strong growth-lines at such an angle as to geniculate.

The specimens have been directly compared with *S. gaspiensis* from the Black Cape section of the south side of the gulf, and the range of dimension, and ornamentation appear to be the same. The shells bear considerable resemblance to *S. lirata*.

Occurrence. Silurian: Chicotte (2), pointe des Morts.

Twenhofel collection.

Stricklandinia salteri Billings

Plate XXI, figure 3

Stricklandinia salteri Billings, Geol. Surv., Canada, Pal. Foss., vol. II, p. 87, Pl. VII, fig. 1 (1874); Schuchert, U.S. Geol. Surv., Bull. 87, p. 417 (1897).

Surface not greatly convex and with an adamantine-like lustre; the two areas apposed to each other, their upper margins forming a single, almost chisel-like edge; greatest width near the middle of the shell, where it is generally from a fourth to a third greater than at the hinge-line. A perfect specimen is 40 mm. long, 45 mm. wide, length of hinge-line 32 mm., depth of both valves 16 mm. The largest specimen has a length of 37 mm. and a width of 52 mm. *S. salteri* is of the *S. lens* type, from which it differs in having no exposed cardinal area and an absence of plain ribbing.

Occurrence. Silurian: Jupiter (2, 3, 5–10), East cliff, Heath and Cormorant points, not common.

In all collections, types not found.

Stricklandinia melissa Billings

Plate XXI, figure 1

Stricklandinia melissa Billings, Pal. Foss., vol. II, pt. I, p. 89, Pl. VII, figs. 4 a–b (1874); Schuchert, U.S. Geol. Surv., Bull. 87, p. 416 (1897).

The surface of this species is smooth like that of *S. salteri*, but the shell is more convex and of different shape. The postero-lateral angles vary from about 90 to 120 degrees, with the sides in front of the angles straight for 2 or 3 mm. Later growth takes place largely at the front and anterior angles, giving to the shell a distorted appearance. It is longer and thicker than *S. salteri*, and the greatest width is near or in front of the middle of the shell.

This shell in the character of its posterior angles, and the fact that the later growth largely takes place about the anterior margin and angles, resembles *S. deformis* Meek and Worthen from the Niagara dolomites of Illinois; but the concentric growth-lines are not so prominent as in that species. From the Clinton (Brassfield) of Dayton, Ohio, Foerste has described *S. tripleciana*, which in some specimens has the cardinal angles similar to *S. melissa* (Geol. Surv., Ohio, vol. VII, 1895, p. 594, Pl. XXVI, figs. 13-14). From the Clinton of Collinsville, Alabama, Foerste has described *S. lens* var. *planus*, which agrees with *S. melissa* in being smooth and having neither fold nor sinus; but the cardinal angles are not so acute, and the growth is not so much about the anterior margin (Proc. Boston. Soc. Nat. Hist., vol. XXIV, p. 323, Pl. V, figs. 1–4 (1890)).

The writer is not certain as to what extent *S. melissa* is a good species, since it is founded on a single specimen which may merely be an abnormal variation of *S. salteri*, a probability which is very great, when it is remembered that the species of this genus are extremely variable.

Occurrence. Silurian: Jupiter (10), Southwest point.

The holotype is in the National Museum of Canada. Specimens in the writer's collection are referred to the species.

Pentamerus oblongus Sowerby

Pentamerus oblongus Billings, Cat. Sil. Foss., Anticosti, p. 45, 1866; Schuchert, U.S. Geol. Surv., Bull. 87, p. 304 (1897); Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, p. 710 (1910); Twenhofel, Geol. Surv., Canada, Mus. Bull. No. 3, 1914.

The Anticosti examples of this species from the Jupiter formation have the typical *P. oblongus* shape in the case of most of the specimens, but considerable variation is shown. Some specimens are very large, one from Bell river having a length of 90 mm., width 76 mm., and a thickness of 48 mm., equalling in this respect the large northern form, *P. estonus*, of Sweden and Russia. The higher forms are very like those from the New York Clinton. Those of the Gun River and lower part of the Jupiter formations are much smaller, far less galeate, and more nearly biconvex than those of the upper part of the Jupiter formation. An average individual from zone 3 of the Gun River formation at Gun river is 40 mm. wide (the greatest width about mid-length), 30 mm. long, and 17 mm. thick. These early forms have smaller spondylia and cruralia than those of the higher horizons, but careful studies and measurements show that the relative proportions and the shapes are the same. These early forms might be designated as *P. oblongus juvenalis*, but so far as the studies have progressed it appears that there is a complete transition from the early to the later forms.

Occurrence. Silurian: Jupiter (2–10), all outcrops; Gun River (variety *juvenalis*) (2–4); Jupiter (variety *juvenalis*) (1).

Plesiotypes are in both the National Museum of Canada and Peabody Museum.

Clorinda becsciensis n. sp.

Plate XVIII, figures 10, 11, 12

Shell transversely ovate, anterior margin straight or concave, anterior and rounded cardinal angles, cardinal slopes straight and meeting at an angle of about 150 degrees, hinge apparently straight.

The only perfect example is 20 mm. long, 27 mm. wide, depth of both valves 12 mm., ventral valve slightly the deeper. Except for lines of growth, the surface is smooth. Ventral valve with a deep triangular sinus in which there is a low rib, both sinus and rib beginning at the beak; beak and umbo small, the former in contact with the umbo of the dorsal valve. Dorsal valve with a triangular fold bounded by depressions. Area present, small and almost concealed.

This shell to some extent resembles the young of *Virgiana barrandei* and may be a derivative from the same stock; but with growth there is no reversal of fold and sinus, and the shell remains equivalved.

In many ways this shell resembles *Clorinda undata* Sowerby, and the two forms appear to be closely related; but the Anticosti form is relatively wider, and there is a greater equality in the size of the two valves.

Occurrence. Silurian: Becscie (1, 4), Bear and Whale cliffs.

The holotype and a single paratype are in Peabody Museum.

Clorinda linguifera (Sowerby)

Athyris tumidula Billings, Cat. Sil. Foss., Anticosti, p. 47, 1866; *Pentamerus linguifera* Davidson, Mon. Brit. Foss. Brach., vol. III, pt. 7, p. 149, Pl. XVII, figs. 11–14 (1871); *Athyris tumidula* Miller, N. Am. Geol. and Pal., p. 335, 1889; *Athyris? tumidula* Schuchert, U.S. Geol. Surv., Bull. 87, p. 150 (1897); *Clorinda* n. sp., Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, p. 710 (1910).

The Anticosti specimens are essentially identical with those of Europe, and specimens from the Wenlock of Dudley, England, can readily be duplicated among those from Anticosti; others from the Lower Ludlow of Ledbury are smaller. An average example is 16 mm. long, 24 mm. wide, and 15·5 mm. thick, and there is one large specimen which is 24 mm. long, 29 mm. wide, and 22 mm. thick. Exfoliated specimens show two diverging septa in the dorsal valve and one in the ventral. There is considerable variation in width and length. Specimens from the basal portion of the Jupiter are wider than long, whereas those from the upper Jupiter River and the Chicotte formation are slightly longer than wide, or the two dimensions are about the same.

In interior America this species is represented by *C. ventricosa*, a form which Hall and Clarke state differs from *C. linguifera* only in that the septa supporting the crural plates are slightly more convergent, and that it would be difficult to point out differences (Pal. N.Y., vol. VIII, pt. 2, p. 243 (1895)).

Occurrence. Silurian: Jupiter (1-3, 5-6, 8-10), most outcrops; Chicotte (1-2), Jumpers and pointe des Morts.

Plesiotypes are in the National Museum of Canada and Peabody Museum.

Virgiana barrandei (Billings)

Pentamerus barrendei Billings, Geol. Surv., Canada, Rept. of Prog. 1853-1856, p. 296 (1857); Billings, Geol. of Can., 1863 p. 316, fig. 327; Shaler, Bull. Mus. Comp. Zool., vol. I, No. 4, p. 69 (1865); Billings, Cat. Sil. Foss., Anticosti, p. 45, 1866; *Barrandella barrandei* Hall and Clarke, Pal., N.Y., vol. VIII, pt. 2, p. 243, fig. 174, Pl.

LXXI, figs. 17-20 (1894); *Clorinda barrandei* Schuchert, U.S. Geol. Surv., Bull. 87, p. 184 (1897); Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, p. 705 (1910).

In the young stages the ventral valve has a sinus and the dorsal a fold, the former becoming obliterated by the growth of an axial rib which develops into a fold; the dorsal fold disappears through its bifurcation, giving rise to a sinus; these changes taking place about 8 to 10 mm. from the beak. In average individuals the ventral umbo projects about 10 mm. beyond the hinge. The specimens increase in size with progress upward, and the striations in the larger forms are also more pronounced. An average specimen of the larger form from Ste. Anne cliff is 55 mm. long, 38 mm. wide (near the front margin where the width is greatest), and 38 mm. thick.

In the early stages the shell is somewhat triangular in outline, rostrate, somewhat trilobed, both valves convex and nearly the same size. The young are nearly always present, and one horizon at pointe aux Graines (zone 3, Becscie River) is almost wholly composed of the shells of young forms.

Occurrence. Silurian: Becscie (2-4), very abundant in the southern exposures of these zones, very rare at Reef point; Gun river (1-2), Ste. Anne and St. Mary cliffs and at the falls of Wreck beach, very rare.

Cotypes, No. 2372, the National Museum of Canada, many specimens in Twenhofel collection.

Virgiana barrandei var. *anticostiensis* n. var.

Plate XIX, figures 1, 2, 3

Shell longitudinally ovate, longer than wide. An average individual is 27 mm. long, 22 mm. wide, depth of both valves 16 mm., hinge-line 13 mm. long. Sides and front rounded, narrowing slightly along the sides to the cardinal angles which are abruptly rounded, thence concave to the beak. Surface marked by prominent growth lamellæ and in some specimens by obscure ribbing near the axis, otherwise smooth. Ventral valve convex, on the umbo a sinus in which is a single rib; umbo large and prominent; rising 3 mm. above the hinge-line, beak incurved to contact with the dorsal valve; apparently no area. Dorsal valve convex, at the umbo a low fold, both umbo and beak small, the latter buried beneath the ventral beak.

This variety originated from the *V. barrandei* stock, and the young, as shown by growth stages, are essentially identical with those of that species. In later life it deviates from the early form by losing its fold and sinus, but retains the original smoothness of the surface. The greater portion of later growth taking place along the anterior margin makes the shell elongate, and the small angle of growth keeps it from becoming galeatiform and the beak from becoming greatly elevated above the hinge-line.

Occurrence. Silurian: Becscie (1, 4), Becscie river and Whale cliff.

Peabody Museum.

Order, **Telotremata**

Rhynchotrema anticostiense (Billings)

Plate XXI, figures 4, 5, 6

Rhynchonella anticostiensis Billings, Pal. Foss., vol. I, p. 142, figs. 119 a-c (1862); Billings, Geol. of Can., 1863, p. 211, fig. 212; Shaler, Bull. Mus. Comp. Zool., vol. I, No. 4, p. 69 (1865); Billings, Cat. Sil. Foss., Anticosti, p. 13, 1866; Miller, N. Am. Geol. and Pal., p. 367, 1889; *Rhynchonella? anticostiensis* Winchell and Schuchert, Pal. Minnesota, vol. III, pt. 1, p. 464, fig. 34 (1893); *Rhynchonella anticostiensis* var. Whiteaves, Pal. Foss., vol. III, pt. 3, p. 179 (1897); *Rhynchonella? anticostiensis* Schuchert, U.S. Geol. Surv., Bull. 87, p. 354 (1897); *Rhynchotrema anticostiensis* Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, p. 696 (1910).

The dorsal beak is deeply buried under the ventral, the deltidial plates being warped thereby. The cardinal process is small, dorsal septum small, and not bifurcating posteriorly to support the hinge-plates.

This species bears considerable resemblance to *R. janeum*, but is less transverse, has a more erect ventral beak, and a more lamellose shell structure. Judging from examples in the Yale collections, the specimens of this species from the Richmond of Wilmington, Illinois, are slightly larger than those from Anticosti.

Occurrence. Ordovician: English Head (1-4), Carleton point, English head, and Makasti cliff; Vauréal (1-5), most exposures; Ellis Bay (4, 7, 9, 10), Ellis and Prinsta bays. As a rule not common.

The National Museum of Canada (No. 2032) and Peabody Museum.

Rhynchotrema janeum (Billings)

Plate XXII, figures 20, 21

Rhynchonella janea Billings, Cat. Sil. Foss., Anticosti, p. 43, 1866; *Rhynchonella (?) janea* Schuchert, U.S. Geol. Surv., Bull. 87, p. 359 (1895); *Rhynchonella (?) janea* Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, p. 698 (1910).

This species is closely related to *R. anticostiensis*, but differs in having an incurved beak, greater proportional width, and not so highly developed concentric lamellæ. Usually there are 4 plications on the fold and 3 in the sinus, but several specimens were collected with 5 on the fold and 3 in the sinus, and an individual from zone 7 of the Ellis Bay formation has 3 on the fold and 2 in the sinus.

Foerste identified this species from the Clinton of Collinsville, Alabama; but his illustrations show his shell to be longer, convex in front, and with a far more upright beak. As his specimens were casts this may perhaps account for the upright beak. He compares his specimens to *Camarotoechia neglecta* with which *R. janeum* has absolutely nothing to do. Savage has identified it from Edgewood limestone of Illinois and Missouri.

Occurrence. Ordovician: English Head (4), North cliff and Nid de Corbeau; Vauréal (1, 3-6), most exposures; Ellis Bay (4-7, 9), Ellis and Big Boulder bays, and cape Henry.

The National Museum of Canada (No. 2279) and Peabody Museum.

Rhynchotrema perlamellosum (Whitfield)

Rhynchonella capax Billings, Cat. Sil. Foss., Anticosti, p. 12, 1866; Schuchert, U.S. Geol. Surv., Bull. 87, p. 370 (1897); Schuchert and Twenhofel, Bull. Geol. Soc., vol. XXI, p. 683 (1910).

The Anticosti examples of this species are essentially identical with those of the Mississippi valley, and between them and those from Stony Mountain, Manitoba, it is possible to point out only trivial differences. The largest have a width of from 60 to 70 mm. and are from 50 to 60 mm. long. The depth of both valves is about 40 mm.

Occurrence. Ordovician: English Head (3, 4); Vauréal (1, 2). May be found in most exposures on the north side, not seen on the south side.

Plesiotypes of this species are in both the National Museum of Canada and Peabody Museum.

Rhynchotrema prinstanum n. sp.

Plate XIX, figures 4, 5, 6

This shell can readily be distinguished from the other Anticosti species of the genus by the fineness and number of its plications and by the fact that the fold and sinus are not sharply delimited, but have their sides covered with plications. There are 4 to 5 plications in the sinus and one more on the fold, about 20 to each valve. In the dorsal valve there is a septum extending nearly half the length of the shell; the crural plates are blunt, short, and flattened on the inner sides. Between them there appears to be a thin process. In the ventral valve the dental plates diverge at an angle of about 45 degrees. Shell structure apparently lamellose. An average example is 14 mm. long, 14 mm. wide, and the depth of both valves is 9 mm.

Occurrence. Ordovician: Ellis Bay (4, 5, 7, 9), Prinsta bay and vicinity.

Peabody Museum.

Camarotoechia ?argentea (Billings)

Plate XXI, figures 13, 14

Rhynchonella? argentea Billings, Cat. Sil. Foss., Anticosti, p. 43, 1866; *Rhynchonella? argentea* Schuchert, U.S. Geol. Surv., Bull. 87, p. 355 (1897).

The shell of this species appears to be somewhat lamellose in structure; dorsal valve more convex; surface completely covered with bifurcating striæ, which are not markedly fine at the beak, but become so at the margin; concentric striæ complete the ornamentation. In the dorsal valve is a small, median septum which bifurcates at its posterior end.

Compared with other species it resembles *C. aequiradiata* from the Clinton of New York and *C. llandoveriana rossina* McLearn, from Arisaig, Nova Scotia, but has finer striations and a more prominent fold and sinus.

Occurrence. Silurian: Jupiter (2, 3, 9), Heath and Southwest points, Box brook, Shallop creek, and East cliff.

A cotype, No. 2516, is in the National Museum of Canada.

Plesiotypes are in Peabody Museum.

Camarotoechia fringilla (Billings)

Plate XXI, figures 7, 8, 9

Rhynchonella fringilla Billings, Pal. Foss., vol. I, p. 141, fig. 118 (1862); Shaler, Bull. Mus. Comp. Zool., vol. I, No. 4, p. 68 (1865); Billings, Cat. Sil. Foss., Anticosti, p. 43, 1866; *Camarotoechia fringilla* Hall and Clarke, Pal. N.Y., vol. VIII, pt. 2, p. 190, Pl. LVI, figs. 28-30 (1899); Schuchert, U.S. Geol. Surv., Bull. 87, p. 166 (1897); *Rhynchonella fringilla* Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, p. 710 (1910).

Extensive collections have made necessary some slight emendations to the description by Billings. The sinus of the ventral valve does not extend to the umbo, but is replaced there by a fold on which are three ribs. Five to 9 ribs are on each side of both fold and sinus. The fold of the dorsal valve is replaced at the umbo by a sinus in which are 4 ribs, none of which ever bifurcates. In the interior of the ventral valve the teeth diverge at an angle of about 90 degrees and are continued on the inner surface of the shell as low, parallel ridges; muscle scar deep and elongate. In the dorsal valve the mesial septum divides at its posterior extremity to enclose a shallow basin. No cardinal process. Shell thin. The "very numerous small specimens" referred to by Billings are in part the young of *C. glacialis.*

This species does not have bifurcating ribs, and almost all extend to the umbo. In the young stages the shell is lenticular. On the fold there are always 4 ribs, which at the umbo are in a sinus. In very old shells one of these may occasionally bifurcate, but such is very rare. The lateral ribs never bifurcate, nor are any new ones implanted. There are always 3 ribs in the ventral sinus which at the umbo are on a fold. They never bifurcate; in a single specimen a new rib was seen to have been implanted. In young specimens the ribs are sharply angular.

This species is readily distinguished from *C. glacialis,* to which it does not appear to be even closely related, by the arrangement of ribs on the fold and sinus, which in this species extend to the beak, and by the absence of bifurcation of the ribs. It bears a superficial resemblance to *Rhynchotrema capax.*

Occurrence. Silurian: Becscie (3-4), Wreck beach (abundant); Gun River (2), Hannah cliff.

The holotype, No. 2370a, and the paratypes, No. 2370b-n, are in the National Museum of Canada. Numerous plesiotypes are in Peabody Museum.

Camarotoechia glacialis (Billings)

Plate XIX, figures 18, 19, 20

Rhynchonella glacialis Billings, Pal. Foss., vol. I, p. 143, figs. 120 a-b (1862); Shaler, Bull. Mus. Comp. Zool., vol. I, No. 4, p. 69 (1865); Billings, Cat. Sil. Foss., Anticosti, p. 43, 1866; *Camarotoechia glacialis* Hall and Clarke, Pal. N.Y., vol. VII, pt. 2, p. 190 (1894); Schuchert, U.S. Geol. Surv., Bull. 87, p. 166 (1897); *Rhynchonella glacialis* Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, p. 710 (1910).

The striking feature of difference between this species and *C. fringilla* is the pronounced bifurcation of the ribs of the former. The shells of young individuals are also different. In the latter the young shell is biconvex with the two valves of nearly equal depth and with neither fold nor sinus well developed, whereas in *C. glacialis* the young shell is angular with prominent fold and sinus. In each species there is a sinus on the umbo of the dorsal valve—more conspicuous in *C. glacialis*—which is obliterated about 6 mm. from the beak by a fold arising within it. On the umbo of the ventral valve in each species is a fold—likewise more pronounced in *C. glacialis*—which about 6 mm. from the beak is replaced by a sinus.

In every case the initial sinus of the dorsal valve has three ribs, of which the middle one does not extend to the beak, but arises by implantation a short distance therefrom. The initial ventral fold at the beak has a single rib which bifurcates at a distance of from 4 to 5 mm., and between these two a third arises by implantation. When the shell is about half grown or younger every rib bifurcates, and this is repeated one or more times before the shell reaches full size; after each bifurcation the ribs are lower, and at the margin they are quite obscure.

Associated with the above shell are others which are smaller, and at one horizon at Wreck beach only the small forms are present, but there appears to be little doubt they are the same species.

Occurrence. Silurian: Becscie (2-4), Wreck beach (very abundant), Reef point; Gun River (3, 4), Gun river and Hannah cliff; Jupiter (2, 4), East and Sand cliffs.

Holotype and other specimens in the National Museum of Canada (No. 2371a-z). Many specimens in Peabody Museum and Twenhofel collections.

Camarotoechia neglecta (Hall)

Atrypa neglecta Hall, Pal. New York, vol. II, p. 70, 274, Pl. XXIII, fig. 4; Pl. LVII, fig. 1 (1852); *Camarotoechia neglecta* Schuchert, U.S. Geol. Surv., Bull. 87, p. 167 (1897).

Specimens referable to this species have been collected at several localities. They have the straight ventral beak and 4 plications on a rapidly widening fold. Three lateral plications are plainly shown and a fourth obscurely indicated. Length, 7·5 mm.; width 7 mm.

Occurrence. Silurian: Becscie (4), Whale cliff; Gun River (3), Gun river and between Gun and Otter rivers.

Peabody Museum.

Camarotoechia peneborealis n. sp.

Plate XIX, figures 7, 8, 9

Shell ovate, adult specimens about twice as wide as long, the width increasing with age as young shells are more or less spherical. The largest example is 13 mm. long, 22 mm. wide, and about 18 mm. thick. Another example is 13 mm. long, 20 mm. wide, and 12 mm. thick. The fold and sinus are very prominent in adult specimens, less conspicuous in young shells. There are 3 plications in the sinus of the ventral valve—an occasional shell shows 4 plications—and 5 to 6 plications on each lateral slope of this valve, of which the outer one or two on each side are very small. There are 4 plications on the fold of the dorsal valve and 6 on each lateral slope. Every plication extends to the beak. The shell on its first appearance has a narrower sinus and a slightly different shape.

This shell has the general appearance of *C. borealis* (Schlotheim) of European strata. There are some differences between it and the examples from Gotland and those of Ringerike, Norway. It is to express this resemblance that the above specific name is applied.

Occurrence. Silurian: Jupiter (3, 4, 9, 10), most exposures; Chicotte (1–2), Southwest point and pointe des Morts.

Twenhofel collection.

Camarotoechia (?) *pyrrha* (Billings)

Plate XXI, figures 10, 11, 12

Rhynchonella pyrrha Billings, Cat. Sil. Foss., Anticosti, p. 44, 1866; Schuchert, U.S. Geol. Surv., Bull. 87, p. 363 (1897).

The number of plications in the sinus varies from 3 to 4 and is commonly 3. The shell is more or less globular, a specimen 14 mm. wide and 13·5 mm. long having a thickness of 10·5 mm. On the ventral initial fold the youngest stage shows at first a single plication, which almost at once bifurcates and between the two thus produced a third arises by implantation. In the initial dorsal sinus there at first appear to be two plications, between which a third is implanted which bifurcates when the shell is about half grown. The lateral plications do not appear to bifurcate, and the number on each half valve varies from 6 to 9. This species appears to be related to *C. glacialis*, from which it is distinguished by its more rotund shape and sharper fold. Typical adult examples are readily separated, but young specimens offer difficulty.

Occurrence. Silurian: Gun River (2, 4), Hannah cliff and vicinity.

The cotypes, No. 2368, are in the National Museum of Canada.

Camarotoechia vicina (Billings)

Plate XIX, figures 21, 22, 23

Rhynchonella vicina Billings, Cat. Sil. Foss., Anticosti, p. 44, 1866; Schuchert, U.S. Geol. Surv., Bull. 87, p. 366 (1897).

There usually are 2 plications in the sinus and 3 on the fold. The shell bears considerable resemblance to *C. indianensis*, but has a greater depth of valves, a more prominent fold, and more angular plications.

Occurrence. Silurian: Chicotte (1, 2), Southwest point and pointe des Morts.

Plesiotypes are in the collections of the National Museum of Canada and Peabody Museum. The holotype has not been discovered.

Plagiorhyncha decemplicata (Sowerby)

Terebratula decemplicata Sowerby, Sil. System, Pl. XXI, fig. 17 (1839); *Rhynchonella eva* Billings, Cat. Sil. Foss., Anticosti, p. 44, 1866; *R. decemplicata*, Davidson, Mon. Brit. Foss. Brach., vol. III, pt. 7, p. 177, Pl. XXIII, figs. 20–24 (1871); *R. decemplicata* Foerste, Proc. Boston. Soc. Nat. Hist., vol. XXIV, p. 320, Pl. VI, figs. 23–24 (1890); *Rhynchonella ? decemplicata* Schuchert, U.S. Geol. Surv., Bull. 87, p. 356 (1897) ; *Rhynchonella ? eva* Schuchert, ibid., p. 357; *Anabaia anticostiana* Clarke, Archivos do Museu Nacional do Rio de Janeiro, vol. X (1899), Author's Eng. Ed., p. 15, Pl. I, figs. 26, 27, 28 (1900) ; *Rhynchonella 10-plicata* Kiaer, Videnskabs-Selskabets Skrifter, I, Math-Naturv. Klasse, bd. II, p. 51 (1908); *Rhynchonella eva* Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, p. 709 (1910); *Camarotoechia decemplicata* Twenhofel, Geol. Surv., Canada, Mus. Bull. No. 3, p. 28 (1914).

This shell is somewhat variable in size, and the shape is more nearly circular than ovate. It bears a little resemblance to *C. whitei* from the Niagara of Waldron, Indiana, but has a more circular outline, is as a rule smaller, and the plications are not nearly so angular. It also resembles *Rhynchonella bidens* Hall, but has a less deep sinus and is more equivalved.

This shell was described in 1866 by Billings as *Rhynchonella eva.* Subsequently (1900), Doctor John M. Clarke figured a specimen, with a size somewhat above the norm, from the Shaler collection at Harvard. It came from East cliff, Anticosti, and had been collected by the Harvard expedition of 1861. This specimen Clarke was not able to identify from any of the descriptions of Billings, and finding that it bore considerable resemblance to his *Anabaia paraia* from Brazil, he described it as *A. anticostiana.* A large series of specimens was collected at the type locality of both forms, and from the descriptions of Billings and from specimens in the National Museum of Canada these were identified as *Rhynchonella eva.* They were also compared with the holotype of *A. anticostiana*, and the two species were found to be identical. The genus *Anabaia* is spire-bearing and is referred to the *Coelospiridae.* Many specimens of *Rhynchonella eva* were studied by grinding and etching with hydrochloric acid and no traces of anything resembling spires were seen, although the preservation was such that traces of them were to be expected had they been present. On the contrary, the internal structure is rhynchonelloid and, as no vestige of a cardinal process appears to be present, the species was referred to the genus *Camarotoechia.* Subsequently, McLearn showed that the teeth are not supported by dental plates produced forward from the walls of the rostral cavity, but are on plates arising from the lateral walls of the ventral valve and referred the shell to his genus *Plagiorhyncha.*

Through the kindness of Professor Johan Kiaer the writer was able to obtain specimens of *Rhynchonella decemplicata* from Etage 6c (Zone with *Rhynchonella 10-plicata*) of Ringerike region near Oslo, Norway, and the identity of *R. eva* with *R. decemplicata* was clearly shown. As the European name has priority by over twenty-five years the American name must yield.

Occurrence. Silurian: Jupiter (2, 4, 9), East and Sand cliffs, and Iron river.

The National Museum of Canada (No. 2449) and Peabody Museum.

Rhynchonella? *nutrix* (Billings)

Plate XXIII, figures 18, 19, 20

Rhychonella nutrix Billings, Cat. Sil. Foss., Anticosti, p. 43, 1866; Schuchert, U.S. Geol. Surv., Bull. 87, p. 361 (1897).

The shell of this species is commonly larger than that of *Rhynchotrema janeum.* The beaks are very closely incurved and not prominent; the margins are gently curved; an average specimen is 18·5 mm. long, 15 mm. wide, and 9 mm. thick. The sinus is 5 mm. wide at the base and 8 mm. at the top and contains 3 plications, there are 4 on the fold which has the same dimensions as the sinus. On each side of the fold and sinus there are 6 plications. Concentric growth lines complete the ornamentation.

This species resembles *Rhynchotrema janeum,* but differs in its greater size, greater transversity, absence of lamellose shell structure, and less prominent beak. It also resembles *Camarotoechia borealis* (Schlotheim) with Norwegian specimens of which it has been directly compared, and *C. peneborealis* n. sp.

Occurrence. Ordovician: Ellis Bay (4, 5, 7, 9), Ellis bay.

The holotype, No. 2278, is in the National Museum of Canada. Plesiotypes are in Peabody Museum.

Protozeuga anticostiana Twenhofel

Plate XXI, figures 15, 16, 17

Protozeuga anticostiana Twenhofel, Geol. Surv., Canada, Mus. Bull. No. 3, p. 31, Pl. I, figs. 8-10 (1914).

Shell very small, longitudinally pentagonal; anterior angles gently rounded, front straight; cardinal angles more abruptly rounded than anterior; cardinal slopes straight, meeting at about 90 degrees; an average specimen from the lower horizons is 5 mm. long, 4 mm. wide, depth of both valves 2·25 mm. Specimens from the upper part of the Ellis Bay formation are 7 mm. long, 6 mm. wide, and 3 mm. thick; surface smooth; shell structure punctate as shown by etching with hydrochloric acid.

Ventral valve highly convex, deepest about one-third the length, keeled at the beak, toward the middle of the valve the keel widens out into a flat-topped fold which at the anterior margin is replaced by a sulcas; slopes to the lateral margins quite steep; and at the cardinal angles the surface is highly concave. Beak small, narrow, truncated by a small foramen, incurved, and overarching the hinge-line; no area.

Dorsal valve convex posteriorly and laterally, slightly depressed or concave just anterior to the hinge and divided into two lobes by a wide, uniformly concave sulcas.

This shell closely resembles *Protozeuga mawii* (Davidson), but is slightly larger and proportionately wider. It occurs in much older strata and, although its brachial apparatus has not been demonstrated, its strong resemblance to the above species indicates that it may be considered congeneric.

Occurrence. Ordovician: English Head (2-4), English head and Carleton point; Vauréal (1, 2), baie Ste. Claire and White cliff; Ellis Bay (1, 2, 7-9), Junction cliff and Vauréal river.

Peabody Museum.

Zygospira recurvirostris aequivalvis n. var.

Plate XIX, figures 10, 11, 12

Rhynchonella ? recurvirostris Billings, Cat. Sil. Foss., Anticosti, p. 13, 1866; *Anazyga recurvirostra* Miller, N. Am. Geol. and Pal., p. 334, 1889; *Zygospira recurvirostra* Schuchert, U.S. Geol. Surv., Bull. 87, p. 464 (1897).

Compared with the Trenton *Z. recurvirostra* the Anticosti specimens are somewhat more finely striate, the two valves are of almost equal size, and the dorsal sinus is vestigial or almost wholly absent. The number of striæ as a rule exceeds twenty-four, the number given by Hall as normal for *Z. recurvirostra.* These differences, coupled with the occurrence in higher strata, have been considered good grounds for the erection of a new variety.

Occurrence. Ordovician: English Head (1-4), as a rule abundant; Vauréal (1-3), commonly abundant.

Peabody Museum.

Zygospira mica (Billings)

Plate XXI, figures 21, 22

Rhynchonella mica Billings, Cat. Sil. Foss., Anticosti, p. 44, 1866; *Zygospira (?) mica* Schuchert, U.S. Geol. Surv., Bull. 87, p. 463 (1897); *Zygospira mica* Twenhofel, Geol. Surv., Canada, Mus. Bull. No. 3, p. 16 (1914).

The shell has the appearance of being a descendant of the earlier *Z. recurvirostra* Hall, from which it differs in being smaller and thicker, more pronouncedly carinate on the ventral valve, and in having a small fold in the dorsal sinus; but this last character is obscure in some specimens or even wanting. It occurs over 1,000 feet above the parent species.

Occurrence. Silurian: Jupiter (8-9), Southwest point and Box brook.

The cotypes, No. 2517, are in the National Museum of Canada. Plesiotypes are in Peabody Museum.

Zygospira paupera Billings

Plate XXI, figures 18, 19, 20

Zygospira paupera Billings, Cat. Sil. Foss., Anticosti, p. 46, 1866; Schuchert, U.S. Geol. Surv., Bull. 87, p. 464 (1897); Twenhofel, Geol. Surv., Canada, Mus. Bull. No. 3, p. 16 (1914).

In zone 5 of the Jupiter River formation were collected two specimens much larger than the average, measuring 9·5 mm. long and 10·5 mm. wide.

Compared with *Z. modesta*, this species has finer and more numerous plications, a deeper and wider dorsal sinus, and a somewhat different aspect. It may be a descendant of that species.

Occurrence. Silurian: Jupiter (1, 6, 7, 9), Jupiter river, East cliff, and Iron river, not common.

Types, No. 2454, the National Museum of Canada.

Zygospira jupiterensis n. sp.

Plate XIX, figures 13, 14, 15

Shell small, longer than wide, ovate in outline. Average width 5 mm., length 6·5 mm., depth of both valves 3·25 mm. Sides and anterior margin uniformly rounded, making an almost perfect ellipse to the cardinal angles, thence straight or concave to the beak. Ventral valve very convex, almost keeled, highest near the middle, straight or slightly concave on the lateral slopes. Ventral beak prominent, incurved, overhanging the dorsal beak, but not in contact. A narrow and relatively deep furrow extends from the umbo to the anterior margin, giving the appearance of a double keel. The riblets bounding this furrow are somewhat larger than the others, and as each of these bifurcates several times laterally a feather-like effect is produced. There are about 12 riblets to each valve. The dorsal valve is slightly convex, divided into two lobes by a sinus which is very narrow at the beak, but at the anterior margin is fully half as wide as the shell. In the sinus there are either 1 or 3 riblets; if 3, the middle one is the largest. New ribs arise on each valve through bifurcation, except in the sinus of the dorsal valve where the two lateral ribs are implanted. Interspaces and ribs are about equal in width. The surface is further ornamented by fine, concentric striations to the number of 2 or 3 to 1 mm.

Externally this shell bears considerable resemblance to *Atrypa putilla* Hall and Clarke from the Edgewood limestone of Illinois and Missouri and the Essex limestone of Illinois; but the resemblance is probably wholly superficial. That shell, also, has a different surface and is more circular.

Occurrence. Silurian: Jupiter (1), west of Jupiter river.

Peabody Museum.

Catazyga anticostiensis (Billings)

Plate XX, figures 10, 11, 12

Athyris headi var. *anticostiensis* Billings, Pal. Foss., vol. I, p. 147, fig. 127 (1862); *A. anticostiensis* Billings, Geol. Can., p. 212, fig. 215 (1863); *Athyris ? anticostiensis* Billings, Cat. Sil. Foss., Anticosti, p. 13, 1866; *Atrypa ? headi* var. *anglica* Davidson, Mon. Brit. Foss. Brach., vol. III, pt. VII, Pl. XXII, figs. 1-7a (1871); *Zygospira anticostiensis* Davidson, Suppl. Brit. Sil. Brach., p. 127, 1889; *Zygospira headi anticostiensis* Miller, N. Am. Geol. and Pal., p. 388, 1882; *Catazyga headi* var. *borealis* Hall and Clarke, Pal. N.Y., vol. VIII, pt. 2, Pl. LIV, figs. 27, 31, 32 (1894); *C. erratica* Schuchert, (partim), U.S. Geol. Surv., Bull. 87, p. 169 (1897); *C. anticostiensis* Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, p. 696 (1910).

At the beak *C. anticostiensis* has a dorsal sinus and a ventral fold, the latter in many specimens becoming a sinus at the anterior margin. An average specimen is 13 mm. long, 11 mm. wide, and depth of both valves 8 mm.; the number of striations about 30 to 35 or about 8 to 1 mm.

This species was first described by Billings in 1862. Subsequently Davidson studied the group and stated that "Upon the examination of a large number of specimens of *Anticostiensis* and *Borealis (a variety from lake St. John, Canada)* Mr. Glass and myself have arrived at the opinion that they are only variations in shape of the same species, but specifically distinct from the *Zygospira (Athyris?) headi* of Billings."

As far as a dorsal sinus is concerned, it is indicated at the beak on all the Anticosti specimens; whereas a ventral sinus is present on specimens from Anticosti to Ohio, so that the greater or lesser development of these features is of minor importance.

Through the kindness of Doctor F. A. Bather of the British Museum of Natural History the writer was able to examine the material which Davidson had for study and his position in respect to this species is partly explained. The collection labelled *Catazyga anticostiensis* consists of six specimens, of which one is most certainly *Zygospira recurvirostra aequivalvis*, two are *C. anticostiensis*, and three through grinding and etching are so mutilated as to make uncertain what they are, though probably the latter.

In 1894 the genus was investigated by Hall and Clarke who state: "That the variety *Anticostiensis* retains more the contour of a *Zygospira*, the pedicle valve being more prominently keeled, the convexity more unequal, and, furthermore, there is a broad sinus on the brachial valve, while there is no trace of one on the other valve. This fossil is like *Z. erratica*, both in contour and in the fine striations of the exterior. If there is a generic difference in the two forms it is extremely slight, too slight, indeed, with our present knowledge, to indicate either in words or illustration." (Pal. N.Y., vol. VIII, pt. 2, p. 158). They state that their material was from the original localities and suggest that Davidson has confounded the typical *A. headi* with the variety *A. anticostiensis*, which "supposition is apparently borne out by the assertion that the Rev. Mr. Glass succeeded in developing the brachial apparatus in *Z. erratica*. This species, as far as we know, is invariably preserved as sandstone casts in a matrix of sandstone, and to develop its internal apparatus has proven an impossibility." If Hall and Clarke's position be correct, it explains the position of Davidson, but it becomes difficult to understand the statement of the former that *C. anticostiensis* is hardly specifically distinct from *C. erratica*. The writer has before him hundreds of specimens of the former species from the type locality, of whose identification there can be no question, and among this great number of specimens there are very few which have a broad "sinus on the brachial valve" and not a single one bears the slightest resemblance to *C. erratica*, with specimens of which from "boulders in the region of Utica, N.Y." they have been directly compared. In the writer's opinion *C. anticostiensis* is specifically distinct from *C. erratica* and closely related to *C. headi*.

Occurrence. Ordovician: English Head (1-4), all exposures; Vauréal (1-4), all exposures.

Plesiotypes of this species are in both the National Museum of Canada and Peabody Museum. The original type material of Billings has not been found.

Atrypina arenacea n. sp.

Plate XIX, figures 16, 17

Shell small, outline nearly circular, about 6 mm. wide and long, about 3 mm. thick, valves nearly equally convex. The surface of both valves sparsely and coarsely plicated, 6 plications to the ventral valve, 5 to the dorsal. The middle plication of the dorsal valve is the largest of the valves and is very prominent; on the ventral valve is an equally prominent depression. The plications extend nearly to, and perhaps to, the beak, but become obscure on the umbones. The ventral beak is prominent, with the pedicle opening in the apex, beneath which the deltidial plates are plainly exposed. Only two well-preserved specimens were collected.

The shell bears great resemblance to *A. disparilis* from the American Niagara, but is a more biconvex shell. It is not so finely plicated as *A. clintoni*.

Occurrence. Silurian: Jupiter (4, 9), Sand cliff and Iron river.

The holotype is in the collection of the writer.

Atrypina? gamachiana n. sp.

Plate XX, figures 7, 8, 9

Shell small, nearly circular to longitudinally ovate, cardinal and anterior angles uniformly rounded, cardinal slopes straight, meeting at the beak at about 90 degrees. An average example is 4 mm. long, 4 mm. wide, depth of both valves a little more than 1 mm. The surface is ornamented with rounded ribs, of which there are 6 on the ventral valve, the 2 central being more than twice as large as the others, elevated, and separated by an interspace which is much wider than any other. On the dorsal valve there are 7 ribs, of which the middle is the largest, though nearly equalled by the two adjoining. The middle rib is situated in a shallow, rapidly widening sinus, and it does not reach the beak; all others do. Concentric lines of growth complete the ornamentation. Ventral valve very convex, beak small, slightly overhanging the hinge and perforate, the foramen apparently being open to the hinge. Dorsal valve almost flat, slightly convex near the beak.

This species differs externally from *A. barrandei* Davidson in being about half as large and in not showing the concentric lamellæ. It is much smaller than *A. disparilis* (Hall) and the central rib of the dorsal valve is much larger, the plications extend to the beak, and the shell is less convex. *A. clintoni* Hall and Clarke is a larger shell and has a single rib on the axis of the ventral valve instead of two. It may be related to *A. similis* Reed from the Keisley limestone of England—high up in the Ordovician—a stratigraphic position similar to that of this species.

Occurrence. Ordovician: Ellis Bay (8-10), Ellis bay.

The holotype and paratypes are in Peabody Museum.

Atrypa marginalis (Dalman)

Atrypa marginalis Billings, Cat. Sil. Foss., Anticosti, p. 40, 1866; Davidson, Mon. Brit. Foss. Brach., Sil., Pal. Soc., vol. III, pt. 7, p. 133, Pl. XV, figs. 1-2 (1871); Davidson, Sup. Brit. Foss. Brach. Sil., p. 122, 1882; Etheridge, Brit. Foss., pt. 1, p. 75 (1888); Miller, N. Am. Geol. and Pal., p. 336, 1889; Schuchert, U.S. Geol. Surv., Bull. 87, p. 153 (1897); Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, p. 702 (1910).

The Anticosti forms of this species are almost identically similar to those from Ontario, England, and Gotland. According to Davidson the interior structure agrees with those from the Wenlock of Shropshire. An average specimen is 15 to 17 mm. long, width about mid-length 18 mm., thickness 8 to 9 mm. The *A. marginalis* of the Chicotte formation is much smaller than that from the Ellis Bay and Becscie formations, but it has essentially the same shape as the young individuals of the latter.

Occurrence. Ordovician: Ellis Bay (2–10), Junction cliff, Ellis bay, and upper Vauréal river. Silurian: Becscie (1–4), Bear cliff to Whale cliff (rare); Chicotte (1–2), most exposures.

Plesiotypes are in Peabody Museum and the National Museum of Canada.

Atrypa reticularis (Linnaeus)

Atrypa impressa Shaler, Bull. Mus. Comp. Zool., vol. I, No. 4, p. 68 (1865); *A. reticularis* Billings, Cat. Sil. Foss., Anticosti, p. 46, 1866; Davidson, Mon. Brit. Foss. Brach., vol. III, pt. 7, p. 129, Pl. XIV, figs. 1–22 (1871); Etheridge, Brit. Foss., pt. 1, p. 75 (1888); Schuchert, U.S. Geol. Surv., Bull. 87, p. 154 (1897); Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, p. 710 (1910).

Some Anticosti shells of this species are decidedly lamellose, the lamellæ being about 0·5 mm. apart and turned up at the edges. The relative equality of the valves, the circular form, and the pronounced lamellose shell structure are the chief features which the Anticosti examples exhibit as compared with those from other localities; but exactly similar specimens occur in the Rochester at Niagara Falls, Niagara at Waldron, and Silurian of Gotland and England. Shaler's statement that "The adult condition of this species differs strikingly from any other form included under the name of *A. reticularis*" is one in which the writer cannot concur.

Occurrence. Silurian: appears in zone 1 of the Jupiter formation and extends to the top of the Chicotte, very abundant.

Lissatrypa atheroidea Twenhofel

Athyris lara Davidson (not Billings), Suppl. Sil. Brach., p. 121, 1882; *Nucleospira* n. sp., Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, p. 714 (1910); *Lissatrypa atheroidea* Twenhofel, Geol. Surv., Canada, Mus. Bull. No. 3, p. 33, Pl. I, figs. 11–15 (1914).

Shell with the characters of the genus; width 14 mm.; length 14 mm.; depth of both valves 7 mm.

This shell is very apt to be taken for *Whitfieldella? lara* (Billings), a mistake which has already been made. For final determination it is necessary to see the character of the spiral. *W. ? lara*, however, has a more prominent ventral beak, is slightly larger, in fewer cases has the ventral sinus and dorsal fold, and does not have a layered structure to the shell. These differences, however, cannot be relied on, since there are many specimens which, so far as external characters are concerned, may be put in either species.

Occurrence. Silurian: Jupiter (1, 4–7), Jupiter river and vicinity.

Eospirifer radiatus (Sowerby)

Spirifer tenuistriatus Shaler, Bull. Mus. Comp. Zool., vol. I, No. 4, p. 70 (1865); *S. plicatella* Billings, Cat. Sil. Foss., Anticosti, p. 48, 1866; *S. radiatus* Schuchert, U.S. Geol. Surv., Bull. 87, p. 402 (1897).

The ventral sinus is broadly concave and nearly flat on the bottom; the dorsal fold triangular and nearly flat-topped. At the anterior margin the fold has a width equal to about two-fifths that of the shell and is bordered on each side by a faint depression. An average example is 17 mm. long, 23 mm. wide, and 13 mm. thick. Ribbing is absent or very obscure in young shells, and is only faintly developed in mature specimens.

Specimens in the Yale collection from the Wenlock of Dudley, England, and the Silurian of Gotland, have the same appearance and dimensions as those from Anticosti, and nearly similar forms are present in the Clinton and Niagara of the North American interior.

Occurrence. Silurian: Jupiter (1–10), commonly present, abundant at Bell river and rivière du Pavillon and Jumpers; Chicotte (1, 2), commonly present, abundant at pointe des Morts.

Cyrtia exporrecta myrtea Billings

Plate XX, figures 13, 14

Cyrtia myrtea Billings, Pal. Foss., vol. I, p. 165, figs. 149a–c (1862); Billings, Cat. Sil. Foss., Anticosti, p. 48, 1866; Hall and Clarke, Pal. N.Y., vol. VIII, pt. 2, p. 42 (1894); Schuchert, U.S. Geol. Surv., Bull. 87, p. 196 (1897).

At the anterior margin the dorsal sinus is 7 mm. wide at the top and 4·5 mm. at the bottom. The dorsal umbo projects about 1 mm. above the hinge-line; the beak is small and on some specimens is slightly incurved.

C. exporrecta and the variety *arrecta* from the Niagara of Louisville, Kentucky, are very close to this form. It is also closely related to *C. exporrecta* (Wahlenburg), considered by Davidson as identical with *C. trapezoidalis* (Hisinger). In Europe these species show great variation, and there are specimens of the former in the Yale collections from the Wenlock of Dudley, England, which are so near to those of the Anticosti measures that, were they found in it, no hesitancy would be felt in referring them to the Anticosti variety. It is smaller than the Gotland forms, but otherwise appears to be the same. As the species has been found only in the Chicotte limestones, where the brachiopods are mostly smaller than elsewhere, the smaller dimensions may possibly be referred to environmental conditions. It appears very probable that *C. exporrecta* and *C. exporrecta myrtea* are little more than varieties of the same species even if they are not identical.

Occurrence. Silurian: Chicotte (1–2), probably in all outcrops, rare. The holotype, No. 2522, is in the National Museum of Canada. Plesiotypes are in both that Museum and Peabody Museum.

Homeospira anticostiana n. sp.

Plate XX, figures 1, 2, 3

Shell similar in contour to the elongated varieties of *H. evax*, but much smaller and more finely striate; sinus of ventral valve scarcely defined except at the front margin where it contains a small rib—the only one not reaching the beak; between 2 and 3 striations to 1 mm. and about 25 to the valve. A small sinus also on the dorsal valve, most prominent at the umbo, at the anterior margin replaced by a fold. On this fold is a striation somewhat wider than any other, and in some specimens this striation bifurcates. Width 7 to 8 mm., length 8·5 to 9 mm., depth of both valves 5 mm. Interior unknown.

The shell resembles *H. bouchardii* (Davidson) from the Wenlock limestone, but, in general, that shell is somewhat larger and has on the axis of the dorsal valve from 2 to 4 striations which are "much smaller or narrower than are those on the lateral portions of the valve" (Davidson, Mon. Brit. Foss. Brach., vol. III, pt. 7, p. 127, Pl. XII, figs. 26–30). Comparison, however, has not been made with original material. The species also appears to be similar to *H. schucherti-elongata* Foerste from the Niagara of Tennessee, but differs in being more closely plicated and having the dorsal sinus more prominent.

Occurrence. Silurian: Gun River (3), Gun river (rare); Jupiter (2, 4, 6, 9), East and Sand cliffs and Heath and Southwest points (rare).

Peabody Museum.

Hindella prinstana (Billings)

Plate XXII, figures 12, 13

Athyris prinstana Billings, Pal. Foss., vol. I, p. 145, figs. 122 a-b (1862); Shaler, Bull. Mus. Comp. Zool., vol. I, No. 4, p. 69 (1865); *Athyris turgida* Shaler, ibid., p. 69, 1865; *A. prinstana* Billings, Cat. Sil. Foss., Anticosti, p. 46, 1866; *Hindella prinstana* Hall and Clarke, Pal., N.Y., vol. VIII, pt. 2, p. 64, Pl. XLI, fig. 28; Pl. XLIX, fig. 1 (1894); Schuchert, U.S. Geol. Surv., Bull. 87, p. 230 (1897).

The chief features, outside of length and shape, which distinguish this form from *H. umbonata*, are the less pronounced size of the umbo, the lesser length of the cardinal slopes and their better definition, the absence of a mesial sinus to the ventral valve, which, however, is indicated in some specimens by a sharp deflexion at the anterior border. Although the extremes appear to be quite different, it is somewhat difficult to separate intermediate forms. A single, ventral interior shows that the dental plates continue forward and slightly converge to enclose an elongate, muscular cavity and then diverge to disappear on the shell surface.

The specimen purporting to be the type of *Athyris turgida* Shaler belongs to this species.

Occurrence. Ordovician: Ellis Bay (1, 2, 4-10), as a rule present, but not common. Silurian: Becscie (1, 2), Bear cliff.

Plesiotypes of this species are in both the National Museum of Canada (2285) and Peabody Museum.

Hindella umbonata (Billings)

Plate XX, figures 21, 22, 23

Athyris umbonata Billings, Pal. Foss., vol. I, p. 144, figs. 121 a-b (1862); Billings, Geol. of Can., 1863, p. 317, fig. 331 (1863); Shaler, Bull. Mus. Comp. Zool., vol. I, No. 4, p. 69; Billings, Cat. Sil. Foss., Anticosti, p. 46, 1866; *Hindella umbonata* Davidson, Suppl. Brit. Sil. Brach., p. 120, fig. in text, 1882; *Meristella umbonata* Foerste, Bull. Denison Univ., I, p. 88, Pl. XIII, fig. 2 (*vide* Schuchert) (1885); Hall and Clarke, Pal. N.Y., vol. VIII, pt. 2, p. 64, figs. 46-51; Pl. XLI, figs. 26, 27, 29, 30 (1894); *Meristella umbonata* Foerste, Geol. Ohio, vol. VII, p. 590, p. 25, fig. 2 (*vide* Schuchert) (1895); *Hindella umbonata* Schuchert, U.S. Geol. Surv., Bull. 87, p. 230 (1897); Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, p. 702 (1910).

Foerste identified this species from the Niagara of Dayton, Ohio, and Hanover, Indiana. The writer has not seen his specimens, but as they come from a higher horizon it is very probable that they do not belong to the Anticosti species.

Occurrence. Ordovician: Ellis Bay (1, 2, 4-10), as a rule common. Silurian: Becscie (1, 2), Bear cliff and Reef point.

National Museum of Canada (2284) and Peabody Museum.

Whitfieldella ? julia (Billings)

Plate XX, figures 15, 16, 17

Athyris julia Billings, Pal. Foss., vol. I, p. 146, figs. 124 a-c (1862); Shaler, Bull. Mus. Comp. Zool., vol. I, No. 4, p. 69 (1865); Billings, Cat. Sil. Foss., Anticosti, p. 46, 1866; *Whitfieldella julia* Schuchert, U.S. Geol. Surv., Bull. 87, p. 461 (1897).

The generic reference of this species is provisional, as the brachial apparatus has not been determined.

Occurrence. Silurian: Gun River (4), Gun river; Jupiter (2, 5-10), East cliff, Jumpers, and Box and Bell rivers.

Type, No. 2525, the National Museum of Canada.

Whitfieldella ? solitaria (Billings)

Plate XXX, figures 7, 8, 9

Athyris solitaria Billings, Cat. Sil. Foss., Anticosti, p. 48, 1866; *Athyris (?) solitaria* Schuchert, U.S. Geol. Surv., Bull. 87, p. 149 (1897).

Externally this species differs from *W. lara* in having a less transverse and more triangular outline and a ventral sinus and dorsal fold. The sides are fairly straight for about half the length of the shell. The cardinal slopes extend for nearly one-third the length of the shell and meet at the beak at about 120 degrees. The interior is known from sections only; the spirals and jugum have not been seen; the dental apparatus is like that of *W. ? lara* but weaker, and the brachial hinge-plates are less high. Shell structure fibrous. The reference to *Whitfieldella* is provisional.

Compared with other species, the shell shows the greatest resemblance to *W. oblata*, some of the Anticosti specimens being that species in miniature; but, in general, the fold and sinus of the latter are better developed, and it is far larger. It is smaller than *W. ? julia*, the apical angle is smaller, and the sinus is narrower, and concave on the bottom instead of flat.

Occurrence. Silurian: Becscie (3-4), Wreck beach.

The original specimen is said to have come from Southwest point. Chicotte formation.

Whitfieldella ? lara (Billings)

Plate XX, figures 18, 19, 20

Athyris lara Billings, Cat. Sil. Foss., Anticosti, p. 47, 1866; Miller, N. Am. Geol. and Pal., p. 335, 1889; *Atrypa ? lara* Schuchert (partim), U.S. Geol. Surv., Bull. 87, p. 152 (1897). Not *Atrypa lara* Davidson, 1882. See also *Lissatrypa atheroidea* Twenhofel, Geol. Surv., Canada, Mus. Bull. No. 3, pp. 14, 16 (1914).

In this shell the spires are directed laterally with at least six coils. A jugum has not been seen, though more than twenty-five shells were sectioned; the extreme delicacy of the brachial apparatus is probably the explanation of its absence. Because of this fact and the further one that the shells are athyroid in appearance the species is referred with doubt to *Whitfieldella*. The hinge-plate of the brachial valve consists of two diverging processes separated by a deep cleft and supported by a median septum. Muscular impressions as in *Whitfieldella*. The teeth are supported by lamellæ resting on the bottom of the valve and bounding the posterior portion of the muscular scar. Shell structure fibrous. The individuals from the Jupiter are larger and relatively wider than those from lower horizons.

Occurrence. Silurian: Becscie (3-4), Wreck beach; Gun River (3), Gun river; Jupiter (8-10), Shallop creek, Bell and Iron rivers, and rivière du Pavillon.

The supposed cotypes, No. 2375, are in the National Museum of Canada. Plesiotypes are in Peabody Museum.

Whitfieldella nitida (Hall)

Atrypa nitida Hall, Rept. 4th Dist., Tab. Org. Rem. 13, 1843, fig. 5 (1852).

Shell small, outline of anterior half oval except for the nearly straight or little-curved front margin. Outline of posterior half trigonal with the cardinal slopes meeting at the beak at an angle of about 75 degrees.

Beaks small, the ventral beak projecting prominently and only slightly incurved, not in contact with the dorsal umbo. The dorsal beak closely incurved.

The surface of the shell is smooth. Growth-lines are obscurely indicated. An average individual is 8 mm. long, 7 mm. wide, and 4 mm. thick.

This shell is either an early, a dwarfed, or young form of *W. nitida*. That it is dwarfed appears probable, since the shells of other brachiopods which occur in association are small. The interiors have not been seen in the Anticosti forms.

Occurrence. Silurian: Chicotte (2), pointe des Morts.

Hyattidina congesta junea (Billings)

Plate XXX, figures 4, 5, 6

Athyris junea Billings, Cat. Sil. Foss., Anticosti, p. 46, 1866; *Hyattella junea* Hall and Clarke, Pal. N.Y., vol. VIII, pt. 2, p. 62, Pl. XL, figs. 29-31 (1894); Schuchert, U.S. Geol. Surv., Bull. 87, p. 232 (1897); *H. congesta* Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, p. 709 (1910).

The place of origin of the fold and sinus is quite variable, and many young forms show neither. When the species first appears, the fold and sinus are extremely short, but in higher beds these undergo a progressive lengthening. It differs from *H. congesta*, in having a shorter fold and sinus and in being more strongly lobate, but it is doubtful if the differences have varietal value. The individuals from the upper part of the Jupiter formation are fully twice as large as those from the Gun River formation, an average individual being 13 mm. wide, 10 mm. long, and 7 mm. thick. The fold and sinus and the secondary depressions are also not so sharp.

Occurrence. Silurian: Gun River (2-4), found in most exposures; Jupiter (1-9), found in most exposures. Apt to be very abundant in small colonies in each formation.

The National Museum of Canada (No. 2374) and Peabody Museum.

Hyattidina carletona Twenhofel

Plate XX, figures 4, 5, 6

Hyattina carletona Twenhofel, Geol. Surv., Canada, Mus. Bull. No. 3, p. 34, Pl. I, figs. 6, 7 (1914).

The single specimen upon which this species was originally based was discovered on a slab from Carleton point, the same slab containing *Phragmolites pannosus, Zygospira recurvirostris æquivalvis*, and other Richmond fossils. Subsequently another specimen was discovered in zone 23 of the Vauréal River section. It is somewhat smaller than *H. congesta junea*, proportionately longer, and has a small, longitudinal groove on the dorsal fold, which is not present in that species. The general shape is elongate-ovate to circular, the posterior outline being trigonal, the anterior two-thirds circular to elliptical. The apical angle is about 110 degrees. Both valves are convex, the ventral slightly the more. The beak of the ventral valve is small, narrow, pointed at the beak, beneath which is a small foramen. A median ridge, furrowed toward the front, extends from the umbo to the anterior margin. The Vauréal River specimen shows a small ridge in the anterior portion of the furrow. From the depressions bounding this ridge the surface rises to the lateral margins. The dorsal valve is marked by three lobes, of which the middle widens toward the margin and becomes divided by a longitudinal groove. No area has been seen on either valve.

The shell from Carleton point is 4 mm. long, 3·5 mm. wide about mid-length, and 1·25 mm. thick just in front of the umbo. The Vauréal shell is 5·5 mm. long, 6 mm. wide, and 3 mm. thick. The interior has not been seen, and it is possible that the shell does not belong to the genus to which it is referred. It is associated with *Protozeuga anticostiana*, and it is possible that it is a modified form of that species. *Hyattidina* has hitherto not been found in America below the Clinton, but in England *Rhynchonella portlockiana* Davidson (demonstrated by Reed to belong to the genus *Hyattidina*) (Reed, Quart. Jour. Geol. Soc., 1897, p. 75) ranges from the upper Llandeilo to the Caradoc; hence, its appearance in American strata as early as the Richmond should occasion no surprise. It differs from *H. portlockiana* in being smaller and in having the lateral slopes near the cardinal angles concave instead of convex, and Reed states that the latter differs from *H. congesta* only in the "presence of a short, median septum in the brachial valve and in the greater length of the process of the loop."

Occurrence. Ordovician: English Head (4), Carleton point; Ellis Bay (8), Vauréal river.

The holotype is in Peabody Museum; the Vauréal River specimen is in the writer's collection.

Coelospira hemispherica (Sowerby)

Atrypa flabella Shaler, Bull. Mus. Comp. Zool., vol. I, No. 4, p. 68 (1865); *Leptocoelia hemispherica* Billings, Cat. Sil. Foss. Anticosti, p. 48, 1866; *Anoplotheca hemispherica* Schuchert, U.S. Geol. Surv., Bull. 87 (1897); Schuchert and Twenhofel, Bull. Geol. Am., vol. XXI, p. 710 (1910).

This species is present in the higher rocks of Anticosti in great numbers and in an excellent state of preservation. An average example from the basal Jupiter is 9 mm. long, 12 mm. wide, and 3 mm. thick. The specimens from the upper part of the Gun River formation and the basal part of the Jupiter formation are as a rule longer than wide, whereas those from the upper part of the Jupiter have the lengths and widths more nearly equal an average example, being 9 mm. long and 10·5 mm. wide. The concentric, imbricating growth-lines are extremely well developed, especially near the margin. On the ventral valve the 3 central plications are conspicuously strong, and on the dorsal valve there are 2 plications in the mesial depression.

Occurrence. Silurian: Gun River (3-4), in all exposures; Jupiter (1–10), common.

Plesiotypes of the species are in both the National Museum of Canada and Peabody Museum.

Coelospira planoconvexa (Hall)

Anoplotheca planoconvexa Schuchert, U.S. Geol. Surv., Bull. 87, p. 145 (1897); Schuchert and Twenhofel, Bull. Geol. Am., vol. XXI, p. 705 (1910).

The Anticosti examples of this species are almost identical with those occurring in the Cataract formation at Dundas and Hamilton, Ontario, the type localities of the species, but they are not more than half as large. The largest specimen has a length and width of 11 mm. and a thickness of 3 mm.

Occurrence. Silurian: Becscie (1), Bear cliff and Vauréal river.

Peabody Museum.

PELECYPODA

Cuneamya anticostiana n. sp.

Plate XXIV, figures 5, 6

Shell above the average size for the genus, a large example being about 55 mm. long. The two ends are of nearly equal height; the beaks are broad, flattened above, nearly terminal, closely enrolled, and prominent; escutcheon narrow, lanceolate, and about half the length of the hinge. Ventral and hinge-margins subparallel, the cardinal almost straight and flattened, the ventral convex and angular, converging both anteriorly and posteriorly. Shell probably angular or sharply rounded posteriorly, truncated anteriorly, the front margin vertical, with the upper end abruptly deflected into the deep, rounded, or cordate lunule. Lunule in the example whose dimensions are given has a width of 4·5 mm. Section anterior to the middle almost perfectly heart-shaped. From the beaks a rapidly widening furrow extends to the ventral margin, which it reaches with the well-defined anterior ridge in front of the middle; posterior ridge not so well defined. Valves deepest on the posterior ridge. The surface is ornamented with concentric lines which are best defined anterior to the umbonal furrow, and all terminate at the margin of the lunule. The largest example has a length exceeding 55 mm., a height of 28 mm., and thickness of 26 mm.

In size and the character of the lunule this species approximates *C. coriformis* Miller from the Richmond of southwestern Ohio, but differs somewhat in outline.

Occurrence. Ordovician: Ellis Bay (4, 5, 6), Ellis bay.

Peabody Museum.

Ctenodonta cf. *elliptica* (Hall)

Tellinomya elliptica Hall, Pal. N.Y., vol. II, p. 102, Pl. XXX, fig. 4b (1852); Foerste, Pal. Ohio, vol. VII, p. 562, Pl. XXXVII, figs. 4 a-c, 10 (1893).

The single specimen collected is 20 mm. long and 13 mm. high. The beaks are a little more prominent than they are in the New York specimens of this species, and the ventral margin a little more convex, otherwise apparently the same.

Occurrence. Silurian: Jupiter (2), East cliff.

The Anticosti plesiotype is in Peabody Museum.

Ctenodonta cf. *obliqua* (Hall)

Nucula obliqua Hall, Am. Jour. Sci. and Arts, vol. XLIII, p. 292 (1845); *Tellinomya obliqua* Meek, Pal. Ohio, vol. I, p. 139 (1873); *Ctenodonta obliqua* Ulrich, Pal. Minn., vol. III, pt. 2, p. 604, Pl. XLII, figs. 83-87 (1897).

Casts answering to the description of this species were collected in considerable abundance in the English Head formation. The specimens are somewhat larger than those from Ohio, but are about the same size as the Minnesota examples. An average example is 9 mm. long and 10 mm. high.

Occurrence. Ordovician: English Head (4), Carleton point.

The plesiotypes from Anticosti are in Peabody Museum.

Ctenodonta cf. *simulatrix* Ulrich

Ctenodonta simulatrix Ulrich, Pal. Minn., vol. III, pt. 2, p. 600, Pl. XIII, figs. 74-75 (1897).

A single perfect cast of an example from Ellis bay appears to be very close to the above species, and higher in the shales of the Becscie formation were collected two other specimens which closely resemble the Ellis Bay form. The specimens also bear resemblance to *C. albertina* from the Richmond of southwestern Ohio. Neither the teeth nor the hinge structures have been seen. The Ellis Bay specimen is 14 mm. long, 10 mm. wide, and 5 mm. thick. The Becscie form is slightly smaller.

Occurrence. Ordovician: Ellis Bay (5), Ellis bay. Silurian: Becscie (3), Wreck beach.

Peabody Museum.

Ctenodonta cf. *socialis* Foerste

Tellinomya (*Nucula?*) *socialis* Foerste, Pal. Ohio, vol. VII, p. 563, Pl. XXXVII, figs. 12 a–c (1893) (Not *C. socialis* Ulrich).[1]

These shells are embedded in limestone with only parts of them exposed. They are poorly preserved and beyond the fact that they are probably Ctenodontas with a fairly circular outline, little else can be determined. Their shape appears to be nearest that of *C. socialis* Foerste.

Occurrence. Silurian: Jupiter (9), Box river.

The Anticosti specimens are in Peabody Museum.

Cyrtodonta anticostiensis Billings

Plate XXIV, figure 11

Cyrtodonta? anticostiensis Billings, Cat. Sil. Foss., Anticosti, p. 14, 1866.

This species is of the *C. harrietti* type with a rectangular outline, but with the posterior portion of the shell somewhat wider than the anterior. It is smaller than that species and proportionally wider and shorter. The shell was probably concentrically striated, as striæ are faintly shown on casts of the interior.

Occurrence. Ordovician: English Head (2–4), English head and Makasti cliff; Vauréal (1), White and High cliffs, and rivière à l'Huile.

Types, No. 2090, the National Museum of Canada. Other specimens in Peabody Museum.

[1] Now known as *C. ohioensis* Bassler, Bassler's bibliography.

Crytodonta harrietti Billings

Plate XXIV, figure 10

Cyrtodonta? harrietti Billings, Pal. Foss., vol. I, p. 149, fig. 129 (1862); Billings, Cat. Sil. Foss., Anticosti, p. 13, 1866.

The outline of this shell is rectangular; the beak, upper anterior margin, posterior ventral margin, and posterior cardinal margin making the four angles. The shape is much like that of *C. ampla* Ulrich from the Minnesota Trenton, but the shell is smaller. The supposed holotype is 42 mm. long, 22 mm. high at the umbones, 27 mm. high at the most elevated part of the dorsal side, left valve 14 mm. deep.

Occurrence. Ordovician: English Head (2–4), English head, Little Makasti bay, and nid de Corbeau.

The holotype, No. 2089, is in the National Museum of Canada. Plesiotypes are in Peabody Museum.

Cyrtodonta (?) insularis Billings

Cyrtodonta? insularis Billings, Cat. Sil. Foss., Anticosti, p. 14, 1866.

Occurrence. Ordovician: English Head (4), English head.

The type material of this species has not been found and no specimens which could be identified as this species have been found in any of the collections.

Vanuxemia acutumbona (Billings)

Plate XXIV, figure 14

Cyrtodonta acutumbona Billings, Cat. Sil. Foss., Anticosti, p. 49, 1866.

This species is a little larger than *V. ungulata* and has far narrower umbones. The beaks also appear to be closer together.

Occurrence. Ordovician: Ellis Bay (4), about a mile east of Junction cliff.

The holotype and only known specimen, No. 2293, is in the National Museum of Canada.

Vanuxemia ungulata (Billings)

Plate XXIV, figure 13

Cyrtodonta? ungulata Billings, Cat. Sil. Foss., Anticosti, p. 15, figs. 2 a–b, 1866; *Cyrtodonta? ungulata* Ulrich, Pal. Minn., vol. III, pt. 2, p. 565 (1897).

This shell is highly convex, with strongly incurved beaks. These are also curved forward and in the cast approach within 3 mm. of each other.

Occurrence. Ordovician: English Head (4), Makasti bay.

The holotype and only known specimen, No. 2108, is in the National Museum of Canada.

Whitella plebia (Billings)

Plate XXIV, figures 15, 16

Cyrtodonta? plebia Billings, Cat. Sil. Foss., Anticosti, p. 14, figs. 2 a–c, 1866; *Whitella plebia* Ulrich, Pal. Minn., vol. III, pt. 2, p. 565 (1897).

This is a small form with the beaks almost terminal. Beaks small, incurved, and curved forward, separated about 2 mm. Umbones prominent, angular on the posterior side with the angularity continuing to the posterior margin. In shape and size this species is in some respects similar to *W. ventricosa* (Hall), but it lacks the cardinal elevation posterior to the hinge.

Occurrence. Ordovician: English Head (4), Carleton point.

The holotype, No. 2091–a, is in the National Museum of Canada. Plesiotypes are in that Museum and Peabody Museum.

Whitella sigmoidea (Billings)

Plate XLIX, figure 6

Cyrtodonta? sigmoides Billings, Geol. Surv., Canada, Rept. of Prog. 1857, p. 186 (1858); Billings, Can. Nat. and Geol., vol. III, p. 438 (1858); Billings, Cat. Sil. Foss., Anticosti, p. 13, 1866; *Whitella sigmoidea* Ulrich, Pal. Minn., vol. III, pt. 2, p. 565 (1897).

Among the Anticosti pelecypods this is the most common and one of the largest, some specimens attaining a length of 60 mm. In the Canadian collections is a specimen of this species bearing the label *Cyrtodonta obscura* with the name ascribed to Billings; no description is known.

Occurrence. Ordovician: English Head (2–4), as a rule common; Vauréal (1, 2, 3, 6), baie Ste. Claire, MacDonald and Vauréal rivers and rivière à l'Huile; Ellis Bay (4, 5), doubtful.

Types, No. 2093, the National Museum of Canada. Other specimens in Peabody Museum.

Pterinea bellilineata Billings

Plate XXIX, figure 9; Plate XXXI, figure 4

Pterinea bellilineata Billings, Cat. Sil. Foss., Anticosti, p. 15, 1866.

The distinctions between this species and *P. prolifica* are pointed out in the description of the latter. The concentric striæ are much closer than described above, in some specimens there being as many as 2 to 1 mm. The radiating lines are also not at all obscure in some specimens. It occurs in association with *P. prolifica*, but is not so common.

Occurrence. Ordovician: English Head (4), Makasti cliff, North cliff, and rivière à l'Huile; Vauréal (1), White and High cliffs.

The holotype, No. 2107, is in the National Museum of Canada. Peabody Museum contains several plesiotypes.

Pterinea curiosa Billings

Plate XXXII, figures 2, 3

ıerinea curiosa Billings, Cat. Sil. Foss., Anticosti, p. 51, figs. 18 a-b, 1866.

The specimen purporting to be the holotype of this species consists of left valve. Viewed laterally the beak of this valve appears to curve backwards, probably the result of distortion.

Occurrence. Silurian: Jupiter (4), Jupiter river.

The holotype and only known specimen, No. 2460, is in the National Museum of Canada.

Pterinea emacerata (Conrad)

Avicula emacerata Conrad, Jour. Acad. Nat. Sci., p. 241, Pl. 12, fig. 15 (1842).

Anterior wing very short and lobe-like; in the young stages the posterior wing extends as far as the body of the shell and in the right valve beyond, but in the adult specimens not so far; left valve strongly reticulated by radiating and concentric lines, dividing both the inner and outer surface into small rectangles which vary in size with the individual and the region of the shell. New radiating striæ arise by implantation, and as the older ones are more prominent, this gives to the rectangles on the inner surface a bilobed appearance. The surface of the right valve appears to be almost smooth except for obscure striations and concentric lines; but on the posterior wing of this valve the ornamentation is similar and fully as prominent as on the left valve. The Anticosti specimens appear to be essentially identical with the New York forms.

Occurrence. Silurian: Becscie (3, 4), Wreck beach; Jupiter (2, 4, 8, 10), East cliff, Jupiter river, and Southwest point.

Peabody Museum.

Pterinea laurentina n. sp.

Plate XXIV, figure 7

The specimens upon which this species is founded consist of two left valves. The shell is small for the genus, hinge-line has a length of 18 mm.—the greatest width; posterior wing long, anterior small and lobe-like; extreme posterior margins not present, but judging from the striæ which meet the hinge at little less than a right angle, the posterior wing was only slightly if at all alate, and below the angle it was slightly concave. The body of the shell is oblique to the hinge, making with it an angle of about 60 degrees; with growth the angle increases, the axis of the body being a curve. The beak of the left valve is narrow, long, incurved over the hinge, and curved forward. The anterior margin makes an angle of about 50 degrees with the hinge, only slightly convex, but the convexity increases about 5 mm. posterior to a line drawn perpendicular to the hinge at the beak. Macroscopically the surface is smooth. This shell is especially distinguished from the other Anticosti *Pterineas* by the extreme fineness and great number of the concentric striæ—about 4 to 6 to 1 mm. These can be seen by the eye with difficulty. An occasional, large, concentric growth-line occurs in both specimens. Under a lens, fine, very closely placed, radial striæ appear.

Occurrence. Silurian: Becscie (3-4), Wreck beach.

The holotype is in Peabody Museum.

Pterinea prolifica Billings

Plate XXXIV, figure 5

Pterinea prolifica Billings, Cat. Sil. Foss., Anticosti, p. 16, 1866.

This species is extremely abundant in the English Head and Carleton formations, where it is associated with *P. bellilineata.* It differs from the latter chiefly in its ornamentation, which is evenly lamellose without undulations. In this species also the anterior wing is less prolonged, and the concentric lines just before reaching the hinge trend at right angles instead of about 45 degrees.

Occurrence. Ordovician: English Head (2-4), commonly present; Vauréal (1-3), baie Ste. Claire, White cliff, and MacDonald river.

Specimens of the species are in the National Museum of Canada (No. 2106) and Peabody Museum.

Pterinea (?) striata (Billings)

Plate XXIX, figure 8; Plate XXXIII, figure 8

Modiolopsis striata Billings, Cat. Sil. Foss., Anticosti, p. 48, 1866.

The shells in the Canadian collections which are referred to this species, as well as similar specimens in the Yale collection, more nearly resemble a *Pterinea* than a *Modiolopsis.* The concentric striæ are concave just before reaching the posterior hinge-line; the right valve is less convex than the left; beaks almost obsolete.

Occurrence. Ordovician: Ellis Bay (1), Junction cliff. Silurian: Becscie (3), Wreck beach.

Types lost; specimens of the species are in the National Museum of Canada (Nos. 2286, 2376) and Peabody Museum.

Pterinea thisbe Billings

Plate XXXIII, figures 6, 7

Pterinea thisbe Billings, Cat. Sil. Foss., Anticosti, p. 52, 1866.

The axis of the right valve makes an angle of about 50 degrees with the hinge-line. In one of the supposed cotypes the hinge of the left valve extends 16 mm. posterior to the beak. The right valve appears to lack this prolonged posterior wing and is the more convex. Specimens in the Yale collection which appear to belong to this species are ornamented with strong, lamellose growth-lines which are from 2 to 3 mm. apart and between them are much finer concentric lines.

Occurrence. Silurian: Jupiter (1, 9, 10), East cliff and Shallop creek.

Types, No. 2459, the National Museum of Canada.

Pterinea varistriata Billings

Pterinea varistriata Billings, Cat. Sil. Foss., Anticosti, p. 50, 1866.

The left valve of this species is more convex than that of *P. prolifica,* and the body of the shell makes a smaller angle with the hinge-line, the angle in that species being about 90 degrees, whereas in *P. varistriata* it varies between 50 and 70 degrees. The left valve is 8 mm. deep, the right about 3 mm. The concentric striæ meet the hinge-line at about 75 degrees.

P. subplana Hall, identified by Billings from point Laframboise (Ellis Bay), is not that species and may be a cast of this.

Occurrence. Ordovician: Vauréal (4-5), Battery point; Ellis Bay (1, 4, 5, 7, 9), Junction cliff and Ellis bay.

The cotypes, No. 2289, are in the National Museum of Canada. Plesiotypes are in Peabody Museum.

Byssonychia anticostiana n. sp.

Plate XXIV, figures 8, 9

Ambonychia radiata Billings, Cat. Sil. Foss., Anticosti, pp. 17, 50, 1866.

This shell is of the type of *B. subrecta* Ulrich, but differs from it in having fewer costæ, being as a rule more narrow, and in the hinge-line making a smaller angle with the anterior margin, the angle being 90 degrees or less. As in that species the beaks are rounded, and incurved, but commonly more acute. The byssal opening is slightly longitudinally ovoid and in some specimens circular. There are 40 to 55 radiating ribs to each valve. One specimen has the hinge-line 20 mm. long, but in most specimens it is somewhat less. Length 40 to 45 mm., greatest width parallel to the hinge is 35 mm.

The shells exhibit considerable variation in the proportional length and breadth and in the angle made by the hinge-line with the anterior margin. The shells of young individuals are much narrower than those of adults.

In many ways this species appears to hold a position intermediate between *B. subrecta* and *B. radiata,* in that the ribs are nearly the same number as in the latter, but the outline is more nearly that of the former.

On the north side, in the basal part of the Ellis Bay formation, were collected fragments of an internal cast of a specimen with very coarse ribs on the middle part of the shell. It probably belongs to a different species, but the material is not good enough for determination or description.

Occurrence. Ordovician: English Head (2-4), commonly present; Vauréal (1-5), as a rule present; Ellis Bay (1, 4-7, 9), Junction cliff, and Ellis and Prinsta bays.

Types in Peabody Museum, other specimens in the National Museum of Canada.

Clionychia (?) *superba* (Billings)

Ambonychia superba Billings, Cat. Sil. Foss., Anticosti, p. 50, fig. 16, 1866; Ulrich, Pal. Minn., vol. III, pt. 2, p. 494 (1897).

Surface obscurely concentrically striated. There appears to have been a ridge on the inner surface which extended about an inch posterior to the beak and made an angle of about 20 degrees with the hinge. No radial striæ.

The generic position of this shell is uncertain. Its size and shape would lead to its reference to the genus *Allonychia*, but the total absence of radial striæ and the presence of concentric striations will not permit such a disposition. It seems to fit best in the genus *Clionychia*.

Occurrence. Ordovician: Ellis Bay (1, 4), Junction cliff and Ellis bay.

Type, No. 2287, the National Museum of Canada. A few specimens in Peabody Museum.

Conocardium elegantulum Billings

Plate XXIX, figures 5, 6

Conocardium elegantulum Billings, Cat. Sil. Foss., Anticosti, p. 53, 1866.

The "strong, rounded ridge" (*See* Billings' description), extending from the beak to the margin, is flat on top, transversely striated with closely placed lines, and with the edges slightly elevated. The "10 or 12 fine striæ" on the posterior portion are concentric to the apex of the siphonal tube, whereas the minute striæ of the anterior portion rise to the hinge-line in somewhat spiral fashion.

Occurrence. Silurian: Jupiter (4), Jupiter river; Chicotte (1), Southwest point.

Type, No. 2537, the National Museum of Canada, a single specimen in Peabody Museum.

Modiolopsis miser n. sp.

Plate XXIV, figures 1, 2

This shell occurs in the form of flattened casts in shale and little more is known than shape, which appears to be Modiolopsoid. The shell is below the medium size for the genus; surface fairly evenly convex from a point about one-fourth the distance from the beak to the posterior ventral border; hinge-line makes an angle of about 60 degrees with the axis. The anterior margin is almost straight, abruptly curved at the base; the basal margin uniformly convex to the posterior extremity where the curvature becomes greater; posterior margin convex, somewhat flattened, or compressed, meeting the hinge-line at an obtuse, but rounded, angle. The shell is longest at about one-third the height. Muscular impressions apparently as in *Modiolopsis*. The greatest length of an average individual parallel to the hinge is 15 mm., height at the posterior extremity of the hinge 10 to 11 mm., at the beak 8 mm. The ornamentation appears to have consisted of concentric striæ. Some of the better preserved specimens show a slightly curved posterior ear, reminiscent of *M. primigenia* of the Medina; but the shell is shorter than that species, and there is a greater space in front of the beak. In the collections of the Geological Survey, Canada, this shell is labelled *M. miser* and, though no description is extant, the name is retained.

Occurrence. Silurian: Jupiter (4), Jupiter river.

The holotype, No. 2377, is in the National Museum of Canada. Plesiotypes are in both that Museum and Peabody Museum.

Mytilarca cf. *mytiliformis* (Hall)

Myalina mytiliformis Hall, Pal. N.Y., vol. II, p. 100, Pl. (1852); Clarke and Ruedemann, Mem. N.Y. State Mus., No. 5, p. 49 (1903) (Not *M. mytiliformis* Foerste).

Only a part of a single specimen was collected—a cast of the right valve with the beak and anterior margin gone. The surface is ornamented with equally spaced concentric lines which are about 1 mm. apart. The shell appears to be very close to the above species.

Occurrence. Silurian: Jupiter (3), Heath point.

The single specimen is in Peabody Museum.

Mytilarca nitida (Billings)

Plate XXXI, figures 6, 7

Ambonychia nitida Billings, Cat. Sil. Foss., Anticosti, p. 50, figs. 17 a-b, 1866; *Ambonychia? nitida* Ulrich, Pal. Minn., vol. III, pt. 2, p. 494 (1897); *Clionychia nitida* Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, p. 714 (1910).

A slight angularity begins at the beak and curves forward with a gentle convexity, then trends backward to the margin which it reaches just above the ventral posterior angle, enclosing an oval outline divided by the compressed cardinal and posterior margins. Hinge short, about 12 mm. long; no teeth observed, as all the specimens are casts; shell apparently tightly closed throughout.

As now defined the reference of this species to the genus *Ambonychia* is no longer possible, nor can it be referred to the genus *Clionychia*, as the shell is too oval in outline and the hinge too short. In general appearance it appears to fit best in the genus *Mytilarca*.

Occurrence. Silurian: Jupiter (4-6), Jupiter river.

The holotype, No. 2458, is in the National Museum of Canada. Plesiotypes are in Peabody Museum.

Rhytimya emma (Billings)

Plate XXXI, figure 5

Cyrtodonta? emma Billings, Geol. Surv., Canada, Pal. Foss., vol. I, p. 150, figs. 130 (1862); Billings, Cat. Sil. Foss., Anticosti, p. 13, 1866; *Rhytimya emma* Ulrich, Pal. Minn., vol. III, pt. 2, p. 619 (1897).

The concentric surface markings are always stronger on the anterior end. According to Ulrich this species is closely related to *R. sinuata* and *R. producta*.

Occurrence. Ordovician: English Head (2-4), most exposures; Vauréal (1), rivière à l'Huile and MacDonald river, and White cliff.

The holotype, No. 2097, is in the National Museum of Canada. Plesiotypes are in both that Museum and Peabody Museum.

Rhytimya prinstana n. sp.

Plate XXIV, figures 3, 4

In the sandstones on the west side of Prinsta bay were collected the internal casts of a large shell, which in shape, strongly incurved beaks, well-defined lunule, and broad, byssal sinus or umbonal furrow agrees with the genus *Rhytimya*. The shells are exceedingly large and ventricose, the largest and best preserved having a length of 80 mm., a height at the umbones of 47 mm. (greatest), and a thickness of 45 mm. The beaks are large and prominent, flattened on the top, and rather strongly incurved, and at the anterior margin where they bound the lunule they are angular. Lunule large and heart-shaped; escutcheon narrow and not so well defined. The anterior margin is rounded. Except where the basal margin intersects the byssal sinus, it is slightly convex. At the intersection with the sinus the margin is concave over a width of 25 mm.—the width of the sinus. Posterior to the beak the shell is narrower than in front, both margins converging, making the shell very narrow at this end with the extremity situated at about one-fifth the height of the shell. Surface of the cast ornamented with concentric lines.

Occurrence. Ordovician: Ellis Bay (6), Prinsta bay.

Type and one additional specimen in Peabody Museum.

GASTROPODA

Metoptoma (?) *alceste* (Billings)

Plate XXIX, figures 10, 11

Metoptoma alceste Billings, Geol. Surv., Canada, Pal. Foss., vol. I, p. 153, figs. 133 a-b (1862); Billings, Cat. Sil. Foss., Anticosti, p. 18 (loc. ref.), 1866; *Metoptoma* (?) *alceste* Ulrich, Pal. Minn, vol. II, pt. 2, p. 822 (1897).

The species is readily distinguished from the other Anticosti patelliform shells by its high, conical shape, subcentral apex, and strong rib anterior to the beak. Its systematic position is uncertain.

Occurrence. Ordovician: English Head (2-3), English head.

Plesiotypes of this species are in both the National Museum of Canada (No. 2138) and Peabody Museum.

Palaeacmaea anticostiensis n. sp.

Plate XXV, figures 17, 18

A specimen bearing the label *Metoptoma anticostiensis* Billings was discovered in the collections of the Geological Survey, Canada, but it does not appear that Billings ever described the species.

It is dome-shaped, not conical, elliptical base; apex anterior, about one-third the length of the radius from the middle; 30 to 35 mm. wide, 45 mm. long, about 23 mm. high. The specimen is a cast of the interior and the surface is ornamented with coarse, concentric lines.

Occurrence. Ordovician: Ellis Bay (7?), Prinsta bay.

The holotype and only known specimen (No. 2307) is in the National Museum of Canada.

Palaeacmaea magnifica n. sp.

Plate XXVI, figure 10

Of this species there is only a single example, a cast of the interior with the surface markings sufficiently well preserved to warrant its description. The shell is extremely large, and although to some extent crushed, it must originally have had a width equal to, or exceeding, 70 mm. and a length greater than 90 mm. The sides of the shell are apparently parallel, so that the base was of elliptical outline. The beak is crushed into the shell, but appears to have been depressed and is situated about half-way between the centre and the anterior border. The height is not known certainly, but judging from the original slope, which is preserved in a few places, it must have exceeded 40 mm. The surface is covered with coarse, rather deep, concentric striæ, parallel to the sides of the shell. There is no evidence that radial striæ were present.

This is the largest member of the genus known and is approached only by *P. quebecensis* (Billings) from the Beekmantown, which has a length exceeding 75 mm., but the concentric undulations of that species are fewer and shallower. *P. magnifica* differs from *P. anticostiense* in being larger with more and stronger concentric lines.

Occurrence. Ordovician: English Head (4), Three Brook bay.
Peabody Museum.

Archinacella estella (Billings)

Plate XXXI, figures 8, 9

Metoptoma estella Billings, Geol. Surv., Canada, Pal. Foss., vol. 1, p. 153, figs. 134 a–b (1862); *Archinacella estella* Ulrich, Pal. Minn., vol. III, pt. 2, p. 829 (1897).

The supposed type specimens of this species are two in number, of which the smaller is 17 mm. wide, 18 mm. long, and 6 mm. high. The larger is 10 mm. high. A specimen in the Yale collection shows obscure concentric striæ.

The shell is less acutely conical than *Metoptoma alceste* and lacks the anterior keel.

Occurrence. Ordovician: English Head (3), English head.

The holotype and a single paratype are in the National Museum of Canada (No. 2140). Several plesiotypes are in Peabody Museum.

Rhaphistoma vaurealense n. sp.

Plate XXV, figures 1, 2

Shell small, 9 mm. wide, 3 mm. high; consisting of not more than three volutions. The top is almost flat, the base conical, sharply angular on the periphery, enlargement of the whorl taking place almost wholly below the keel. In no example is the surface preserved. The umbilicus is about 2·5 mm. wide and filled with material different from that of which the cast is composed, so that an umbilicus extending to the summit was probably present in the shell.

This shell appears to be very similar to *R. peracutum* Ulrich from the Black River of Minnesota, but is somewhat smaller.

Occurrence. Ordovician: English Head (4), Three Brook bay; Vauréal (3), Vauréal river from drift on beach.

Peabody Museum.

Liospira americana (Billings)

Pleurotomaria americana Billings, Can. Nat. and Geol., vol. V, p. 164, fig. 7 (1860); Billings, Cat. Sil. Foss., Anticosti, p. 17, 1866; *Liospira americana* Ulrich and Scofield, Pal. Minn., vol. III, pt. 2, pp. 953, 996 (1897).

The Anticosti examples of this species attained a maximum diameter of 50 mm. and a height of 23 mm. Most are smaller. No part of the surface was found preserved, but some casts show transverse lines trending backward from the suture to keel.

Occurrence. Ordovician: English Head (2–4), English head and Makasti cliff; Vauréal (1–5), commonly present; Ellis Bay (4, 5, 7, 9), Junction cliff, and Ellis and Prinsta bays.

Specimens are in the National Museum of Canada (Nos. 2123, 2124, 2125) and Peabody Museum.

Liospira helena (Billings)

Plate XLVI, figures 4, 5

Pleurotomaria helena Billings, Can. Nat. and Geol., vol. 5, p. 165, fig. 8 (1860); Billings, Cat. Sil. Foss., Anticosti, p. 17, 1866; *Liospira helena* Ulrich, Pal. Minn., vol. III, pt. 2, p. 994 (1897).

Although the umbilicus of this species is closed, there is, nevertheless, a small depression in mature specimens, but apparently none in young individuals. It resembles *L. persimilis* Ulrich from the Trenton of Tennessee, but that species has no depression in the umbilical region, and the proportional height is somewhat less.

Occurrence. Ordovician: Ellis Bay (5–7), cape James (abundant), Ellis bay (rare).

Plesiotypes of this species are in both the National Museum of Canada and Peabody Museum.

Clathrospira subconica (Hall)

Pleurotomaria subconica Hall, Pal. N.Y., vol. I, pp. 174, 304 (1847); Billings, Cat. Sil. Foss., Anticosti, p. 17, 1866; Whitfield, Geol. Wis., vol. IV, p. 216, Pl. VI, fig. 1 (1883); *Clathrospira subconica* Ulrich, Pal. Minn., vol. III, pt. 2, p. 1006, Pl. LXIX, figs. 47–50; Pl. LXX, figs. 5–6 (1897).

Specimens agreeing with the illustrations and descriptions of this species are present in both the Yale and the Canadian collections. One specimen shows a small part of the band on the peripheral keel. This is rather broad, concave, and margined by two ridges. In the cast there is a small umbilicus.

Occurrence. Ordovician: English Head (2–4), commonly present; Vauréal (1), White cliff and rivière à l'Huile; Ellis Bay (2, 4, 5), Junction cliff and Ellis bay.

Specimens in the National Museum of Canada and Peabody Museum.

Lophospira acutocarinata n. sp.

Plate XXV, figure 3

This shell is like *L. peracuta* Ulrich, from the Stones River of Tennessee, in having a sharp, peripheral keel. The apical angles are also about the same. Like that species the upper surface is without a keel, except that there is a flat space near the suture, the outer edge of which may have been angular when the shell was present. About 1·5 mm. below the periphery there is a low keel. In this respect it differs from the Tennessee species. The upper surface for about 0·5 mm. near the suture is almost flat, thence the surface is concave to the periphery. Below the peripheral keel the surface is concave for about 1 mm., and thence convex to the umbilical region. Each whorl covers the preceding to the low keel below the periphery. Apical angle about 70 degrees; diameter and height each about 13 mm. The extremely sharp keel and small height readily serve to distinguish this species from the other Anticosti Lophospiras.

Occurrence. Ordovician: Ellis Bay (4), Ellis bay.

The holotype is in Peabody Museum.

Lophospira? *circe* (Billings)

Pleurotomaria circe Billings, Geol. Surv., Canada, Rept. of Prog. 1853–1856, p. 303 (1857); Cat. Sil. Foss., Anticosti, p. 17, 1866.

The types of this species have not been found. Material that seems to belong to the species is in the Twenhofel collection.

Occurrence. Ordovician: English Head (3, 4), English head; specimens which may belong to this species are also present in zones 1 and 4 of the Ellis Bay formation at Ellis bay and Junction cliff.

Lophospira gamachiana n. sp.

Plate XXV, figure 4

Murchisonia ventricosa Billings, Cat. Sil. Foss., Anticosti, pp. 18, 55, 1866.

An average example is 22 to 23 mm. high and about 16 mm. wide at the base; apical angle 60 to 70 degrees. A specimen in the Canadian collections is 30 mm. high and 20 mm. in diameter at the base. There appear to have been not more than five whorls. The whorls are concave from the suture to the periphery which is bounded by two spirals with an intermediate one between; band situated about three-fourths the height of the whorl. The lower side is ventricose, concave, or straight for a short distance below the keel, and thence convex to the umbilical region; umbilicus wanting. The surface is marked by fine, transverse lines, strongly curving back from the suture to the keel and below the keel to the umbilical region where the surface appears to become smooth. The aperture is quadrate, the lower side being sub-parallel to the upper surface of the whorl and the outer margin parallel to the ventral side of the preceding whorl. The shell in the character of the upper surface resembles *L. sybellina*, from which the greater size and larger apical angle of the latter readily distinguish it. It differs from *L. modesta* in not having a keel near the suture and in having a larger apical angle. In size it compares with *L. ampla* of the Ohio Richmond, but is narrower and lacks the revolving spiral on the upper surface.

Occurrence. Ordovician: Ellis Bay (4-7), Ellis bay.

The holotype, No. 2305, is in the National Museum of Canada. Plesiotypes are in Peabody Museum.

Lophospira modesta (Billings)

Plate XXV, figure 19

Murchisonia modesta Billings, Geol. Surv., Canada, Rept. of Prog. 1853-1856, p. 220 (1857); Billings, Cat. Sil. Foss., Anticosti, p. 18, 1866.

The apical angle is between 45 and 50 degrees, peripheral keel rounded angular, very prominent on well-preserved casts, about half the height of the whorl. Below the keel the surface is concave for about half the height of the lower side. This concavity is bounded below by a slight elevation, thence is convex to the umbilical region. A small umbilicus is present in the cast, probably not visible when the shell was present. Aperture not known.

Occurrence. Ordovician: English Head (2-4), commonly present; Vauréal (1, 2, 6?), baie Ste. Claire, White cliff, and Vauréal river?.

Types, No. 2132, National Museum of Canada. Other specimens in Peabody Museum.

Lophospira? papillosa (Billings)

Plate XLV, figures 5, 6, 7

Murchisonia papillosa Billings, Geol. Surv., Canada, Rept. of Prog. 1863-1865, p. 301 (1857); Billings, Cat. Sil. Foss., Anticosti, p. 55, 1866.

Except at the outer upper corner, the aperture is rounded; inner lip thickened; apertural notch V-shaped in its outer portion, terminating posteriorly in a slit with a length of about 2 mm. The slit band is concave and about 1 mm. wide. The generic characters of this shell are nearest to those of *L. ? notabilis* Ulrich of the Black River formation of Tennessee, a shell that Ulrich is disposed to refer to a new genus because of its trochchonemoid expression. The possession of vertical sides limited above by the slit band suggests relationship to *Trochonema*, whereas the concave slit band and narrow slit ally it to *Phanerotrema*. The resemblance to *Pleurotomaria baltica* of the Ordovician of Reval is in the ornamentation, but that shell is larger, the peripheral band is narrower, the shape of the aperture is different; and Murchison's figures show no sign of a slit, but only a notch.

Occurrence. Ordovician: Ellis Bay (2, 4, 5), Junction cliff and Ellis bay.

The cotypes, No. 2303, are in the National Museum of Canada. Plesiotypes are in Peabody Museum.

Lophospira sybellina (Billings)

Plate XLVII, figures 5, 6

Pleurotomaria sybellina Billings, Cat. Sil. Foss., Anticosti, p. 54, figs. 19 a-b, 1866.

The revolving spiral on the upper side of the whorls is very apt not to be present on the lower whorls, this being the case in the supposed type specimen; but as far as observed, it is always present on the higher whorls, so that in young specimens this spiral extends to the aperture. The apical angle varies from 70 to 80 degrees. An average example is 34 mm. wide, 25 mm. high, height of body whorl 17 mm., width 16 mm. The umbilicus of the cast is small, and there was probably none when the shell was present. There is no tendency to uncoil.

Occurrence. Ordovician: Ellis Bay (2, 4, 5, 7, 9, 10), Junction cliff, Ellis bay, and cape James.

The holotype, No. 2300, is in the National Museum of Canada. Plesiotypes are in Peabody Museum.

Lophospira? varians (Billings)

Plate XLVI, figure 6

Murchisonia varians Billings, Geol. Surv., Canada, Rept. of Prog. 1853-1856, p. 300 (1857); Billings, Cat. Sil. Foss., Anticosti, p. 18, 1866.

The supposed holotype of this species appears to be a broken *Lophospira modesta*, so that it has not been possible to determine certainly the correctness of the identifications. Reliance has been placed on the size of the apical angle, which is 58 degrees in this species as compared with 45 to 50 degrees on *L. modesta*. No specimens have been seen showing the three keels on the peripheral band.

Occurrence. Ordovician: English Head (2), English head.

Peabody Museum.

Spirorapha cryptata (Billings)

Plate XLVII, figure 7

Pleurotomaria cryptata Billings, Cat. Sil. Foss., Anticosti, p. 54, 1866.

The specimens purporting to be paratypes of this species, and others which except for dimensions agree with the description, are much larger than Billing's description would imply. The last whorl is rounded, but with greater convexity on the upper outer part than elsewhere, and in the higher whorls it is plainly angular at the suture. Specimens in the later collections show the characters in somewhat greater detail. The shell attains a diameter of 75 mm. and a height of 45 to 50 mm., and there are between 4 and 5 whorls. The sutures are prominent and deep. From the suture to just above the marginal band the surface is convex. The band is narrow and apparently convex and is situated on the upper side of the whorl, which also extends outward beyond the band. The surface below the band is convex to the umbilicus. The surface above the whorl is marked by coarse growth-lines which extend backward from the suture to the band. The surface below the band appears to be ornamented by lines of a similar character extending forward from the band. The characters of the shell are such that its reference to Perner's genus appears justified.

Occurrence. Silurian: Gun River (2-4), most exposures; Jupiter (4, 8, 10), most exposures.

The cotypes, No. 2462, are in the National Museum of Canada. Plesiotypes are in Peabody Museum.

Spirorapha? communis (Billings)

Cyclonema communis Billings, Cat. Sil. Foss., Anticosti, p. 55, 1866.

A mould of the interior, supposed to be a type, shows a surface ornamented with coarse, revolving striæ and finer, transverse ones. This is thought not to belong to this species, but probably to *C. decora* or *C. percingulata.* The other specimens in the Canadian collections may be correctly credited to this species. There were collected at the Jumpers a number of specimens which are similar to some of the supposed types, and these also answer to Billings' description. All are casts and show no ornamentation, and were they spirally or otherwise ornamented it would seem that some indications would be present. Their general characters appear to agree best with *Spirorapha perner*, and they differ from *S. cryptata* in having a higher spire. A specimen from the type locality is 45 mm. wide and 25 to 30 mm. high.

Occurrence. Silurian: Jupiter (8-10), Southwest point, Jumpers, Box brook, and rivière du Pavillon.

The holotype and a cast of it, No. 2530, are in the National Museum of Canada. Probably authentic material is in the writer's collection.

Spirorapha? corrugata n. sp.

Plate XXV, figure 5

The specimen on which this species is based consists of the external mould of a specimen of about the dimensions of *S.? communis.* The upper surface of the lower whorl is ornamented by rounded ridges which are 2 to 3 mm. wide and 1 mm. high. This specimen shows no indication of a slit band which characteristic, if not present, would not permit its reference to the genus *Spirorapha.* The shell was at least 45 mm. wide and 50 mm. high. There were at least 3 whorls.

Occurrence. Silurian: Jupiter (5), Cormorant point.

Twenhofel collection (2 specimens).

Schizolopha gigantea n. sp.

Plate XXV, figure 6

Shell large, the largest with a height exceeding 50 mm. and a width greater than 40 mm. The number of whorls exceeds 6; apical angle between 50 and 65 degrees. On one specimen a parasitic growth of *Protarea* has preserved a part of the shell. On this specimen the slit band is retained on two volutions and at the extremity the slit is open for 11 mm. The band is about 2·3 mm. wide, with a sharp ridge on each side. It is situated at about three-fourths the height of the whorl, is convex, and ornamented with coarse, lamellose plates which are concave toward the slit.

On the upper side of each whorl the surface is concave from the suture to the keel, placed about one-third the distance from the suture to the periphery, and then again concave to the peripheral band. The lower side is concave for a small space below the band, and thence convex to the umbilical region. Higher whorls appear to have a small keel below the band, but this is most certainly not present on the body whorl. In the best-preserved specimen the lower part of the body whorl is broken off, but it must have had a height of fully 25 mm. and a width of over 20 mm. An umbilicus is present in the casts, but it is small, and there was probably none when the shell was present. The surface is ornamented with coarse, lamellose lines of growth which bend forward from the suture to the slit band and below the band forward to the umbilical region.

The large size of this species readily distinguishes it from other American members of the genus. It is more coarsely lamellose than *S. textiliformis* and has a keel above the peripheral band, which is wanting in *S. moori*.

Occurrence. Ordovician: Ellis Bay (1, 4, 5, 7), Junction cliff and Ellis bay.

The holotype and other specimens are in Peabody Museum.

Hormotoma? aculeata (Billings)

Loxonema aculeata Billings, Cat. Sil. Foss., Anticosti, p. 55, 1866.

The apical angle is from 10 to 15 degrees. One specimen indicates that the whorls are rounded angular. Associated with the larger examples are many casts of smaller specimens which have been referred to this species, though it is by no means certain that they belong with it. The specimens are generally in such poor preservation that any identification is little more than a guess.

Occurrence: Silurian: Gun River (1-4), specimens which appear to belong to this species are commonly present; Jupiter (2, 3), East cliff and Heath point. Billings' specimens appear to have come from zone 9 of the Jupiter formation.

Types?, No. 2463, National Museum of Canada.

Hormotoma? funata (Billings)

Murchisonia funata Billings, Cat. Sil. Foss., Anticosti, p. 55, 1866.

The imperfect characters of the material of this species do not permit much detail to be given. In some specimens the whorls appear to be moderately convex from one suture to the other, whereas others appear to indicate that the whorls are obtusely angular in the middle. Coiling only moderately close. A specimen from cape MacGilvray, apparently of this species, indicates that the shell grew to a large size. This specimen has three whorls with both ends gone and is 53 mm. long. The apical angle is about 15 degrees.

Occurrence. Silurian: Gun River (2-4), forms appearing to belong to this species in all exposures; Jupiter (1-10), forms which seem to belong to species generally present.

Types, Nos. 2379, 2536, the National Museum of Canada, other specimens in Peabody Museum.

Hormotoma gigantea (Billings)

Plate XIII, figure 7

Murchisonia gigantea Billings, Geol. Surv., Canada, Rept. of Prog. 1853-1856, p. 298 (1857).

A specimen in the collections of the Geological Survey, Canada, shows the slit band; this is about two-fifths the height of the whorl, concave, and about 6 mm. wide where the whorl has a width of 44 mm. From the suture, coarse striæ sweep backward to the slit band in curves which are convex toward the aperture and from the lower side of the band forward to the suture below, the two sets of striæ meeting at the band at an angle of about 40 degrees. The species differs from *H. teretiformis* in having the whorls rounded instead of flat on the periphery, in being longer, and in having a smaller apical angle. It has the slit band lower than in *H. trentonensis* and the whorls more closely fitting than *H. major*.

Occurrence. Ordovician: Ellis Bay (7), Ellis and Prinsta bays, Lousy cove, and Vauréal river.

Specimens in all collections, types seem to have been lost.

Hormotoma cf. *gracilis* (Hall)

Murchisonia gracilis Hall, Pal. N.Y., vol. I, p. 181, Pl. XXXIX, figs. 4 a–c; p. 303, Pl. LXXXIII, figs. 1a–b (1847); Billings, Cat. Sil. Foss., Anticosti, pp. 18, 55, 1866; *Hormotoma gracilis* Ulrich, Pal. Minn., vol. III, pt. 2, p. 1014, Pl. LXX, figs. 18–21 (1897).

In the Richmondian rocks of Anticosti there are great numbers of casts of a slender *Hormotoma*. Almost all the casts have the same general aspect, though showing slight differences, not sufficient for differentiation; and since if a differentiation were made it would be of no value, they have been placed together. As they appear to meet the general description of the *Hormotoma gracilis*, they have been referred to that species, to which some of them belong or are closely related. A single specimen from Ellis Bay shows a portion of the shell which is also like that of *H. gracilis*.

Occurrence. Ordovician: English Head (1–4); Vauréal (1–6); Ellis Bay (1, 2, 4–10). All exposures.

Specimens of this species are in both the National Museum of Canada and Peabody Museum.

Hormotoma multivolvis (Billings)

Murchisonia multivolvis Billings, Geol. Surv., Canada, Rept. of Prog. 1853–1856, p. 299 (1857); Billings, Cat. Sil. Foss., Anticosti, p. 18, 1866.

The whorls of this species are extremely close fitting, each overlapping the preceding. This character adequately distinguishes it from other Anticosti *Hormotomas*.

Occurrence. Ordovician: English Head (4), North cliff and rivière à l'Huile; Vauréal, the locality of Billings, which is probably zone 5.

The cotypes, No. 2134, are in the National Museum of Canada.

Hormotoma teretiformis (Billings)

Murchisonia teretiformis Billings, Geol. Surv., Canada, Rept. of Prog. 1853–1856, p. 298 (1857); Billings, Cat. Sil. Foss., Anticosti, p. 18, 1866; *Hormotoma teretiformis* Ulrich, Pal. Minn., vol. III, pt. 2, p. 1014 (1897).

The whorls of this species are close fitting as in *H.? major* (Hall). They are almost flat on the under side, and there is a somewhat flattened band on the outer surface, from which the descent is rather abrupt to the under side. This is a feature of difference from *H.? major* in which the descent from the sides to the suture is rather gentle. The best specimen in the collections in the Geological Survey, Canada, has both ends missing, but the length could hardly have exceeded 5 inches. The lowest whorl has a width of 26 mm., and the entire shell at this point is 50 mm. wide. At least eight whorls are present.

Whiteaves has identified *H. teretiformis* from Manitoba, and he considered it identical with *H. ? major* (Hall); and both have been considered only large varieties of *H. bellacincta* (Hall). According to Ulrich, *H.? major* has overlapping sutures, which do not occur in *H. bellacincta*. *H. teretiformis* Billings may have had overlapping sutures, although no part of the shell has been seen; but Ulrich states that it does not occur in *H. teretiformis* Whiteaves.

Occurrence. Ordovician: English Head (4), Carleton point (Billings); Vauréal (1, 4), White cliff and West point.

Specimens in the National Museum of Canada (No. 2127) and Peabody Museum, types appear to be lost.

Hormotoma? turricula (Billings)

Plate XLII, figures 8, 9

Murchisonia turricula Billings, Geol. Surv., Canada, Rept. of Prog. 1853–1856, p. 301 (1857); Cat. Sil. Foss., Anticosti, p. 55, 1866; not *M. turricula* Hall.

This species may have a height slightly exceeding 15 mm. and a diameter of 10 mm. Most are smaller, having a length equal to that given by Billings and a diameter of 7 to 8 mm. The shell is imperforate; the keel is so prominent that some of the specimens resemble a screw; aperture not well preserved, probably round, inner lip thickened. The peripheral keel contains the band which in the largest examples is about 1 mm. wide, bounded by a sharp ridge on each side, not trilineate. At the end of the slit band is a V-shaped notch which appears to be continued backward for about 2 mm. as a slit. Between the sutural and peripheral keels the surface is concave.

Occurrence. Silurian: Jupiter (10), Jumpers.

The supposed cotypes, No. 2535, are in the National Museum of Canada. Plesiotypes are in Peabody Museum.

Bellerophon (?) fraternus Billings

Bellerophon fraternus Billings, Cat. Sil. Foss., Anticosti, p. 19, 1866.

The type material of this species has been lost, and there are no specimens in any of the collections which answer to Billings' description.

Occurrence. Ordovician: English Head (3?), English head.

Bellerophon laurentinus n. sp.

Plate XXV, figures 7, 8

The shell exceeds the medium size for the genus, apparently composed of not more than two closely embracing whorls, of which but little more than the outer one is visible. The increase in size is fairly uniform until the aperture is reached, where it is abruptly and greatly expanded laterally. Volutions are bean-shaped, triangular in section, the ventral indentation being made by the preceding volution which projects into the succeeding volution nearly one-fourth its height. The surface slopes with a gentle convexity from the keel to the margin of the umbilicus, where it is abruptly rounded. The umbilicus is deep, about 6 mm. wide in the average specimen. Lines of growth curve gently forward from the rather high and fairly sharp keel to the margin of the umbilicus, the curve being convex toward the aperture. Aperture not known, but apparently triangular ovate with the height a little greater than, or about equal to half the width. The margin has not been seen, but the lines of growth indicate a deep sinus in the outer lip, whereas the inner appears to have been reflected. No slit band has been observed. An average example is more than 30 mm. wide at the aperture. From the apertural end of the keel the diameter is about 24 mm.

Occurrence. Ordovician: English Head (4), Makasti, North, and White cliffs.

Peabody Museum.

Bellerophon miser Billings

Bellerophon miser Billings, Cat. Sil. Foss., Anticosti, p. 20, 1866; Ulrich, Pal. Minn., vol. III, pt. 2, p. 853 (1897).

The type material of this species has been lost and it has not been recognized in later collections.

Occurrence. Ordovician: English Head (4), Makasti bay.

Bellerophon solitarius Billings

Bellerophon solitarius Billings, Cat. Sil. Foss., Anticosti, p. 20, 1866.

The type material of this species has not been found and it has not been recognized in any of the collections.

Occurrence. Ordovician: English Head (4), Makasti bay.

Bucania ellisensis n. sp.

Plate XXV, figures 9, 10

This species is founded on two specimens, both distorted by pressure and neither having the aperture preserved; but the surface is present in each. There are about three volutions, closely enrolled, probably cordate in section, each volution wider than high, gradually enlarging except at the aperture where the enlargement is rapid. The growth lamellæ are from 2 to 2·5 mm. apart and extend from the umbilical region backward to the keel. They are quite coarse and are crossed by much finer, but plainly visible striæ which converge forward from the umbilical region to the keel. The keel is prominent, concave at the summit—gutter-like—and crossed by very fine, lamellose riblets which are concave toward the aperture. From the keel to the umbilicus the surface is gently convex and at the margin of the latter abruptly so. Umbilicus deep and well defined. The better preserved example is 14 mm. wide, 18 mm. in diameter, which, however, does not represent the entire diameter since some of the shell is missing. The aperture is not well known, but it is expanded and nearly twice as wide as long. The species resembles *B. halli* Ulrich from the Stones River of Tennessee and Black River of Kentucky, but has a much narrower umbilicus.

Occurrence. Ordovician: Ellis Bay (4, 7).

The holotype and paratype are in Peabody Museum.

Sinuites cf. *bilobatus* (Sowerby)

Bellerophon bilobatus Billings, Cat. Sil. Foss., Anticosti, p. 20, 55, 1866; *Protowarthia bilobata* Ulrich, Pal. Minn., vol. III, pt. 2, p. 873 (1897).

Either this, *S. cancellatus*, or a closely related species, is represented in the Anticosti strata, but the specimens—casts of the interior—are so poorly preserved that identification is more a matter of guess work than otherwise. The specimens, however, resemble similar casts found in the Lorraine and Richmond shales of southwestern Ohio, which generally are referred to one of the above species. Several specimens show the marginal notch and the rounded apertural lobes. An average example is about 12 mm. wide at the aperture and 14 mm. in diameter.

McCoy considered *S. bilobatus* and *S. cancellatus* as the same species, but Ulrich states that they are distinct. As the Anticosti examples occur in association with many species of European origin and appear contemporaneously with a wave of European migration, it has been thought best to refer them to the European species, but no great weight can be laid on the identification.

Occurrence. Ordovician: English Head (3, 4); Vauréal (1-6); Ellis Bay (1, 2, 4-9).

Specimens are in both the National Museum of Canada and Peabody Museum.

Oxydiscus giganteus n. sp.

Plate XXV, figures 11, 12

Bellerophon acutus Billings (not Sowerby), Cat. Sil. Foss., Anticosti, pp. 18, 56, 1866.

Shell large for the genus; between 3 and 4 volutions, each deeply impressed on the succeeding. Diameter over 30 mm.; width of the last whorl near the supposed aperture 15 mm., of which about 5 mm. overlaps the preceding whorl; umbilicus about 15 mm. wide, depth equal to about half the height of the shell. The inner margin of each whorl rounded angular and almost perpendicular to the preceding whorl; lateral surface gently convex; periphery sharply keeled. On a single specimen growth-lines are preserved; these curve forward from the keel to the umbilical region with the convexity toward the aperture. Aperture not known.

From descriptions it would appear that this shell is closely related to *O. (Cyrtolites) magnus* (Miller) from the Richmond of Indiana, but it is somewhat larger. It is also related to *O. (Bellerophon) acutus* (Sowerby) with which it was identified by Billings. It is, however, much larger than that species.

Occurrence. Ordovician: Ellis Bay (1, 4, 7, 9), Ellis and Prinsta bays.

The holotype and paratypes are in Peabody Museum.

Oxydiscus tenuis n. sp.

Plate XXV, figures 13, 14

This species is distinguished from *O. giganteus* by its extreme thinness. Only three specimens were collected, all casts. Whorls 2 to 3, very closely enrolled; umbilicus very shallow and narrow; only a small part of the inner volutions showing. From the margin of the umbilicus to the keel the surface is gently convex and the whorl is thickest about one-third the distance from the margin; keel extremely acute; umbilical margin abruptly convex. Each volution V-shaped in section, each preceding volution being impressed on the succeeding for about three-fourths its width. The largest and best specimen is 18 mm. in diameter, a little over 2 mm. thick, body whorl 9 mm. wide; umbilicus 3·5 mm. in diameter.

The extreme thinness, the shallow and small umbilicus readily differentiate this species from *O. giganteus*.

Occurrence. Ordovician: English Head (2-3), English head.

The holotype and two other specimens are in Peabody Museum.

Tetranota cf. *obsoleta* Ulrich

Tetranota obsoleta Ulrich, Pal. Minn., vol. III, pt. 2, p. 880, Pl. LXV, figs. 19-23 (1897).

The specimens referred to this species occur wholly as casts in shale and are about the same size as specimens of this species from the *Ctenodonta* bed (Black River) of Goodhue county, Minnesota. The umbilicus is about one-fourth the width of the shell and fairly deep; the slit band is over 1 mm. wide and only a single pair of the lateral revolving ridges is shown. The outer lip has a rounded sinus. The Anticosti examples also bear considerable resemblance to a specimen figured by Ulrich from the Utica of Cincinnati (op. cit., Pl. LXV, fig. 24), but the material is too poor for accurate determination.

Occurrence. Ordovician: Ellis Bay (4, 5, 7), Ellis bay.

Peabody Museum.

Phragmolites desideratus (Billings)

Plate XXXV, figures 4, 5

Cyrtolites desideratus Billings, Cat. Sil. Foss., Anticosti, p. 21, 1866.

The specimens (No. 2145) purporting to be the types of this species appear to belong to *Cyrtolites ornatus*, but specimens answering the original description have been collected at several localities. At Ellis bay was collected one showing the shell. This is ornamented by lamellæ similar to those on *P. pannosus*, but farther apart, nearly 2 mm. as compared with 1 mm. in *P. pannosus*. In this specimen the aperture is preserved. It is expanded, about 16 mm. wide, and 8 mm. high.

Occurrence. Ordovician: English Head (4), Makasti bay; Ellis Bay (5), Ellis bay.

Peabody Museum.

Phragmolites pannosus (Billings)

Plate XXXV, figures 2, 3

Cyrtolites pannosus Billings, Cat. Sil. Foss., Anticosti, p. 20, 1866; *Conradella pannosa* Ulrich, Pal. Minn., vol. III, pt. 2, pp. 852, 906 (1897); Schuchert and Twenhofel, Bull. Geol. Soc., Am., vol. XXI, p. 696 (1910).

In section the volutions of this shell are cordate, the indentation being made by the keel of the preceding volution; increase in the size of the whorls not marked. It differs from other species of the genus in being less thick dorso-ventrally, the volutions in every case being wider than high. It is larger than either *C. dyeri* or *C. elegans*, the two species to which it appears most closely related.

Occurrence. Ordovician: English Head (2-4), English head and Makasti bay; Vauréal (1-4, 6), most exposures.

The type material is missing. Plesiotypes are in both the National Museum of Canada and Peabody Museum.

Salpingostoma canadensis (Billings)

Plate XXXIX, figure 3; Plate XLI, figure 9

Bellerophon canadensis Billings, Cat. Sil. Foss., Anticosti, p. 18, fig. 6, 1866; *Salpingostoma canadensis* Ulrich, Pal. Minn., vol. III, pt. 2, p. 851 (1897).

This species has a very rapid increase in the size of the whorls; the dorsum is sharply angular or keeled, but this disappears about an inch from the aperture. The umbilicus is not large and rapidly narrows inward, but probably extends nearly to the centre.

Occurrence. Ordovician: English Head (4), Makasti bay; Ellis Bay (4, 7), Ellis bay.

No. 2136, Geol. Surv., Canada; Peabody Museum.

Salpingostoma orientalis n. sp.

Plate XXVI, figures 1, 2

Bellerophon dilitatus? Billings (not Sowerby), Cat. Sil. Foss., Anticosti, p. 56, 1866.

Shell large, diameter just back of aperture 45 mm.; whorls wider than high; surface ornamented with revolving lines; slit band narrow, less than 1 mm. wide; aperture expanded beyond the width of the shell with its margins parallel to the plane of the opening; height exceeds 65 mm., width about 50 mm. The apertural margin is ornamented with coarse ribs which are about 2 or 3 mm. apart on the periphery. In the Chicotte formation a specimen was collected consisting of the expanded opening. This has ornamentation as described above, and has an horizontal width of 105 mm. and a height of 130 mm.

This shell was identified by Billings as *Bellerophon dilitatus*? Sowerby, from which it differs chiefly in that the apertural margin does not partly enclose the spire. It is of the *S. canadensis* type, but differs from that species in that the whorls are narrow and little expanding until the aperture is reached.

Occurrence. Silurian: Jupiter (2-4, 7-9), East cliff, Heath and Cormorant points, Iron river, and rivière du Pavillon; Chicotte (2), pointe des Morts.

Holotype, Peabody Museum.

Eccyliomphalus nitida n. sp.

Plate XXV, figures 15, 16

Surface ornamented with numerous moderately coarse lines of growth; aperture not known; diameter of largest example 24 mm., but fragments indicate a diameter of 35 mm.; diameter of body whorl exceeds 14 mm.; height 13 mm. In the best-preserved example the outer whorl is 9 mm. wide, and one turn back 2 mm. The number of volutions exceeds 2, increase in diameter gradual. In the Canadian collections this shell is labelled *E. nitida* Billings, and though no description is extant, the name is retained.

Also in the Canadian collections is a fragment from Junction cliff bearing the label *E. bella* Billings (No. 2298). This fragment has the shell preserved. It is ornamented with low, longitudinal ridges about 1 mm. apart, which are more angular than the separating depressions and are crossed by transverse, undulating lines, bending forward on the ridges and backward in the interspaces. The fragment is 15 mm. long, 8 mm. in diameter at the large end, and 3·5 mm. at the small. It is very probable that it belongs to the above species.

Occurrence. Ordovician: Ellis Bay (2, 4, 5), Junction cliff and Ellis bay.

Holotype, No. 2299, is in the National Museum of Canada. Other specimens are in Peabody Museum.

Euomphalus (?) *anticostiensis* n. sp.

Plate XXVI, figures 3, 4

The shells upon which this species is founded were collected at Hannah cliff and cape MacGilvray. Those from the former locality are not over 12 mm. in diameter, consisting of about 3 whorls with the spire depressed below the body whorl, which expands rapidly near the aperture and is ventricose on the lower side. The body whorl is about 4 mm. wide and high. On the dorsum the whorls are fairly uniformly convex, somewhat abruptly rounded above, and then more gently to the inner side. The umbilicus is about one-fourth the width of the shell. The largest specimen has a diameter of 20 mm. and came from cape MacGilvray. In this specimen the body whorl is 8 mm. high and 7·5 mm. wide. No surface markings of any kind have been observed. The specimens are much like the earliest variety of *E. gothlandicus* Lindstrom from Wisby, Gotland. The two shells have about the same degree of enrolling, general shape, and abrupt rounding of the whorls on the upper side.

Occurrence. Silurian: Gun River (2, 4), Hannah cliff and cape MacGilvray.

Peabody Museum.

Cyclonema bellulum Billings

Plate XLIII, figures 9, 10

Cyclonema bellula Billings, Cat. Sil. Foss., Anticosti, p. 55, 1866.

This shell has no umbilicus; the aperture is round except at the upper outer corner, where it is rounded angular; inner lip thickened and reflected. The surface is ornamented with numerous transverse and revolving striæ, resulting in a minutely reticulated surface. The two sets of striæ vary in their development; in some examples the transverse being the stronger in others the revolving, and in some examples both are absent. The last is thought to have resulted from wear. The shell is much like *C. cancellatum* Hall from the Clinton lower green shale at Sodus, Wayne county, New York, and between that place and Rochester; but the Anticosti shell seems to be more conical.

Occurrence. Silurian: Becscie (3, 4), Wreck beach; Gun River (3, 4), Hannah cliff and cape MacGilvray; Jupiter (2, 6, 9, 10), East cliff, rivière du Pavillon, Southwest point, and Jumpers.

Cotypes, No. 2532, in the National Museum of Canada, plesiotypes in Peabody Museum.

Cyclonema decorum Billings

Plate XLII, figures 10, 11

Cyclonema decora Billings, Cat. Sil. Foss., Anticosti, p. 56, 1866.

About 4 whorls, aperture nearly circular, apical angle about 90 degrees, 16 mm. high, 15 mm. wide, aperture 8 mm. in diameter, surface covered with strong, revolving striæ of which there are about 2 to a mm.

Occurrence. Silurian: Chicotte (1, 2), Southwest point.

Holotype, No. 2529, in the National Museum of Canada, not recognized in later collections.

Cyclonema percingulatum Billings

Plate XXIX, figure 7

Cyclonema percingulata Billings, Geol. Surv., Canada, Rept. of Prog. 1853-1856, p. 304 (1857); Billings, Cat. Sil. Foss., Anticosti, p. 55, 1866.

This species resembles the Carleton *C. varispirum;* but is larger, more ventricose, has a greater apical angle, and a greater number of spiral lines on the upper halves of the whorls. The aperture is round; inner lip thickened and reflected; no umbilicus. The largest specimen collected is 30 mm. wide and high. It also resembles *C. cancellatum* Lindstrom, from Gotland, but that shell appears to be larger and does not have the spirals above the periphery nearly so prominent. *C. daytonensis* from the Clinton (Brassfield) of Centreville, Ohio (comparison has been made with specimens in the author's collection) is also closely related, but is larger, has a larger apical angle, and a deeper suture.

Occurrence. Silurian: Jupiter (4–7, 9–10), Jupiter river and rivière du Pavillon, and Southwest point.

The types, No. 2534, are in the National Museum of Canada. Other specimens are in the Peabody Museum and Twenhofel collections.

Cyclonema thalia (Billings)

Plate XLII, figure 12

Pleurotomaria thalia Billings, Geol. Surv., Canada, Rept. of Prog. 1853–1856, p. 303 (1857); *Cyclonema thalia* Billings, Cat. Sil. Foss., Anticosti, pp. 17, 55, fig. 5, 1866.

The aperture is not well shown, but it appears to be round; the margin is slightly expanded and the inner lip thickened and reflected. On the upper half of the whorl there are about 8 transverse striæ to 1 mm., not so well developed on the lower half. The supposed holotype is 7·5 mm. high and 7 mm. in diameter at the base. A larger specimen from Makasti cliff is 13 mm. high and 12 mm. wide.

Occurrence. Ordovician: English Head (4), Makasti and du Puyjalon cliffs and Caplan river; Vauréal (2), Observation cliff; Ellis Bay (4–7, 9–10), Junction cliff and Ellis bay.

Holotype, No. 2129, is in the National Museum of Canada. Other specimens are in Peabody Museum and Twenhofel collections.

Cyclonema varispirum n. sp.

Plate XXVI, figure 5

Shell small, not more than three whorls, obtusely conical, apical angle about 75 degrees. On the upper half of the body whorl are 6 prominent spiral lines about 1·5 mm. apart, the lowest almost on the periphery (about one-third the height of the whorl). Between these larger striæ there are from 1 to 5 smaller ones. The lower half of each whorl is covered with fine, spiral lines of different sizes, there being about 2 to 1 mm. Just below the periphery there are 2 or 3 like those above the periphery. All of these are crossed by fine, transverse lines which trend backward from the suture to the umbilical region, producing on the lower part of the whorl, where they are strongest, a cancellated surface. There is no umbilicus. The aperture appears to have been round and slightly expanded, with the inner lip thickened and a slight depression behind it. All whorls are rounded; there is no keel. The best specimen is 13 mm. wide at the aperture; width of body whorl at aperture 6·5 mm.; height not over 12 mm. The shell bears some slight resemblance to *C. bilex*, but the variation in the size of the spirals and the convexity of the base readily serve to separate them. It resembles *C. thalia* Billings, but has less strong spiral lines, though many more, and less strong, transverse lines. The name *varispirum* is given in reference to the variation in the size of the spirals.

Occurrence. Ordovician: English Head (4), Makasti cliff, Caplan river, and Carleton point; Vauréal (1–3), most localities.

Peabody Museum.

Cyclonema varians Billings

Plate XLIII, figures 7, 8

Cyclonema varians Billings, Geol. Surv., Canada, Rept. of Prog. 1853–1856, p. 305 (1857); Cat. Sil. Foss., Anticosti, p. 55, 1866.

Specimens with the shell preserved show no umbilicus. The apical angle is about 50 degrees. In addition to the growth-lines the surface is ornamented with very fine revolving striæ, of which there are 8 to 10 to 1 mm. Except for the fine striæ the aspect is that of *Holopea*. There is a single specimen in the collection which has the upper surface of the lowest whorl concave, although all other parts of the shell are like that of the other specimens.

Occurrence. Silurian: Chicotte (1–2), Southwest point and pointe des Morts.

The electotype and plesiotype which are supposed to be of this species are in the National Museum of Canada (2533).

Holopea (?) *mediocris* Billings

Plate XLIII, figure 11

Cyclonema mediocris Billings, Cat. Sil. Foss., Anticosti, p. 56, 1866.

The specimen purporting to be the type has about the dimensions of *Diaphorostoma humile*, but has a higher spire. The height and width are each about 12 mm. The transverse undulations without revolving striæ ally the shell to the genus *Holopea*.

Occurrence. Silurian: Jupiter (5?), 4 miles west of Southwest point.

The supposed holotype is in the National Museum of Canada.

Holopea vaurealensis n. sp.

Plate XXVI, figure 6

This species is founded on a single, fairly well-preserved specimen. There seem to be not more than three whorls; but as the apex is slightly eroded, the number may be a little more. A whorl is gently curved outward to nearly flat from the suture to the peripheral margin, the surface being almost in the plane of the slope of the shell. At the margin the surface is sharply and uniformly curved to the under side, which is gently convex to the umbilical region. Except for transverse undulations of growth, best shown adjacent to the aperture, the surface is smooth. The aperture is round except at the top where it is angular. There is no umbilicus, but a small depression exists in the shell where it should be. The shell is 15 mm. wide at the base and 18 mm. high.

Occurrence. Ordovician: Ellis Bay (9), zone 23 of Vauréal River section.

The holotype is in the writer's collection.

Trochonema umbilicatum? (Hall)

Pleurotomaria umbilicatum (Hall), Pal. N.Y., vol. I, p. 43, 175, Pl. X, figs. 9 a-h; Pl. XXXVIII, figs. a-g (1847); *Trochonema umbilicata* Billings, Cat. Sil. Foss., Anticosti, p. 18, 1866; Ulrich, Pal. Minn., vol. III, pt. 2, p. 1047, Pl. LXXVII, figs. 1-8 (1897).

Casts of a trochonemoid shell are not uncommon in the lower beds of Anticosti. The diameter is about 35 mm. and the height about 21 mm. The reference to *T. umbilicatum* is provisional.

Occurrence. Ordovician: English Head (2-3), English head.

All collections.

Loxonema (?) rugosum (Billings)

Plate XXXV, figure 6

Murchisonia rugosa Billings, Geol. Surv., Canada, Rept. of Prog. 1853-1856, p. 299 (1857); Billings, Cat. Sil. Foss., Anticosti, pp. 18, 55, 1866.

A specimen of this species covered with *Paleofavosites prolificus* was collected, and underneath the coral the shell was found to be preserved. The surface is ornamented with coarse, rugose striæ, strongly developed on the upper half of the whorl and trending backward with a broad curve concave toward the aperture. The same specimen shows the presence of spiral striæ about 1 mm. apart, the two sets producing a cancellated surface. The whorls are more convex in the middle than elsewhere. There is no umbilicus. The aperture is not well known, but it appears to face away from the shell. Casts differ from *H. gigantea*, with which it is associated, in the smaller apical angle and strong, transverse striæ. There is no slit band.

Occurrence. Ordovician: Vauréal (4), Battery point (doubtful), Ellis bay (7), Ellis and Prinsta bays.

Plesiotypes are in both the National Museum of Canada (No. 2135) and Peabody Museum. The proterotypes are lost.

Subulites ellisensis n. sp.

Plate XXVI, figure 7

Subulites elongata Billings, Cat. Sil. Foss., Anticosti, p. 53, 1866.

Aperture fusiform acuminate above, increasing in width nearly to the base which is somewhat obliquely truncated; as long or a little longer than the height of the last whorl; width about three-sevenths the length. Length 90 to 100 mm.; width about 20 mm. (across middle of aperture); body whorl 30 mm. high and 13 mm. wide; apical angle 17 to 18 degrees. Only casts have been collected; in these the sutures are well defined. Some few specimens show no sutures, but such are always worn. The number of whorls must have exceeded five. One specimen shows suggestions of a concave band.

Occurrence. Ordovician: Ellis Bay (4, 5, 7, 9), Ellis bay and vicinity and Vauréal river.

The holotype, No. 2294, is in the National Museum of Canada. Other specimens are in Peabody Museum.

Subulites richardsoni Billings

Plate XLIX, figure 7

Subulites richardsoni Billings, Geol. Surv., Canada, Rept. of Prog. 1853-1856, p. 209 (1857); Ulrich, Pal. Minn., vol. III, pt. 2, p. 1070 (1897).

This species is very large, one example of a little more than two whorls having a length of 114 mm. Neither the apex of the shell nor the basal part of the aperture is known. The apical angle is about 15 degrees. The aperture is known to have been at least 50 mm. long and probably reached 60 mm. It is fusiform above, widens below to at least 15 mm. The shell probably reached a length of 135 to 145 mm. It is larger than *S. ellisensis* and has a slightly smaller apical angle.

Occurrence. Ordovician: English Head (4), Carleton and Makasti points.

The National Museum of Canada, No. 2117.

Cyrtospira notata (Billings)

Plate L, figures 9, 10

Subulites notatus Billings, Cat. Sil. Foss., Anticosti, p. 54, 1866; *Cyrtospira notatus* Ulrich, Pal. Minn., vol. III, pt. 2, pp. 1070, 1074 (1897).

The curving of the outline on the posterior side becomes concave toward the lower side of the aperture; the latter is fusiform and narrowest above. The concave band about the suture has a width of about 2 mm.

The short spire, the arcuate outline of the posterior side of the shell, and the absence of marked truncation of the lower end of the aperture are the characters on which Ulrich founded the genus *Cyrtospira*.

Occurrence. Ordovician: Ellis Bay (4-7), Ellis bay.

Holotype not discovered. Paratypes are in the National Museum of Canada. Plesiotypes are in Peabody Museum.

Diaphorostoma humile (Billings)

Plate XLII, figures 13, 14

Cyclonema humilis Billings, Cat. Sil. Foss., Anticosti, p. 56, 1866.

This shell resembles *D. niagarense* Hall, but differs in that the shell is smaller, the apical whorls are smaller, the body whorl proportionately larger, more rapidly expanded, and the sutures not so deep. The spire is also higher in that the apical whorls rise above the body whorl. It may be only a variety of that species, but it appears to be distinct. It probably has little connexion with *Holopea obsoleta* as stated by Billings.

Occurrence. Silurian: Gun River (4), Gun river and east; Jupiter (1-4, 7-10), all exposures.

The holotype (?), No. 2531, is in the National Museum of Canada. Plesiotypes are in both that and Peabody Museum.

Diaphorostoma niagarense (Hall)

Platystoma niagarensis Hall, Pal. N.Y., vol. II, p. 287, Pl. LX, figs. 1 a-v (1852).

Shell a depressed cone, almost lenticular, 2 to 3 whorls, apical whorl minute, whorls fairly rapidly, but not abruptly, enlarging; body whorl constitutes nearly the whole of the shell. Sutures deep; whorls apparently only lightly in contact; the inner whorls rising only slightly above the succeeding. Aperture round, except a little irregular at the upper, inner corner; umbilicus about one-fifth the width. The margins of the aperture are not well preserved, but the inner lip appears to be reflected. Surface ornamented with transverse striæ, which trend in almost straight lines from the suture to the umbilicus, arranged in a slightly fasciculate manner. In addition faint, revolving striæ can be made out. Width of the largest example 21 mm.; height 16 mm.; width of umbilicus 4 mm.; width and height of the body whorl near the aperture 13 mm. The size and features of the shell are practically those of specimens of this species from Lockport, New York.

Occurrence. Silurian: Jupiter (2, 3, 6-9), all exposures; Chicotte (1-2), Southwest point and pointe des Morts.

The Anticosti plesiotypes are in Peabody Museum.

Platyceras niagarense (Hall)

Acroculia niagarensis Hall, Pal. N.Y., vol. II, p. 288, Pl. LX, fig. 3 (1852).

Specimens of this species which do not differ from those of the Niagara of New York are present in considerable abundance in the crystalline limestones of the Chicotte formation.

Occurrence. Silurian: Chicotte (1-2), Southwest point and pointe des Morts.

The Anticosti plesiotypes are in the National Museum of Canada.

PTEROPODA

Pterotheca anticostiana n. sp.

Plate XXVI, figure 8

Pterotheca transversa Billings (not Salter), Cat. Sil. Foss., Anticosti, pp. 22, 57, 1866.

The specimens referred to this new species are mostly in poor condition. The shell is 55 mm. wide in the largest, about 20 mm. of this belongs to the wing-like expansions. The cavity of the shell must have been of little height, but wide. The dorsal side appears to have readily separated from the ventral, suggesting that the two sides were not firmly united. The dorsal keel is high, 4 to 5 mm. A mould of one-half of a dorsal exterior shows that the exterior was ornamented by fine, sharp, radiating striæ, which by repeated bifurcation become arranged in bundles to some extent; these are quite marked and are crossed by fine concentric striæ, giving to the radiating striæ a beaded appearance, such as exists in the brachiopod *Schuchertella*.

Occurrence. Ordovician: English Head (2-4), English head; Vauréal (1, 4), White cliff, cape Henry.

The holotype and paratypes are in Peabody Museum.

Conularia asperata Billings

Plate XXVII, figure 10

Conularia asperata Billings, Cat. Sil. Foss., Anticosti, p. 21, 1866; Whiteaves, Pal. Foss., vol. III, pt. 3, p. 201, Pl. XXI, figs. 2-2a (1897).

This species differs from *C. splendida* in having the nodes on the ridges better developed and in having no median ridge on the interior surface. It appears to be very close to *C. trentonensis*, but the transverse lines cross the median ridges in gentle curves, and not in angles. The holotype and only specimen is not well enough preserved to point out many differences.

Occurrence. Ordovician: English Head (4), Makasti bay.

The holotype and only specimen, No. 2156, is in the National Museum of Canada.

Conularia batteryensis n. sp.

Plate XXVI, figure 9

This species differs from the other Anticosti *Conularias* in having no nodes of any kind on the transverse lines, in having these lines farther apart, and in the absence of longitudinal striæ. There are about 8 transverse striæ in 5 mm. at the larger end and 11 in the same distance at the smaller. The grooves at the angles are concave on the bottom, and in them the transverse lines of opposite faces meet in alternation. In the centre of each side is a zigzag ridge—something like an old-fashioned rail fence. This unites the transverse lines, which meet it at the angles, so that they are in alternation. Each bar of this ridge is about 1 mm. long at the larger end and a little less at the smaller. They meet at angles of about 90 degrees and with the transverse lines make angles of about 140 degrees. As far as known, the central ridge is confined to the exterior. The tops of the transverse ridges are slightly rounded, about 0·25 mm. wide on top and a little wider below. The intervening depressions are nearly flat or only slightly concave. The holotype is 6 mm. wide at the larger end, 2 mm. at the smaller, and has a length of 23 mm. The apical angle is about 18 degrees.

Occurrence. Ordovician: Vauréal (4), Battery point.

The holotype and one other specimen are in Peabody Museum.

Conularia niagarensis Hall

Conularia niagarensis Hall, Pal. N.Y., vol. II, p. 294, Pl. LXV, figs. 1a-b (1852).

A single specimen which appears to belong to this species was collected. It is embedded in the rock with only the interior of two sides showing. There are about 14 transverse striæ in 5 mm. and about 20 longitudinal striæ in the same distance.

Occurrence. Silurian: Jupiter (4), Jupiter river.

The specimen is in Peabody Museum.

Conularia splendida Billings

Plate XXVII, figure 9

Conularia splendida Billings, Cat. Sil. Foss., Anticosti, p. 21, 1866.

The median central line is straight (a distinct difference from *C. batteryensis*) and is crossed by the transverse lines with a gentle curve, concave toward the aperture. The groove at the angles is about the same width as in *C. batteryensis*, but the margins are not so abrupt, nor do the transverse lines stop at the groove, but continue across so that a single transverse line is continuous all the way round. There are 21 transverse lines in 5 mm. at the smaller end and 15 in the same distance at the larger. The longitudinal striæ are continuous across the transverse striæ and give to the latter their nodulose appearance. The specimen has a length of 42 mm. and the apical angle is about 22 degrees. Comparison with specimens of *C. trentonensis* in the National Museum of Canada collections shows that the differences pointed out by Billings are not real, and that *C. trentonensis* in some specimens has more and in others fewer longitudinal striæ, and that on this basis there are no reasons for considering the two forms distinct. There are, however, other differences. The median ridge of *C. splendida* when exfoliated leaves on the cast of the interior a rather deep and narrow groove, showing the existence of a median ridge on the interior of the shell. Such has not been seen in *C. trentonensis*. The transverse lines of the latter cross the median line at an angle or at least bend very abruptly, whereas in the former species a gentle curve is made. The longitudinal striæ are also fainter in the Anticosti species.

Occurrence. Ordovician: English Head (4), Carleton point.

The holotype and only known specimen, No. 2157, is in the National Museum of Canada.

Tentaculites ornatus Sowerby

Tentaculites ornatus Sowerby, Murchison's Sil. Syst., p. 638, Pl. XIII, fig. 25 (1839); McCoy, Brit. Pal. Foss., p. 63, 1855; Etheridge, Brit. Foss., pt. 1, p. 37 (1888).

The specimens resemble *T. niagarensis* and might be considered as belonging to that species. They are, however, somewhat larger. They are from 12 to 15 mm. long, in which length there are from 25 to 30 annulations. Between the annulations there are from 3 to 6 fine striations. At the larger end there are about 3 annulations in 2 mm. There are no longitudinal striations.

Judging from descriptions and illustrations, the specimens are very close to *T. ornatus* from the Wenlock of Dudley, in that the size and ornamentation are the same.

Occurrence. Silurian: Gun River (3-4), Gun river and vicinity; Jupiter (1-10), all exposures.

The Anticosti plesiotypes are in Peabody Museum.

Tentaculites cf. *minutus* Hall

Tentaculites minutus Hall, Pal. N.Y., vol II, p. 183, Pl. A 41, figs. 8 a-e (1852); Hall, Pal. N.Y., vol. VII, Suppl. to vol. V, pt. 2, p. 5, Pl. CXIV, figs. 1-2 (1888).

At three localities were collected very small specimens of a species of *Tentaculites* with a length not over 5 mm., in which length perfect examples have more than 20 annulations. They appear to be nearest to *T. minutus* from the New York Clinton of Rochester where that species is associated with *Coelospira hemispherica*, and on Anticosti the same association obtains.

Occurrence. Silurian: Jupiter (1, 4, 7-9), East cliff, Southwest point, and Iron and Jupiter rivers.

Peabody Museum.

CEPHALOPODA

THE CEPHALOPOD FAUNA OF ANTICOSTI

Auguste F. Foerste

Endoceras fulgur (Billings)

Orthoceras propinquum Billings (not Eichwald), Geol. Surv., Canada, Rept. of Prog. 1853-1856, p. 320 (1857); *O. fulgur* Billings, Cat. Sil. Foss., Anticosti, Geol. Surv., Canada, p. 22, 1866.

Type Specimen (No. 2161, Geol. Surv., Canada). Specimen 230 mm. in length, enlarging from an estimated diameter of 75 mm. at the base to 85 mm. at the top of the phragmacone. Along the lower 130 mm. of its length it enlarges at an apical angle of 4·5 degrees, but above this length its rate of enlargement is slight. Along the lower third of the specimen 14 cameræ occur in a length equal to the diameter of the conch at the top of the series counted; along the middle third there are 17 cameræ in a corresponding length, and at the top the height of the cameræ corresponds more nearly to that of the cameræ forming the lower third of the specimen. The sutures of the septa are directly transverse. The depth of concavity of the septa equals 20 mm. No trace of the siphuncle remains, and only half of the circumference of the specimen is at hand.

North Cliff Specimen. Diameter of siphuncle 43 mm. in a specimen 86 mm. in diameter, its nearest side being 13 mm. from the ventral wall of the conch. It is estimated that 12 cameræ occupied a length equal to the diameter of the conch.

Caplan River Specimen. Siphuncle 40 mm. in diameter at the base of the specimen, where the diameter of the conch is 74 mm. It is estimated that 12 cameræ occurred in a length equal to the diameter of the conch (No. 2, Twenhofel collection).

In typical *Endoceras fulgur* the number of cameræ in a length equal to the diameter of the conch is about 12, increasing in number on approaching the base of the living chamber of fully mature specimens. In the type specimen the number of cameræ along the lower third would be 12 if all the cameræ were of the same length as those which predominate here, but several are distinctly lower than the rest.

Specimens of *Endoceras* with a relatively smaller number of cameræ occur in the English Head and Vauréal formations, but it is not known definitely that they belong to *Endoceras fulgur*. One specimen from some unknown locality is 75 mm. in diameter and has 8 cameræ in a length equal to this diameter. Another specimen (No. 3801, in Peabody Museum), from nid de Corbeau, is 67 mm. in diameter, and has 7·5 cameræ in this length. Another (No. 3802, in Peabody Museum), from Carleton point, is 57 mm. in diameter, and has 7 cameræ in this length.

Occurrence. Ordovician: English Head (4), English head, North cliff, Caplan river, and Carleton point.

Endoceras sp.

Specimen 30 mm. long, apical angle unknown, about 25 mm. in diameter. Three cameræ occupy a length of 21 mm., which is at the rate of 3·5 cameræ in a length equal to the diameter of the conch. The sutures of the septa are directly transverse. The depth of concavity of the septa is 6 mm. The siphuncle is 9·5 to 10·5 mm. in diameter, or about two-fifths of the diameter of the conch, and its nearest part is about 4 mm. from the ventral wall of the latter. Compared with other known forms, the number of cameræ and the diameter of the siphuncle are relatively small.

Occurrence. Ordovician: Ellis Bay (1), Junction cliff.

No. 3803, Peabody Museum.

Billingsites newberryi (Billings)

Plate XL, figure 4

Ascoceras newberryi Billings, Geol. Surv., Canada, Pal. Foss., vol. I, fig. 148a, not 148b (advance sheets 1862); Billings, Cat. Sil. Foss., Anticosti, pp. 23, 59, 1866.

The specimen figured by Billings is characterized by the rotundity of its cross-section at mid-height, its fullness dorso-ventrally compared with its height, and the moderate height of its dorsal saddles, which is due to the moderate height of the specimen itself. According to Billings, this specimen was 12 lines high, 10 lines wide, and 8 lines thick dorso-ventrally; the upper dorsal saddle rose 11 lines above the base of the specimen. The sutures of the two dorsal saddles separated at mid-height and were scarcely half a line apart where they crossed the dorsal side. This type came from English head and has since been lost.

Among the specimens in the collections of the Geological Survey, Canada, there is one from English head, numbered 2178, which agrees with the type of *Billingsites newberryi* in size, outline, and in the course of the sutures of the septa. That it is not the specimen figured by Billings is shown by the fact that it exposed only one dorsal saddle on the side figured by him, though two are seen on the opposite side; moreover, the lower half of the oblique basal suture is not exposed, and the rotund basal outline is not preserved. Nevertheless, among the specimens now at hand, this specimen is most similar to the original type. It is 26 mm. in height, 20·5 mm. wide, and has a maximum dorso-ventral diameter of 18·5 mm., reduced to 14 mm. at the median part of the upper dorsal saddle. On the side opposite to the one figured by Billings two saddles are visible, scarcely 1 mm. apart.

Two other specimens, numbered 2178b and 2178c respectively, form parts of the same individual, being right and left halves, separated by sectioning the specimen in a vertical dorso-ventral direction. In the interior of this specimen the septa are discrete along their entire length, though coalescent toward the base of the specimen exteriorly. Probably they came from English head.

A specimen numbered 2178a includes the ventral valve of *Catazyga headi* in the upper part of its living chamber and consists of a brownish, sandy, fine-grained rock, such as that often found in the so-called Lorraine strata of Ontario and Quebec. It is probably the specimen mentioned by Billings as coming from the south side of the St. Lawrence, opposite Three Rivers.

Occurrence. Ordovician: English Head (4), English head.

Billingsites anticostiensis (Billings)

Plate XL, figure 5

Ascoceras newberryi Billings (only the part referring to Junction cliff or Ellis Bay specimen), Pal. Foss. 1, Geol. Surv., Canada, 1868, p. 163, fig. 148b (not 148a); *A. anticostiense* Billings, Cat. Sil. Foss., Anticosti, Geol. Surv., Canada, p. 60, 1866.

The specimen figured by Billings from Junction cliff differs from typical *Billingsites newberryi* in the relatively tall and erect lateral suture of the dorsal saddle; this saddle must have been considerably taller than in the latter species, and suggests a relatively taller specimen. The specimen figured appears to have been flattened dorso-ventrally, but that may have been due to pressure. This type has been lost.

In the absence of the original type, it has become advisable to select some other specimen as the type, if the name is to be retained. For this purpose there has been selected a much larger specimen than the original type (2334a2, Geol. Surv., Canada), but one much more expressive of the ordinary appearance of a well-preserved specimen of ordinary size. Specimens of this size are common in the Ellis Bay formation about Ellis bay. Height 46 mm., width 34 mm., dorso-ventral diameter 30 mm. Lateral outline broadly elliptical, rounded at the base. The oblique basal suture rises 18 mm. above the base of the specimen. The lower dorsal saddle rises 30 mm. above this base, and the upper saddle rises 5 mm. farther. The contracted, neck-like prolongation rises at least 7 mm. above the upper saddle. The aperture is transversely elliptical in outline, 24 mm. wide, and 19 mm. in a dorso-ventral direction. Its margin rises from the dorsal toward the ventral side.

Other typical specimens, from the Ellis Bay formation, include No. 4, Twenhofel collection, from zone 5 at Ellis bay, with a neck only 3 mm. long on its dorsal side; and No. 5, Twenhofel collection, from zone 7 at Junction cliff, with a neck fully 7 mm. long; and No. 3804, Peabody Museum, from zone 4 in the English Head formation, at Carleton point, is another typical specimen, with a neck also 7 mm. long.

Occurrence. Ordovician: English Head (4), Carleton and Makasti points and rivière à l'Huile; Vauréal (2), north shore; Ellis Bay (1, 4-7), Junction cliff and Ellis bay.

Billingsites elongatus sp. nov.

Plate XXVII, figures 1, 2

Gerontic group of living chambers, elongate ovate, 39 mm. long, 24 mm. wide, and 21 mm. thick dorso-ventrally. The angle made by the erect dorsal saddles and their ventral continuation is sharply acute, and is located 11 mm. above the base of the specimen. There are 3 saddles, the lower one of which rises to an elevation of 20·5 mm., the middle to 26 mm., and the top to 35 mm. The 3 dorsal saddles are well outlined, and their sutures are distinct when the specimen is moistened.

Occurrence. Ordovician: Ellis Bay (7?), Ellis bay.

No. 2321, Museum Comparative Zoology.

Billingsites canadensis (Billings)

Plate XL, figure 3

Ascoceras canadense Billings, Geol. Surv., Canada, Rept. of Prog. 1853-1856, p. 310 (1857); *Billingsites canadense* Hyatt, Proc. Boston Soc. Nat. Hist., 22, p. 278 (1884).

The type specimen (No. 2171, Geol. Surv., Canada), is 55 mm. in length, including in this length 3 erect dorsal saddles, but no part of the neck which is located above the latter; maximum width 49 mm., dorso-ventral diameter 42 mm.

Compared with the larger specimens of *Billingsites anticostiensis*, here regarded as typical of that species, the maximum width attained by the specimens is at about the level of the top of the lower more erect dorsal saddle, rather than distinctly below this level. In a similar manner, the maximum dorso-ventral diameter tends to be located farther up, and the dorsal outline tends to be more gibbous. Moreover, the angle included between the lower coalescent part of the erect dorsal saddles and their ventral continuation is distinctly more acute. Finally, in *Billingsites canadensis*, the number of the more erect dorsal saddles is 3, whereas in *B. anticostiensis* this number usually is 2.

In a specimen from rivière à l'Huile the elevation of the uppermost dorsal saddle is 60 mm. above the base of the specimen, the neck or constricted part rising 6 mm. above this level on its dorsal side.

A specimen from Carleton point (No. 3809, Peabody Museum), is 65 mm. in height along its ventral side, with a lateral diameter of 46 mm., and a dorso-ventral diameter of 42 mm. The corresponding diameters of the aperture are 40 mm. and 31 mm. respectively. It is estimated that on the dorsal side of the specimen the margin of the aperture is 4 mm. above the top of the uppermost dorsal saddle.

Occurrence. Ordovician: English Head (4), English head, Carleton point, and rivière à l'Huile; Vauréal (1-3), West cliff.

Billingsites acutus sp. nov.

Plate XXVIII, figures 1, 2, 3

Specimen (No. 3810, Peabody Museum) measures 140 mm. in length, with a lateral diameter of 76 mm., and a dorso-ventral one of 64 mm. There are 3 erect dorsal saddles, of which the lowest is 97 mm. above the base of the specimen, the highest 121 mm. above, and the dorsal margin of the aperture is about 12 mm. farther up. The angle formed by the lower coalescent part of the dorsal saddles and its still lower ventral continuation is fully as acute as in *Billingsites canadensis*, and the flattening of the median part of the ventral side is similar, but the lower part of the specimen is extended downward to an inversely conical termination, whose ventral side continues the convex lengthwise curvature of the remainder of the specimen, showing the same ventral flattening as the part immediately above.

Occurrence. Ordovician: English Head (2), English head.

Orthoceras desideratum (Billings)

Plate XL, figure 2

Glossoceras desideratum Billings, Cat. Sil. Foss., Anticosti, Geol. Surv., Canada, p. 60, 1866.

The type specimen (No. 2539, Geological Survey, Canada) is 60 mm. in length and is estimated to have been 30 mm. in diameter, but of this original dimension only a thin fragment, 6 or 7 mm. in thickness, showing no trace of the siphuncle, has been preserved. Two cameræ are included in its length, of which the lower one is 22 mm. in height, and the upper one 18 mm., so that the number of cameræ in a length equal to the diameter of the conch must have equalled between 1·4 and 1·7; the septa were deeply concave, and the surface of the specimen apparently was smooth, but its exterior is not exposed.

A specimen from three-eighths of a mile east of Junction cliff consists of one camera and the lower half of another. It is 39 mm. in diameter, and the entire camera is 27 mm. in length, indicating the presence of

1·44 cameræ in a length equal to the diameter. The sutures are directly transverse. The depth of concavity of the septa is from 10 to 13 mm. The centre of the siphuncle is 10·5 mm. from the nearest wall of the conch. Its passage through the septum is narrowed to 3·5 mm. at the septal necks, the latter being 2 mm. long on the dorsal side, and 2·5 mm. long on the ventral one. No part of the connecting ring remains, but the small amount of flaring of the septal necks toward their lower margin indicates that the enlargement of the siphuncle within the cameræ was small. This form probably is distinct from *Orthoceras desideratum.*

Occurrence. Silurian: Chicotte (2), Southwest point.

Orthoceras chicottense sp. nov.

Plate XXVII, figure 3

Specimen 70 mm. long. Apical angle unknown, but estimated at about 4 degrees. Diameter at base of specimen about 36 mm. Four cameræ occupy a length equal to the diameter of the conch. The sutures of the septa are directly transverse. The depth of concavity of the septa equals 11 mm., which is more than the height of one of the cameræ. Where the diameter is 36 mm., the centre of the siphuncle is 12 mm. from the ventral wall of the conch. At its passage through the septum its diameter is 3 mm., enlarging to 3·5 mm. within the cameræ. The form of the segments of the siphuncle is assumed to have been nearly cylindrical, enlarging but slightly beyond the diameter of 3·5 mm. seen at the base of the septal necks, though no trace of the connecting ring remains (No. 3811, Peabody Museum).

Occurrence. Silurian: Chicotte (1), Southwest point.

Orthoceras ferecylindricum sp. nov.

Plate XXVII, figures 4, 5

Specimen 75 mm. long, enlarging from 22 mm. at the base to a diameter of 24·5 mm. at the top, indicating an apical angle of 2·5 degrees. Seven cameræ occupy a length of 61 mm. or the number of cameræ in a length equal to the diameter ranges from 2·5 at the base of the specimen to 3 at its top. Sutures of septa directly transverse. The depth of concavity of the septa equals 6 mm. Where the dorso-ventral diameter is 22 mm., the centre of the siphuncle is located 8 mm. from the ventral wall of the conch. At its passage through the septa the diameter of the siphuncle is 2·7 mm., the length of the septal neck being 1 mm. on its ventral side, and enough less on its dorsal side to make the lower margin of the septal neck horizontal.

In a second specimen from the same locality and horizon, the segments of the siphuncle are cylindrical in outline, narrowing very slightly at the septal necks. Where the diameter of the conch is 22 mm., that of the siphuncle is 2·5 mm., narrowing to 2 mm. at the septal necks. Three cameræ occur at a length equal to the diameter of the conch (No. 3812, Peabody Museum).

Occurrence. Silurian: Jupiter (8), Bell river.

Donacoceras bellense sp. nov.

Plate XXVII, figure 6

Siphuncle, with no trace of the remainder of the conch, including 7 segments in a length of 56 mm., the upper segments being slightly longer than the lower ones. The diameter is 9 mm. at the base of the specimen and 10 mm. at its top, narrowing 1 mm. at the septal necks. These necks are 1 mm. in length. The moderate enlargement of the siphuncle within the cameræ, and the relatively large size of the siphuncle compared with the height of its segments, are the chief distinguishing features.

Occurrence. Silurian: Jupiter (8), Bell river.

No. 12, Twenhofel collection.

Geisonoceras ellisense sp. nov.

Plate XXIX, figure 1

Specimen 90 mm. long, enlarging from a diameter of 40 mm. at the base, with an apical angle of 7 degrees. Section circular. Three cameræ occur in a length equal to the diameter of the conch. The sutures of the septa are directly transverse. The depth of concavity of the septa equals about the height of one of the cameræ. Where the diameter of the conch is 38 mm., the centre of the siphuncle is 13 mm. from its ventral wall. At its passage through the septum the diameter of the siphuncle is 5 mm., enlarging to 6·7 mm. at mid-height within the cameræ. The form of the segments of the siphuncle is narrowly fusiform, its enlargement within the cameræ being relatively small. The surface of the shell is banded transversely, 5 to 8 bands occurring in a length of 5 mm.

Occurrence. Ordovician: Ellis Bay (7), Ellis bay.

No. 3813, Peabody Museum.

Polygrammoceras gen. nov.

Genotype, *Polygrammoceras twenhofeli* sp. nov.

If the term *Kionoceras* be restricted to those orthoceracones in which the surface of the shell is vertically ribbed and fluted, and if the term *Protokionoceras* be restricted to those orthoceracones in which the fluted areas are striated vertically, there remains unassigned an assemblage of orthoceracones in which the surface of the shell is vertically striated, ribbed, or barred, but not fluted. The intermediate areas either are narrow grooves, or are shallow, and relatively flat, linear spaces. For this unassigned assemblage the new generic term *Polygrammoceras* is here proposed. The species selected as the type has low, flat ribs rising abruptly over shallow, flat, linear interspaces. Both the ribs and the interspaces are narrow, so that their number within the circumference of the conch is much greater than in typical *Kionoceras*. The interspaces may be as wide or wider than the intermediate ribs, but they never are deep or broad enough to suggest fluting. If this term be restricted to those species in which the numerous low ribs are flat or only slightly convex, rising abruptly over shallow intermediate spaces, the relationship of the included group appears to be close. Those forms having numerous, narrow striæ, or ribs, with angular crests, are more distantly related.

Polygrammoceras twenhofeli sp. nov.

Plate XXIX, figures 3, 4

Specimen enlarging from a lateral diameter of 25 mm. at its base to 36 mm. at a point 95 mm. farther up, this point being at the third camera below the living chamber. Above this point the lateral diameter enlarges to 37 mm. in a distance of 22 mm., and diminishes again to 36 mm. in an additional distance of 35 mm. The phragmacone enlarges at an apical angle of 7 degrees, but the living chamber is more nearly cylindrical. The cross-section is circular.

Six and two-thirds cameræ occur in a length equal to the diameter of the conch. The sutures of the septa are directly transverse. The concavity of the septa equals the depth of one camera. The centre of the siphuncle is 8 mm. from the ventral side, both at the base of the specimen and at its top. At the base of the specimen the maximum diameter of the segments of the siphuncle is 3·5 mm., narrowing to 2 mm. at the septal necks. The general aspect of these segments is elongate ellipsoidal, but truncated at top and bottom. The length of the necks is about one-fourth of a millimetre.

The surface of the shell is marked by numerous, vertical, raised lines. The number of these lines within the circumference of the type specimen is estimated at 185 at its base. Under a lens, these lines appear low and flat, but their lateral margins are sharply delineated, and their width is slightly less than that of the intervening, shallow, flat, depressed, linear spaces. The latter in many cases are occupied by one or two very fine raised lines, visible only under a lens. Many of the low, flat, raised lines show a tendency toward narrow shallow grooving along their median line, but this feature in many cases is absent and is not regarded as diagnostic. A little below the middle of the phragmacone of the type specimen a small area is marked by numerous, very fine, vertical lines, about 15 in a width of 4 mm., but 9 within this width are shown elsewhere on the same specimen and are more normal for the species

Occurrence. Ordovician: Ellis Bay (1), Junction cliff.

No. 13, Twenhofel collection.

Polygrammoceras ellisense sp. nov.

Plate XXVII, figures 7, 8

Forms closely related to *Polygrammoceras twenhofeli*, but with broader and less numerous vertical striæ or ribs, occur at various localities in the Ellis Bay formation. The ribs tend to be flattened on the back and the intermediate grooves are shallow. At Ellis bay, in zone 7, was found a specimen (Plate XXIV, figures 7, 8) with 6·7 cameræ in a length equal to the diameter of the conch, and with about 70 vertical ribs. The ribs are fully as wide, or even wider than the intervening spaces (No. 3815, Peabody Museum).

At cape James, specimens were found with 8 cameræ in a length equal to the diameter. The vertical ribs within the circumference of the conch number 72, 83, and 90 in different specimens (No. 3816, Peabody Museum).

At Table mountain, a specimen was found with 8·5 cameræ within a length equal to the diameter. The number of vertical ribs is only 55.

These ribs are stronger than in any other specimen of this type found so far (No. 3817, Peabody Museum).

At Sand cliff, 3 miles up Jupiter river, a specimen was found with 6 cameræ in a length equal to the diameter. This specimen has about 100 vertical ribs.

One specimen, originally labelled *Orthoceras archaici* Billings, from Gull cape, in zone 4 of the Gun River formation, consisting chiefly of the living chamber, has 110 vertical ribs (No. 2384a, Geol. Surv., Canada).

It is not possible to determine from the material at hand to what extent the difference in number of the vertical ribs is associated with other characters indicating the presence of distinct species. For the present, the more coarsely ribbed forms are regarded as distinct from typical *Polygrammoceras twenhofeli*.

Occurrence. Ordovician: Ellis Bay (1, 2, 4, 7-9), Ellis bay, cape James, and Table hill.

Polygrammoceras latolineatum sp. nov.

Plate XXIX, figure 2; Plate XXX, figure 3

Specimen (Plate XXIX, figure 2) 50 mm. in length, 39 mm. in diameter, with a circular cross-section; more or less distorted within its interior; nevertheless, most of its interior structure can be determined with confidence. Five cameræ occur within a length equal to the diameter of the conch. The sutures of the septa are directly transverse. The depth of concavity of the septa equals the height of one of the cameræ. The siphuncle is nearly central in position. The maximum diameter of the siphuncle, at mid-height within the cameræ, is 9 mm., or nearly one-fourth of the diameter of the conch. At the septa it narrows to 6 mm. The septa extend inward, between the segments of the siphuncle, for a distance of 1·75 mm., curving slightly downward at their inner margin, where the central passage is only 3·5 mm. in diameter. There is no true septal neck, in the sense of a downward-curving structure. It is estimated that the surface of the shell was ornamented by about 185 flat, vertical ribs, about 0·5 mm. in diameter, separated by narrow grooves equalling from one-third to one-fourth of the diameter of the ribs. Many of the ribs tend to be double, a faint groove following their median line (No. 2316, Peabody Museum).

A second specimen (Plate XXX, figure 3) is in several fragments. The larger one of these enlarges from a diameter of 41 mm. to 55 mm. in a length of 90 mm., indicating an apical angle of 8·5 degrees. Six cameræ occur in a length equal to the diameter of the conch. Where the diameter of the conch is 41 mm., the centre of the siphuncle is 15 mm. from the ventral wall of the conch. Only a small fragment of the surface of the shell remains, but this is ornamented as in the preceding specimen and the structure of the siphuncle is also the same (No. 2818, Peabody Museum).

Occurrence. Ordovician: Ellis Bay (2, 7), Junction cliff and Ellis bay.

Polygrammoceras chicottense sp. nov.

Plate XXXI, figures 1, 2; Plate XXXII, figure 1; Plate XXXIII, figures 1, 2

Specimen is considerably crushed (Plates XXXI and XXXII), but the structure of the interior of the conch can be determined to a considerable extent. Length of specimen 102 mm. Diameter of conch at base of specimen estimated at 70 mm. The number of cameræ in a length equal to the diameter of the conch is estimated at 8, each of the lower 4 cameræ being 11 mm. in length. Along the median part of one of the exposed sides the sutures of the septa curve downward a distance of 5 mm., producing here an angle of 160 degrees. Along this median part, the matrix filling the interior of the conch is penetrated by a vertical, cylindrical body with a lateral diameter of 16 mm., and a dorso-ventral diameter of 18 mm. This cylindrical body is in contact with the adjacent wall of the conch. That it was in existence during the life of the animal is shown by the downward curvature of the septa on approaching it, both laterally and along the shell wall. The siphuncle is located within 3 mm. of that side of the cylindrical body which faces the interior of the conch. It consists of a series of nearly globular segments, 11 mm. in diameter and 11 mm. long; however, owing to the contraction of these segments to a diameter of 7 mm. at their contact with the septa, the segments appear elongated vertically, rather than mathematically globular. A fault-plane appears to have passed between the cylindrical body and the siphuncle, in contact with the surface of the latter. The surface of the shell is ornamented by low, and relatively flat, primary ribs, alternating with narrow, secondary, elevated lines. The linear spaces between the primary ribs tend to be flat, rather than distinctly fluted, and their median part is occupied in many places by a single one of the secondary lines. Near the cylindrical body there are 6 primary ribs in a width of 11 mm., but more distant from this body 6 ribs occupy a width of 13 mm. The total number of primary ribs within the circumference of the conch is estimated at 90. The ribs usually vary between $\frac{3}{5}$ mm. and $\frac{4}{5}$ mm. in width, many of the intervening linear spaces exceeding 1 mm. in width. The secondary lines usually vary between $\frac{1}{7}$ mm. and $\frac{1}{4}$ mm., though rarely nearly $\frac{1}{2}$ mm. wide. Thirteen or fourteen distinct transverse lines of growth occur in a length of 20 mm. (No. 3819, Peabody Museum, Box river, Jupiter (8).)

A second specimen is 170 mm. in length, badly crushed laterally, but exposing both the cylindrical body and the siphuncle. The former is 18 mm. in diameter and is exposed for a length of 50 mm. Where it passes through one of the septa, the suture of the latter forms an angle of about 60 degrees with the vertical axis. The siphuncle is located 3 mm. nearer the interior of the specimen. Five segments of the siphuncle are exposed, 4 of which are continuous. Their diameter is 11·5 mm., and their length, in ascending order, is 11, 10, 10, 8·5, and 7 mm. respectively. This shortening of the segments indicates that the specimen was approaching maturity. Only two septa are preserved in this specimen, and both are deeply concave. The surface of the shell is ornamented by flat, vertical ribs, 8 or 9 in a width of 20 mm. Where best preserved, the ribs are 1 mm. wide, and are separated by flat, linear spaces of equal width. About 10 transverse lines of growth occur in a length of 30 mm. Specimen from Goose point, zone 6 to 8 of the Jupiter formation.

A third specimen is 125 mm. long, strongly crushed, apparently in a lateral direction. In its present condition the specimen enlarges from a diameter of 65 mm. at the base to 88 mm. at a point 100 mm. farther up, the apical angle being 14 degrees. At the top of the specimen the septum exposed is deeply concave; at the base of the specimen the septum is only gently concave; the discrepancy can not be explained from the meagre evidence at hand. The surface of the shell is ornamented by 100 to 110 vertical ribs, from $\frac{3}{5}$ to $\frac{4}{5}$ mm. in width, separated by shallow, flat grooves which are equal or slightly wider. Where the surface is well preserved, intermediate, narrow, secondary lines are seen. Ten transverse lines of growth occur in a length of 25 mm. (Southwest point, zone 1, Chicotte, Twenhofel collection.)

The type of *Tretoceras bisiphonatum* (Sowerby) (Lower Llandovery) according to J. F. Blake (Brit. Foss. Ceph., 1882, p. 164, Pl. 16, figs. 3, 3a, 3b, 4) has a cylindrical tube, 13 mm. in diameter, in direct contact with the ventral wall of the conch, and separated by a distance of 2 mm. from the ventral side of the siphuncle. This cylindrical tube appears like a backward prolongation of the body chamber. A corresponding structure occurs in a small cyrtoceroid found in the Murfreesboro division of the Stones River of Tennessee. In this case some of the specimens show a tubular structure, similar in size and location in different specimens, but not present in all, suggesting that the structure is not an essential part of the animal organism and may be of adventitious introduction. Possibly it is a case of symbiotic relationship between the living cephalopod and some other animal, the latter occupying the tube. The wall of the tube may have been secreted by the cephalopod around its symbiotic associate in an effort to wall it off.

It is assumed that in *Polygrammoceras chicottense*, also, the cylindrical body was not an essential feature of the conch, but an occasional introduction of some symbiotic or commensal associate. The fact that this body always is introduced at the same point, and develops in the same way must have some significance. In the case of the Anticosti and British species this point appears to be along the median line of the ventral side, near the ambulatory funnel, which may have been the point of most easy ingress into the conch.

The specimens at hand do not enable the investigator to determine at what stage in the growth of the conch the cylindrical body makes its appearance, how large a space it then occupies, and whether it ever disappears.

Occurrence. Silurian: Jupiter (6-8), Box river and Goose point; Chicotte (1), Southwest point.

Protokionoceras anticostiense sp. nov.

Plate XXXIV, figures 1, 2

One specimen (Plate XXXIV, figure 1) is estimated to have enlarged at an apical angle of 5 degrees, attaining a diameter of 50 mm. at its top. The surface of the shell is ornamented by 4 sets of vertical raised lines, designated here, in their order of prominence, as primary, secondary, Tertiary, and Quaternary. Of the primary there are 40 within the circumference of the conch; with these alternate 40 secondary lines. The Tertiary lines alternate with the primary and secondary ones, and the Quaternary alternate with the three preceding. The primary lines vary from $\frac{4}{10}$ mm. to $\frac{5}{10}$ mm. in width; the secondary are distinctly smaller, and the Quaternary requires a lens for detection. The transverse striæ number 11 in a length of 4 mm., but are preserved only locally. A second specimen (Plate XXXIV, figure 2) is 130 mm. in length, enlarges from 49 mm. at its base to 59 mm. at its top, indicating an apical angle of 4 degrees. Five cameræ occupy a length equal to the diameter of the conch. The sutures of the septa are directly transverse. Such traces of the surface ornamentation as remain resemble those of the preceding specimen (No. 17, Twenhofel collection, No. 3820, Peabody Museum). Another specimen (No. 3821, Peabody Museum) contains only 4 cameræ in a length equal to the diameter of the conch.

Compared with *Protokionoceras medullare*, the Anticosti species has finer vertical striæ, and the Tertiary and Quaternary striæ are more in evidence. Moreover, the Anticosti species does not show the rythmic occurrence of transverse striæ or bands as in the Racine species.

Occurrence. Silurian: Jupiter (2, 8), west of Southwest point; Chicotte (2), southwest point.

Kionoceras magnisulcatum (Billings)

Plate XL, figure 1

Orthoceras magnisulcatum Billings, Geol. Surv., Canada, Rept. of Prog. 1853-1856, p. 330 (1857); Billings, Cat. Sil. Foss., Anticosti, p. 23, 1866.

The type specimen (No. 2168, Geol. Surv., Canada), is 40 mm. long measured along the wall of the conch, exposing less than half the circumference, but estimated to have enlarged from a diameter of 32·5 mm. at the base to 38 mm. at the top, suggesting an apical angle of about 10 degrees. The specimen presents 7 vertical ribs in a width of 58 mm., where the diameter is 36·5 mm., suggesting the presence of 14 ribs around the former circumference of the specimen. The intervening spaces are distinctly concave. The sutures of the septa are very oblique, forming an angle of 60 degrees with the vertical axis.

Occurrence. Ordovician: English Head (4), Carleton point.

Kionoceras cf. *scammoni* (McChesney)

Cf. *Orthoceras scammoni* McChesney, Desc. New Fossils, p. 92, 1861; *O. angulatum* Hall (not Wahlenberg), 20th Rept. New York State Cab. Nat. Hist., p. 353, Pl. XIX, figs. 10, 11, 1868.

The specimen (No. 23, Twenhofel collection) identified as above is 20 mm. long, enlarging from a diameter of 19 mm. at its base to 21 mm. at its top, indicating an apical angle of 6 degrees. Twenty-six strongly defined vertical ribs occur within the circumference, and the intermediate grooves are distinctly concave. The vertical ribs and grooves are crossed transversely by relatively coarse, elevated striæ or bands, of which 10 or 11 occur in a length of 10 mm. These bands are relatively low, broad, and rounded, and suggest rhythmic enlargements of the shell of the conch.

Judging from the description of *Orthoceras scammoni*, that species has about 28 vertical ribs. Although no transverse striæ are mentioned these occur on a number of specimens collected at Chicago during the lifetime of McChesney, and bearing the label *Orthoceras scammoni*. The specimen figured by Hall has about 26 vertical ribs, and slightly more than 10 transverse striæ in a length of 10 mm.

Occurrence. Silurian: Becscie (3, 4), Wreck beach.

Kionoceras bellense sp. nov.

Plate XXX, figures 1, 2

Specimen 90 mm. in length, enlarging from a diameter of 33 mm. at the base to 38 mm. at a point 75 mm. farther up, indicating an apical angle of 4 degrees. The cross-section is circular. The number of cameræ in a length equal to the diameter of the conch ranges from 3·5 at the base to 4 farther up. The sutures of the septa are directly transverse. The concavity of the septa equals the height of one of the cameræ. The siphuncle is slightly excentric in position, its centre being 15 mm. from the ventral wall, where the diameter of the conch is 34 mm. The diameter of the siphuncle is 6·5 mm., diminishing to 4·5 mm. at the septa. The surface of the shell is ornamented by 31 primary ribs, $\frac{4}{5}$ mm. wide, alternating with an equal number of secondary ribs $\frac{1}{2}$ mm. wide. The primary ribs are relatively prominent, and not flattened on the back.

Occurrence. Silurian: Jupiter (8 or 9), Iron river.

No. 3822, Peabody Museum.

Kionoceras bellatulum (Billings)

Plate XLIV, figure 5

Orthoceras bellatulum Billings, Cat. Sil. Foss., Anticosti, Geol. Surv., Canada, 1866, p. 58.

Two specimens were described by Billings in his original description of the species. Regarding these he states: "Should it turn out that the two specimens above described belong to distinct species I desire that the first, as it shows the surface marking, may be accepted as the type." Unfortunately this first specimen has been lost, and only the second remains.

According to the description presented by Billings, the first specimen differs from the second in having 50, instead of 34, vertical flutings on its surface, and in having its surface markings preserved, which was not true of the latter. He describes the surface as "covered with minute transverse and longitudinal striæ which are equally distinct both in the grooves, and on the ridges between them, about 20 striæ in one line (or 2 mm.)."

The second of the two specimens described by Billings is 86 mm. in length, consisting of the living chamber and 9 cameræ; enlarging at an apical angle of 6 degrees, from a width of 23 mm. at the base to 30 mm. at a point 67 mm. farther up. The living chamber is 45 mm. in length, and shows the usual constriction of its interior toward its top. The sutures of the septa are directly transverse. About 8 cameræ occur in a length equal to the diameter of the conch. The concavity of the septa equals the depth of $1\frac{1}{2}$ cameræ. The centre of the siphuncle is 7 mm. from the ventral wall of the conch, and its passage through the septum is 2·3 mm. in diameter. The surface of the specimen is marked by 34 relatively prominent vertical ribs, separated by concave spaces which are distinctly wider than the ribs. Within the vertical flutings there are faint traces of minute vertical lines, about 6 in a width of 1 mm. Minute transverse striæ can not be detected under a lens (No. 2466, Geol. Surv., Canada).

Traces of minute transverse striæ are fairly common on the later specimens collected. Among the best is No. 18, Twenhofel collection, on which nearly 20 transverse striæ occur in 2 mm. The number of vertical striæ rarely exceeds 10 in a width of 2 mm. These vertical striæ present the most variable features. In some specimens none can be detected. In others there are 3 in each groove, the middle one being more prominent. In others there are 5, of which the 2 on opposite sides of the middle one are very faint. When there are 7, all are more nearly of the same size. In one specimen 14 vertical striæ occur in a width of 2 mm. The largest specimens do not exceed 30 mm. in diameter. The apical angle varies from 3 degrees to 10 degrees, angles of 5 or 6 degrees being by far the most common. The number of cameræ in a length equal to the diameter of the conch usually is 5 or 6, but occasionally equals 7. The excentricity of the siphuncle varies from 24 per cent of the diameter of the conch to 38 per cent in different specimens.

Occurrence. Silurian: Gun River (4), cape MacGilvray; Jupiter (1-5, 9, 10), common.

Ephippiorthoceras formosum (Billings)

Orthoceras formosum Billings, Geol. Surv., Canada, Rept. of Prog. 1853-1856, fig. 317 (1857); Billings, Cat. Sil. Foss., Anticosti, pp. 22, 58, 1866.

Three specimens are mentioned by Billings in his original description of *Orthoceras formosum*. Of these, the first and third are still in existence. Since the name *formosum* evidently is based on the beauty of the surface ornamentation, the third and best-preserved specimen is selected here as the type.

This specimen (No. 2159a, Geol. Surv., Canada) is 140 mm. long, enlarging from a dorso-ventral diameter of 36 mm. at the base to 52 mm. at a point 90 mm. farther up, indicating an apical angle of 10 degrees. Where the dorso-ventral diameter is 40 mm. the lateral diameter is 38 mm. The conch is faintly curved lengthwise, the convex side being nearer the siphuncle, and hence regarded as ventral. The dorsal side is faintly concave. The amount of curvature in the entire length of the specimen equals only about 2 mm. The number of cameræ in a length equal to the diameter of the conch, at the top of the series counted, is 7. The depth of the lateral lobes, at mid-height of the specimen, equals 7 mm. The intermediate dorsal and ventral saddles are broadly rounded. At a point 80 mm. above the base of the specimen, the radius of dorso-ventral curvature of the septum is 38 mm., that of lateral curvature being 55 mm. Where the dorso-ventral diameter is 35 mm., the centre of the siphuncle is 12·5 mm. from the ventral wall of the conch. Where the diameter of the conch is 48 mm., the siphuncle is almost central in position. At the smaller diameter of the conch the maximum diameter of the siphuncle within the cameræ is 8 mm., diminishing to 2·5 mm. at its passage through the septa. The general form of its segments is depressed globular. The septal necks are $\frac{3}{4}$ mm. long. At the larger diameter mentioned above, the passage of the siphuncle through the septa is nearer 5 mm. in diameter. The surface of the shell is ornamented by numerous, very fine, sharply raised vertical equally prominent lines, varying from 12 to 15 in a width of 5 mm. These lines are about $\frac{1}{8}$ mm. or $\frac{1}{7}$ mm. in width, and are separated by flat intervals from 2 to 4 times wider. They are crossed by much finer and fainter transverse lines of growth, of which 6 to 8 occur in a length of 1 mm. In addition there is an obscure transverse wrinkling, descending from the ventral toward the dorsal side of the conch at an angle of about 10 degrees, and with a slight sigmoid curvature which may not be a constant feature of the species.

The first specimen mentioned by Billings contains 12 cameræ in a length of 58 mm., measured along the median part of the lateral side. Apical angle 9 degrees, the dorso-ventral diameter increasing from 19 mm. at the base to 28·5 mm. at the top. The cross-section at the base is circular, but toward the top there is a little lateral compression. The number of cameræ in a length equal to the dorso-ventral diameter varies from 4·5 at the base to 5·5 at its top. At the base of the specimen, where its dorso-ventral diameter is 17·5 mm., the centre of the siphuncle is 6·5 mm. from the ventral wall; at its top, where the dorso-ventral diameter is 27 mm., the centre of the siphuncle is 9·5 mm. distant.

Similar specimens, but with 6 or 7 cameræ in a length equal to the diameter of the conch, occur both at English head and also east of MacDonald river.

Occurrence. Ordovician: English Head (3, 4), English head and MacDonald river.

Ephippiorthoceras plicatulum sp. nov.

Plate XXXIII, figures 4, 5

Specimen 90 mm. long, 45 mm. being included in the living chamber. Dorso-ventral apical angle 10 degrees. About 20 mm. below its top the dorso-ventral diameter is 41 mm., and the lateral one is 35 mm. The number of cameræ in a length equal to the dorso-ventral diameter is 6·6; the upper two cameræ are shorter. The lateral lobes and intervening saddles are as in the preceding species. The siphuncle appears to have a central location.

The vertical striæ are very narrow and sharply raised, as in *Ephippiorthoceras formosum*, but they number about 23 in a width of 5 mm., where the preceding species numbers 16. The faint lines of growth follow a similar sigmoid curvature on descending from the ventral toward the dorsal side of the conch.

The chief distinction is the presence of oblique wrinkling. On each of the lateral sides there are equally spaced wrinkles whose crests are from 3 to 4 mm., rarely 5 mm., apart, and which form an angle of about 40 degrees with the vertical axis. They slope from the dorsal toward the ventral side of the conch, and cross each other more or less, along the median line of these sides.

In addition, the surface is covered by an encrusting bryozoan which forms prominent vertical ridges at intervals of 4 or 5 mm. These produce an appearance very similar to that of a *Kionoceras*, but they apparently have no connexion with the oblique wrinkles, and, therefore, can not be considered as a cause of the latter.

Occurrence. Ordovician: English Head (4), White cliff.

No. 3831, Peabody Museum.

Ephippiorthoceras schucherti sp. nov.

Plate XXXV, figure 1

Specimen 205 mm. in length, 100 mm. belonging to the living chamber, the original length of which probably was 5 to 10 mm. greater. Conch slightly curved lengthwise, the curvature of the ventral side being convex to an extent of 4 mm., whereas the dorsal side is slightly concave. The lateral diameter of the phragmacone enlarges from 44 mm. near the base to 60 mm. at the top, 90 mm. farther up. The lower part of the living chamber enlarges at the same rate as the phragmacone for a distance of 80 mm. above its base, where the lateral diameter is 74 mm. Immediately above this point the cavity on the interior of this chamber contracts slightly along a transverse area 18 mm. in width, measured in a vertical direction. This contraction is due to a deposition of calcareous material on the inner wall of the chamber, in an annular manner. The cross-section of the conch is circular, the lateral diameter being only 1 mm. shorter than the dorso-ventral one. The apical angle of the conch is about 10·5 degrees.

The number of cameræ in a length equal to the diameter of the conch is about 9·5; the uppermost camera being very much shorter than the rest, indicating that the conch was fully mature. Along the upper part of the phragmacone the lateral lobes are 8 mm. in depth, the dorsal and ventral saddles being broadly rounded. The septa curve much less laterally than dorso-ventrally. The siphuncle can not be located with confidence, but its position appears to be central.

The surface of the shell is ornamented by narrow, sharply raised vertical lines and weakly defined, oblique, transverse lines of growth as in *Ephippiorthoceras formosum*, but it differs greatly from the latter species in having, in addition, prominent vertical raised lines of ribs, from $\frac{1}{2}$ mm. to $\frac{3}{4}$ mm. in width, which produce an appearance somewhat as in *Protokiono-ceras*. At the top of the specimen these ribs are from 4 to 4·5 mm. apart, and at its base this interval varies from 3·5 to 4 mm. It is estimated that at the base of the specimen 37 ribs occur within the circumference of the conch; at its top their number increases to 53 ribs. The spaces between the ribs are flat or faintly concave. Where the ribs are 4·5 mm. apart, 6 or 7 of the very fine vertical lines occupy the intermediate area. Locally, still finer striæ may be detected.

Occurrence. Ordovician: Ellis Bay (2), Junction cliff.

No. 3883, Peabody Museum.

Ephippiorthoceras sieboldi (Billings)

Orthoceras sieboldi Billings, Cat. Sil. Foss., Anticosti, Geol. Surv., Canada, pp. 23, 58, 1866.

The type specimen (No. 2219, Geol. Surv., Canada) is 330 mm. long, enlarging from a dorso-ventral diameter of 38 mm. at its base to 61·5 mm. at the top of the phragmacone, 180 mm. farther up, indicating an apical angle of 7·5 degrees for the latter. From the base of the living chamber the conch narrows to 53 mm. in a distance of 110 mm., and then retains the same diameter for the following 35 mm. The cross-section of the conch is elliptical, the compression being lateral. At the base of the living chamber the lateral diameter is estimated at 57 mm., or 92 per cent of the dorso-ventral diameter.

The number of cameræ in a length equal to the dorso-ventral diameter equals 4·5 at the base, and 5 near the top of the phragmacone. The last two cameræ are successively shorter than those immediately below. The sutures of the septa form lateral lobes 7 mm. deep; the dorsal and ventral saddles are of about the same height. The dorso-ventral curvature of the septa has a radius of 35 mm., the radius of lateral curvature being 65 mm. Where the dorso-ventral diameter is 40 mm., the centre of the siphuncle is 18 mm. from the ventral wall. The maximum diameter of its segments is 9·5 mm., narrowing to 4 mm. at the septa. The general outline of the segments is globular or depressed globular. The length of the septal necks is 1 mm. No trace of surface ornamentation remains.

Occurrence. Ordovician: Vauréal (4), West point.

Ephippiorthoceras altocameratum sp. nov.

Plate XXXVII, figures 2, 3

The type specimen (No. 3820, Peabody Museum) is 111 mm. long, consisting of 6 cameræ, of which the upper two are broken off and sectioned vertically, exposing the siphuncle. The lower fragment enlarges from a dorso-ventral diameter of 52 mm. at its base to 57·5 mm. at its top, 68 mm. farther up, indicating an apical angle of 4·5 degrees. The corresponding lateral diameters are 45 and 49 mm. respectively. Three and a third cameræ occur in a length equal to the dorso-ventral diameter. The lateral lobes are 8 mm. in depth. The dorsal saddles rise about 4 mm. higher than the ventral ones. Where the dorso-ventral diameter of the conch is 52 mm., the centre of the siphuncle is 16·5 mm. from the ventral wall. In case of two upper fragments, where the dorso-ventral diameter is 56 mm., the passage of the siphuncle through the septum is slightly over 5 mm. in diameter. The septal necks are 2 mm. long. Only the adjacent parts of the connecting rings are preserved, but these indicate maximum diameters of 11 mm. at mid-height within the cameræ, the general outline of the segments of the siphuncle being sub-fusiform.

Another specimen (No. 24, Twenhofel collection) is 127 mm. long: dorso-ventral diameter at base 55 mm., lateral diameter 41 mm., apical angle 7 degrees, in a dorso-ventral direction. From 3·5 to 4·5 cameræ occupy a length equal to the larger diameter.

From *Ephippiorthoceras sieboldi* this species is distinguished by its more elongate cameræ, and its more flattened lateral sides.

Occurrence. Ordovician: English Head (3, 4), North cliff and English head.

Spyroceras microlineatum sp. nov.

Plate XXXVI, figures 1, 2; Plate XXXVII, figure 1

The type specimen (Plate XXXVI, figures 1, 2, No. 3855, Peabody Museum) is 115 mm. long, enlarging from a lateral diameter of 39 mm. at the base to an estimated diameter of 43·5 mm. at a point 50 mm. farther up, indicating an apical angle of 5 degrees. The specimen is faintly curved lengthwise, the concavity of the dorsal side equalling 1·8 mm., the convexity of the ventral side probably being commensurate. Toward the upper part of the specimen the dorsal side becomes moderately flattened. Toward the median part of this side the transverse annulations curve more or less distinctly downward, the downward curvature beginning rather abruptly along the dorso-lateral wall of the conch. A corresponding but less abrupt, elevation is shown toward the median part of the ventral side. Five and a half annulations (or four and a half cameræ) occupy a length equal to the lateral diameter of the conch. The sutures of the septa occur in the grooves between the annulations, and curve in the same direction. The concavity of the septum at the base of the specimen is 5 mm., or half the height of the lowest camera. The centre of the siphuncle is located 15 mm. from the ventral wall of the conch, where the diameter of the conch is 37·5 mm. Its passage through the septum is 3·5 mm. in diameter. The annulations rise about 1 mm. above the intervening grooves. Their crests are evenly rounded for a width of 3 mm., and the grooves have a width of 5 or 6 mm. In addition, the shell is ornamented by numerous vertical lines of approximately the same size, separated by narrow grooves of the same width, 11 lines in a width of 1 mm.

Two specimens (Nos. 2170 and 2170a, Geol. Surv., Canada) have 6 annulations in a length equal to the diameter of the conch in one and 6·5 in the other. The first specimen retains the vertical striæ, 7 to 10 within a width of 1 mm., and the second shows the siphuncle in vertical section. Its maximum width, within the cameræ, where their diameter is 43 mm., is 5·5 mm., narrowing to 4 mm. at the septal necks, which are from $\frac{1}{2}$ mm. to $\frac{3}{4}$ mm. in length. The general form of the segments is elongate elliptical.

Occurrence. Ordovician: English Head (4), White cliff; Vauréal (2), cape Henry.

Spyroceras balteatum (Billings)

Plate XL, figure 6

Orthoceras balteatum Billings, Geol. Surv., Canada, Rept. of Prog. 1853-1856, p. 318 (1857); Billings, Cat. Sil. Foss., Anticosti, p. 22, 1866.

The type specimen (No. 2162, Geol. Surv., Canada) is 22 mm. in length, enlarging from 14 to 15·5 mm. in a length of 14 mm., indicating an apical angle of 6 degrees. Septum at base of specimen has a depth of concavity of 3 mm.; no other septum is preserved. Six strongly defined annulations occur in a length of 16·5 mm. The rounded crests of these annulations are 1 mm. wide, and are separated by grooves ½ mm. deep, and increasing from 2 to 2·5 mm. in width in ascending order. The annulations slope slightly dorso-ventrally. The surface of the shell is ornamented by extremely narrow, raised lines, varying from 11 to 20 in a width of 2 mm. which in many cases change their direction slightly at the lines of growth. These are much narrower than the intervening flat linear spaces, and this is the chief characteristic of the species, as far as known at present. In addition, there are very minute lines of growth, usually less conspicuous, and irregular in distribution.

According to Billings the original specimen had diameters of 14 and 9 mm., but the lower part of the specimen apparently was broken off at a septum, and now is missing.

Occurrence. Ordovician: English Head (4), English head.

Spyroceras microcancellatum sp. nov.

Plate XXXI, figure 3

Species characterized by the presence of transverse raised lines which are as prominent and as numerous as the vertical lines or striæ. Both sets of lines, moreover, are relatively broad, so that there is not a strong contrast between the extremely narrow vertical lines and the distinctly broader intermediate spaces, observed in the preceding species.

The type specimen (No. 28, Twenhofel collection) is 58 mm. long, enlarging from 17 mm. to 20 mm. within a length of 28 mm., indicating an apical angle of 6 degrees. From this point it diminishes to 19 mm. in a length of 15 mm., and then enlarges slightly again toward the top. This suggests that the upper part of the specimen includes the constricted part in many cases characteristic of the upper part of the living chamber of orthoceracones. The 2 cameræ at its base are each 3·5 mm. in height. This suggests 5 cameræ in a length equal to the diameter. The sutures of the septa are nearly directly transverse, but the annulations slope distinctly dorso-ventrally, their angle at the base of the specimen being 10 degrees with the vertical axis. The depth of concavity of the septa is 5 mm.

Seven annulations occur in a length equal to the diameter, decreasing to 6·3 at its top, suggesting that the specimen was mature. The rounded crests of the annulations are scarcely 1 mm. wide, the width of the intervening grooves 2 mm., and their depth about ½ mm. In addition, the surface of the shell is ornamented by numerous vertical and transverse raised lines, 8 or 9 in a distance of 1 mm. in each case, but many of the vertical lines alternate in distinctness, and the transverse lines locally are slightly more distinct than the vertical ones.

This species is distinguished from *Spyroceras tenuiclathratum* by the much closer reticulation of its intersecting ornamenting lines.

Occurrence. Ordovician: Ellis bay (1), Junction cliff.

Spyroceras tenuiclathratum sp. nov.

Plate XXXIV, figure 3

Compared with *S. clathratum* Hall, this species is characterized by more numerous vertical and horizontal striæ, and more prominent annulations.

The type specimen is 28 mm. long, 13 mm. in diameter, not enlarging to an appreciable extent in the short length at hand. Cross-section circular. Two cameræ occupy a length of 11·5 mm., which is almost equal to the diameter of the conch. The depth of concavity of the septa is 4 mm. The centre of the siphuncle is 4·5 mm. from the ventral wall. The segments of the siphuncle are almost cylindrical in form, narrowing from 1·5 mm. at mid-height within the cameræ to 1·1 mm. at the septal necks, the latter being $\frac{1}{2}$ mm. in length.

The annulations are almost directly transverse; their rounded crests are $\frac{3}{4}$ mm. in width, where the intervening grooves measure 1·75 mm.; the depth of the grooves is $\frac{2}{5}$ mm. Six annulations occur in a length equal to the diameter of the conch.

The surface of the shell is ornamented by vertical and transverse striæ, the former being more prominent. Six or seven of the more prominent vertical striæ occupy a width of 2 mm. Their width is less than $\frac{1}{10}$ mm. The intermediate spaces are relatively flat, but many are marked by a much less conspicuous median striation. Twelve to fifteen transverse striæ occupy a length of 2 mm. Under a lens, the more prominent vertical lines appear connected by much less prominent horizontal bars, the intercalated vertical lines being still weaker.

Occurrence. Silurian: Gun River (3 or 4), Wreck beach.

The type is No. 3837, Peabody Museum.

Spyroceras chicottense sp. nov.

Plate XXXIV, figure 4

Compared with *S. tenuiclathratum*, this species is characterized by the greater number of its annulations, and by the greater prominence of the transverse striæ compared with the vertical ones. Compared with *S. microcancellatum*, its annulations are more numerous, and both the transverse and vertical striæ are less numerous, the latter being far less distinct.

The type specimen (No. 29, Twenhofel collection) is 39 mm. long, enlarging from 7·3 mm. to 10 mm. in a length of 35 mm., indicating an apical angle of 4 degrees. Faintly curved lengthwise, the convex side is assumed to be ventral. Cross-section circular. Seven cameræ occupy a length of 31·5 mm., their height increasing from 3·5 mm. at the base of the specimen to 5 mm. at the top of this series, the eighth camera being only 4 mm. in height. Two cameræ occupy a length equal to their diameter. The depth of concavity of the septa is 2 mm. at the top of the specimen. The centre of the siphuncle is 3·6 mm. from the ventral wall where the diameter of the conch is 10 mm. At the base of the specimen, the segments of the siphuncle have a maximum diameter of 1·7 mm., contracting to 1·2 mm. at the septal necks, their general form being oblong elliptical.

Nine annulations occur in a length equal to the diameter of the conch. Their rounded crests are less than $\frac{1}{2}$ mm. wide where the intervening grooves measure $\frac{3}{4}$ mm. They slope slightly downward from the concave toward the convex side of the conch. The surface of the shell is striated faintly in a transverse direction, 6 striæ occurring in a length of 1 mm. Vertical striæ detected with difficulty; about 5 occur in a width of 1 mm.

Occurrence. Silurian: Chicotte (2), pointe des Morts.

Spyroceras anticostiense sp. nov.

Plate XXXVII, figures 4, 5

Species characterized by relatively coarse, vertical striæ, 7 in a width of 5 mm.; transverse striæ not conspicuous, so far as known.

The type specimen (No. 26, Twenhofel collection) is 58 mm. long, the living chamber being at least 31 mm. in length. Conch curves slightly lengthwise, its radius of curvature being about 150 mm. along its convex outline. Along its opposite, or dorsal, outline the concave curvature is confined to the upper part of the living chamber, the lower part of the specimen being straight. The rate of enlargement of the lower part of the conch is not shown by this specimen. The largest lateral diameter, at the third camera beneath the living chamber, is 21 mm. in width, and 18·5 mm. dorso-ventrally, diminishing to 17 and 14 mm. respectively at a point 30 mm. farther up, and then increasing again in both dimensions toward the aperture. Corresponding to the contraction of the living chamber, a short distance beneath its aperture, there is an increase in the distance between the annulations. Along the lower part of the specimen 6·5 annulations occur in a length equal to the diameter of the conch, diminishing to 5 along the upper part of the living chamber. Along the lower part of the specimen the annulations are directly transverse, but toward its top they slope increasingly downward from the ventral toward the dorsal side. The sutures of the septa occur in the bottom of the grooves between the annulations. Five and a half annulations occupy a length equal to the lateral diameter of the conch. The depth of concavity of the septa is 2·5 mm. The siphuncle is central.

The surface is marked by horizontal ribs, 7 in a width of 5 mm. They are most distinct along the upper part of the ventral side; weathering causes some of the ribs to appear double. A specimen from English head, Plate XXXVII, figure 5 (V), retains the upper part of a phragmacone 52 mm. long, with an apical angle of about 8 degrees.

Occurrence. Ordovician: English Head (2), English head and North cliff; Vauréal (1), near Indian harbour.

Spyroceras vaurealense sp. nov.

Plate XXXVII, figure 6

Compared with *S. anticostiense*, the apical angle of the conch is much larger, the vertical ribs are more numerous, and the latter are ornamented by granules arranged in transverse rows at rhythmical intervals.

The type specimen (Natiskotek bay, Vauréal (5), No. 27, Twenhofel collection) is strongly flattened by pressure, presenting a maximum apical angle of 12 degrees, which is assumed to correspond closely to the angle existing previous to the distortion of the specimen. Six annulations occur in a length equal to the maximum diameter at the top of the series counted. Where the rounded crests of the annulations are scarcely 1 mm. wide, the intervening grooves are fully 3 mm. wide and $\frac{1}{2}$ mm. deep. The surface of the shell is marked by sharply defined, narrow vertical ribs, of which 11 occur in a width of 5 mm. at the top of the specimen. The width of the crests of the ribs varies from $\frac{1}{7}$ mm. to $\frac{1}{6}$ mm., where the intervening grooves are $\frac{4}{10}$ mm. wide. The crests of these ribs are denticulated by sharply defined granules, of which 5 occur in a length of 2 mm. along the upper part of the specimen. These granules occur in transverse rows, and are connected with rhythmical intervals of growth. Owing to weathering, the crests of some of the ribs appear double.

Occurrence. Ordovician: Vauréal (5), Natiskotek bay.

Spyroceras ferum (Billings)

Plate XL, figure 7

Orthoceras ferum Billings, Cat. Sil. Foss., Anticosti, Geol. Surv., Canada, p. 22, 1866.

Two specimens were described by Billings, one from the west end, the other from near Junction cliff (Ellis Bay, 4). The first has been lost, the second is still in existence and is here selected as the type (No. 2319, Geol. Surv., Canada).

Type specimen 47 mm. long, consisting of cameræ 10, 11, 12·5, and 13·5 mm. long, respectively, apparently in ascending order. Diameter at base 35 mm. Specimen crossed by 4 annulations, one near mid-length of each of the cameræ. The annulations are low and broad, and of about the same width as the intervening grooves. The latter are about 1·5 mm. in depth. The surface of the shell is ornamented by numerous vertical lines and ribs, differing in their prominence. Of the more prominent ribs there are 25 to 28 within the circumference of the conch, of which the alternate ones tend to be stronger. These vary in width from $\frac{1}{2}$ mm. to nearly a whole mm. Between each two of the 25 to 28 vertical ribs there are 3 smaller ribs, of which the median one is more prominent, and $\frac{4}{10}$ mm. wide; the two lateral ones are $\frac{3}{10}$ mm. wide. Finally, in the intervals between the ribs so far described, there are single striæ, about $\frac{1}{8}$ mm. wide, which are detected only under a lens. Traces of very minute and numerous transverse striæ are present, but not readily detected.

A specimen from zone 4 in the Vauréal formation (No. 30, Twenhofel collection) consists of two cameræ, 22 mm. in length, and 30 mm. in diameter, with 7 vertical angulations within half the circumference of the conch. The angulations are distinct only where passing over the crests of the annulations. The centre of the siphuncle is 9 mm. from the ventral wall of the conch. The septal necks are 3 mm. in diameter and 1 mm. in length; they flare out at their lower margin, suggesting an elongate elliptical outline for the segments of the siphuncle.

Occurrence. Ordovician: Vauréal (4), Battery point; Ellis Bay (4), 1 mile east of Junction cliff.

Spyroceras crocus (Billings)

Orthoceras perannulatum Billings (not Portlock, 1843), Geol. Surv., Canada, Rept. of Prog. 1853-1856, p. 317 (1857); *O. crocus* Billings, Cat. Sil. Foss., Anticosti, p. 22, 1866.

According to the descriptions of Billings, the crests of 4 annulations occur within a length equal to the diameter of the conch, about 3 cameræ occurring in the same length. The diameters mentioned correspond to

17 and 25·4 mm. The types (presumably from the Vauréal formation) have been lost; and only one specimen has been found corresponding to the measurements given by Billings (Carleton point, English head, 4, No. 3834, Peabody Museum). This specimen is 90 mm. long, enlarging from 27·5 mm. near the base to 29 mm. at a point 39 mm. farther up, indicating an apical angle of 2·5 degrees. Four and three-fourths annulations and three and three-fourths cameræ occur in a length equal to the diameter of the conch. The annulations are prominent, and rise about 1·2 mm. above the intervening grooves. Their rounded crests are 2 mm. wide; the width of the intervening grooves is more nearly 6 mm. Traces of the surface ornamentation are limited to very narrow vertical lines, averaging about 1 mm. apart. Until the surface ornamentation is better known, its character must remain in doubt, and the species cannot be considered as established. At least, the writer is unable to refer any of the new species here described to *S. crocus*, as defined by Billings. In fact, even the reference of his species to *Spyroceras*, is, to a certain extent, an assumption.

Occurrence. Ordovician: Vauréal (1-5), West point.

Dawsonoceras cf. *americanum* (Foord)

Orthoceras annulatum americanum Foord, Cat. Foss. Ceph. Brit. Mus., p. 56, 1888.

Specimen (Twenhofel collection) enlarging from a lateral diameter of 19 mm. at the base to 25 mm. at a point 58 mm. farther up, indicating an apical angle of 6 degrees. The number of annulations in a length equal to the diameter of the conch varies from 5 at the base to 5·5 at the top. The number of cameræ varies from 4 to 4·5 in the same length. The rounded crests of the annulations are 2 mm. wide, the intervening grooves being 4 mm. wide and 1 mm. deep. The depth of concavity of the septa is 4 mm., and the passage of the siphuncle through the septa is 3 mm. in diameter. Along the upper part of the specimen traces of the transverse frilled lamellæ are preserved distinctly, 4·5 to 5 downward-curving frills occupying a width of 5 mm.

Occurrence. Silurian: Jupiter (7), Cliff east of Iron river.

Sactoceras bucklandi Billings

Plate XLIV, figure 2

Orthoceras bucklandii Billings, Geol. Surv., Canada, Rept. of Prog. 1853-1856, p. 330 (1857); Billings, Cat. Sil. Foss., Anticosti, p. 57, 1866.

The type specimen (No. 2542, Geol. Surv., Canada) is 48 mm. in length, enlarging from a diameter of 30 mm. at the base to 32 mm. at a point 30 mm. farther up. The cross-section is circular. Seven cameræ occur in a length equal to the diameter of the conch. The centre of the siphuncle is 9 mm. from the ventral wall of the conch, where the diameter of the conch is 30 mm. It varies in diameter from 4·2 mm. at the base to 3·7 mm. at its top. At the base, the segments of the siphuncle are more globular, though truncated at top and bottom; toward its top they are more elongate as well as narrower. The septal necks are ½ mm. in length.

The connecting rings, in vertical section, are very faint and thin, and are outlined chiefly by differences in colour and texture of the deposits lining the inside and outside of the rings. The surface of the shell is weathered, but apparently was smooth.

A second specimen described by Billings is lost. It had a diameter of 22 lines and the centre of the siphuncle was 7 lines from the margin of the conch.

Occurrence. Silurian: Chicotte (1 or 2), Southwest point.

Sactoceras lyelli (Billings)

Plate XLIV, figure 3

Orthoceras lyelli Billings, Geol. Surv., Canada, Rept. of Prog. 1853-1856, p. 320 (1857); Billings, Cat. Sil. Foss., Anticosti, p. 22, 1866.

The type specimen (No. 2165, Geol. Surv., Canada) is 90 mm. long, enlarging from a lateral diameter of 17 mm. at the base to 20 mm. at the top, indicating an apical angle of 2 degrees. The conch is slightly depressed dorso-ventrally, the amount equalling ½ mm. The number of cameræ in a length equal to the diameter is 6 at the base of the specimen, increasing to 8 along the middle and upper parts. This suggests that at younger stages of growth the cameræ might be less crowded than was regarded as typical in the original description of the species. At present the sutures of the septa slope downward from the supposed dorsal toward the supposed ventral side of the specimen at an angle of 10 degrees, but originally this direction may have been almost directly transverse, the slope being due to pressure during fossilization. The location of the siphuncle is central, though, before the specimen was sectioned, a protrusion at the base of the specimen suggested an excentric position. The maximum diameter of the segments of the siphuncle, at the base of the specimen, is 3·2 mm., contracting to 2 mm. at the septal necks. The outline of these segments is globular, but slightly truncated at each end. There are no conspicuous calcareous deposits of an Actinoceroid character within the interior of the siphuncle. The surface of the shell is smooth.

Occurrence. Ordovician: Vauréal (4), Salmon river.

Apsidoceras magnificum (Billings)

Gyroceras (Lituites) magnificum Billings, Geol. Surv., Canada, Rept. of Prog. 1853-1856, p. 307 (1857); *Lituites? magnificum* Billings, Cat. Sil. Foss., Anticosti, p. 23, 1866; *Apsidoceras magnificum* Hyatt, Proc. Boston Soc. Nat. Hist., vol. XXII, p. 289 (1883).

The specimen selected as the type specimen (No. 2220, Geol. Surv., Canada) includes only the phragmacone. The maximum diameter across the volutions is 165 mm., at right angles to which the diameter is 140 mm. This is the specimen described by Billings as 6 inches in diameter. The lateral side of two volutions is exposed, leaving a central space at least 30 mm. in diameter, but the location of the apical end is not known definitely. The mode of growth is gyroceran, without contact between successive volutions. At the larger end of the conch the volutions are 15 mm. apart; one volution back from this end the volutions are 4 or 5 mm. apart.

At a point 100 mm. back from the larger end, the lateral diameter of the whorl is 48 mm., and the dorso-ventral one is 32 mm. The ventral side is almost flat, and the lateral and dorsal sides form an almost even curve including slightly more than half of a circle. Five and a half cameræ occur in a length equal to the lateral diameter. The sutures of the septa form broad, ventral lobes, angular ventro-lateral saddles, and distinct dorso-lateral lobes, but the dorsal saddles are relatively broad and not prominent. The depth of concavity of the septa equals the height of one of the cameræ. The centre of the siphuncle is located one-fourth of the dorso-ventral diameter of the conch from its ventral side. It contracts from 6 mm. at mid-height within the cameræ to 4 mm. at its passage through the septa. The septal neck is 1 mm. in length. The general outline of the segments of the siphuncle is elongate elliptical.

A second specimen (cotype of Billings) consists of a phragmacone and most of a living chamber. The maximum diameter of the phragmacone across the volutions is 145 mm., with a diameter of 103 mm. at right angles to the latter. Of the living chamber a length of 390 mm. remains, the upper end, toward the aperture, being broken off. The radius of lengthwise curvature of the ventral side of the living chamber is 110 mm. at its lower end and 200 mm. toward its top. The dorso-ventral diameter at the base of the living chamber is 35 mm.; at the top of the part preserved it is 52 mm. The flattening of the ventral side of the living chamber continues undiminished along its entire length. The transverse striæ ornamenting the surface of the shell curve much more strongly backward than the sutures of the septa, indicating successive stages of the deep hyponomic sinus. Along the ventro-lateral angles the striæ tend to fasciculate at more or less regular intervals. This is the specimen described by Billings as 8 inches in diameter (West point, Vauréal, 5, No. 2215, Geol. Surv., Canada).

Occurrence. Ordovician: Vauréal (5), West point.

Apsidoceras magnificum major var. nov.

Plate XXXVI, figures 3, 4; Plate XXXVIII, figures 3, 4

A specimen (No. 2222, Geol. Surv., Canada, White cliff, English head, 4) is 140 mm. in length, consisting of the upper part of a phragmacone, with a small part of the base of the living chamber attached. At the base of the specimen the lateral diameter is 56 mm., and the dorso-ventral one is 37 mm. A little over 5 cameræ occur in a length equal to the lateral diameter of the conch. The specimen is abnormal in the entire or partial absence of the dorsal saddles along the few sutures presented. The centre of the siphuncle is one-fourth of the dorso-ventral diameter of the conch from its ventral side. Its passage through the septum is fully 4 mm. wide. Traces of the surface striæ are preserved distinctly. Along the ventral side of the shell they curve downward about 25 mm., and they rise evenly about 8 or 10 mm. on the dorsal side. Owing to the downward curvature of the sutures of the septa the transverse striæ cross about 3 cameræ on this dorsal side. Entire phragmacone originally probably not over 160 mm. in diameter across the volutions.

This may be the specimen listed by Billings, in his original description of *Gyroceras magnificum,* as 2 inches, 4 lines wide.

Two well-preserved specimens from Makasti cliff have dorso-ventral and lateral diameters comparable with those of the White Cliff specimen. One of these (Plate XXXVI, figures 3, 4, No. 3842, Peabody Museum) is 120 mm. long. The amount of lengthwise curvature of its ventral side suggests a conch not over 180 mm. in diameter across the volutions. The lateral diameter at the base of the specimen is 57 mm. and the dorso-ventral diameter is 33 mm. A little over 5 cameræ occur in a length equal to the lateral diameter of the conch. The dorsal saddles are distinctly developed. The lowest camera has been sectioned vertically, and shows the enlargement of the siphuncle within the camera.

The other specimen (No. 3843, Peabody Museum) is 107 mm. in length. Only one-half of the width of the conch is preserved. The lengthwise curvature of the ventral side is much less than in the preceding specimen, so that the original diameter of the phragmacone across its volutions may have equalled 250 to 275 mm. The lateral diameter of this specimen is estimated at 80 mm., its dorso-lateral one being 54 mm. The number of cameræ in a length equal to the lateral diameter is 7½. The dorsal saddles are distinct.

A specimen from Caplan river retains only one side of the conch including the basal part of a living chamber and parts of 7 cameræ. The latter are interesting on account of the shortening of the upper four, on approaching the living chamber, indicating that the conch was entering its gerontic stage. Judging from the lengthwise curvature of the ventral side, the phragmacone originally may have had a diameter across the volutions of 160 mm. or less. Its dorso-ventral diameter is 44 mm., and its lateral one is estimated at 70 mm. (No. 34, Twenhofel collection).

The specimens here described from the English Head formation as *A. magnificum* variety *major* differ from typical *Apsidoceras magnificum* from the Vauréal formation in the larger cross-section of their whorls, when volutions of the same diameter are compared. This suggests that the conchs of the variety enlarged more rapidly within the same length.

Occurrence. Ordovician: English Head (4), Caplan river, White cliff, and English head.

Apsidoceras magnificum altum var. nov.

Plate XXXIX, figure 1

A specimen from Table hill, zone 7 or 8 of the Ellis Bay formation (No. 3844, Peabody Museum), is 145 mm. in length. The lengthwise curvature of its ventral side has a radius of about 400 mm. From this it is impossible to estimate the original maximum diameter of the conch across its volutions. Possibly the specimen belongs to some individual that began to uncoil long before reaching maturity, so that more apical portions of the conch would show much greater rates of curvature. The dorso-ventral diameter at the base of the specimen is 62 mm., its lateral one is estimated at 62 to 64 mm.; the centre of the siphuncle is two-fifths of the length of the dorso-ventral diameter from the ventral wall of the conch. About 4·5 cameræ occupy a length equal to the lateral diameter.

This specimen is characterized by its relatively large dorso-ventral diameter.

Occurrence. Ordovician: Ellis bay (7 or 8), Table hill.

Apsidoceras magnificum multicameratum var. nov.

Plate XXXIX, figure 2

The lengthwise curvature of the ventral side indicates a phragmacone not exceeding 195 mm. in diameter across the volutions. The dorso-ventral diameter is 36 mm., and the lateral diameter is estimated at 52 mm. The number of cameræ in a length equal to the lateral diameter is nearly 8. The length is 160 mm. (No. 2223, Geol. Surv., Canada).

This specimen differs from typical *Apsidoceras magnificum* only in the greater number of cameræ, when conchs which have attained the same diameter across the volutions are compared. A part of the specimen shows a faintly impressed zone, but this is not regarded as diagnostic of the variety, but merely a feature shown by occasional individuals.

Occurrence. Ordovician: Ellis Bay (5), one mile east of Junction cliff.

Leuronotoceras gen. nov.

Genotype, *Leuronotoceras anticostiense* Foerste

Conch similar to *Apsidoceras* in its cross-section, the ventral side being flattened, and the lateral sides converging in a dorsal direction; the dorsal side is much narrower than the ventral side and more rapidly rounded. It differs from *Apsidoceras* in being transversely marked by strong ribs, which are faint on the ventral side, but strong along the ventro-lateral angles and thence around the dorsal side of the conch. As far as may be judged from the specimen at hand, the suture of the septa is directly transverse along the ventral side and rises a little less rapidly than the transverse ribs along the lateral and dorsal sides. Nothing is known of its siphuncle. Faint, longitudinal raised lines or striæ are present.

Leuronotoceras anticostiensis sp. nov.

Plate XLI, figures 6, 7

The type specimen (No. 3858, Peabody Museum) is 44 mm. in length, apparently consisting of the lower part of the living chamber and the uppermost camera of the phragmacone. The radius of lengthwise curvature of the ventral side is 45 mm., that of the concave dorsal side being about 22 mm. From this it is estimated that the maximum diameter of the phragmacone across the volutions did not exceed 80 mm., and the diameter at right angles to the latter probably was less than 70 mm. It is not known whether the specimen was mature or not. At the larger end of the specimen the dorso-ventral diameter is 21 mm., that at the smaller end being 19 mm., the interval being 37 mm. when measured along the ventral side of the conch. This is a rapid rate of enlargement in that direction. The corresponding lateral diameters are 19 and 17·5 mm. The transverse ribs are prominent along the dorsal and lateral walls of the conch, but they are most prominent at the ventro-lateral angles, where they abruptly diminish in height, being inconspicuous in their course across the ventral side. Here they curve backward 4 or 5 mm., indicating progressive stages of the deep, hyponomic sinus. At the smaller end of the specimen the transverse ribs rise at an angle of 20 degrees with the horizontal from the ventro-lateral angles toward the dorsal side, but at its larger end the rise is much less. Usually such a change suggests that the shell is approaching maturity. Three costæ occur in a length equal to the dorso-ventral diameter of the conch; this suggests the presence of 2 cameræ within this length. The suture of the septum at the base of the living chamber is directly transverse in its source across the ventral side, and rises along the lateral sides of the conch, but to a less degree than the transverse ribs. The surface of the shell appears to be marked by numerous, very faint, longitudinal striæ, 9 or 10 in a width of 5 mm.

Occurrence. Ordovician: English Head (3 or 4), English head.

Sphyradoceras sp.

Represented by a fragment 60 mm. in length and estimated to have been about 40 mm. in diameter dorso-ventrally, and 33 mm. laterally, though in neither direction is the full diameter exposed. The concave lengthwise curvature of the dorsal side has a radius of about 80 mm. The transverse annulations are prominent dorsally and laterally; their ventral course is unknown. Their rounded crests are fully 1 mm. in width, and the intermediate grooves vary in width from 3 mm. on the dorsal side on the conch to 5·5 mm. along its ventro-lateral side. Apparently the direction of these annulations was almost directly transverse to the central axis of the conch, except probably toward its ventral side, where they probably curved backward or downward. The surface of the shell is ornamented by sharply defined, longitudinal striæ, about $\frac{1}{4}$ mm. in width, separated by relatively smooth, flat intervals 2 mm. in width. These striæ are present both laterally and dorsally. Apparently the shell was gyroceran, and not trochoceran, in its lengthwise curvature. It can easily be identified by its surface ornamentation, but it is too fragmentary to serve as a type (No. 3840, Peabody Museum).

Compared with *Goniotrochoceras twenhofeli* Foerste, the transverse ribs are nearly straight, as far as preserved, and there is no evidence of the presence of secondary longitudinal striæ, alternating with the primary ones.

Occurrence. Ordovician: English Head (4), Carleton point.

Sphyradoceras (?) *anticostiense* sp. nov.

Plate XLI, figures 1, 2, 3

The type specimen (No. 3839, Peabody Museum), is 30 mm. long, including 3 cameræ in a length of 26 mm., measured along the ventral side. The conch is compressed laterally, its diameter being 24·5 dorso-ventrally, and 21 mm. laterally, measured along the crests of the annulations. The annulations are strongly defined. Their crests are about 2 mm. wide, and the intermediate grooves vary in width from 4·5 mm. along the dorsal side to 7·5 mm. ventrally. They slope downward from the dorsal toward the ventral side of the conch, with only a slight increase in the downward slope at the ventro-lateral angles. The cameræ occur in a length equal to the dorso-ventral diameter. The sutures of the septa are almost directly transverse. The centre of the siphuncle is 7 mm. from the ventral wall of the conch, where the dorso-ventral diameter is 20 mm., measuring along the contracted part of the conch at its basal end. The ornamentation of the surface of the shell is unknown.

Occurrence. Ordovician: Vauréal (1), White brook.

Goniotrochoceras gen. nov.

Genotype, *Goniotrochoceras twenhofeli* Foerste

Goniotrochoceras appears related most closely to *Mitroceras,* with *Trochoceras gebhardi* Hall (Pal. New York, 2, 1852, p. 335, Pl. 77, fig. 2; Pl. 77a, figs. 1a-d) as the genotype.

In the genotype of *Mitroceras*, the conch is coiled very much like a large, broad-based gastropod. The elevation of its spire equals four-fifths of its width at the base. The cross-section of the whorls is approximately rhomboid, with the longer axis directed from its lower, outer angle toward its upper, inner angle. The siphuncle is located near the upper extremity of the shorter axis, at the upper angle of the whorl. Successive volutions are in contact with each other along approximately horizontal planes.

The generic name *Goniotrochoceras* is proposed here for a fragment in which the cross-section of the whorls is ovate, rather than rhomboid. The acute margin is directed outward and downward, the outer and lower faces meeting at an angle of about 65 degrees. For a width of 8 mm. both faces present distinct concave curvatures along this acute margin. The curvatures of the outer and lower surfaces of the whorl appear to be only slightly unsymmetrical with reference to each other. The location of the siphuncle is unknown, but is assumed to be at the upper end of the shorter diameter of the whorl. In other respects the conch differs strongly from *Mitroceras.* The volutions were not in contact with each other; at least not along their upper and lower faces. It is not known that the conch formed a spire, although this is regarded as probable. The whorl is crossed by transverse ribs, at least along its upper and outer surface. Both the ribs and the sutures between the septa curve distinctly backward along this outer surface, thus indicating the presence of relatively deep ventral lobes, and corresponding stages of the hyponomic sinus. Finally, the striation of the surface is longitudinal, rather than transverse.

For these reasons *Goniotrochoceras* is regarded as representing a distinct generic type, though still imperfectly known.

Goniotrochoceras twenhofeli sp. nov.

Plate XXXVIII, figures 1, 2

The type specimen (No. 38, Twenhofel collection) is 93 mm. in length, consisting of the living chamber with 2 cameræ still attached. The specimen is curved lengthwise. The convexly curved outer margin has a radius of 85 mm., and the concavely curved side has a radius of 60 mm. It is estimated that the diameter of the entire conch, across its volutions, was approximately 130 mm. Apparently the volutions were not in contact with each other. At least there is no evidence of contact along any part of the surface preserved. The specimen probably enlarged as far as the base of the living chamber, but orad from the latter, it retains the same width for a length of about 50 mm., measured along the outer margin, and then diminishes rapidly toward the aperture. At the base of the living chamber the width is 42 mm., at 50 mm. farther up it is 40 mm., and toward the aperture it is estimated at 36 mm. or less, the last interval being 30 mm. This contraction of the living chamber indicates that the conch had attained maturity. The shorter, or dorso-ventral, diameter at the middle of the specimen is estimated at 27 mm.

The ventral side of the conch is strongly costated transversely, 9 costæ occurring in a length equal to the lateral diameter of the conch. The costæ are distinct from the inner or concave margin to within 12 or 13 mm. of the outer or convex margin, beyond which they become much weaker. Weak traces of transverse costæ are seen also along the outer margin of the lower or dorsal side, but the remainder of this side is not preserved. The costæ appear to be about as numerous as the cameræ. It is estimated that 7 cameræ occupy a length equal to the maximum transverse diameter of the conch. The sutures of the septa curve broadly backward along the ventral side of the conch for a distance of $1\frac{1}{2}$ cameræ, rising more rapidly on the concavely curved side of the conch than on the convexly curved one.

In addition to transverse costæ, the surface of the shell is ornamented by raised, longitudinal lines. Along that part of the ventral side which is nearest the concavely curved side these lines tend to alternate in prominence, the more prominent lines being about 2 mm. apart, whereas toward the convexly curved side they are 3 or 4 mm. apart. Longitudinal lines occur also along the dorsal side of the conch, but little is known beyond the fact that a very prominent one is located between 7 and 8 mm. from its acute margin. Apparently the dorsal side of the conch was not costated as conspicuously as the ventral one, but most of this side is missing in the specimen at hand.

Occurrence. Ordovician: Vauréal (1), Girard cove.

Characteroceras hercules (Billings)

Nautilus hercules Billings, Geol. Surv., Canada, Rept. of Prog. 1853-1856, p. 306 (1857); Billings, Cat. Sil. Foss., Anticosti, p. 23, 1866; *Litoceras? hercules* Hyatt, Proc. Am. Phil. Soc., vol. XXXI, p. 480 (1893).

The type specimen (Carleton point, No. 2221, Geol. Surv., Canada) has a maximum diameter across the volutions of 163 mm.; the diameter at right angles to the latter originally was about 120 mm., but the specimen has been crushed in that direction on one side. The lateral diameter increases from about 49 mm. one volution back from the aperture to 99 mm. at the base of the living chamber, and 109 mm. at the top of that part of the living chamber which is preserved. The first interval is about 170 mm., and the second is 80 mm. measured along the central axis of the conch. The lateral apical angle evidently diminishes at mature stages of growth. The specimen is regarded as mature, since the upper 3 cameræ are distinctly shorter than those immediately beneath. The dorso-ventral diameter enlarges from 42 mm. at a point 82 mm. beneath the living chamber to an estimated thickness of 59 mm. at the base of this chamber, and to 63 mm. at the top of that part of this chamber which is preserved, the latter point being 75 mm. above the base of the living chamber. In this direction also the apical angle diminishes at mature stages of growth. At the base of the living chamber, the ratio of the dorso-ventral to the lateral diameter is as 2 to 3. The maximum lateral diameter of the whorl is ventral of its centre.

The number of cameræ in a length equal to the lateral diameter of the conch is 7, when the length is measured along the ventral outline of the upper part of the phragmacone. The sutures of the septa are nearly directly transverse, with a slight, downward curvature along its dorso-lateral sides, and a slight, upward curvature ventrally. The impressed zone along the median part of the dorsal side is 45 mm. in width and 4 mm. deep at the larger end of the specimen.

The surface of the shell is ornamented with transverse lines, which number 8 to 9 in a length of 10 mm. along the dorso-lateral sides. They curve downward to an increasing rate from the dorso-lateral to the ventro-lateral angles of the whorl, and evidently formed a relatively wide and deep hyponomic sinus along the ventral side of the conch.

A specimen from Bear point (No. 2216, Geol. Surv., Canada) is 65 mm. wide at the base of the living chamber and has a lateral apical angle of 25 degrees. The impressed zone is 15 mm. wide and 3 mm. deep at the base of the living chamber. In this impressed zone the sutures of the septa curve distinctly downward. The upper cameræ are shorter, as though the conch had attained maturity, notwithstanding its small size. The transverse striæ on the surface of the shell curve downward a distance of 22 mm. on crossing its ventral side, where the lateral diameter of the specimen at the upper part of their course is 76 mm.

A specimen from West cliff (No. 33, Twenhofel collection) represents a part of a phragmacone which is nearly 100 mm. in lateral diameter in the better preserved part of the whorl. Where the dorso-ventral diameter is 22 mm., the centre of the siphuncle is 8 mm. from the ventral wall of the conch.

Occurrence. Ordovician: English Head (4), Carleton point; Vauréal (1-4), de Puyjalon cliff and Bear point.

Uranoceras (?) sp.

The presence of a species of *Uranoceras* on Anticosti was noted by Hyatt (Proc. Boston Soc. Nat. Hist., 22, 1884, p. 299). The affinities of the specimen here described can not be determined definitely. It is curved lengthwise, and the siphuncle is located with its centre half-way between the centre of the conch and the ventral wall. The dorsal side is not impressed, but convexly curved in a lateral direction. The siphuncle is relatively large, elongate elliptical in vertical outline, 4·5 mm. in diameter at mid-height within the cameræ, narrowing to 3 mm. at its passage through the septa. The upper cameræ are distinctly shorter, indicating that the conch had entered on its gerontic stage. It can not be determined definitely, however, that the conch is gyroceran in form, and not similar to that of *Beloitoceras*, though the large size of its siphuncle and the distance of the latter from the ventral wall excludes it from the latter genus (No. 3862, Peabody Museum).

This specimen probably represents a new genus of which too little is known for adequate discrimination.

Occurrence. Ordovician: English Head (4), nid de Corbeau.

Schroederoceras (?) sp.

Specimen (No. 3841, Peabody Museum) consists of 3 cameræ, 15 mm. in total length along the dorsal side and 38 mm. along the ventral side, the lengthwise curvature of the latter having a radius of 50 mm. The dorso-ventral diameters are 1 or 2 mm. greater than the lateral ones. The dorsal side is more broadly rounded than the ventral one, the lateral sides converging slightly in a ventral direction. It is estimated that 3·5 cameræ occupied a length equal to the lateral diameter of the conch, when this length is measured along the ventral side of the conch. The sutures of the septa curve slightly downward along the lateral sides, but rise distinctly ventrally. The concavity of the septa equals fully the height of one of the cameræ, their maximum concavity being dorsad of the centre, where the siphuncle is located. The centre of the siphuncle is 23 mm. from the ventral wall, where the dorso-ventral diameter is 33 mm. The maximum diameter of its segments within the cameræ, equals their height, but owing to the large size of the passage of the siphuncle through the septa, the general outline of the segments is elongate elliptical, rather than globular. There are numerous, fine striæ, about 6 in a length of 2 mm., on the dorso-lateral and lateral sides of the specimen; these curve distinctly downward on approaching the ventro-lateral side of the conch, and indicate the presence of a broad, but distinct, hyponomic sinus. There is no impressed zone on the dorsal side of the conch.

This specimen is excluded from typical *Schroederoceras* by the absence of the impressed zone and the large size of its siphuncle; moreover, the elliptical form of the segments of this siphuncle is a distinguishing feature. From *Uranoceras* it is distinguished by the dorsad location of its siphuncle. It probably represents a new genus, of which too little is known for diagnosis here.

Occurrence. Ordovician: Ellis Bay (4), one-half mile east of Junction cliff.

Actinoceras anticostiense (Billings)

Orthoceras anticostiense Billings, Geol. Surv., Canada, Rept. of Prog. 1853-1856, p. 316 (1857); Billings, Cat. Sil. Foss., Anticosti, p. 22, 1866; Barrande, Syst. Sil. Boheme, vol. II, p. 434, figs. 9-10 (1870); Barrande, ibid. vol. II, text, pt. 3, p. 731 (1874).

The type specimen (No. 2160, Geol. Surv., Canada) is 230 mm. long, lateral diameter enlarging from a width of 60 mm. at a point 55 mm. above its base, to 86 mm. at a point 140 mm. farther up, indicating an apical angle of 10 or 11 degrees. The ventral side is strongly flattened. At the top of the specimen the radius of lateral curvature of this ventral side is 110 mm. for a width of 55 mm., changing to 30 mm. along the lateral sides, and 42 mm. along the dorsal one. The dorso-ventral diameter is estimated as equalling four-fifths of the lateral one.

The number of cameræ in a length equal to the lateral diameter is 7 near the base of the specimen, and 8 near its top. Along the lateral sides the sutures of the septa slope downward at an angle of 5 degrees, with the horizontal toward the ventral side of the conch. Along the ventral side, however, they curve downward strongly for a distance equalling the height of $1\frac{1}{2}$ cameræ. Within the conch, the septa slope strongly downward from the dorsal side of the conch as far as the dorsal side of the siphuncle, approaching the latter at an angle of 60 to 65 degrees with the vertical axis. Within this distance the concave curvature of the septa is slight, though much more conspicuous in a lateral direction. The siphuncle is depressed dorso-ventrally, the ratio of its dorso-ventral diameter to its lateral one being 85 per cent, chiefly owing to the flattening of the ventral side of the siphuncle, where the connecting rings are in flattened contact with the wall of the conch for a width of 30 mm. or a little more. The more contracted parts of the siphuncle, at the septal necks, are 2 mm. distant from the ventral wall at the top of the specimen. The siphuncle is large compared with the size of the conch, equalling about 64 per cent of its width and 67 per cent of its dorso-ventral diameter. Four segments occur in a length equal to the lateral diameter of the siphuncle. The segments are almost horizontal, sloping at an angle of 3 degrees downward toward the ventral side. For a distance of 160 mm. from the base of the specimen, the septal necks are longer than the intervening connecting rings, in the ratio of 5 to 4, but above that level the septal necks are more nearly of the same size, or even shorter. Where the septal necks are longer they tend to present straighter outlines along the middle of their length. The connecting rings extend from 2·2 to 2·5 mm. outward from the more contracted parts of the septal necks. Along the dorsal side of the siphuncle, the connecting rings are adnate to the upper face of the septa for a width of 3 mm. measured from the more vertical part of the necks.

Four specimens from West point (Nos. 2205, 2205a, 2160b, 2562, Geol. Surv., Canada) give additional information as follows. The lateral diameter of specimen 2205a, at the base of the living chamber, is 105 mm., and that part of the living chamber which is preserved is 240 mm. long. The original length of the specimen, including the phragmacone, is estimated at 850 mm., possibly 900 mm.

The ratio of the dorso-ventral to the lateral diameter in specimen 2205a is 81 per cent; and in 2160b it is 70 per cent. The ratio of the dorso-ventral to the lateral diameter of the siphuncle in specimen 2205a is 29 to 37 where the conch is 65 mm. wide and in specimen 2205 it is 33 to 37 where the conch is 57 mm. wide. In specimen 2160b the nearest part of the dorsal side of the septal neck is 20 mm. distant from the ventral wall of the conch, where the width of the conch is 100 mm.; where this width is 90 mm. the annular part of the siphuncle is in contact with the ventral wall of the conch for a distance of 19 mm.

The number of cameræ in a length equal to the lateral diameter of the conch in specimen 2205a is 11·5 where this diameter is 105 mm., and 10 where the diameter is 85 mm. In specimen 2160 it is 9·5 where the diameter is 100 mm. and 8·5 where the diameter is 85 mm. In specimen 2205 it is 8·5 where the diameter is 70 mm., and the number is greater farther up, along the upper part of the phragmacone. In specimen 2562 it is 10·3 where the diameter is 85 mm.

These measurements indicate considerable variation within the limits of the same species. Evidently differences of structure are of more importance than differences in the relative proportion of parts in the discrimination of species.

Occurrence. Ordovician: English Head (4), Carleton point; Vauréal (4), West point.

Actinoceras serum sp. nov.

Plate XLI, figures 4, 5; Plate XXXIII, figure 3

The type specimen (No. 3845, Peabody Museum) is 65 mm. in length, enlarging from a lateral diameter of 40 mm. to one of 51 mm. in this length, the apical angle being 10 degrees. The ventral side is slightly flattened, and the dorso-ventral diameter is estimated at 44 mm. Five cameræ occupy a length equal to the lateral diameter of the conch. The sutures of the septa curve strongly downward along the ventral side, probably for a vertical distance equal to the height of one camera. The downward slope along the dorso-lateral sides is much less. At the base of the specimen, the lateral diameter of the siphuncle is three-fourths of that of the conch, and the dorso-ventral diameter may be 2 mm. shorter; the diameter at the septal necks is estimated to be 8 mm. less than at the connecting rings. The ventral side of the siphuncle is in contact with the ventral wall of the conch along its connecting rings for a width of 21 mm. The septal necks, however, are free from contact. The connecting rings slope slightly downward toward their dorsal side. The depth of concavity of the septa equals the height of the camera. The length of the septal necks almost equals the height of the connecting rings, the ratio being as 4 to 5; however, owing to the oblique direction of the septa, the septal necks appear slightly longer in vertical sections.

Compared with *A. anticostiense*, the number of cameræ is relatively less, and the septal necks are shorter and are curved more strongly and more evenly.

Occurrence. Silurian: Chicotte (1), Jumpers.

Actinoceras gamachense sp. nov.

Plate XLI, figure 8; Plate XLII, figures 1, 2

The type (3846, Peabody Museum) is 50 mm. long, enlarging from a lateral diameter of 30 mm. to 36 mm. in a length of 35 mm., at an apical angle of 10 degrees. The ventral side of the conch is distinctly flattened, producing a shorter dorso-ventral diameter, estimated at 30 mm. where the lateral diameter is 36 mm. The number of cameræ in a length equal to the lateral diameter is almost 7. The sutures curve strongly downward along the ventral side, for a distance equal to $1\frac{1}{2}$ cameræ. The downward slope along the dorso-lateral sides is much less. The siphuncle varies in width from 25 mm. at the base to 30 mm. at the top, the corresponding dorso-ventral diameters being 15 and 17·5 mm. The ventral side of the siphuncle is flattened strongly where in contact with the wall of the conch for 21 mm. at its base to 25 mm. at a point 35 mm. farther up. Even the contracted parts of the siphuncle are in contact with the ventral wall of the conch for widths of 13 to 16 mm. The segments of the siphuncle are nearly horizontal.

This species differs from *Actinoceras anticostiense* chiefly by having the siphuncle in contact with the ventral wall of the conch along the septal necks as well as along the connecting rings. Moreover, the relative number of segments of the siphuncle, compared with its diameter, is greater.

Occurrence. Ordovician: Ellis Bay (5), Ellis bay.

Actinoceras carletonense sp. nov.

Plate XLIII, figures 1, 2; Plate XLII, figure 3

The type of this species (No. 35, Twenhofel collection) consists of four cameræ occupying a length of 45 mm. The lateral diameter at its base is 55 mm., enlarging to 62 mm. at its top, at an apical angle of 7 or 8 degrees. The conch is depressed dorso-ventrally, probably chiefly on its ventral side, the diameter in this direction being estimated at 61 mm. Five and a half cameræ occupy a length equal to the lateral diameter. The sutures of the septa curve strongly downward along the ventral side of the conch, for a distance slightly exceeding half the height of one of the cameræ. Along the dorso-lateral sides of the conch the sutures appear almost directly transverse. The depth of concavity of the septa slightly exceeds the height of one camera. The centre of the siphuncle is 12 mm. from the ventral wall where the dorso-ventral diameter is estimated at 50 mm. The contracted part of the siphuncle, at the septal necks, is 11 mm. in diameter. At these septal necks the septa curve broadly downward and then outward, their total length equalling 4 or 4·5 mm., and their outward curvature at the base equalling 2 mm. A faint trace of part of the outline of the connecting rings at one point suggests that these rings extended outward from the septal necks almost 5 mm. This would result in connecting rings 20 to 21 mm. in diameter, and 2 mm. distant from the ventral wall. The connecting rings evidently were longer vertically than the septal necks, in the ratio of 7 to 4 or 4·5 mm.

This species differs from *Actinoceras anticostiense* in having only slightly more than 2 segments of the siphuncle in a length equal to their diameter. The septal necks are shorter. The centre of the siphuncle is nearer the ventral wall, and the nearest part of the siphuncle is free from contact with the ventral wall.

Occurrence. Ordovician: English Head (4), Carleton point.

Ormoceras ellisense sp. nov.

Plate XLIII, figures 5, 6

The type specimen (Geol. Surv., Canada) is 63 mm. in length enlarging from a diameter of 18 mm. at the base to 33 mm. at the top, at an apical angle of 12 degrees. The cross-section appears circular. Five cameræ occupy a length equal to the diameter. The sutures of the septa slope downward toward the ventral side at an angle of 10 degrees below the horizontal. The depth of concavity of the septa equals the height of one camera. At the top of the specimen, where its diameter is 33 mm., the centre of the siphuncle is 10·5 mm. from the ventral wall of the conch. The maximum diameter of the siphuncle here is 9 mm., narrowing to 2·5 mm. at the septal necks. The length of these necks is ½ mm. On the ventral side of the siphuncle the septa are adnate to the lower part of the segments for a width of 1·5 to 2 mm. On the dorsal side the septa come in contact with the lower part of the segments at the top of the septal neck. Owing to their excentric position the segments incline at an angle of 15 degrees with the horizontal plane. One and a half segments occur in a length equal to the diameter of the siphuncle.

This species resembles *Ormoceras bayfieldi* in the diameter and height of the segments of the siphuncle, but the latter is excentric, and the segments are correspondingly oblique.

Occurrence. Ordovician: Ellis Bay (1), Junction cliff.

Ormoceras prinstaense sp. nov.

Plate XLIII, figures 3, 4; Plate XLII, figure 4

The type (No. 3847, Peabody Museum) is about 80 mm. long, enlarging from a lateral diameter of 31 mm. at the base to 36 mm. at a point 55 mm. farther up, indicating an apical angle of 5 degrees. In its present condition the dorsal side appears somewhat flattened, probably owing to pressure during fossilization. About 8 cameræ occur in a length equal to the lateral diameter. The sutures incline downward at an angle of 15 degrees from the dorsal side beyond the middle of the lateral sides, but farther ventrad the sutures are more nearly directly transverse. The depth of concavity of the septa is 5 mm. The maximum diameter of the siphuncle is 8 mm., and its margin is probably less than 1 mm. from the ventral wall. At the septal necks it contracts to 5·5 mm., the latter being scarcely ½ mm. in length. The septa come in contact with the lower part of the connecting rings at the inner margin of the septa, on the ventral side of the siphuncle, whereas dorsally they come in contact a slight distance exterior to the outer edge of the upper part of the septal necks.

The chief characteristic of this species is the small size of the siphuncle, and the closeness of the siphuncle to the ventral wall of the conch. Only 2 segments of the siphuncle occur in a length equal to the diameter of the latter.

Occurrence. Ordovician: Ellis Bay (8), Prinsta bay.

Ormoceras morrisi sp. nov.

Plate XLV, figures 3, 4; Plate XLII, figure 5

The type specimen (No. 2386, Geol. Surv., Canada, *Orthoceras morrisi* Billings is on the label) is 120 mm. long, 32 mm. in diameter at the base, enlarging at an apical angle of 5·5 degrees. The cross-section is circular. The upper part of the specimen is crushed dorso-ventrally. Eight cameræ occur in a length equal to the diameter of the conch. In the present state of the specimen, the sutures of the septa incline downward from the ventral toward the dorsal side at an angle of 15 degrees with the horizontal; originally, however, their course may have been more nearly directly transverse. The concavity of the septa equals the height of the two cameræ. The centre of the siphuncle is 13 mm. from the ventral wall of the conch, where the diameter of the conch is 32 mm. and that of the siphuncle is 13 mm.

Slightly more than 3 segments occur in a length equal to the diameter of the siphuncle. The septal necks are from $\frac{1}{4}$ mm. to nearly $\frac{1}{2}$ mm. in length. The segments enlarge from 8 mm. at the septal necks to nearly 13 mm. within the cameræ.

Compared with *O. prinstaense* the siphuncle is larger and more central. The siphuncle is larger and more central than in *Armenoceras raptor*. In *A. chicottense* the septa extend much farther into the interior of the siphuncle beyond the general convexity of the lateral walls of its segments.

Occurrence. Silurian: Gun River (3 or 4), near Otter river.

Ormoceras sp.

Specimen about 40 mm. long and 42 mm. in diameter, with a very small rate of enlargement. Six and a half cameræ occur in a length equal to the diameter of the conch. The concavity of the septa equals the height of 1·5 cameræ. The centre of the siphuncle is 17 mm. from the ventral wall of the conch. Its passage through the septa is 5·5 mm. in diameter. At a septal neck the septum curves rapidly downward and then outward. The length of the septal necks does not exceed $1\frac{1}{3}$ mm. A very short trace of one of the connecting rings, at its contact with the lower end of one of the septal necks, suggests that the diameter of this ring was about 9 or 10 mm. In that case, 1·5 segments occur in a length equal to the diameter of the siphuncle. The segments slope downward at an angle of 15 degrees toward the centre of the conch (No. 36, Twenhofel collection).

This form is distinguished by the relatively small size of the siphuncle, the small number of segments in a length equal to the diameter of the siphuncle, and the obliquity of these segments.

Occurrence. Silurian: Jupiter (3), Sand cliff.

Armenoceras sedgwicki (Billings)

Orthoceras sedgwicki Billings, Geol. Surv., Canada, Rept. of Prog. 1853-1856, p. 320 (1857); Billings, Cat. Sil. Foss., Anticosti, p. 22, 1866.

The type specimen (No. 2164, Geol. Surv., Canada) is 190 mm. long, enlarging from a dorso-ventral diameter of 53 mm. at a point 50 mm. above its base to 64 mm. at a point 70 mm. farther up, at an apical angle of 10 degrees. The specimen has been sectioned vertically in a dorso-ventral direction, and an unknown amount here has been removed, but the lateral diameter at the two points mentioned above is estimated at 56 and 67 mm. Apparently the cross-section was nearly circular, but slightly depressed dorso-ventrally. The number of cameræ in a length equal to the dorso-ventral diameter is 9 at the base of the specimen, and 8 at its top. The concavity of the septa equals the height of 1·5 cameræ. The number of segments of the siphuncle in a length equal to their diameter equals 4·7 near the base, 5 near mid-length of the specimen, and 4·5 along its upper part. The dorso-ventral diameter of the siphuncle varies from 25 mm. near the base, to 27 mm. at a point 50 mm. above the base, and to 37 mm. at a point 85 mm. farther. The distance of the siphuncle from the ventral wall of the conch varies from 4 mm. at its base to 5·5 mm. at the point 135 mm. farther up. The segments are almost directly horizontal. Both the overlying and underlying segments are adnate to the inner parts of the septa, the former for a width of 4 mm., and the latter for a width of 3 mm. from their inner margin, along the dorsal side of the siphuncle, the corresponding measurements being 5 and 2·5 mm. along the ventral side. Surface of shell nearly smooth, with a few, raised, transverse lines at the sutures of the septa.

Occurrence. Ordovician: Vauréal (?), West point.

Armenoceras chicottense sp. nov.

Plate XLV, figures 1, 2

The type specimen (No. 37, Twenhofel collection from cliffs west of Iron river) is 110 mm. long, enlarging from 40 mm. at the base to 59 mm. at a point 90 mm. farther up, the apical angle being 12 degrees. The cross-section is circular. About 9 cameræ occur in a length equal to the diameter of the conch at the top of the series being counted. The sutures of the septa are directly transverse. The concavity of the septa equals the height of 2 cameræ. Where the diameter of the conch is 59 mm., the centre of the siphuncle is 21 mm. from the ventral wall, and the diameter of the siphuncle also is 21 mm. The obliquity of the segments is slight, probably not equalling 5 degrees. Slightly more than 3 segments occur in a length equal to the diameter of the siphuncle. At its passage through the septa the diameter of the siphuncle at the top of the specimen is constricted to 11 mm. At the inner margin the septa curve slightly downward. The lateral walls of the segments present semicircular vertical outlines. The upper walls of the segments are in contact with the lower surfaces of the septa for a width of 3 mm.; their lower walls are in contact with the upper surfaces of these septa for a width of nearly 4 mm. The surface of the shells is banded transversely, the upper margin of each band being raised sufficiently to appear as a narrow striation. Along the upper part of the specimen 12 transverse striæ occur in a length of 10 mm.

A specimen (No. 38, Twenhofel collection), very similar to *Actinoceras chicottense,* was found at Sand cliff, on Jupiter river, 3 miles above its mouth, where zones 1 to 3 of the Jupiter formation are exposed. This specimen agrees with the latter in the size of its siphuncle compared with the diameter of the conch. The centre of the siphuncle is slightly nearer the ventral wall of the conch. The surface of the shell is marked by similar transverse striations, about 16 in a length of 10 mm., where the diameter of the conch is 31 mm. The siphuncle, however, has only 2, instead of 3, segments in a length equal to the diameter of the siphuncle. Moreover, the surface of the shell is marked by numerous, very fine, vertical, incised striæ, of which 10 occur in a width of 2 mm. These vertical striæ probably would be visible only on well-preserved surfaces.

Occurrence. Silurian: Jupiter (1-3, 8, 9), Sand cliff and Iron river.

Armenoceras excentrale sp. nov.

Plate XLVI, figures 1, 2; Plate XLII, figure 6

Specimen 110 mm. long, enlarging from a diameter of 41 mm. at the base to 62 mm. at the top, indicating an apical angle of 11 degrees. The cross-section is circular. Nearly 9 cameræ occur in a length equal to the diameter of the conch. The sutures of the septa are directly transverse. The concavity of the septa equals the height of 1·5 cameræ. At the base of the specimen the siphuncle is 14 mm. in diameter and its centre is 10 mm. from the ventral wall; at the top of the specimen the corresponding dimensions are 22 and 17 mm. Three segments occur in a length equal to the diameter of the siphuncle. Notwithstanding the close proximity of the siphuncle to the ventral wall, the obliquity of its segments is small, apparently being less than 5 degrees. On the dorsal side of the siphuncle, the vertical outline of the segments is evenly convex, and both the overlying and underlying segments are in contact with the inner part of the septum for a width of 2·5 mm., at the base of the specimen. On the ventral side, however, the overlying segment is in contact with the septum for a width of 3·5 mm., whereas the underlying one has an area of contact scarcely 2 mm. in width. From the point where the septa become free from the segments the septa rise strongly upward. The surface of the shell appears to be smooth (No. 39, Twenhofel collection).

From *Actinoceras chicottense* this species differs chiefly in the closer proximity of the siphuncle to the ventral wall and the smooth surface of the shell.

Occurrence. Silurian: Jupiter (8), Iron river.

Armenoceras raptor (Billings)

Plate XLIV, figure 4

Orthoceras raptor Billings, Cat. Sil. Foss., Anticosti, Geol. Surv., Canada, p. 57, 1866.

Two specimens are mentioned by Billings at the end of his description of *Orthoceras raptor*. The first was collected one mile east of Otter creek, and the second was found 3 miles west of Jupiter river. Since the first has been lost, the second is selected as the type.

This specimen (No. 2383, Geol. Surv., Canada) is 120 mm. in length, enlarging from a diameter of 23 mm. near the base to 31 mm. at a point 65 mm. farther up, the apical angle being 8·5 degrees. The cross-section of the conch and the relative location of the siphuncle can not be determined definitely. The number of cameræ in a length equal to the diameter of the conch varies from 7 at the base of the specimen to 9 near its top, where the diameter of the conch is 36 mm. The concavity of the septa equals the height of $1\frac{1}{2}$ segments of the siphuncle. The siphuncle enlarges from 7 mm. where the diameter of the conch is 23 mm. to 9 mm. where this diameter is 36 mm. At the upper level 6 segments occur in a length of 24 mm. It is impossible to determine whether the inner margin of the septa has a distinct septal neck or is constructed as in *Armenoceras*. The number of segments in a length equal to the diameter of the siphuncle varies from 1·6 near the base to 2 at a point 65 mm. farther up.

This species is characterized by the small size of its siphuncle and the relatively large number of its cameræ, compared with the diameter of the conch.

Another specimen (same locality, No. 2409, Geol. Surv., Canada) enlarges from a diameter of 32 mm. at the base to 34 mm. at a point 38 mm. farther up. Eight cameræ occur in a length equal to the diameter.

The sutures of the septa are directly transverse. Its cross-section is circular. No trace of the siphuncle is exposed. This specimen conforms with the initial part of the description of the species by Billings: "Section circular; septa moderately convex, 6 to 1 inch where the diameter is 15 lines," but it is not from the area east of Otter river, and, therefore, is not a type.

Occurrence. Silurian: Jupiter (1), Jupiter river.

Armenoceras medon (Billings)

Plate XLIV, figure 6

Orthoceras medon Billings, Cat. Sil. Foss., Anticosti, Geol. Surv., Canada, p. 57, 1866.

The type specimen is 190 mm. long, enlarging from a diameter of 40 mm. at the base to 64 mm. at a point 120 mm. farther up, indicating an apical angle of 11·5 degrees. Cross-section assumed to have been circular. The number of cameræ in a length equal to the diameter of the conch varies from 4·5 mm. at the base to 5 at its top. The concavity of the septa varies from the height of 1 cameræ at the base to 1·5 cameræ at the top. Two and a fourth segments of the siphuncle occur in a length equal to their diameter. The obliquity of the segments appears to be about 4 degrees; from this it is assumed that the position of the siphuncle is slightly excentric. The course of the sutures of the septa is not known. The diameter of the siphuncle varies from 22·5 mm. at its base to 30·5 mm. at a point 120 mm. farther up. At their inner margins the septa curve slightly downward, for a vertical distance of $\frac{1}{4}$ mm., but do not form a neck. Both the overlying and underlying segments of the siphuncle are in contact with the septum, the former for a width of 4 or 5 mm., the latter for a width of 2 mm. At the base of the specimen, where the diameter of the siphuncle is 22·5 mm., the passage of the siphuncle through the septum is 10·5 mm. in diameter (No. 2543, Geol. Surv., Canada).

This species is characterized by the relatively small number of cameræ and the relatively large size of the siphuncle, compared with the diameter of the conch.

Occurrence. Silurian: Chicotte (2), Southwest point.

Armenoceras jupiterense sp. nov.

Plate XLII, figure 7; Plate XLVII, figures 1, 2, 3

The type specimen is 150 mm. long, at present in two parts; the upper, 60 mm. in length, has been cut vertically in a lateral direction through the centre of the siphuncle; the lower consists of the ventral half of the conch and exposes the dorsal side of the siphuncle. The specimen enlarges from a diameter of 43 mm. at its base to 53 mm. at a point 85 mm. farther up, indicating an apical angle of 6·5 degrees. About 5·7 cameræ occur in a length equal to the diameter of the conch. The sutures of the septa are directly transverse. The concavity of the septa equals the length of 1·5 cameræ. At the base of the specimen the centre of the siphuncle is 13 mm. distant from the ventral wall of the conch; 85 mm. farther up its distance is 20 mm. The diameter of the siphuncle enlarges from 14·5 mm. at the base to 18 mm. at a point 85 mm. farther up. Along the upper part of the specimen almost 2 segments occur in a length equal to the diameter of the siphuncle; near the base of the specimen $1\frac{3}{4}$ segments occur in a corresponding length. The surface is smooth. In the upper part of the specimen, where the maximum diameter of the siphuncle is 19 mm., it narrows to 9 mm. at its passage through the septum. There is no conspicuous downward curvature of the septum at its lower margin. The underlying segment is in contact with the lower side of the septum for a width of 1 mm. from its lower margin, and the overlying segment is in contact with the upper side for a width of 2 to 2·5 mm. (near Heath point, Jupiter, 4, No. 40, Twenhofel collection).

Another specimen (South point, Twenhofel collection) is 65 mm. long, and 41 mm. in diameter. It contains only 5 cameræ in a length equal to the diameter.

Compared with *Elrodoceras whitei* Stokes, the surface of the shell is smooth, instead of transversely striated or banded; the number of cameræ in a length equal to the diameter is 5, instead of 4; the diameter of the siphuncle compared with that of the conch is 0·33 or 0·37, instead of 0·39; and the diameter of the siphuncle compared with the height of its segments is 1·7 to 2 instead of 1·55. Compared with *Armenoceras medon*, the cameræ are relatively more numerous, the diameter of the siphuncle is relatively less, and the diameter of the siphuncle compared with the height of the segments is 1·7 to 2 instead of 2·45.

Occurrence. Silurian: Jupiter (4, 8), near Heath point and South point.

Armenoceras angustum sp. nov.

Plate XLVIII, figure 1

The type specimen is 175 mm. long, enlarging from a diameter of 26 mm. at its base to 46 mm. at a point 160 mm. farther up, indicating an apical angle of 7 degrees. Cross-section circular. Along the greater part of the length of the specimen $3\frac{2}{3}$ cameræ occur in a length equal to the diameter, but at the top this number increases to $4\frac{1}{2}$. The concavity of the septa equals the height of one camera. The centre of the siphuncle is 14 mm. from the ventral wall, where the diameter of the conch is 34 mm. The diameter of the siphuncle increases from 12 mm. at the base to 15 mm. at the eleventh segment and 17 mm. at the top of the eighteenth segment from the base. The number of segments in a length equal to the diameter of the siphuncle varies from 1·4 at the base to 1·55 toward the top. At the eleventh segment from the base the siphuncle narrows from a maximum diameter of 15 mm. to 12·5 mm., where the overlying segment comes in contact with the upper surface of the septum, to 9 mm. where the underlying segments come in contact with the lower surface of this septum, and to 5 mm. at its passage through the septum. On approaching this passage the septum curves slightly downward. The surface of the conch appears to be smooth.

Compared with *Elrodoceras whitei*, the ratio of the diameter of the siphuncle to that of the conch is 45 per cent instead of 39 per cent; this difference alone will serve to distinguish the Anticosti species. Sections of *Elrodoceras indianense* (Miller), from the Laurel formation of Indiana, have shown precisely the same interior structure of the conch as *Elrodoceras* *whitei* (Stokes), as far as the latter is known (Cont. Mus. Geol. Univ. Michigan, vol. 2, p. 61, Pl. 3, fig. 5, text figure 2 (1924)).

Occurrence. Silurian: Jupiter (10), Jumpers.

The type is No. 3848, Peabody Museum.

Armenoceras sp.

A specimen from Makasti cliff (No. 41, Twenhofel collection) is 75 mm. in length, apparently enlarging at an apical angle of 16 degrees. Cross-section apparently circular, possibly slightly flattened ventrally. The lower part of the specimen, for a length of 4 cameræ, is curved lengthwise. Along the ventral side the radius of convex curvature is between 30 and 40 mm. Corresponding to the increase of this lengthwise curvature toward the base of the specimen there is an increase of the downward slope of the sutures of the septa in a ventrad direction on approaching its lower end. Five cameræ occur in a length equal to the diameter. Along the upper part of the specimen the sutures are directly transverse. At the top of the fifth camera from the base the obliquity of the suture equals 6 degrees; at the base of the specimen it equals 20 degrees. At the fourth segment of the siphuncle from the base, where the diameter of the conch is estimated at 26 mm., the centre of the siphuncle is 11 or 12 mm. from the ventral wall of the conch, the diameter of the siphuncle is 12 mm., and the height of the segment is 6 mm. This is equivalent to 2 segments in a length equal to the diameter of the conch. Both the overlying and underlying segments of the siphuncle are in contact with the septum for a width of at least 2 mm. At its passage through the septum the siphuncle contracts to 5 mm. The downward curvature of the septum at its inner margin is slight.

The lengthwise curvature of the basal part of the conch is known in *Elrodoceras indianense* (Miller), *Elrodoceras abnorme* Hall, and related forms. If the Anticosti species described here had the surface of its shell transversely banded or striated at rhythmical intervals it would be assigned to the same genus, but the ornamentation of its surface is unknown.

Occurrence. Ordovician: English Head (4), Makasti cliff.

Huroniella persiphonata (Billings)

Plate XLIV, figure 1

Orthoceras persiphonatum Billings, Geol. Surv., Canada, Rept. of Prog. 1853-1856, p. 329 (1857); Billings, Cat. Sil. Foss., Anticosti, p. 57, 1866; *Huronia persiphonata* Foord, Cat. Foss. Ceph. Brit. Mus., pt. 1, p. 204 (1888).

Two specimens, both siphuncles, are at hand, one 147 mm. in length, the other 97 mm. long. The first (No. 2465, Geol. Surv., Canada) may be the one described by Billings as 6½ inches long. It has been sectioned vertically in a direction diagonal to the dorso-ventral axis; in the process of sectioning it may have lost two segments of the siphuncle, which would be sufficient to account for its length of 147, instead of 165, mm. This specimen enlarges from a diameter of 33 mm. at its base to 39 mm. at the second segment from the top, the interval being 122 mm. The height of the segments varies from 11 mm. at its base to 14 mm. at the top. The ratio of the height of the segments to their diameter varies from 40 to 48 per cent. Along the lower half of the segments, the lateral walls diverge at an angle of 75 to 78 degrees, with slightly concave vertical outlines; the upper part of the segments consists of evenly rounded annulations. That part of a septum which extends between successive segments curves diagonally downward for a width of 2 mm. surrounding the passage of the siphuncle through the septa; this passage is 25 mm. in diameter. The septa are adnate to the lower part of the segments as far up as that part of the annulations where the concave vertical outline changes to convex. The ventral side of the siphuncle is 2 mm. from the nearest wall of the conch. A part of this ventral wall, including 2 adjacent septa, is preserved for the height of one camera. About $2\frac{3}{4}$ segments occur in a length equal to their diameter. The obliquity of the segments equals 10 degrees.

The second specimen (No. 2541, Geol. Surv., Canada), has $2\frac{3}{4}$ segments in a length equal to their diameter. The obliquity of these segments is 10 degrees. The ratio of their height to their diameter varies from 35 to 40 per cent. The segments enlarge from a diameter of 30 mm. at their bases to 36 mm. at their annulations. Billings' statement that the siphuncle is strongly annulated in the upper two-thirds and cylindrical or but gradually expanded in the lower third probably is due to the fact that neither specimen in his possession was sufficiently freed from the matrix.

Huroniella persiphonata is related closely to *H. inflecta* (Parks), differing chiefly in its taller segments, which in the latter species number $3\frac{1}{2}$ in a length equal to their diameter.

Occurrence. Silurian: Jupiter (5), Cormorant point.

Huroniella sp.

Specimen 137 mm. long, including 14 segments in a length of 117 mm. The diameter at its base is 26 mm., and its rate of enlargement is about 4·5 degrees. Three and two-thirds segments occur in a length equal to the diameter of the siphuncle. The obliquity of the segments is slight, being scarcely perceptible at the base where the specimen is not distorted. The septa are adnate to the lower side of the lateral walls of the segments for a width of 3 mm., showing slightly concave, vertical outlines. Between successive segments the walls of the siphuncle are inflected narrowly for a width of 1·5 mm., curving downward toward their inner margins. At the base of the specimen, where the maximum diameter of the segments is 26 mm., their diameter at the exterior border of the inflected part is 18 mm., and their diameter at the passage of the siphuncle through the septa is 15 mm. Very little difference is noted between the convexity of the vertical outline of the walls of the segments, suggesting that the location of the siphuncle was central, or nearly central (No. 3849, Peabody Museum).

Compared with *H. inflecta* (Parks), the area of adnation of the septa to the lower part of the segments is of more restricted width.

Occurrence. Silurian: Gun River (1), Hannah cliff.

Huronia vertebralis Stokes

Huronia vertebralis Stokes, Trans. Geol. Soc. London, 2nd ser., 1, Explanation of Pl. 28, figs. 2, 6 (1824); *Orthoceras canadense* Billings, Geol. Surv., Canada, Rept of Prog. 1853-56, pp. 321-328 (1857); *Huronia vertebralis* Barrande, Syst. Sil. de Centre Boheme, 2, Pl. 436, figs. 5-7 (1870).

The specimen described by Billings as *Orthoceras canadense* (No. 2544, Geol. Surv., Canada) is 120 mm. long, consisting of 6 segments of a siphuncle, broken into 3 parts, each consisting of 2 segments. The upper 4 segments are broken along a vertical plane passing through the centre of the siphuncle; the lower two of this set of 4 have been polished along one side of the broken surface, and are represented by figure 6 published by Barrande in the work cited above; his figure 7 may represent the lower end of this fragment; and his figure 5 may represent the exterior surface of this fragment or of the lower 2 segments, but drawn so as not to show the weathering along its median part. The diameter of the annulations increases from 29 mm. at the lowest to 32 mm. at the uppermost one, the interval being 100 mm. The ratio of the height of the segments to their diameter at the annulations is 65 per cent, whereas the ratio to the diameter at their bases varies from 80 to 90 per cent. At their base, the segments enlarge at a moderate rate; near their middle they enlarge much more rapidly, curving distinctly outward on approaching the annulations. The annulations slope at an angle of 15 degrees toward the ventral side and equal about half the height of the segments.

Compared with typical *Huronia vertebralis* Stokes, the Anticosti form is more constricted toward the base of its segments; the annulations are relatively taller, and the constricted parts beneath the annulations are relatively shorter, and less cylindrical.

Occurrence. Silurian: Chicotte (2), Southwest point.

Huronia obliqua Stokes

Huronia obliqua Stokes, Trans. Geol. Soc., London, 2nd ser., 1, Pl. 28, fig. 4 (1824).

Siphuncle enlarging from a dorso-ventral diameter of 26 mm. at the base to 35 mm. at a point 110 mm. farther up. From 2 to $2\frac{1}{5}$ segments occupy a length equal to the diameter of the siphuncle. The obliquity of the segments equals 15 degrees. The walls of the lower half of the segments diverge at an angle of 35 degrees, presenting concave outlines here, whereas the upper part of the segments is rather broadly convex (No. 23, Twenhofel collection). Another specimen, 160 mm. long, was obtained at the Jumpers.

From typical *H. obliqua* the Anticosti form is distinguished by its smaller obliquity.

Occurrence. Silurian: Jupiter (5), Cormorant point; Chicotte (1), Jumpers.

Huronia chicottense sp. nov.

Plate XLVIII, figure 2

Specimen 110 mm. in length, enlarging from a diameter of 38 mm. at the base to 43 mm. in a length of 45 mm. Two and three-quarter segments occur in a length equal to the diameter of the siphuncle. Where their diameter is 43 mm. their height is 14 to 17 mm. The obliquity of these segments is 9 degrees. At their bases, the sides of these segments diverge upward at an angle of 30 degrees; at mid-height of the segments these sides curve increasingly outward as far up as the annulations, which occupy a height of 4 to 5 mm. out of the total of 14 or 17 mm. mentioned above (No. 42, Twenhofel collection).

This specimen resembles *Huronia paulodilatata* Foerste (Cont. Mus. Geol. Univ. Michigan, 2, p. 50, Pl. 15, fig. 3; Pl. 10, fig. 2 (1924)), but differs in the smaller height of its segments, in the greater prominence and smaller height of its annulations, and in the more distinct outward curvature of the sides of the segments directly beneath these annulations.

Occurrence. Silurian: Chicotte (2), Southwest point.

Discosorus gunensis sp. nov.

Plate XLVI, figure 3; Plate XLIX, figure 1

Specimen (Plate XLIX, figure 1) (No. 44, Twenhofel collection) 115 mm. in length, consists of a conch preserving traces of its exterior contour, and weathered on one side so as to expose the siphuncle. From such traces as remain it is estimated that the diameter of the conch at the lowest segment of the siphuncle present was about 29 mm., whereas the corresponding diameter at the uppermost segment of the siphuncle was about 53 mm., the interval being 75 mm. This suggests an apical angle of 19 degrees. The conch was slightly curved lengthwise, and it is estimated that the ventral side had a convex curvature with a radius of 220 mm., whereas the dorsal side was relatively straight. No traces of the septa remain. The siphuncle is on the ventral side of the conch, apparently from 3 to 6 mm. removed from actual contact. The ventral side of the siphuncle has a lengthwise curvature similar to that of the conch; the dorsal side is estimated to curve distinctly less. The diameter of the siphuncle increases from 10 mm. at its lowest segment to 22 mm. at the eighth segment, 21 mm. at the eleventh, and apparently 18 mm. at the twelfth. The height of the successive segments increases from 5 mm. at the lowest segment to 7 mm. along the sixth, seventh, and eighth segments, decreasing to 5 mm. at the eleventh, and 4 mm. at the twelfth. The segments of the siphuncle appear to be directly transverse to the vertical axis of the conch, but they form angles with the ventral outline of the latter, which are more acute toward the base than along the upper part of the siphuncle.

A second specimen (Plate XLVI, figure 3) (No. 44a, Twenhofel collection) consists of nothing but the ventral half of the siphuncle. There are 8 segments, of which the third from the base equals in diameter the basal segment of the specimen described first. This second specimen has 7 segments in a length in which the first has only 6. At the top of the specimen where the lateral diameter of the segment is 21 mm., the diameter of the septal neck is only 9·5 mm.

The nearest relative of this Anticosti species appears to be *Stokesoceras engadinense* Foerste, from the Manistique formation of the northern peninsula of Michigan (Cont. Mus. Geol. Univ. Michigan, 2, p. 82, Pl. 9, fig. 1 (1924)), but the siphuncle is distinctly more curved and its segments are more oblique to the vertical axis of the siphuncle.

Occurrence. Silurian: Gun River (3), Gun river.

Discosorus (?) infelix (Billings)

Plate XL, figure 8

Orthoceras infelix Billings, Cat. Sil. Foss., Anticosti, p. 57, 1866; Hyatt, Proc. Boston. Soc. Nat. Hist., vol. XXII, p. 272 (1884).

The types consist of two fragments of siphuncles (Nos. 2545 and 2545a, Geol. Surv., Canada) of which the first is 57 mm. long, and includes all of 9 segments and the ventral side of a tenth. The siphuncle is compressed laterally; at its top, where the dorso-ventral diameter is 31 mm., the lateral is 26 mm. or a little less. The siphuncle enlarges rapidly at first, from a dorso-ventral diameter of 18 mm. at the base to 28 mm. at the fourth segment, and 30 mm. at the fifth; then the rate of enlargement becomes less, the diameter being 31 mm. at the sixth segment, and remaining the same as far as the ninth segment. In a lateral direction the siphuncle enlarges from 17 mm. at the base to 25 mm. at the fourth segment, 25·5 mm. at the fifth, reaching 26 mm. at the top. At the base of the specimen the lowest segment forms an angle of 78 degrees with the vertical axis of the siphuncle, changing to 83 degrees at the fifth segment, and 90 degrees at the ninth. The vertical axis of the specimen is virtually straight, but along its lower half both the ventral and the dorsal sides curve convexly lengthwise, the specimen contracting toward the base. The number of segments in a length equal to the dorso-ventral diameter is 5.

The second specimen described by Billings is 39 mm. long and includes 7 segments of the siphuncle. Its dorso-ventral diameter enlarges from 17 mm. at the base to 26 mm. at the top. It agrees with the first specimen in the more rapid enlargement of the siphuncle along its lower half, and in the change of obliquity of the segments on proceeding upward from the base of the specimen. In this specimen the line of contact at which the septa become free from the lower face of the segments rises distinctly from the dorsal toward the ventral side of these segments, and the margin of the segments appears to have been in contact with the ventral wall of the conch, of which, apparently, a slight trace remains.

A fragment from near Southwest point (No. 3850, Peabody Museum) is 65 mm. in length, consisting of a badly crushed conch, broken so as to show a vertical section of the siphuncle. At the base of the specimen, where the dorso-ventral diameter of the siphuncle is 13·5 mm., the corresponding diameter of the conch is estimated at 33 mm. and the lateral one at 30 mm. Thirty-five millimetres farther up the corresponding diameters are estimated at 47 and 38 mm. At the base of the specimen the lowest segment of the siphuncle forms an angle of about 80 degrees with a vertical axis of this siphuncle. Farther up, the segments appear nearly horizontal. The diameter of the siphuncle is not known to exceed 22 mm.

Another specimen from near rivière du Pavillon (No. 45, Twenhofel collection) is 70 mm. long, consisting of a part of a badly crushed conch. Along its lower half, it has been sectioned vertically in a dorso-ventral direction. The lowest segment of the siphuncle is 15·5 mm. in diameter dorso-ventrally; from this it enlarges to 23 mm. at the sixth segment, above which this diameter remains constant. The siphuncle is in contact with the ventral wall of the conch. Along the ventral side, 9 cameræ occur in a length of 51 mm.

Occurrence. Silurian: Jupiter (9), Southwest point and rivière du Pavillon.

Megadiscosorus crassisegmentatus orientalis var. nov.

Plate XLIX, figures 2, 3

Cf. *Megadiscosorus crassisegmentatus* Foerste, Lake Timiskaming Report; Geol. Surv., Canada, Mem. 145, p. 90 (1925).

Specimen 95 mm. long, consisting chiefly of the siphuncle, but with part of the ventral side of the conch still attached. The siphuncle retains 8 segments and the lower half of a ninth. The segments enlarge from a lateral diameter of 18 mm. at the base to 32·5 mm. at the fifth and sixth segments, and then contract to 28 mm. at the seventh segment, 25 mm. at the eighth, and still less at the ninth. In a similar manner the dorso-ventral diameter of the segments, measured parallel to their plane, increases from 17·5 at the base to 31·5 mm. at the fifth and sixth segments, and then diminishes to 28 mm. at the eighth segment. The dorsal aspect of the siphuncle is elongate elliptical. Its dorsal vertical outline is nearly straight, and with this dorsal outline the plane of the segments of the siphuncle makes an angle of about 70 degrees. The ventral outline of the conch, on the contrary, is distinctly curved lengthwise, with a radius of about 110 mm. Along the dorsal side of the siphuncle the vertical outline of the segments is evenly convex, whereas on the ventral side the segments are flattened obliquely by contact with the adjoining wall of the conch. From the small part of the conch remaining it is estimated that the original diameter of the conch was about 65 mm. at the same level as the sixth segment of the siphuncle (No. 3851, Peabody Museum).

The Anticosti specimen differs from the Lake Timiskaming type of the species chiefly in the greater flattening of the siphuncle dorso-ventrally, in its more elliptical aspect when viewed from the dorsal side, and in the somewhat greater obliquity of its segments.

Occurrence. Silurian: Jupiter (10), Jumpers.

Triptoceras xiphias (Billings)

Orthoceras xiphias Billings, Geol. Surv., Canada, Rept. of Prog. 1853-1856, p. 318 (1857); Billings, Cat. Sil. Foss., Anticosti, p. 22, 1866; *Triptoceras xiphius* Clarke, Pal. Minn., vol. III, pt. 2, p. 793 (1897).

The type specimen (No. 2163, Geol. Surv., Canada) is 32 mm. in length, enlarging from a dorso-ventral diameter of 14·5 mm. at its base to 17·5 mm. at its top. The section has been sectioned vertically in a dorso-ventral direction, removing most of the siphuncle. Estimating the width of the part removed at 3 mm., the lateral diameter increased from 31 mm. at its base to 39 mm. at its top. The dorso-ventral apical angle is estimated at 5·5 degrees, and the lateral one at 13 degrees. At the top of the specimen the transverse curvature has a radius of 45 mm. on its ventral side, and

22 mm. dorsally. The lateral angles tend to be correspondingly nearer the ventral side of the conch, and they are narrowly rounded, rather than truncated or angular. The number of cameræ in a length equal to the lateral diameter is estimated at 10, though only 8 cameræ remain in the type specimen. The sutures of the septa curve downward strongly, both on the dorsal and ventral sides, for an amount equalling about the height of 2 cameræ. The lateral saddles are correspondingly high. The septa slope slightly downward from the dorsal toward the ventral side of the conch. Where the dorso-ventral diameter is 17 mm., the centre of the siphuncle is 3 mm. from the ventral wall of the conch. The septal necks are $\frac{3}{5}$ mm. in length. The diameter of these necks is at least 1 mm., and the segments of the siphuncle widen to at least 2 mm., possibly more, within the camera, their outline being fusiform.

The collections of the Geological Survey, Canada, contain three specimens collected at West point. Of these, one is 81 mm. long, has a lateral apical angle of 13 degrees, and consists of 7 cameræ and the lower part of a living chamber. At the base of this chamber its lateral diameter is 38 mm. It is estimated that nearly 9 cameræ occupied a length equal to the lateral diameter of the conch at the top of the series of cameræ counted. Another specimen is 56 mm. long, and has a lateral apical angle of 15 degrees. Only one septum is exposed, and that is at the base of the specimen, where the lateral diameter is 20 mm. The third specimen, 97 mm. long, has an apical angle of only 5 degrees. Apparently it includes a living chamber 45 mm. wide at the base. The small, apical angle suggests that it may belong to a distinct species.

The sutures of the septa on the dorsal side of the conch do not approach the lateral angles with a sigmoid change of curvature, as in *Tripteroceras hastatum*, *T. planoconvexum*, *T. planodorsatum*, *Lambeoceras lambi*, and *L. richmondensis* (Jour. Cin. Soc. Nat. Hist., vol. 22, p. 44, Pl. I, figs. 3 a-d; Pl. III, fig. 2 (1917)).

Occurrence. Ordovician: Vauréal (4, 5), baie Ste. Claire.

Cyrtorizoceras ellisense sp. nov.

Plate XLVII, figure 4

Specimen consisting of the living chamber with parts of 9 cameræ still attached, the lower ones being represented only by their ventral sides. Curved lengthwise, with a radius of convex curvature of 36 mm. along the ventral side, and a radius of concave curvature of 50 mm. along its dorsal side. The transverse section is compressed laterally, with a dorso-ventral diameter of 26·5 mm. and a lateral diameter of 23·5 mm. at the base of the living chamber, enlarging to 32 mm. and 27 mm. respectively at the aperture. About 7 mm. beneath the aperture this lateral diameter is 28 mm. The living chamber is about 28 mm. in height laterally. The sutures of the septa form very shallow lateral lobes and low dorsal and ventral saddles. The siphuncle is located close to the ventral wall of the conch. The hyponomic sinus is shallow but distinct. The transverse bands on the surface of the shell are formed by rather faint, transverse lines which on the dorsal side number 10 or 11 in a length of 10 mm.

Occurrence. Ordovician: Ellis Bay (7), Ellis bay.

No. 3852, Peabody Museum.

Beloitoceras fragile (Billings)

Plate XL, figures 11, 12

Cyrtoceras fragile Billings, Cat. Sil. Foss., Anticosti, Geol. Surv., Canada, p. 59, 1866.

The original type of *Cyrtoceras fragile* has been lost, but from the original description it is evident that the species was relatively small and slender. The best-preserved specimen described by Billings had the following dimensions; dorso-ventral and lateral diameters at the aperture 14 and 11 mm. respectively; at the base of the living chamber 18 and 14 mm.; at the tenth septum beneath this chamber 8 and 6 mm.; height of living chamber 14 mm. About 8 septa occurred in a length of 25 mm. measured along the ventral outline, the upper 5 of these occupying a length of 14 mm. The lengthwise curvature of the ventral side, from the aperture to the tenth septum beneath the living chamber, had a radius of 25 mm., thence toward the apical end the curvature was less.

Topotype (No. 3853, Peabody Museum). Specimen 40 mm. in length, consisting of the living chamber and the upper half of the phragmacone, showing the ornamentation of the surface of the shell, but not its interior structure. The conch is strongly curved lengthwise. The radius of curvature of the convex ventral side is 25 mm., that of the concave dorsal side being 35 mm. The maximum dorso-ventral diameter of the conch may be 2 or 3 cameræ below the base of the living chamber, as in *Beloïtoceras percurvatum* Foerste, to which this species is closely related, but the exact location of this maximum diameter with reference to the base of the living chamber is not known definitely. In the specimen at hand, this maximum diameter is 20 mm., and from this point the conch contracts to 16 mm. at the aperture, which is 19 mm. farther up, and to 13 mm. at the base of the specimen, which is 21 mm. farther down. Where the dorso-ventral diameter is 20 mm. the lateral diameter is 15·5 mm.

The surface of the shell is striated transversely by relatively coarse, raised lines, of which 11 occur in a length of 10 mm. along the ventro-lateral side of the conch, where its diameter is greatest. Along the dorsal side of the conch, these transverse lines are nearly at right angles to its vertical dorsal outline, but curve strongly downward on approaching the ventral side. Since the ventral side of the cross-section of the conch is rounded more rapidly than its dorsal side, the downward curvature of the transverse lines results in a V-shaped curve along the median line of the ventral side, indicating corresponding outlines for successive stages of the hyponomic sinus. Other specimens are Nos. 3854, 3855, and 3856, Peabody Museum.

Occurrence. Ordovician: Ellis Bay (5, 7), Ellis bay.

Beloïtoceras percurvatum sp. nov.

Plate XLIX, figures 4, 5

The type specimen (No. 3814a, Geol. Surv., Canada) consists of a living chamber with 9 cameræ still attached; strongly curved lengthwise; radius of convex curvature 30 mm. along the ventral side, and radius of concave curvature 35 mm. along its dorsal side. The maximum dorso-ventral diameter, at the third camera beneath the living chamber, is 30 mm., diminishing to 29 mm. at the base of this chamber, and 23 mm. at the aperture. In the opposite direction this diameter diminishes to 21 mm. at the base of the specimen. Along the dorsal side of the specimen, the lower half of the living chamber and the upper 4 cameræ present a distinctly less-concavely curved outline than the parts immediately above and below, but there is no gibbosity on this side. The maximum lateral diameter, at the third camera beneath the living chamber, equals 21 mm., but the conch evidently is compressed laterally by pressure. Along the more gibbous part of the conch dorso-ventrally 3 cameræ occupy a total length of 14 mm., measured along the ventral side. The uppermost camera is distinctly shorter. The structures of the septa present broad, lateral lobes, almost 2 cameræ in depth. They curve strongly upward along the ventral side of the conch, the ventral saddle rising considerably higher than the dorsal ones.

Another specimen (No. 2314b, Geol. Surv., Canada) has the ratio of the lateral to the dorso-ventral diameter 21·5 mm. to 32 mm.; the radius of curvature of the lateral lobes is 25 mm., and the siphuncle is almost in contact with the ventral wall.

Other specimens are in Peabody Museum (Nos. 3857, 3858).

Compared to *B. fragile*, this species has relatively broader lateral sides, is larger, and the lateral lobes are deeper.

Occurrence. Ordovician: Ellis Bay (4-7), Ellis bay and near Junction cliff.

Beloitoceras accultum sp. nov.

Plate L, figure 1; Plate LI, figure 1

Specimen consisting of a living chamber with 9 cameræ still attached, only a trace of the uppermost camera being seen. Curved lengthwise; the radius of convex curvature along the ventral side is 60 mm., and that of concave curvature along the dorsal side is 110 mm., but the latter is interrupted along the lower half of the living chamber by a faint gibbosity. Transverse section elliptical, with the ventral side only slightly more narrowly rounded than the dorsal one at the top of the phragmacone, but apparently equally rounded at the base. Living chamber about 35 mm. in height; slightly contracted along its dorsal side, 20 mm. above its base, directly over the gibbosity. At the base of this chamber the dorso-ventral diameter is 47 mm., and the lateral one 41 mm. Toward the top of the chamber the corresponding diameters are estimated at 40 and 36 mm. Nothing is known of the aperture. At the base of the specimen the dorso-ventral diameter is 36 mm. and the lateral one is estimated at 32·5 mm. The number of cameræ along the ventral side is 9 in a length equal to the dorso-ventral diameter. The sutures of the septa are almost directly transverse to the vertical axis along the dorsal and lateral sides at the base of the specimen, rising toward the ventral side. Toward the top of the phragmacone the sutures begin to rise nearer the dorsal side, and they rise more strongly toward the ventral side. The convexity of the septa equals the depth of one camera. The siphuncle is near the ventral wall of the conch (No. 48, Twenhofel collection).

This species is characterized by its elliptical, rather than oval cross-section. The gibbosity of the dorsal outline is located along the lower half of the living chamber rather than chiefly along the upper part of the phragmacone.

Occurrence. Ordovician: English Head (3), MacDonald river.

Beloitoceras magisterium sp. nov.

Plate LII, figure 1; Plate LI, figure 2

Specimen consisting of part of a living chamber with 19 cameræ still attached, radius of convex ventral curvature 100 mm. along the phragmacone, changing to 140 mm. along the living chamber. Radius of concave dorsal curvature 180 mm., except along the upper 8 cameræ and the basal part of the living chamber where there is a faint gibbosity of outline, with its maximum at the base of the third camera from the top. Transverse section oval, distinctly more narrowly rounded on its ventral side. Of the living chamber a height of 55 mm. remains, but its original height was at least 70 mm. and may have been more. At the base of the living chamber the dorso-ventral diameter is 75·5 mm. and the lateral one is 61 mm.; at a point 50 mm. farther up these diameters have diminished to 72·5 and 52 mm. In an opposite or downward direction these diameters diminish to 43 and 31 mm. at the base of the phragmacone. The number of cameræ in a length equal to the dorso-ventral diameter is 9, if counted along the ventral side. Along the lower half of the phragmacone the sutures of the septa rise but slowly from the dorsal side, until near the ventral side where the rate of rise increases. Toward the top of the phragmacone the sutures rise in almost a straight line toward the ventral side. The concavity of the septa equals the height of one camera at the base of the specimen. The siphuncle is located close to the ventral wall. Judging from the faint lines of growth, the margin of the aperture was almost directly transverse to the vertical axis along the dorsal and lateral sides, but it curved strongly downward ventrally along the hyponomic sinus (near Caplan river, English Head, 4).

Occurrence. Ordovician: English Head (4), Caplan river; Vauréal (1 or 2), near de Puyjalon cliff.

The type is No. 46, Twenhofel collection.

Beloitoceras obstructum sp. nov.

Plate LII, figures 2, 3

Specimen consisting of the living chamber with 7 cameræ and part of two additional cameræ still attached. Radius of convex lengthwise curvature along the ventral side 140 mm.; dorsal side concave along the living chamber, but distinctly gibbous along the upper part of the phragmacone, with its maximum convexity at the fourth camera beneath the living chamber. Transverse section oval, distinctly more narrowly rounded along the ventral side. Living chamber 96 mm. in height; with a dorso-ventral diameter of 67 mm. and a lateral diameter of 57 mm.; at the top of the chamber the corresponding diameters are estimated at 65 and 41 mm. The ventro-lateral walls increase in their amount of flattening and convergence toward the aperture. Judging from the faint lines of growth, the margin of the aperture was approximately directly transverse to the vertical axis of the conch, but curved strongly downward ventrally at the hyponomic sinus. The interior of the living chamber was obstructed along its dorsal side by a callous thickening of the inner wall of the shell, 3 mm. thick and 15 mm. wide in a vertical direction; toward the dorso-lateral side of the chamber this band of thickening diminishes rapidly in prominence, and disappears altogether ventro-laterally. On the rest of the interior of the chamber this callous band is represented by a groove, which is conspicuous dorsally. Along the most gibbous part of the phragmacone the dorso-ventral diameter is 68·5 mm. Along the ventral side about 8 cameræ occupy a length equal to the dorso-ventral diameter. Along the lowest septum the dorso-ventral diameter is 63 mm. and the lateral one 46 mm., indicating that the earlier parts of the phragmacone are less flattened laterally than its upper part, and still less flattened compared with the top of the living chamber. At the base of the specimen the sutures of the septa are almost directly transverse to the vertical axis dorsally and laterally, but rise distinctly ventrally. Toward the top of the phragmacone the sutures rise distinctly in an almost straight line from the dorsal toward the ventral side of the conch. The siphuncle is not exposed, but is assumed to be on the convexly curved side of the conch.

Compared with *Maelonoceras magisterium* the conch is less curved lengthwise, the dorso-ventral diameter is relatively shorter, and the conch appears to have been more elongate. The transverse callous band along the dorsal and lateral walls of the interior of the living chamber, disappearing to a large extent ventrally, is a distinguishing feature.

Occurrence. Ordovician: Vauréal (2), north side of Anticosti.

The type is No. 8859, Peabody Museum.

Beloitoceras (?) jamesense sp. nov.

Plate XLVIII, figures 3, 4; Plate L, figure 2

Specimen (No. 3860, Peabody Museum) (Plate XLVIII, figure 3) consisting of a living chamber with 1 camera still attached. The ventral side has a convex lengthwise curvature with a radius of 30 mm. The dorsal side is slightly gibbous along the upper part of the living chamber and for a height of 10 mm. above the base of the chamber. For a distance of 5 mm. above this level the dorsal side is constricted, the constriction extending slightly upward ventrally, but diminishing much in depth. The upper part of the dorsal side, up to a height of 18 mm. above its base, is inclined outward. The cross-section is compressed elliptical, the dorso-ventral diameter being 23 mm., and the lateral one 18 mm. The dorso-ventral curvature of the septum at its base has a radius of 21 mm., the lateral curvature having about the same rate. The siphuncle is almost in contact with the ventral wall of the conch.

A second specimen (3861, Peabody Museum) (Plate XLVIII, figure 4) consists of the living chamber with 5 camera and parts of 5 additional cameræ still attached. The gibbosity along the dorsal side includes not only the lower two-thirds of the living chamber, but also the upper 3 cameræ of the phragmacone. The upper 2 cameræ are distinctly shorter than the remainder, indicating that the conch was entering on its gerontic stage. The longer cameræ are about 3 mm. long. The sutures of the septa have broad, lateral lobes and distinct dorsal and ventral saddles. The siphuncle is almost in contact with the ventral wall of the conch. Its segments are obliquely oval in outline, are 2 mm. in maximum diameter, and contract slightly over 1 mm. where they pass through the septa.

Occurrence. Ordovician: Ellis Bay (1 or 2), cape James.

Beloitoceras (?) fererectum sp. nov.

Plate L, figures 3, 4; Plate LI, figure 3

Specimen (No. 3863, Peabody Museum) consisting of a living chamber with 6 cameræ still attached. Faintly curved lengthwise; the ventral side has a radius of convex curvature of 70 mm.; that part of the dorsal side which is preserved is virtually straight, except near the apertures where the dorsal outline is distinctly, though slightly, concave. Transverse section almost elliptical, slightly more narrowly rounded along its ventral side. The dorso-ventral diameter increases from 24 to 27 mm. in a length of 18 mm. along that part of the phragmacone which remains. The corresponding lateral diameters are 19 and 21 mm. About 10 cameræ occupy a length equal to the dorso-ventral diameter. The sutures of the septa form broad, lateral lobes, with a curvature equalling the depth of one camera. The ventral saddles rise slightly higher than the dorsal ones. The siphuncle is located close to the ventral wall of the conch.

The slight lengthwise curvature of the conch, and its very small rate of enlargement, indicate that this species belongs to a group distinct from *Beloitoceras*, but not differentiated at present.

Occurrence. Ordovician: Ellis Bay (1-4), cape James.

Oncoceras carletonense sp. nov.

Plate L, figure 5; Plate LI, figure 4

Specimen (No. 3864, Peabody Museum) is 51 mm. long, consisting of the living chamber with 6 cameræ still attached. Conch curved lengthwise. The convexity of the ventral side has a radius of 45 mm. The lower part of the dorsal side is distinctly concave, but the upper part of the phragmacone, for a length of 5 cameræ, and the lower part of the living chamber, are distinctly gibbous, the maximum gibbosity at the base of the latter equalling 1·5 mm. The dorso-ventral diameter enlarges from 32 mm. at the base of the specimen to 41 mm. at the base of the living chamber, and then diminishes to 33 mm. near the aperture. The maximum lateral diameter, at the base of the living chamber, is 37 mm., narrowing distinctly toward the aperture. The outlines of the aperture are not clearly defined. Along the ventral wall, the lower 7 cameræ occupy a total length of 33 mm., the uppermost camera being distinctly shorter than the rest, indicating that the conch had reached gerontic conditions. The sutures of the septa form very shallow and broad lateral lobes and correspondingly low dorsal and ventral saddles. The dorso-ventral curvature of the septa has a radius of 40 mm. The siphuncle, at the base of the specimen, is 2·5 mm. from the ventral wall, its maximum diameter is 2 mm., decreasing at its passage through the septum. Its segments are oblong-cylindrical in form.

This species is characterized by the relatively large distance of the siphuncle from the ventral wall of the conch.

Occurrence. Ordovician: English Head (4), Carleton point.

Oncoceras (?) curvicameratum sp. nov.

Plate L, figure 6

Specimen (No. 3865, Peabody Museum) consists of a living chamber with the dorsal part of 6 cameræ still attached; slightly curved lengthwise. Judging from the small part of the ventral side of the living chamber remaining, the radius of convex curvature of the ventral side of the conch was about 38 mm. The greater part of the dorsal side of the conch evidently was curved in a concave direction, but along the upper 4 or 5 cameræ of the phragmacone and the lower part of the living chamber the outline was slightly gibbous, the maximum gibbosity at the base of the living chamber equalling 1 mm. The maximum dorso-ventral diameter, at the base of the living chamber, is 29 mm., diminishing to 23·5 mm. at the aperture. The corresponding lateral diameters are 24·5 and 18 mm. It is estimated that the upper 6 cameræ, measured along their ventral side, occupied a length of 23 mm. The sutures of the septa curve downward laterally the height of one camera, forming low dorsal and ventral saddles. The curvature of the septa is greater in a dorso-ventral than in a lateral direction (No. 3865, Peabody Museum).

This species is characterized by its lateral compression and by its conspicuous lobes and saddles.

Occurrence. Ordovician: Ellis Bay (1, 2, 4), cape James.

Cyrtoceras (?) sp.

Conch depressed dorso-ventrally; where the lateral diameter is 14 mm., the dorso-ventral one is 13 mm., and at this point the convexity of the dorsal and ventral sides, in a lateral direction, is approximately the same. The specimen enlarges from a lateral diameter of 9 mm. at its base to 15 mm. at its top, in a length of 27 mm. measured along its ventral or convex side. Where the dorso-ventral diameter is 8 mm., the centre of the siphuncle is located 2 mm. from the ventral wall of the conch. The siphuncle appears to be small, at least at its passage through the septum. All except the basal part of the specimen belongs to the living chamber.

This specimen is of interest chiefly on account of its depressed form, and the relatively long length of its living chamber, features unusual in cephalopods of Richmond age. It is evidently not a true *Cyrtoceras*, in the restricted sense in which that generic term is employed at present. But it is a depressed cyrtoceroid, and as such is worth noting. It probably belongs to an undescribed genus, but too little is known of it at present for adequate discrimination.

Occurrence. Ordovician: English Head (4), English head.

The type is No. 3879, Peabody Museum.

Amphicyrtoceras futile (Billings)

Oncoceras futile Billings, Cat. Sil. Foss., Anticosti, Geol. Surv., Canada, p. 59, 1866; *Orthoceras pileolum* Billings, Cat. Sil. Foss., Anticosti, Geol. Surv., Canada, p. 58, 1866.

It should be noted that the description of *Orthoceras pileolum* precedes that of *Oncoceras futile* in the publication cited above, but the type of the former is so unfit to give any proper understanding of the species that the latter name is given preference. Although the type of *Oncoceras futile* is lost, the species is represented in the collections of the Geological Survey, Canada, by one specimen (No. 2464a) and by numerous specimens in the Peabody Museum and Twenhofel collections. One of the Peabody Museum specimens has been selected as a topotype.

Topotype. Specimen (No. 3866) at least 66 mm., possibly 69 mm. long, strongly curved lengthwise. Along the ventral side the maximum convex curvature is at the base of the second camera beneath the top; both above and beneath this level, especially the latter, the curvature is distinctly less. The dorsal side is strongly gibbous, the maximum gibbosity being located at the base of the living chamber. The amount of this gibbosity equals 5 mm. Beneath the gibbous area the ventral outline is strongly concave. At the level of the top of the phragmacone the conch is most distended laterally as well as dorso-ventrally. Above this level it contracts toward the aperture in both directions. The sutures are almost straight from the dorsal toward the ventral side, but they rise slightly along this path, and tend to form very low and slightly angular, ventral saddles, readily overlooked. Along the ventral side of the conch, the upper 5 cameræ have a total length of 18 mm. Traces of the transverse striæ indicate that the hyponomic sinus was relatively broad and shallow, but distinctly angular along the median line of the ventral side; its depth is estimated at 4 mm. compared with the course of the same transverse striæ along the lateral sides of the upper part of the living chamber. Of the transverse striæ about 8 occur in a length of 5 mm. along the upper part of the living chamber. At the apical end of the specimen there is a sort of weak banding, accompanied by colour markings, which number 5 to 6 in a length of 5 mm. The inner surface of the shell and the cast of its interior are striated vertically with faint, fine, close-set lines.

The cross-section of the conch at its point of greatest gibbosity is nearly circular; in the best-preserved specimens the dorso-ventral diameter is only 1 mm. shorter than the lateral one. The height of the living chamber varies from three-fifths of the maximum diameter to four-fifths, occasionally equalling even nine-tenths. The siphuncle varies in position from almost in contact with the ventral wall of the conch to nearly 1 mm. distant from the latter. In a specimen 37 mm. in diameter the maximum diameter of the segments of its siphuncle equals about 4 mm., where the septa are about 2·5 mm. distant from each other in most direct measurement. This suggests somewhat nummuloidal segments. In other specimens the maximum diameter of the segments is relatively less and the segments appear more elongated. In both cases the upper part of the segments is in contact with the septum, immediately above, along an area almost equal to the cross-section of the segment, but the septal neck comes down within the ventral half or two-fifths of this area. The septal neck, on the contrary, projects downward from the dorsal side of the area of contact of the segment with the septum beneath. The aperture of the living chamber is distinctly smaller than the basal part of this chamber, and it shows a slight tendency toward angularity along the middle of its ventral side.

Orthoceras pileolum Billings is 35 mm. long and consists of the greater part of a phragmacone of *A. futile* which has been greatly deformed by pressure in the dorso-ventral diameter (No. 2387, Geol. Surv., Canada).

Occurrence. Silurian: Jupiter (4-6), Sand cliff, Jupiter river, and for about a mile east.

Amphicyrtoceras gunense sp. nov.

Plate L, figures 7, 8

Specimen (No. 3880, Peabody Museum) 28 mm. long, enlarging from a lateral diameter of 14 mm. at the base to 22·5 mm. at a point 20 mm. farther up, and then contracting rapidly to 21 mm. in the following 4 mm., at the margin of the aperture. The specimen is regarded as immature, the distance along which contraction takes place being abnormal for a mature specimen. The ventral side is convex, and the greater part of the dorsal side is concave, but toward the upper part of the portion preserved the dorsal side shows the faint beginning of a reversal of curvature, such as should exist at the lower part of the gibbous portion of this side. The most characteristic part of the specimen, as far as preserved, is the rhythmic succession of relatively strong, transverse, raised lines or striæ, 8 in a length of 5 mm., alternating with which are single, much finer striæ. These transverse striæ are much more conspicuous than those of *Amphicyrtoceras futile*, to which the specimen is regarded as closely related.

Occurrence. Silurian: Gun River (3?), East cliff.

Orchadoceras incertum sp. nov.

Plate LIII, figure 1

Specimen (No. 3870, Peabody Museum) is 155 mm. long, including 14 cameræ and the lower part of the living chamber, the latter 50 mm. in length, its total being unknown. The maximum lateral diameter and dorso-ventral diameters are at the sixth or seventh camera below the living chamber. In a lateral direction the conch enlarges from 52 mm. at its base to 71 mm. at the sixth segment below the living chamber, and then contracts to 69 mm. at the base of this chamber, and to 59 mm. at a point 35 mm. above the latter. The lengthwise curvature of the conch along the lateral side of the phragmacone has a radius of 300 mm., decreasing slightly along the living chamber. Along the median part of the specimen, assumed to be its ventral side, the lengthwise curvature is 120 mm. along the lower 5 cameræ, and 330 mm. along the upper part. The cross-section of the specimen is nearly circular at its lower end, but appears to be slightly depressed dorso-ventrally. The sutures of the septa slope distinctly downward from the dorsal toward the ventral side of the conch, especially toward its upper end, where the slope equals 14 degrees. It is assumed that a large part of this obliquity is due to compression during fossilization. Nine cameræ occur in a length equal to the lateral diameter. No trace of the siphuncle is exposed. The cast of the interior of the conch exhibits low, broad, but distinct vertical ribs, about 9 in a width of 30 mm., some of them grooved medially, so as to appear double.

The relatively low rate of enlargement of the conch suggests relationship to *Orchadoceras*, but its reference to that genus must remain tentative until it is proved that the lengthwise curvature of its dorsal side is concave without any gibbosity.

Occurrence. Silurian: Jupiter (8), near Southwest point.

Hercocyrtoceras gen. nov.

Genotype, *Oncoceras amator* Billings

Cyrtoceracone depressed dorso-ventrally, irregularly annulated. Surface of the shell ornamented by vertical and horizontal, sharply raised lines or striæ. Lateral margins of the hyponomic sinus abruptly defined by two of the primary vertical striæ, at which the horizontal striæ bend abruptly and angularly downward, meeting at the intermediate secondary striation along the median line of the ventral side at an equally abrupt angle. This feature is unknown to the writer in any other Palæozoic cephalopod. Usually the margin of the hyponomic sinus is convexly rounded laterally and concavely rounded along the median line, in a sigmoid manner.

Hercocyrtoceras amator (Billings)

Plate XL, figures 9, 10

Oncoceras amator Billings, Cat. Sil. Foss., Anticosti, Geol. Surv., Canada, p. 59, 1866.

The type specimen (No. 2538, Geol. Surv., Canada) is 25 mm. long, with a radius of convex curvature of 60 mm. along the ventral side, the dorsal side being concave lengthwise. The lateral diameter enlarges from 9 mm. at the base to 13 mm. at a point 12 mm. farther up, and to 19 mm. in an additional length of 10 mm. The rate of enlargement of the conch is irregular, maximum enlargements taking place at points 13·5 and 23 mm. above the base of the specimen, the intermediate parts presenting concave outlines. The resulting annulations are distinct ventrally and laterally, but are relatively obscure dorsally. It is not known whether these annulations are due to changes in the rate of expansion of an individual conch or are characteristic of all members of this species. The dorso-ventral diameter at the top of the specimen is about 2 mm. shorter than the lateral one.

The surface of the shell is ornamented by numerous vertical and horizontal sharply raised lines. The conspicuous vertical markings consist of 12 primary lines alternating with 12 secondary ones, which differ distinctly in width and prominence ventrally and laterally, but not on the dorsal side of the specimen. Along the ventral side the primary ribs are about 3 mm. apart. In each vertical space between the primary and secondary lines there are several much less conspicuous vertical lines, usually 3, but in some cases 4. The transverse lines also vary in size and the larger ones occur at rhythmic intervals. Along the lower and middle parts of the specimen 5 occur in a length of 5 mm., but at the top 5 are in a length of only 2 mm. Intermediate between the more prominent horizontal lines are numerous much finer ones.

The course of the transverse lines at the hyponomic sinus is characteristic of the species, and presumably of the genus, as here proposed. The lateral borders of this sinus are formed by two of the primary vertical lines, 4 mm. apart at the upper end of the specimen. The median line is occupied by the intermediate secondary striation. At the primary lines the horizontal bend abruptly downward at an angle of 25 degrees with the horizontal, meeting at the secondary striation at an angle of 130 degrees. Both angles are relatively abrupt.

Occurrence. Silurian: Chicotte (2), Southwest point.

Asaphiceras gen. nov.

Genotype, *Asaphiceras schucherti* Foerste

Conch compressed laterally; sutures of the septa with shallow lateral lobes and low dorsal and ventral saddles, the latter rising slightly higher than the former at the top of the phragmacone. Siphuncle, relatively large; near the ventral wall of the conch, but not in contact with the latter. Segments of the siphuncle oblong in outline, their lateral walls slightly convex in vertical section, but strongly incurved at contact with the septa. Dorsal side faintly convex. Vertical axis of the conch straight or nearly straight.

Asaphiceras schucherti sp. nov.

Plate LVIII, figures 2, 3

Specimen (No. 3871, Peabody Museum) consists of the basal part of the living chamber with 9 cameræ still attached. The cast of the interior of the living chamber is marked, along a line 4 mm. above its base, by an annular groove, corresponding to an annular line of thickening along the interior of the conch, used presumably for the attachment of the animal within the chamber. The convexity of the dorsal side of the specimen equals 1 mm. The ventral side appears straight, but may have been slightly convex in complete specimens, since the sutures rise slightly higher along the ventral side. At its maximum gibbosity, 4 or 5 cameræ below the living chamber, the dorso-ventral diameter is 43·5 mm., and the lateral diameter is estimated at 38·5 mm. From this point both diameters shorten slightly, both upward and downward, as far as the specimen is preserved. Seven cameræ occur in a length equal to the dorso-ventral diameter. The concavity of the septa equals the depth of one camera. The margin of the siphuncle is 3·5 mm. distant from the ventral wall. Its segments are 6·5 mm. in length, and their diameter also is 6·5 mm., narrowing to 2·5 mm. where the siphuncle passes through the septa. There are no septal necks, the curvature of the septa being constant as far as their inner margin, at the passage of the siphuncle.

Occurrence. Silurian: Jupiter (2), East cliff.

Hyperoceras gen. nov.

Genotype, *Hyperoceras twenhofeli* Foerste

Conch compressed laterally, nearly straight, but assumed to have been curved slightly lengthwise. Sutures of the septa straight, or nearly so. Siphuncle relatively small, and close to the ventral side of the conch, but not in contact with the latter. Segments similar in outline with those of typical *Huronia*, but much smaller and with a different structure. The lower half or three-fifths of each segment is cylindrical; the upper part expands into an annulation. The upper part of the annulation is in contact with the lower surface of the overlying septum. The inner margin of this septum curves downward, forming a septal neck about $\frac{1}{2}$ mm. long. The diameter of this neck is less than that of the cylindrical part of the segment immediately above. The septa are not adnate to the cylindrical part of the segments of the siphuncle as in typical *Huronia*, to which this genus is not related. The interior of the siphuncle does not contain any calcareous deposits with Actinoceroid structure.

Hyperoceras twenhofeli sp. nov.

Plate LIV, figures 1, 2

Specimen (No. 3872 Peabody Museum) consists of the basal part of the living chamber, to which 11 cameræ and parts of two additional cameræ are attached; distorted by lateral pressure. Apparently slightly curved lengthwise, with the ventral side convex. Cross-section elliptical. At the base the dorso-ventral diameter is 42 mm., and the lateral diameter is 34 mm.; rate of enlargement apparently small. About 9 cameræ occur in a length equal to the dorso-ventral diameter. In ascending order, the height of the cameræ increases from 4 mm. at the base to 7 mm. at the fifth and fourth cameræ from the top, and then diminishes to less than 5 mm. at the top. The concavity of the septa equals the depth of one camera. The siphuncle is 1 mm. distant from the ventral wall. The segments of the siphuncle have the form of inverted pestles. In one segment 3 mm. in height, the cylindrical part is 3·2 mm. in diameter, enlarging at the top to an annulation 4·5 mm. in diameter; the septal necks are between 2·5 and 2·8 mm. in diameter and $\frac{1}{2}$ mm. in length. The cylindrical part of the segments meets the septum beneath almost at a right angle. The cast of the interior of the conch is marked by broad and faint vertical ribs, about 4 in a width of 5 mm. The exterior surface of the shell may have been smooth.

Occurrence. Ordovician: English Head (4), Carleton point.

Diestoceras obesum (Billings)

Plate XLIV, figure 7

Gomphoceras obesum Billings, Geol. Surv., Canada, Rept. of Prog. 1853-1856 (1857); Billings, Cat. Sil. Foss., Anticosti, p. 23, 1866.

Specimen (No. 2172, Geol. Surv., Canada) is 85 mm. in length, consisting of a living chamber 34 mm. in height, to which 9 cameræ are attached. A shallow groove, 4 mm. in width, and between 3 and 4 mm. above the base of the living chamber, extends around the cast of the interior of this chamber, and locates an annular callous thickening of its inner wall, probably for the attachment of the included animal. Since the aperture is not preserved, the original height of the living chamber is not known, but it probably was not much over 35 mm. The maximum dorso-ventral diameter, at the base of the living chamber, is 65 mm. The maximum lateral diameter at present is 51·5 mm., but the specimen is crushed in this direction, and its former lateral diameter undoubtedly was greater. The walls of the living chamber converge from all sides toward the aperture. The hyponomic sinus is located on that side of the conch toward which the sutures of the septa slope slightly downward. The upper part of the left side of the living chamber has been crushed over toward the middle of the aperture, the right side being but slightly flattened. The general outline of the conch, viewed from its sides, is oval-elliptical, the phragmacone converging more rapidly toward the base than the living chamber in the opposite direction. Most of the cameræ are from 5·5 to 6 mm. in height. The course of the sutures is virtually straight, but they rise slightly higher on the dorsal side, and are slightly taller here. In the present condition of the specimen, the septum at the base of the specimen appears deeply concave, continuing the general elliptical outline of the conch, but this appearance may be largely the result of pressure, since in most species of *Diestoceras* the septa have relatively little curvature.

Occurrence. Ordovician: English Head (4), 3 miles east of Carleton point.

Diestoceras arenicolum sp. nov.

Plate LV, figures 1, 2, 3

Specimen (No. 3874, Peabody Museum) consists of a living chamber to which 2 cameræ, and parts of 2 additional cameræ, are attached. The specimen has been compressed both laterally and vertically in an oblique direction. The conch probably attained its greatest diameters 2 or 3 cameræ below the living chamber. In the present condition of the specimen, its dorso-ventral diameter at the base of the living chamber is 59 mm., and the lateral one is 52 mm. From this level the walls of the living chamber curve inward, especially ventrally and ventro-laterally, until a dorso-ventral diameter of 40 mm. and a lateral one of 34 mm. are reached. At this level the walls of the living chamber appear to curve almost horizontally inward for a width of 2 or 3 mm. around the entire border of the aperture. The enclosed aperture is oval in outline, being distinctly more narrowly rounded at the very shallow hyponomic sinus than it is dorsally. The sutures of the septa are directly transverse. The second camera from the top is 4 mm. in height, the uppermost one being 2 mm. high, indicating that the conch had entered on gerontic conditions. The suture between the third and fourth cameræ beneath the living chamber is not exposed, but the ventral side of the enclosed segments of the siphuncle is seen. These segments may have been 7 or 8 mm. in diameter, though strongly contracted at the passage of the siphuncle through the septa; their general outline, in their state of exposure, appears oblong, with their vertical axis the greater.

Occurrence. Ordovician: Ellis Bay (4), Cape James bay.

Diestoceras scalare sp. nov.

Plate LVI, figure I

Specimen (No. 2211, Geol. Surv., Canada) is 130 mm. long, of which only 48 mm. belong to the phragmacone. The original length of this phragmacone may have been 75 mm. The maximum diameter appears to be not at the base of the living chamber, but 25 mm. above the latter. At the base of the living chamber the dorso-ventral diameter is 81 mm.; 25 mm. farther up it is estimated at 86 mm.; and near the aperture it contracted apparently to 62 mm. The lateral diameter was at least 75 mm. The upper 3 cameræ are each about 8 mm. in height and the septa rise higher on the dorsal side of the conch. The concavity of the uppermost septum is about 10 mm. The distance of the siphuncle from the ventral wall of the conch increases from 2 mm. at the base of the specimen to 5 mm. at the top of the phragmacone. The segments of the septum, in vertical dorso-ventral sections, present trapezoidal outlines; their sides are relatively straight, rather than strongly convex, and they converge obliquely downward and toward the ventral side at a moderate angle. The dorsal sides of these segments succeed each other in scalariform order, the conditions being inverted on their ventral side. The interior of the siphuncle contains peculiar lamellar deposits extending upward and downward from about the level of the adjacent septa, and in a direction approximately parallel to the dorsal and ventral sides of the segments. These lamellar deposits terminate at approximately the same levels within the segments, and they are transverse to the dorso-ventral axis, instead of annular in form at the bottom of the specimen, where a cross-section is presented. The structure of this siphuncle is so anomalous that other specimens are needed to demonstrate its constancy within the boundaries of this species.

The nearest approach, known so far, to the scalariform succession of segments of the siphuncle, on its dorsal side, is presented by *Amphicyrtoceras futile*, but the latter lacks the vertical lamellæ within the interior of the segments.

Occurrence. Ordovician: Vauréal (4), West point.

Diestoceras strangulatum sp. nov.

Plate LVII, figures 1, 2

Specimen (No. 50, Twenhofel collection) consists of the greater part of the living chamber, to which 2 cameræ and traces of 2 additional cameræ are attached. The transverse section is nearly circular, the maximum and minimum diameters at the base of the living chamber being 69 and 66·5 mm. respectively. The most striking feature of this specimen is the small height of the living chamber and its rapid rate of contraction. The walls of the conch curve convexly inward for a height of 18 to 22 mm., where the maximum and minimum diameters are 55 and 49 mm. respectively. At this point there begins an inward curvature, resulting in a faintly concave vertical outline. This upper part can be traced only for a distance of 3 mm.; the aperture probably was only a very short distance farther up, and must have been nearly circular. The attachment ring, or annular callous thickening within the interior of the living chamber, is at the base of this chamber, in contact with the septum beneath. The height of the upper cameræ still attached is about 5 mm., except in the case of the uppermost one, whose height is 2 mm. Apparently the upper 2 or 3 cameræ had about the same diameters as the basal part of the living chamber.

Occurrence. Ordovician: Vauréal (1), near du Puyjalon cliff.

Diestoceras vagum sp. nov.

Plate LIV, figure 3

Specimen (No. 3875, Peabody Museum) 66 mm. long, consists of living chamber, with 10 cameræ still attached. Greatest expansion at base of living chamber; here the larger diameter is 44 mm., and the one at right angles to the latter is estimated at 41 mm. For a distance of 3 or 4 mm. above the base of the living chamber the diameter remains the same or increases slightly and then it diminishes up to a level 23 mm. above the base of the chamber where the larger diameter is reduced to 36 mm. Above this, for a distance of 4 or 5 mm., there is a reversal of curvature of the vertical outline from convex to moderately concave. The aperture should be immediately above, but it is not outlined distinctly, and most of the conch at this level is broken off. The phragmacone has an apical angle of 22 degrees. Eleven cameræ occur in a length equal to the maximum diameter. The lower cameræ are slightly more than 3 mm. in height, the upper ones are 4 mm. in height, the uppermost one is less than 2 mm. high. Sutures of septa directly transverse, and straight. Depth of curvature of septa one camera. Location of siphuncle unknown, but assumed to be along the longer diameter.

Occurrence. Ordovician: English Head (4), White cliff.

Diestoceras carletonense sp. nov.

Plate LIV, figure 4

Specimen (No. 3876, Peabody Museum) 55 mm. in length, consists of the living chamber with 11 cameræ still attached, of which the uppermost camera is shorter than the rest. At the base of the living chamber the longer diameter is 36·5 mm., and the shorter one is 33 mm. The lower part of the living chamber retains about the same dimensions for a height of 7 mm., and then it curves moderately inward until a level 18 mm. above the base of the chamber is reached; thence, up to a level of 24 mm., the vertical outline is faintly concave. In the direction of the shorter diameter the contraction appears to be to 26 mm. The lower part of the phragmacone has an apical angle of 35 degrees, becoming much less toward its upper part. About 13 cameræ occur in a length equal to the larger diameter. The sutures of the septa are directly transverse, and they are straight or nearly straight. The location of the siphuncle is not shown by the specimen, but is assumed to be near one end of the longer diameter.

Compared with *Diestoceras vagum* Foerste, the conch is smaller at maturity, the number of cameræ in a length equal to the maximum diameter is greater, and the tendency toward obesity affects a greater part of the upper part of the phragmacone and the lower part of the living chamber.

Occurrence. Ordovician: English Head (4), White cliff and Carleton point.

Diestoceras anticostiense sp. nov.

Plate LV, figures 4, 5

Oncoceras constrictum Billings (not Hall, 1847), Cat. Sil. Foss., Anticosti, Geol. Surv., Canada, p. 23, 1866.

Specimen 40 mm. long, consists of a living chamber with 8 cameræ still attached. The maximum dorso-ventral diameter, at the second camera beneath the living chamber, is 28 mm., diminishing to 23 mm. at the aperture. The corresponding lateral diameters are 24 and about 17 mm. The height of the living chamber is about 17 mm.; up to a height of 15 mm. the inward curvature of the lateral sides of the living chamber is fairly uniform, but above that level there is a very faint tendency toward a concave vertical outline. The apical angle of the lower part of the phragmacone is 27 degrees, but at the base of the third camera beneath the top the obese rounding of the conch begins. Nine cameræ occur in a length equal to the maximum dorso-ventral diameter. The height of the cameræ is about 3 mm., reduced to 2 mm. in case of the uppermost one. The sutures of the septa are directly transverse in an almost straight line, except on the ventral side, where they form low saddles. The concavity of the septa equals the depth of one camera. The siphuncle is located close to the ventral wall of the conch, near the end of the longer diameter, but is not in contact with this wall.

This species is characterized by its small size at maturity; the smaller number of cameræ in a length equal to the maximum dorso-central diameter; and in the distinct, though low, ventral saddles.

Occurrence. Ordovician: Vauréal (4), West point.

The type is No. 2173, Geol. Surv., Canada.

Eotrimeroceras gen. nov.

Genotype, *Eotrimeroceras jupiterense* Foerste

Trimeroceras Hyatt is founded on *Gomphoceras staurostoma* Barrande (Syst. Sil. du Centre Boheme, Pl. 73), which has 3 dorsal lobes in the aperture, one directed toward the right, one toward the left, and a shorter one directed straight back toward the dorsal side of the conch. All of these lobes are relatively narrow. The remainder of the aperture is linear and is directed in a dorso-ventral direction. At its ventral end it terminates in an expanded lip or spout.

In the Anticosti species cited above there are no narrow dorsal lobes, but there are 3 emarginations of the border of the dorsal lobe, one on each side, and a smaller one along the middle of its dorsal margin, which resemble the early stages of development of the much narrower constrictions found in typical *Trimeroceras*. Hence the name *Eotrimeroceras* here proposed, although it is not known that there is any genetic connexion between the Anticosti form and the Bohemian forms included under *Trimeroceras*.

Eotrimeroceras jupiterense sp. nov.

Plate LIII, figures 2-6; Plate LI, figure 5

Specimen 37 mm. long; erect and fusiform; consisting of the living chamber and the upper half of the phragmacone. Its original length may have equalled 50 mm. Its maximum dorso-ventral diameter is 20·5 mm., its maximum lateral diameter is 19 mm. Above this line of maximum diameters the dorsal side of the living chamber rises 20 mm.; the base of the hyponomic sinus rises a shorter distance. The walls of the living chamber converge toward the aperture, the lateral diameter at the widest part of the dorsal lobe being 12 mm. Along the dorso-lateral angles the margin of the aperture curves outward and diagonally downward along a width of 4 or 5 mm., the outward and downward curvature equalling about 1·5 mm. Along the median part of the dorsal side there is a similar outward and downward curvature, along a width of 2·5 to 3 mm., and for a distance of 1 mm. downward and outward. Judging from the change of colour at the maximum diameter of the conch, the base of the living chamber is located here. The rate of tapering of the conch below this line corresponds fairly well with its rate of contraction in an upward direction. The surface of the shell is weakly striated in a transverse direction.

There are four additional specimens from the same locality and horizon. In one (No. 3877b), the base of the lip or spout of the hyponomic sinus rises only 12 mm. above the base of the living chamber, the dorsal margin at the aperture rising fully 20 mm. A third specimen exposes a septum at its base. This septum appears strongly concave.

Occurrence. Silurian: Jupiter (4), 2 miles east of Jupiter river.

Type is No. 3877a in Peabody Museum.

Phragmoceras anticostiense sp. nov.

Plate LVIII, figure 1

Specimen 105 mm. long, consists of a living chamber with 7 cameræ attached. Original length estimated at 130 mm. Vertical axis of conch only slightly curved. Concave ventral outline with a radius of curvature of 150 mm. An attempted restoration of the dorsal side gave a radius of convex lengthwise curvature of 200 mm. Lateral aspect of conch broadly cuneate, with the pointed end directed downward. The dorso-ventral diameter at the base of the living chamber is 68 mm., and the lateral one is 50 mm. The height of the living chamber, on its dorsal side, is 45 mm., and the top of this chamber slopes downward toward the ventral side at an angle of 15 degrees. The dorsal lobe of the aperture faces almost directly dorsally, with only a relatively slight upward tilt. Its lateral diameter is 30 mm., and in a vertical or dorso-ventral direction it does not exceed 17 mm. The dorso-ventral apical angle of the phragmacone is 38 degrees, the second and third cameræ below the top are each 9 or 10 mm. in height, the uppermost camera having a height of 6 mm., all measurements being taken along the dorso-ventral side of the specimen.

Among described American species, *Phragmoceras canadense* Whiteaves most resembles the Anticosti form, but the latter is less cuneate on lateral view, the living chamber is relatively higher and shorter in a dorso-ventral direction, and the cameræ are more numerous in a length corresponding to the dorso-ventral diameter.

Occurrence. Silurian: Chicotte (1), Southwest point.

No. 3878, Peabody Museum.

TRILOBITA

Order, **Hypoparia**

Eoharpes ottawaensis anticostiensis n. var.

Plate LVI, figures 2, 3

Harpes ottawaensis Billings, Pal. Foss., vol. I, p. 182, figure 165 (1862); Billings, Cat. Sil. Foss., Anticosti, p. 28, 1866; Vogdes, U.S. Geol. Surv., Bull. 63 (1890); Clarke, Pal. Minn., vol. III, pt. 2, p. 757, fig. 79 (1897).

The proterotypes of this species came from the Trenton limestone of Ottawa, Canada, and, compared with specimens from that locality and horizon, those from Anticosti differ in having the punctæ farther apart, hence the varietal differentiation.

Occurrence. Ordovician: English Head (3), English head and Schooner point.

Nos. 2196, 2197, Geol. Surv., Canada.

Harpes consuetus Billings

Plate LIV, figure 8

Harpes consuetus Billings, Cat. Sil. Foss., Anticosti, p. 64, 1866; Vogdes, U.S. Geol. Surv., Bull. 63 (1890).

The species resembles *Eoharpes ottawaensis*, but is narrower, does not have so convex a head, and the depressed space on each side of the glabella is narrower. The head is 12 mm. long and 20 mm. wide at the neck segment. The glabella is 6 mm. long.

Occurrence. Silurian: Chicotte (1), Southwest point.

Holotype and plastotype, No. 2550, Geol. Surv., Canada.

Order, **Opisthoparia**

Illænus grandis Billings

Plate LI, figure 9

Illænus grandis Billings, Can. Nat. and Geol., vol. IV, p. 380 (1859); Billings, Cat. Sil. Foss., Anticosti, pp. 27, 60, 1866.

The discovery of two nearly perfect specimens of this species enables its description to be given in greater completeness. The specimens have been slightly crushed, so that some of the figures of dimension may need slight modification. The length of the pygidium measured with the curve, since it is to some extent bent under, is between 55 and 60 mm. and it has a width of 78 mm. The anterior margin of the middle lobe is slightly convex forward; the margin is concave forward at the longitudinal furrows and sharply convex forward at about the middle of the pleural lobes, the outer edge being deflected backward to the place of greatest width of the pygidium, which is about 13 mm. behind the anterior margin. On the pleural lobes of the pygidium the anterior margin next the longitudinal furrows is slightly elevated, giving to the longitudinal furrows the appearance of being turned laterally, a feature more striking in young specimens.

Thorax of nine segments, each about 4 or 5 mm. wide, the entire length being 40 mm. The longitudinal furrows are deep, dorsal lobe, barrel-shaped; pleural lobes, flat near the furrow, and rising for about half their width and then turned downward and the segments backward. The sides are subparallel or only slightly convex outward. The thorax is 83 mm. wide, of which 38 mm. belong to the middle lobe.

The character of the cephalon is fairly well shown in one specimen. Measured on the convex surface it has a length of 78 mm. and a width of 87. The posterior margin is concave backward, though a part of this may be a result of distortion. The anterior margin is broadly rounded, genal angles likewise. The posterior portion is trilobed, the middle lobe 20 to 25 mm. wide, slightly convergent forward, side lobes about a third wider than the middle lobe. In front of the eyes the surface is uniformly convex; the facial sutures have not been made out. The eyes in a larger specimen are 35 to 40 mm. apart, bordered on their outer sides by a depression, only moderately large, flat on top and lunate. The specimens from the Chicotte formation are pygidia, of which all except one or two do not exceed a width of 25 mm.

This species differs from those with which it has been compared, in addition to the characters mentioned by Billings, in having the eyes more prominent, in being far larger, and in the total absence of any convergence of the longitudinal furrows on the pygidium. Another species to which it bears some resemblance is *I. daytonensis* Hall and Whitfield from the Clinton of Ohio and the Niagara of Illinois and Wisconsin, but it is far larger, does not have the longitudinal furrows parallel on the cephalon, the anterior part of the pygidium is different, and there are other points of difference.

Occurrence. Silurian: Gun River (4), Sandtop cape; Jupiter (1, 4-10), most western exposures; Chicotte (1, 2), pointe des Morts.

The cotypes, No. 2322, are in the National Museum of Canada. The Peabody Museum and Twenhofel collections contain the most perfect specimens.

Bumastus orbicaudatus (Billings)

Illænus *orbicaudatus* Billings, Can. Nat. Geol., vol. IV, p. 379 (1859); Billings, Cat. Sil. Foss., Anticosti, p. 27, fig. 10, 1866; Clarke, Pal. Minn., vol. III, pt. 2, p. 722 (1897).

This species resembles *Bumastes trentonensis* from the Trenton of New York and Minnesota, but is larger and Clarke says it has a less convex cephalon. There are ten segments to the thorax. A perfect example of *B. orbicaudatus* is 53 mm. long, of which 16 mm. belong to the cephalon, 14 to the thorax, and 23 to the pygidium. It is 30 mm. wide across the genal angles and 26 mm. across the anterior portion of the pygidium. That it grew to a larger size is shown by an imperfect specimen which has a width of 45 mm. across the pygidium.

Occurrence. Ordovician: English Head (3-4), English head and Carleton point; Vauréal (1, 4), High cliff and Battery point; Ellis Bay (4, 5, 9), Ellis and Prinsta bays and Vauréal river. Silurian: Becscie (1?, 4?), Bear and Whale cliffs and Wreck beach.

The holotype, No. 2324, is in the National Museum of Canada. A perfect specimen is in Peabody Museum.

Brachyaspis alacer (Billings)

Plate LVII, figures 10, 11, 12

Asaphus alacer Billings, Cat. Sil. Foss., Anticosti, p. 26, fig. 9a, 1866; *Brachyaspis alacer* Raymond, Trans. Roy. Soc., Canada, vol. V, sec. IV, p. 119, Pl. II, fig. 3 (1912); Raymond, Victoria Memorial Museum, Bull. No. 1, Pl. III, fig. 6 (1913).

The eyes are nearly on a level with the central portion of the cephalon, which is slightly convex from one eye to the other. This feature sharply differentiates the species from *B. altilis* and *B. notans*.

Occurrence. Ordovician: English Head (4), Carleton point; Ellis Bay (4), Ellis bay.

The holotype, No. 2179, is in the National Museum of Canada. The Peabody Museum and Twenhofel collections have each a well-preserved specimen.

Brachyaspis altilis Raymond

Asaphus platycephalus Billings, Cat. Sil. Foss., Anticosti, p. 26, fig. 9b, 1866; *Brachyaspis altilis* Raymond, Trans. Roy. Soc., Canada, vol. V, sec. IV, p. 119, Pl. II, figs. 4-5 (1912); Raymond, Victoria Memorial Museum, Bull. No. 1, p. 47, Pl. IV, figs. 3, 7 (1913).

So far as known this species is small. The holotype (No. 2181, Geol. Surv., Canada) has a length of 20 mm. from the anterior margin of the cephalon to the anterior margin of the pygidium. The cephalon is 8 mm. long and 15 mm. wide. A better specimen in the Yale collection is 30 mm. long measured along the convexity. The cephalon is 10 mm. long and 18 mm. wide at its posterior margin. The thorax has the same width as the cephalon and the middle lobe is 7 mm. wide. The pygidium is 12 mm. wide and 6 mm. long. Both cephalon and pygidium are rather uniformly convex, glabella and middle lobe obsolete, both uniformly rounded at the front margin and not pointed in any way or depressed at the margin. The facial sutures follow the edge of the front margin, and they do not meet at an angle. The eyes are small, high, their outer margins 9 mm. apart, and the surface from one to the other is pretty uniformly concave. There are no genal spines. The species differs from *B. alacer* in having smaller eyes, being concave from one to the other, and in having a relatively narrower axis.

Occurrence. Ordovician: English Head (3), English head; Vauréal (1, 3, 6), White cliff and cape Henry.

Brachyaspis notans (Billings)

Asaphus notans Billings, Cat. Sil. Foss., Anticosti, p. 24, fig. 8, 1866; *Brachyaspis notans* Raymond, Trans. Roy. Soc., Canada, vol. V, sec. IV, p. 119, Pl. I, fig. 1 (1912).

The rounded cephalon and pygidium are characters sharply differentiating this species from not only *Isotelus gigas* with which Billings compared it, but the entire genus to which that species belongs. Its characters are those of Salter's genus *Brachyaspis*.

Occurrence. Ordovician: English Head (2, 3), English head and MacDonald river; Ellis Bay (4), Ellis bay and one-half mile east of Junction cliff.

No. 2180, Geol. Surv., Canada.

Isotelus gigas DeKay

Isotelus gigas DeKay, Ann. Lyceum Nat. Hist., N.Y., vol. I, p. 176, Pl. XII, fig. 1 (1824); *Asaphus platycephalus* Billings, Cat. Sil. Foss., Anticosti, p. 24, fig. 7, 1866; *Isotelus gigas* Raymond and Narraway, Ann. Carnegie Mus., vol. VII, No. 1, p. 53, Pl. XV, figs. 1-2 (1910); Raymond, Bull. Mus. Comp. Zool., vol. 58, No. 5, pp. 247-263, Pls. 1-3 (1914).

Good specimens of this species occur rarely in the lower Anticosti strata. The individuals showing genal spines are small and spines have not been observed on those of mature dimensions, although no mature individual retaining the entire genal angles has been collected. It may be that the forms should be referred to *I. maximus*, or a new species. However, as the shields are triangular rather than rounded in outline, it has been thought best to refer them as above.

Occurrence. Ordovician: English Head (2-4); Vauréal (1-6); Ellis Bay (1, 4-7). As a rule common.

Anticosti plesiotypes of this species are in both the National Museum of Canada and Peabody Museum.

Triarthrus becki var. *macastyensis* Twenhofel

Plate LV, figures 6, 7

Triarthrus spinosus Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, p. 694 (1910); *T. becki macastyensis* Twenhofel, Geol. Surv., Canada, Mus. Bull. No. 3, p. 35 (1914).

This new form is like *T. becki* except in one respect. The facial sutures are slightly more sinuous, and in front they diverge from the axis instead of converging as in *T. becki.* The glabella of the most perfect example is 3·5 mm. wide; 4·5 mm. long; the entire cephalon 5 mm. long. That it grew to a larger size is proved by a specimen which has the cephalon at least 8 mm. long. The same type of facial suture is shown in the *T. becki* from the Collingwood black shale of Ottawa, Canada; and Doctor Ruedemann has called the writer's attention to the fact that *T. jemtlandicus* Lindstrom has a similar facial suture, though otherwise different.

Occurrence. Ordovician: Macasty formation.

The holotype and a single paratype are in Peabody Museum.

Proetus alaricus Billings

Plate LI, figure 8

Proetus alaricus Billings, Can. Nat. and Geol., vol. V, p. 68, fig. 12 (1860); Billings, Cat. Sil. Foss., Anticosti, p. 28, 1866.

The eyes are situated near the back part of the glabella. There are only 5 segments to the central axis of the pygidium and only 4 can be made out on the sides.

Occurrence. Ordovician: English Head (4), Carleton point and MacDonald river; Ellis Bay (4), Ellis bay.

Holotype, No. 2198, Geol. Surv., Canada, two nearly perfect specimens are in the Twenhofel collection.

Proetus? perplexus (Billings)

Dionide? perplexa Billings, Cat. Sil. Foss., Anticosti, p. 67, 1866.

The supposed type (No. 2559, Geol. Surv., Canada) is not a *Dionide*, although it is very probable that it is the original specimen. The longitudinal furrows do not converge as Billings stated, but are nearly parallel. The lip is slightly projecting and truncated which, however, may be the result of distortion. The facial suture appears to cut the posterior margin just back of the eye, but this is not certain. The posterior portion of the cephalon looks like *Dalmanites*.

The writer requested Doctor P. E. Raymond to examine the specimen and he states that he feels very certain "that it belongs to the *Proetidae*, and it could be called *Proetus*, I suppose, in the loose meaning of the name. The eyes are large and far back, the posterior part of the facial suture cutting the margin but little outside the eye."

Occurrence. Silurian: Jupiter (10), Jumpers.

Cyphaspis anticostiensis n. sp.

Plate LVII, figure 3

This trilobite is related to *C. girardeauensis* Shumard from the Girardeau limestone of Missouri, but differs in having the surface covered with tubercles, a more convex and higher central lobe to the glabella, a greater difference in height between the central lobe and the smaller lateral lobes, and in not being pointed at the front margin. No entire specimens have been collected, only cephala and pygidia, and as the two have not been found connected it is not certain that they belong to the same species.

The cephalon is small, semi-elliptical, the marginal rim narrow, apparently smooth, bordered within by a deep and narrow furrow which projects downward and inward. Between the marginal furrow and the furrow bounding the glabella is a very convex elevation or rim which is wider than the marginal rim and is covered with distinct tubercles. The central lobe of the glabella is ovoid, about 1·75 mm. wide, 3 mm. long, widest in front. Surface very convex, much elevated above the cheeks and lateral lobes, highest just back of the middle. Lateral lobes oval, situated at the posterior end of the central lobe, very small, not more than half as high as the central lobe, separated from the central lobe by deep and narrow furrows. Cheeks not well preserved and eyes unknown.

Neck furrow comparatively wide, side next the glabella steep, slope to the top of the occipital segment gentle. Occipital segment prominent, not so high as the glabella, and with a prominent tubercle in the centre. The entire cephalon is 5·5 mm. long. The entire surface, except where otherwise described, is covered with minute tubercles, although it is not certain that they are in the furrows. What is thought to be the pygidium of this species is 2·75 mm. long, about 4 mm. wide; central axis 1 mm. wide, at least 5 segments, and reaching within 1 mm. of the end. The lateral segments curve backward. The surface is covered with small tubercles.

C. trentonensis Weller is another species to which this bears some resemblance in size and contour; but the surface of that species is not tuberculated, but pitted; the furrow bounding the glabella projects upward and inward instead of downward and inward; the slope from the top of the glabella to the front margin is less steep; and the slope from the glabella into the dorsal furrow is gentle instead of steep. Also in *C. trentonensis* the occipital segment is about as high as the glabella. *C. planifrons* Eichwald from the Ordovician of the east Baltic (Kuckers formation) has the side lobes smaller, pointed in front, and the marginal rim rises higher on the sides.

Occurrence. Ordovician: Ellis Bay (4, 6, 7), Ellis and Prinsta bays and zone 22 of the Vauréal River section. Silurian: Becscie (1?), Fox bay.

Peabody Museum.

Cyphaspis borealis n. sp.

Plate LVII, figures 4, 5

The entire length is about 1 cm., but as the pygidium in each specimen is missing the length was a little greater. The thorax is 4 mm. wide and about 5 mm. long. It consists of at least 8 segments. The cephalon is about 3 mm. long, and it is a little wider than the thorax. The genal angles are prolonged in prominent genal spines which extend backward to about the seventh segment. The central lobe of the thorax is very convex and prominent, with the bounding furrows parallel. These lateral furrows are very slightly convergent where they bound the glabella, which is very convex and steep in front. The side lobes of the glabella are about 0·75 mm. long and 0·5 mm. wide. The occipital segment of the cephalon is wider and higher than any segment of the thorax, and the occipital furrow is deep. A furrow extends entirely around the margin of the cephalon and is continued upon the genal spines. The marginal rim is about ½ mm. wide. It is not unlikely that the Gun River specimen may belong to a distinct variety, but this is not determinable from the material at hand.

Occurrence. Ordovician: Ellis Bay (4), Ellis bay; Gun River (3), Gun river.

Twenhofel collection.

Cyphaspis cf. *christyi* Hall

Cyphaspis christyi Hall, N.Y. State Mus., 28th Rept., p. 188, Pl. XXXII, figs. 5-7 (1878); Lesley, Geol. Surv., Pennsylvannia, Dict. of Fossils, vol. I, P 4, p. 174, 3 text figs. (1889).

A cephalon from which the free cheeks are missing agrees with this species. It has a length of 6 mm. The occipital segment is 1 mm. wide and the neck furrow is narrow and shallow. The glabella is 3·5 mm. long and 2·5 mm. wide at the front. The anterior glabella furrow is narrow, which is also true of the marginal furrow; but it is wider than the glabella furrow. The ridge separating the two furrows is about 0·5 mm. wide.

Occurrence. Silurian: Jupiter (10), Jumpers.

Peabody Museum.

Goldius insularis (Billings)

Plate LIV, figure 9

Bronteus insularis Billings, Cat. Sil. Foss., Anticosti, p. 66, 1866.

The 16 ribs radiate from the central axis of the pygidium, are about uniform in size, and can readily be followed to the margin.

Occurrence. Silurian: Chicotte (1), Southwest point.

Holotype only, No. 2558, Geol. Surv., Canada.

Amphilichas canadensis (Billings)

Plate LVII, figure 9

Lichas canadensis Billings, Cat. Sil. Foss., Anticosti, p. 65, fig. 22, 1866.

The anterior lobe of the glabella has a width of 20 mm. and is margined by a lip 3 to 4 mm. wide. The fixed cheeks appear to be large and separated from the glabella by deep furrows.

A single specimen (Twenhofel collection) from the basal zone of the Jupiter formation shows 8 thoracic segments and the pygidium. A part of a cephalon from near the same locality shows that the central lobe greatly expands in the anterior portion and that there are at least three side lobes.

Occurrence. Silurian: Jupiter (1, 3, 4), East and Sand cliffs and near Jupiter river.

Holotype and paratype, Nos. 2471, 2471a, Geol. Surv., Canada.

Amphilichas arenaceus n. sp.

Plate LIX, figure 1

This species is founded on a single pygidium (Twenhofel collection), whose characters are best told by the illustration. It is covered with tubercles like *A. canadensis*, but it lacks the occasional large tubercle, and the other tubercles are smaller than they are in that species. The lateral segments of the pygidium also have a different shape, and the end of the central lobe appears to be different, although this is not certain. On the anterior portion of the pygidium three segments of the axial lobe are shown. Instead of crossing at right angles to the lobe, as they do in *A. canadensis*, they turn backward, making a curve strongly convex backward.

Occurrence. Silurian: Gun River (4), brooks west side of cape Sandtop.

Amphilichas shallopensis n. sp.

Plate LVII, figure 6

The cephalon of the holotype (No. 2546, Geol. Surv., Canada) is 15 mm. long, bordered anteriorly by a rim about 1 mm. wide. The anterior lobe of the glabella is pear-shaped; the constrictions between the second lobes are 1·5 mm. long, separated from the second lobes by rather deep furrows. The second lobes are reniform on the inner side, concave on the outer. The furrows separating the second lobe from the outer lobes are shallow. The outer lobes appear to be conical. The posterior part of the central portion of glabella is somewhat expanded behind and elevated into a ridge, on which are two relatively large tubercles. The neck furrow is not deep, but is complete and extends at least to the third lobe. Wherever preserved, the surface is covered with rounded tubercles of several sizes and scattered among the larger are numerous smaller ones.

This cephalon differs from that referred to *A. canadensis* in not being steep on the frontal portion of the glabella; but rather uniformly convex from the anterior to the posterior extremity, whereas in that species it is very steep in front and almost flat on top.

Occurrence. Silurian: Jupiter (9), Shallop creek.

Amphilichas borealis n. sp.

Plate LVII, figures 7, 8

The specimen on which the following description is founded is related to *Amphilichas dalecarlica* Angelin, from which it differs in being somewhat more tuberculose, having the first lateral lobes of the cephalon more nearly straight on the outside, instead of quite concave, and the second lateral lobes larger and longer. Like that species the surface is covered with tubercles of two sizes, the smaller surrounding the larger. The central lobe at its posterior end is 3 mm. wide, 10 mm. across the front, and following the convex surface is 15 mm. long; its projection on a plane surface is 8 mm. long. The first lateral furrows are deep, narrow, widely diverging forward, and concave outward. The second lobes are widest posteriorly where the width is 3·5 mm., in front less than 3 mm. wide, about as high as the central lobe, and their projections on a plane are 7 mm. long. The side lobes are 4 mm. long. The second lateral furrows are deep, narrow, and almost parallel to the front. The neck furrow is deep, narrow, and concave forward. The neck segment is complete.

Occurrence. Ordovician: English Head (3), English head.
Peabody Museum.

Order, **Proparia**

Encrinurus laurentinus n. sp.

Plate LIX, figures 2-5

Encrinurus multisegmentatus Billings, Cat. Sil. Foss., Anticosti, p. 61, 1866.

Pygidia and parts of cephala of this new species are quite abundant in some parts of the lower Anticosti rocks, but no entire specimens have been found. The marginal rim of the cephalon is narrow: a smooth space not over 1·5 mm. separates the margin from the base of the eye mound, which is a conical elevation about 1·5 mm. high, covered with rugged, conical tubercles and separated from the glabella by deep, narrow, and widely diverging furrows. It is 8 mm. between the summits of the eyes. The eyes are stalked mounds. The glabella is rounded in front, narrowed posteriorly to a neck which is not over 1·5 mm., wide; the front about 4 mm. wide; the whole covered with tubercles, of which those near the anterior margin are arranged in the form of a ring, are somewhat larger, and overhang the margin. The front tubercles are more or less dome-shaped; those near the back are conical. No glabella furrows are distinguishable. The neck furrow is deep posterior to the eyes, but is very shallow where it crosses the axis.

The pygidium is triangular, wider than long; an average example is 12 mm. long and 13 mm. wide, composed of from 35 to 40 segments which are deeply separated on the sides of the axis, but less so on the central portion and towards the posterior portion the segments are barely indicated. There are 12 or more side ribs. These are arched backward near the axis and become parallel to it near their extremities, and near the end the last two or three ribs are almost completely parallel. There are no tubercles on any part of the pygidium.

This trilobite was identified by Billings as *E. multisegmentatus* Portlock which it somewhat resembles. Through the courtesy of the officers of the Museum of Practical Geology, London, the writer was given an opportunity to study the material of Portlock on which the species was founded. The pygidium figured by Portlock has about 25 segments in the central lobe. These are less sharply separated on the top of the axis than on the sides, but are plainly shown. No nodes are on any part of the pygidium, and the length of the pygidium is equal to the width and each is about 16 mm. On the lateral slopes of the pygidium there are 13 segments. Anteriorly they roughly correspond to the axial segments, but posteriorly this is not the case.

The cephalon and fixed cheeks of Portlock's species are coarsely tuberculated. In front of the glabella there is a ring of 9 large tubercles. On each fixed cheek posterior and lateral to the eye there are 3 tubercles equal in size to those on the front margin. Each of these is between 1 and 2 mm. in diameter. Between the row in front of the glabella and the latter there is a small depression, behind which on the front of the glabella there is a row of 9 tubercles of which each is not more than one-third as large as those in front. Then follow 4 rows of tubercles with numbers 6, 5, 4, 3. Those of the row in which there are 6 are not more than half as large as those of the row on the front of the glabella, and posteriorly the decrease in size is systematic, those of the last row being quite faint. The front tubercles are rounded; those behind are somewhat conical. The other tubercles of the fixed cheeks are not more than a fifth or a fourth as large as the three larger ones on each cheek. The axial furrows are widely diverging, and the cephalon is 10 mm. long and 20 mm. wide. This arrangement of tubercles is quite different from that on the Anticosti examples, and the European form has fewer segments to the pygidium.

Occurrence. Ordovician: English Head (4), Makasti bay and MacDonald river; Vauréal (6), Vauréal river; Ellis Bay (1, 4-8), Junction cliff, Ellis bay, and Vauréal river.

Holotype and cotype, Nos. 2325e and 2325, Geol. Surv., Canada; other specimens in Peabody Museum and Twenhofel collections.

Encrinurus anticostiensis n. sp.

Plate LIX, figures 6-10

Encrinurus punctatus Billings, Cat. Sil. Foss., Anticosti, p. 61, 1866.

Of this species there are numerous pygidia and cephala and two nearly entire specimens (Twenhofel collection, holotype). The axial lobe of the pygidium has from 25 to 30 segments, which are represented by notches on the sides and become nearly obsolete toward the posterior end. It terminates in a hollow spine about 2 or 3 mm. long. There are from 5 to 7 low tubercles on this lobe with either 3 or 4 segments between any 2 segments bearing tubercles. There are 8 pairs of pleural segments, and these bear small tubercles near the proximal ends. The entire length of the pygidium is about 15 mm. Associated with the pygidia with terminal spines are others without such appendages. As they present no other differences, they have been referred to the same species. A nearly entire specimen from Sand cliff carries a spine, whereas a better specimen shows none, although the pygidium of the latter is somewhat mutilated, and it may have been present. One specimen which has two appendages was collected at Gun river (zone 3, Gun River formation). Another such specimen was collected at Iron river (zone 9 of Jupiter River formation). This may be a variation which could not maintain itself, but it may also be a distinct form.

There are 11 segments to the thorax. The seventh axial segment bears a large tubercle, and there is another on the tenth. There is also a tubercle on each of the 7 posterior lateral segments at about one-third the length from the proximal end.

The glabella is large and tumid, narrowing backward, the lateral lobes reduced to 3 large tubercles. It is nearly spherical in front and apparently overhangs the narrow anterior margin, completely covered with tubercles of different sizes. The axial furrows are deep and diverge anteriorly.

The eyes are pedunculate, situated on a tuberculated mound at the edge of which there is a ring of large tubercles. The genal angles at the junction of the neck segment and the margin each bears a large tubercle, and is thence prolonged into a spine about 5 mm. long. The Anticosti forms bear considerable resemblance to *E. punctatus* Wahlenburg.

Occurrence. Silurian: Gun River (3, 4), Jupiter (1-10), as a rule common.

Encrinurus elegantulus (Billings)

Plate LVI, figures 4, 5

Encrinurus elegantulus Billings, Cat. Sil. Foss., Anticosti, p. 62, 1866; *E. (Cybele) elegantulus* Vodges, Trans. San Diego Soc. of Nat. Hist., vol. I, No. 7, p. 64 (1907).

A single complete specimen (Twenhofel collection) collected on the expedition of 1919 permits a more complete description than hitherto has been possible. There are 9 pairs of pleura to the side lobes of the pygidium, of which the last pair is fused to the axis. The extension of these last two segments into spines may be true for some individuals, but there is no evidence of such in the complete specimen. The thorax has 11 segments, of which none bears nodes. The glabella is as described by Billings. The eyes are situated on tuberculated mounds and immediately surrounding each eye is a narrow, thread-like depression from which the spherical eye rises for a height of about 0·5 mm. The genal angles are sharply rounded and not spinose.

This species differs from *E. anticostiensis*, with which it is associated, in being without nodes or spines on any part of the thorax or pygidium, in having the tubercles of the glabella and eye mounds much smaller, in the absence of 10 conspicuous tubercles around the outer margin of the glabella, and in having the glabella of triangular shape rather than circular bulbous. Also, the eyes are not pedunculate, and the genal angles are not spinose.

Occurrence. Silurian: Jupiter (10), Jumpers.

The holotype is in the National Museum of Canada. A perfect specimen is in the writer's collection.

Sphaerocoryphe salteri Billings

Plate LI, figures 6, 7

Sphaerocoryphe salteri Billings, Cat. Sil. Foss., Anticosti, p. 63, 1866.

The genal angles are produced into spines having a width of about 1 mm. at the base in a specimen of which the middle lobe of the glabella has a width of 2 mm. The fixed cheeks extend to the posterior margin of the front lobe of the glabella, from which they are separated by extremely deep grooves. The front lobe of the glabella is flattened, resembles a ball when seen from above, and overhangs the anterior portion of the cephalon for about half its length. This species resembles *S. granulata* Angelin, but as no original material is available for comparison, it is thought best to retain the name given by Billings.

Occurrence. Ordovician: Ellis Bay (1, 2, 4, 5), Junction cliff and vicinity, and Ellis bay.

No. 2328, Geol. Surv., Canada, also Peabody Museum and Twenhofel collections.

Calymene meeki Foerste

Calymene blumenbachi Billings (partim), Cat. Sil. Foss., Anticosti, p. 28, 1866; *C. callicephala* Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, p. 698, etc. (1910); *Calymene meeki,* Foerste, Bull. Denison Univ., June, 1910, p. 84.

The Ordovician strata of Anticosti contain the above species in considerable abundance and present very little or no difference from those of the interior of North America.

The specific name *meeki* is used in preference to that of *callicephala*, as the latter was founded on a specimen stated to have been obtained from a locality where no rocks of the Richmond series occur, and, as Foerste has pointed out, the figure given by Green in his *Monograph of North American Trilobites* does not represent the trilobite common to the rocks of the Richmond division.

Occurrence. Ordovician: English Head (3-4), Vauréal (1-6), Ellis Bay (1-10), as a rule common.

Calymene niagarensis Hall

Calymene blumenbachi Billings (partim), Cat. Sil. Foss., Anticosti, p. 60, 1866; *C. niagarensis* Weller, Bull. Chicago Acad. Sci., vol. IV, pt. 2, p. 190 (See this paper for complete bibliography), 1907.

This species ranges throughout the Silurian portion of the Anticosti section. The lower forms are not readily distinguished from *C. meeki*, but careful examination will show that the longitudinal furrows of the cephalon are more nearly parallel, so that the width of the glabella is more nearly the same throughout. The anterior lobe of the glabella is also proportionately larger.

Occurrence. Silurian: Becscie (1-4); Gun River (1-4); Jupiter (1-10), as a rule common.

Calymene schucherti n. sp.

Plate LX, figure 1

At several horizons in the Anticosti Silurian are the remains of a large trilobite of the *C. vogdesi* type; but differing in several details about the cephalon. The size of the Anticosti form is about the same as that species. The chief differences are found in the glabella. In the Anticosti species the axial furrows are not so converging and the central portion of the glabella—the lobes excluded—is not so prominent as in *C. vogdesi*. The posterior lobes of the glabella are not so large, but are proportionately longer in a direction perpendicular to the axis; between the last lobe and that immediately preceding there is a plainly visible circular lobe. This is not shown in the Ohio form as figured by Foerste, and specimens from the type locality (Centreville, Ohio) do not show it. The occipital furrow of the Anticosti form is slightly different in its curves, and the fixed cheeks in their posterior portion have their margins nearly parallel instead of diverging toward the axis as in *C. vogdesi*. The axial lobes of the thorax are differently curved, and the posterior portion of the pygidium is not so rounded as in that species.

The salient differential features of *C. schucherti* are as follows. The terminus of the pygidium is straight; pygidium has 8 segments, the long posterior pair of lateral segments nearly parallel to the axis. On the glabella the second glabella lobe is partly fused to the fixed cheeks, thus interrupting the continuity of the axial furrows. The surface is finely granulated.

This new species also resembles the English *C. blumenbachi*, but the end of the pygidium of that species is not so straight, the lateral segments of the pygidium are shorter, and do not tend to become parallel to the axis; there are 6 or 7 segments to the pygidium instead of 8; and the longitudinal furrows of the cephalon are not interrupted by the partial fusion of the second glabellar lobes with the free cheeks.

Occurrence. Silurian: Jupiter (1-10), common in zones 1 and 3, rare elsewhere.

The holotype is in Peabody Museum, four nearly complete specimens are in the Twenhofel collection.

Ceraurus numitor (Billings)

Cheirurus numator Billings, Cat. Sil. Foss., Anticosti, p. 27, fig. 1, 1866; *C. pleurexanthemus* Billings, ibid., p. 27, 1866; Clarke, Pal. Minn., vol. III, pt. 2, pp. 737-738 (1897); Raymond and Barton, Bull. Mus. Comp. Zool., vol. LIV, No. 20, p. 540, Pl. I, fig. 5 (1913).

In the specimen purporting to be the holotype (No. 2199, Geol. Surv., Canada) the glabella widens anteriorly. The third pair of glabella furrows are no deeper than the second; but as the glabella is narrower, they appear to be so, and the same is true in respect to the second pair. The third pair of glabella furrows extend across to the next furrow, but are shallow as they cross over the lobe which they separate from the axial portion of the glabella. The greater part of the fixed cheeks is not more than two-thirds as long as the glabella, and the eyes are very close to the anterior margin. The neck furrow extends to the genal spines, is shallow and narrow on the cheeks, but deep and wide across the axis. The occipital segment is prominent, particularly over the axis. On the sides it is narrowed about the middle, and on each end of the narrowed part there is a tubercle. The axial portion is high and prominent with three tubercles or short stout spines on the apex, with the middle spine a little in advance of the other two. There appear to be at least 10 segments to the thorax, of which each bears 2 tubercles on the axial portion, these tubercles being in line with those on the occipital segment and about 1 mm. apart. No pygidia were found attached, although one specimen probably has its pygidium attached but buried in the matrix. Associated pygidia have lobose terminations of which the anterior pair are 16 mm. long on a specimen about 8 mm. wide at the anterior end. The other three pairs are very short.

Occurrence. Ordovician: English Head (3, 4), English head, Carleton point, and North and Makasti cliffs; Vauréal (1-6), generally common; Ellis Bay (4-6, 8), Ellis and Prinsta bays.

A single specimen of this species is in the collections of the Museum of Comparative Zoology. Other specimens are in the Peabody Museum and Twenhofel collections.

Cheirurus nuperus Billings

Plate LIV, figures 5, 6, 7

Cheirurus nuperus Billings, Cat. Sil. Foss., Anticosti, p. 60, fig. 20; *C. insigens*, ibid., p. 60 (1866).

This species resembles *Ceraurinus icarus*, having the same kind of glabella and short genal spines, but has the anterior spines of the pygidium elongated. The glabella, where well preserved, is minutely granulated, and the facial lobes are pitted. One specimen has a length of 55 mm., of which 18·5 mm. belong to the cephalon, 30 to the thorax, and 6·5 to the pygidium. The cephalon is 33 mm. wide at the genal angles, glabella 10 mm. wide, axis of thorax 8 mm. wide, lateral pygidial spines 10 mm. long.

The specimen purporting to be that identified by Billings as *C. insignis* Beyrich consists of the glabella and parts of the free cheeks. The longitudinal furrows are slightly closer in front than behind, expanding from a width of 6·5 mm. at the front to 8 mm. at the neck furrow. The length of the glabella including the occipital segment is 12 mm. The transverse glabella furrows are deep and of nearly equal length, the posterior pair turned toward the neck furrow, but not confluent therewith. The neck furrow is relatively shallow and bent forward a little in the middle of the glabella. The eyes are broken off, but are situated opposite the second lobe of the glabella. The surface of the glabella appears to be granular, but this is not certain as the integument is wanting. The fixed cheeks are pitted. The specimens have the characters of *C. nuperus* and are referred thereto. They came from Southwest point, zone 2 of Chicotte formation.

Occurrence. Silurian: Jupiter (1, 2, 9, 10); East cliff, Southwest point, Jupiter, Iron, and Salmon rivers, and Jumpers; Chicotte (2), Southwest point.

The types have not been found. The description is based on specimens in Peabody Museum.

Ceraurinus icarus (Billings)

Cheirurus icarus Billings, Can. Nat. and Geol., vol. V, p. 67, fig. 11 (1860); Billings, Cat. Sil. Foss., Anticosti, p. 27, 1866; *Ceraurinus icarus* Barton, Bull. Mus. Comp. Zool., vol. LIV, No. 21, p. 551, Pl., fig. 7, 1913.

The eyes have a small, shallow depression beginning at the side, extending around the posterior margin, and ending in a small pit near the base of the palpebral lobe. The surface is finely granular, and the fixed cheeks are covered with small depressions. On the thorax a little less than half the length of the pleuræ from their proximal ends, there is on each side of the axis a shallow furrow parallel to the longitudinal furrow, and just outside of this furrow there is in each furrow between the pleuræ a small elevation, one-half of which is made by each segment. One imperfect specimen has the glabella 15 mm. wide and this individual must have been fully 150 mm. long. A perfect specimen has a length of 37 mm., width of 18 mm. at the genal angles, and glabella with width of 7 mm.

C. icarus has three pairs of glabellar furrows, the last pair separating off an oval elevation by reaching the occipital furrow. There are 6 short spines of equal length to the pygidium, their distal margins forming a curve convex outward. *Cheirurus nuperus* also has three pairs of glabellar furrows, but the lateral spines of the pygidium are longer and broader than the others.

Occurrence. Ordovician: English Head (2-4); Vauréal (1-6); Ellis Bay (4, 5, 6, 8); generally common.

Pseudosphaerexochus canadensis (Billings)

Plate L, figure 13

Sphaerexochus canadensis Billings, Cat. Sil. Foss., Anticosti, p. 64, fig. 21, 1866.

There are only two pairs of glabellar furrows, the anterior pair very indistinct, the posterior sharply defined and not cutting off subcircular basal lobes. The holotype (No. 2557, Geol. Surv., Canada), shows an additional short and very shallow depression in front of the anterior furrow; this may represent a furrow. The glabella is 13 mm. long and 15 mm. wide and it is covered with small, dome-shaped tubercles about ½ mm. in diameter.

This species differs from *P. conformis* (Angelin) (considered synonymous with *P. granulata* Ang. by Schmidt) in having the anterior glabellar furrows less sharply defined and in that the posterior furrows do not cut off basal lobes.

Occurrence. Silurian: Chicotte (1), Southwest point.

Phacops (*Portlockia*) *orestes* (Billings)

Plate L, figures 11, 12

Phacops orestes Billings, Can. Nat. and Geol., vol. V, p. 65, figs. 10, 10a (1860); Billings, Cat. Sil. Foss., Anticosti, p. 61, 1866; Clarke, Pal. Minn., vol. III, pt. 2, p. 734 (1897); *Acaste orestes* Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. XXI, p. 710 (1910).

This probably is the most abundant species of trilobite in the Anticosti section, and there is no difficulty in obtaining many perfect specimens. The original description of Billings and the illustrations are ample for its identification.

Occurrence. Silurian: Gun River (3, 4), Jupiter (1-10), mostly common.

The types are in the National Museum of Canada. Excellent specimens are in the Peabody Museum and Twenhofel collections.

Dalmanites caudatus jupiterensis n. var.

Plate LX, figure 2

Dalmanites caudatus Brünnich, Salter, Mon. Brit. Trilobites, Pal. Soc., p. 49, Pl. III, figs. 4-8, Pl. IV, figs. 1-5 (1883).

The description is founded on a single, well-preserved cephalon and parts of a pygidium (Peabody Museum). The former is 15 mm. long and 32 mm. wide across the eyes. The anterior margin is rounded, slightly produced in the middle, and depressed—shovel-like, margined by a moderately broad furrow which, however, is narrow in front of the glabella. The frontal lobe of the glabella is of trapezoidal outline, 12 mm. wide, 7 mm. long, posterior portion more convex than anterior, slightly produced in the middle of the front with a shallow depression on each side, not markedly convex. The width of the second lobes slightly exceeds 1 mm. where they unite with the axis, but they are a little wider at the distal end. The third and fourth glabellar lobes are almost rings, not more than 1 mm.

wide, the third slightly fused with the second at the distal end. The first pair of furrows diverges from the axis, but the other two pairs and the neck furrow are perpendicular to the axis. The third and fourth pairs of furrows are deep on the sides and extend across the axis. The neck furrow is deep and narrow and slightly offset backward at the longitudinal furrows, the latter only moderately deep and not markedly diverging. The occipital segment is elevated on the axis and has a small knob in the centre.

The eyes are large, markedly lunate, the lens-bearing surface about 2 mm. high, 12 mm. around the arc, and 4 mm. across its chord. The top of the visual surface is about 1 mm. higher than the palpebral lobe, toward which it is inclined and around which there is a concentric groove. Lenses large and prominent, arranged in one vertical and two oblique rows, neither of which is most prominent. There are 36 vertical rows with 8 or 9 lenses in the middle rows and over 225 in all. The palpebral lobe is circular.

The facial suture originates at the lateral margin just back of the eye and, in a course obliquely convex forward, ascends to the eye, and thence down the side of the lateral furrow to the front margin in the manner characteristic of the genus. The surface is only sparingly smooth, but on the exfoliated surface of the frontal lobe of the glabella small tubercles are indicated. All that is known of the thorax is that the segments are grooved. The associated pygidium is poorly preserved and has at least 9 or 10 segments.

The specimen resembles the common *Dalmanites caudatus* from the English Silurian, but the eyes appear to be larger, though there is the same number of lenses with the same number in the vertical row. As a rule the English specimens are tuberculated, but such is only slightly true in the variety *vulgaris*. It also bears some resemblance to *D. verrucosus* Hall, but the surface is not nearly so highly tuberculated, and there are differences in the shape and size of the glabellar lobes.

Occurrence. Silurian: Jupiter (1, 6), vicinity of Jupiter river.

Chasmops anticostiensis n. sp.

Plate LX, figures 3, 4

Dalmanites macroura Billings (not Angelin), Cat. Sil. Foss., Anticosti, p. 61, 1866.

This species was doubtfully identified by Billings as *D. macroura* Angelin, with the statement that the "eye is rather smaller and closer to the glabella and the pygidium shorter and more round at the apex" and that the "vertical rows of lenses" in the eyes "are more conspicuous" than the oblique series, whereas the reverse is true in the specimen figured by Angelin.

The cephalon is broadly rounded in front, the posterior to a greater degree; genal angles prolonged into broad, flat spines which extend backward more than 10 mm. The free cheeks are small, originating at the margin about 4 mm. from a line drawn across the posterior margin. The suture first trends toward the anterior margin of the eye and then backward to its posterior margin, thence forward diverging slightly from the axis toward the lateral margin, thence around the large, anterior lobe of the glabella, and reaches the margin about 5 mm. from the centre of the glabella.

The eyes are large, lunate, and conical. The palpebral lobe is triangular and inclined toward the longitudinal furrows, the top on a level with the top of the eye, from which it is separated by a triangular depression concentric to the upper margin of the eye. The vertical rows of lenses are the more prominent, about 24 rows with about 12 lenses in the middle rows, and about 200 to the eye. The longitudinal furrows are deep and narrow. The anterior lobe of the glabella is 15 mm. long. The cat-ear lobes are separated from the glabella by shallow furrows. The neck furrow is deep and narrow and, lateral to the eyes, it diverges from the posterior margin. The entire head, particularly the glabella, is covered with small tubercles.

The pygidium is highly convex, subtriangular in outline, sides rounded; apex rounded angular and slightly elevated. The axial lobe extends to within 1·5 mm. of the apex. One of the largest is 18 mm. long and 24 mm. wide. The thorax has 10 segments. The sides appear to be nearly straight and parallel. The axial lobe is rather strongly convex, and the segments have a compound curve with the apex directed forward. The pleural lobes immediate to the furrows are somewhat flat, segments grooved, first curved backward and then forward, and with rounded ends. The complete specimen has a length of 55 mm., of which 15 mm. belong to the pygidium, 23 mm. to the thorax, and 17 mm. to the cephalon. This individual is 30 mm. wide at the genal angles.

The species differs from *Chasmops macroura* (Angelin) in having a greater proportional length to the cephalon and a greater number of lenses to the eye. The second and third lobes of the glabella of the Anticosti specimens are vestigial as they are in *C. macroura*. *Dalmanites breviceps* Hall from the upper part of the "Hudson River" group of Lebanon, Ohio, is a trilobite of the same type; but it has only 5 lenses to the vertical rows of the eye, the eye is far smaller, the cephalon shorter, and there are only 10 to 12 segments to the pygidium, whereas this species has from 16 to 18.

Several other species have similar cephala. One is *C. bisseti* Reed from Girvan district, Scotland (Reed, Mon. Lower Pal. Tri. Girvan Dist., Pal. Soc., 1903-1906, p. 157, Pl. XX, figs. 1-3); but the pygidium has 11 segments, is proportionately wider, the cat-ear lobes of the glabella are less elongated, the axial furrows of the glabella more diverging, the eye larger with 30 rows of lenses and from 12 to 14 lenses in the middle rows. Other forms are *C. wesenbergensis* Schmidt and the new Anticosti species described as *C. occidentalis*. It differs from the latter in having a larger head shield, the cat-ear lobes are of different shape and differently aligned, and the axial furrows of the pygidium are straight instead of curved. The curves of the axial segments of the pygidium are fewer, and they curve differently.

Occurrence. Ordovician: English Head (4), English head; Vauréal (1, 6), White cliff and Vauréal falls; Ellis Bay (1, 4-5, 7, 9), Junction cliff and vicinity, and Ellis bay.

The holotype and one additional specimen are in the National Museum of Canada. Other specimens are in Peabody Museum.

Chasmops cf. *truncato-caudatus* (Portlock)

Phacops truncato-caudatus Portlock, Geol. Rept. Tyrone, Pl. II, figs. 1-4. *Paradoxides bucephali*, ibid. (*labrum* only), Pl. I, fig. 8 (*vide* Salter), 1843; (Sect., *Dalmania*) Salter, Mem. Geol. Surv. of the United Kingdom, Art. 1, p. 7, Dec. 2 (1849); Salter, Morris Cat., 2nd ed., 1854; *Phacops (Chasmops) truncato-caudatus* Salter, Mon. Brit. Tri. Pal. Soc., p. 42, Pl. IV, figs. 13-15 (1883).

There is only a single glabella identified as above. It appears to resemble the European species very closely, the only apparent difference being that the glabella furrow second from the front curves backward a little more than it does in that species, whereas the second lobes of the glabella do not project forward so much, and the third lobes are turned backward a little instead of outward nearly at right angles. The specimen is broken off at the neck furrow, and although it may be distinct, the material at hand does not offer enough difference for separation (Peabody Museum).

Occurrence. Ordovician: Ellis Bay (2), Ellis bay.

Chasmops occidentalis n. sp.

Plate LX, figure 5

Dalmanites callicephalus Billings, Cat. Sil. Foss., Anticosti, p. 27, 1866.

This trilobite, identified by Billings as *D. callicephalus*, is represented by parts of two cephala and what is probably the pygidium of the same species. The better of the two head shields (the holotype) is 14 mm. wide and 9 mm. long. The other cephalon is about 20 mm. wide and 11 mm. long. The front margin is broadly rounded, but slightly pointed and projecting in the centre. Posterior margin straight across the axis, trending backward laterally and terminating in a genal spine with a length equalling that of the cephalon. On the larger of the two cephala the facial suture orginates at least 1·5 mm. back of a line drawn at the posterior margin of the eyes and trends forward, slightly diverging until on a line just in front of the rear margin of the eye, to which it then directly ascends. Its further course is not known. There are about 20 vertical rows of facets to the eyes and the number to a row varies with size. Eight is the greatest number observed. At the top they rise above the palpebral lobes, from which a small depression separates them. In the larger example the frontal lobe of the glabella is 10 mm. wide, 4 mm. long, and has a low, longitudinal depression in the middle of the front margin. In the smaller cephalon the frontal lobe of the glabella is 8·5 mm. wide and 3·5 mm. long. In this specimen the cat-ear lobes are ovoid in shape with the longer axis directed forward and outward, and there is a small depression at the proximal end. The third lobe is small, forming a ring across the axis where it is wider than elsewhere, separated from the occipital segment by the relatively deep and narrow neck furrow; the occipital segment highly elevated and prominent (these characters best shown in the larger example). The axial furrows of the glabella are deep, narrow, and rather widely diverging. Entire glabella surface covered with tubercles with little system in their arrangement.

The pygidium is about 16 mm. long and 12 mm. wide. Fourteen axial segments appear to be present. The anterior segment appears to be smooth on top and straight; the second curves forward in the middle and has 2 and perhaps 4 tubercles. The others curve backward in the middle and each has 4 tubercles. At the anterior end the axis is 5·5 mm. wide, and it is 1·5 mm. wide at the posterior end. The decrease in width is at first quite rapid, but near the mid-length the axial furrows become nearly parallel. There are 9 pairs of lateral segments, of which the last is quite indistinct. Each lateral segment is grooved for about two-thirds the length, each groove originating at about one-third the length from the axis. They trend backward and gradually merge with the depressions between the segments. The pygidium extends 2 mm. beyond the central axis and ends in a rounded angle.

Occurrence. Ordovician: English Head (3, 4), English head; Vauréal (4), Vauréal river.

Types in the National Museum of Canada; a single specimen in Peabody Museum.

BRANCHIOPODA

Ischyrina winchelli Billings

Plate LVI, figures 6, 7

Ischyrina winchelli Billings, Cat. Sil. Foss., Anticosti, p. 16, figs. 4a-c, 1866; Ulrich, Pal. Minn., vol. III, pt. 2, p. 613 (1897).

Shell equivalved with two strong ridges radiating from the beak in the interior of each valve. The right valve (left valve of Billings) is 21 mm. high at the umbones and is 29 mm. long. An evenly concave furrow with a maximum width of 6 mm. extends from the beak to the posterior extremity of each valve. The beaks are small, closely incurved, and in the cast it is probable that there is the impression of only a single beak. Three different types of lines ornament the surface: (1) concentric striæ placed at irregular intervals and most prominent along the ventral margin; (2) just anterior to the ridge bounding the dorsal posterior furrow there are 2 ridges and 3 furrows, the apices of the ridges being about 1 mm. apart and both ridges and furrows are covered with minute, parallel striæ to the number of about 6 to 1 mm.; (3) the rest of the surface is ornamented with radiating striæ which are a little more than 1 mm. apart on the posterior portion of the shell and a little less than 1 mm. on the anterior portion.

In his consideration of the genus *Technophorus*, Ulrich refers to this genus and states that "the internal ribs are better developed, the posterior one especially," and in a footnote it is stated that a study of the protero-types of *I. winchelli* and *I. plicata* showed "That in a cast of the interior of the first, the internal ribs are shown as represented by Billings. It shows further that the beaks are pressed down on the hinge and though the impression is of one valve only, the evidence is fairly conclusive that the beaks were united in casts as in *Technophorus*. The second species proves to be, as I expected, a true *Technophorus*, with close relations to *T. subacutus* and *T. punctostriatus*." A specimen in the writer's collections shows that the beaks are probably slightly separated in the cast.

Occurrence. Ordovician: English Head (2-4), English head, North and Makasti cliffs, and Carleton point.

The cotypes, No. 2114, are in the National Museum of Canada. Other specimens are in Peabody Museum.

Technophorus plicata (Billings)

Plate LVI, figure 8

Ischyrina plicata Billings, Cat. Sil. Foss., Anticosti, p. 52, 1866; *Technophorus plicata* Ulrich, Pal. Minn., vol. III, pt. 2, p. 613 (1897).

The casts of the two beaks show them united. In front of the beaks there is a deep impression made by partitions in the valves which evidently met in the living animal, since the depression is continuous from one side to the other. It has a depth of 1·5 mm. In the posterior portion of the shell there are 2 grooves which extend to the lower posterior angle; one lies immediate to the hinge-line and is about 2 mm. wide, the other is parallel and about half the width. The surface is ornamented by concentric rows of small papillæ, there being 7 to 8 rows to 1 mm.

Occurrence. Ordovician: Ellis Bay (4), Junction cliff and cape Eagle.

The holotype, No. 2291, is in the National Museum of Canada. A single specimen is in the Twenhofel collection.

OSTRACODA

By R. S. Bassler

Leperditia selwyni Jones

Leperditia selwynii Jones, Geol. Surv., Canada, Cont. Micro. Pal., pt. III, p. 89, Pl. XII, figs. 1-5 (1891).

This is the largest ostracod found in the Anticosti rocks, and it may be distinguished at once from the associated species by its size, although *L. anticostiana* approaches it in dimensions. The two valves vary somewhat in outline, but the general characteristics are too distinct from other Anticosti ostracods to require comparison.

Occurrence. Silurian: Becscie (4), Wreck beach; Gun River (2, 3) Gun river and Hannah cliff; Jupiter (1-10), as a rule common.

Leperditia frontalis Jones

Leperditia frontalis Jones, Quart. Jour. Geol. Soc. London, vol. XLVI, p. 547, Pl. XXI, figs. 8a, 8b (1890).

This Leperditia is 6·2 mm. long, 4·7 mm. high, and 3 mm. thick. The shape is subrhomboidal with the antero-lateral angle strongly pronounced.

Occurrence. Silurian: Jupiter (10), Jumpers.

Leperditia anticostiana (Jones)

Leperditia canadensis var. *anticostiana* Jones, Geol. Surv., Canada, Dec. III, p. 95, Pl. XI, fig. 17 (1858); *L. anticostiana* Billings, Cat. Sil. Foss., Anticosti, Geol. Surv., Canada, p. 66, 1866; Jones, Ann. and Mag. Nat. Hist. (5), vol. XIV, p. 341 (1884); Dwight, Trans. Vassar Bros. Inst., vol. V, p. 76 (1890); *L. anticostiensis* Jones, Geol. Surv., Canada, Con. Micro-Pal., pt. 3, pp. 98, 99 (1891); *L. fabulities anticostiana* Jones, Ann. and Mag. Nat. Hist. (5), vol. VIII, p. 344, Pl. XIX, fig. 8 (1881).

Specimens which most closely resemble the figures of this form given by Jones occur in the Gun River and Jupiter formations at several Anticosti localities. As pointed out by Jones, these specimens have a rather short hinge-line and well-marked ocular tubercle and muscle spot, visible only by its slightly darker tint. Other characteristics are the strong, central convexity from which the valves slope rapidly.

Jones cites the species from the upper part of the Hudson River group at East point, Anticosti, but it is believed that his specimens were obtained in the Jupiter formation at this locality. The species occurs also in the Jupiter formation at East Jupiter cliff and other localities in Anticosti.

Occurrence. Silurian: Jupiter (1, 3-6), East cliff, Jupiter river, etc.

Isochilina vaurealensis n. sp. [1]

Plate LX, figure 6

This ostracod is small. It is equally convex over most of the surface, except at the base where it is rather sharply deflected to the union of the two valves. The larger and less perfect of the two specimens (Twenhofel collection) collected is 65 mm. long and about 4·5 mm. high. The smaller specimen, which is taken as the holotype, is perfect. It has a length of 5·5 mm. and a height of 4·5 mm. The hinge-line is 4 mm. long with the eye spot 1 mm. posterior to the anterior end of the hinge and about 1 mm. below it. Over the surface are a great number of dark spots.

Occurrence. Ordovician: Vauréal (6), Vauréal falls.

Aparchites minutissimus (Hall)

Leperditia (Isochilina) minutissima Hall, Twenty-fourth Rept. New York State Cab. Nat. Hist. (ext. 1871, p. 7), p. 231, Pl. VIII, fig. 13 (1872); *L. minutissima* Miller, Cincinnati Quart. Jour. Sci., vol. I, p. 122 (1874); *L. (Isochilina) minutissima* Hall and Whitfield, Geol. Surv., Ohio, Pal. II, p. 102, Pl. IV, figure 4 (1875); *Aparchites minutissimus* Ulrich, Geol. Surv., Canada, Cont. Micro-Pal., pt. 2, p. 49, Pl. IX, fig. 5 (1889); Whiteaves, Geol. Surv., Canada, Pal. Foss., vol. III, pt. 2, p. 126, 1895.

The Anticosti collections contain several specimens of this small Aparchites. The convexity of the valve varies, the surface in some cases not rising into a subcentral prominence.

Occurrence. Ordovician: Vauréal (1), Sauvage cove.

[1] Description by W. H. Twenhofel.

Schmidtella sublenticularis (Jones)

Polycope sublenticularis Jones, Quart. Jour. Geol. Soc. London, vol. LXVI, p. 550, Pl. XXI, figs. 6a, 6b (1890).

The shell is 1·1 mm. long, 0·86 mm. high, and 0·53 mm. thick. The shape is suborbicular and the colour usually is black.

Occurrence. Ordovician: English Head (3, 4), English head; Vauréal (1), Sauvage cove.

Primitia ? lativia Ulrich

Primitia lativia Ulrich, Geol. Surv., Canada, Cont. Micro-Pal., pt. 2, p. 50, Pl. IX, figs. 8, 8a (1889); Whiteaves, Geol. Surv., Canada, Pal. Foss. III, pt. 2, p. 126 (1895).

An average specimen is 1·35 mm. long, 0·91 mm. high, and 0·3 mm. thick. The valves are rather strongly convex and suboval. The dorsal margin is straight and equal to two-thirds the length of the valve. Ventral margin convex. Sulcus wide, strongly impressed, extending from the dorsal margin half-way across the valve.

Occurrence. Ordovician: English Head (4), nid de Corbeau.

Tetradella lunatifera (Ulrich)

Strepula lunatifera Ulrich, Geol. Surv., Canada, Cont. Micro-Pal., pt. 2, p. 56, Pl. IX, figs. 14-14b (1889); Lesley, Geol. Surv., Pennsylvania, Rept., P 4, p. 1100, text figs. (1890); *Tetradella lunatifera* Ulrich, Jour. Cincinnati Soc. Nat. Hist., vol. XIII, p. 112 (1890); Ulrich. Geol. and Nat. Hist. Surv., Minnesota, Final Rept., vol. III, P 2, p, 680, Pl. XLVI, figs. 12-14, text figs. 51a, 51b (1894); Whiteaves, Geol. Surv., Canada, Pal. Foss., vol. III, pt. 2, p. 127 (1895); Ulrich and Bassler, Proc. U.S. Nat. Mus., vol. XXXV, Pl. XXXIX, fig. 6 (1908).

A large valve is 1·55 mm. long, 0·87 mm. high, and a single valve is 0·32 mm. thick. Valves slightly elongate-oval in outline. The dorsal edge is straight and one-fifth shorter than the length of the valve.

Occurrence. Ordovician: Vauréal (3), cape Henry.

Tetradella simplex (Ulrich)

Tetradella quadrilirata var. *simplex* Ulrich, Geol. Surv., Canada, Cont. Micro-Pal., pt. 2, p. 55, Pl. IX, fig. 13 (1889); Whiteaves, Geol. Surv., Canada, Pal. Foss., vol. III, pt. 2, p. 127 (1895); *Tetradella simplex* Ulrich and Bassler, Proc. U.S. Nat. Mus., vol. XXXV, p. 307 (1908).

This species, originally considered a variety of the very abundant *Tetradella quadrilirata*, differs from that form in having the postero-median ridge simple instead of bifurcated below. The vertical plates dividing the anterior edge of *T. quadrilirata* into shallow cavities are also developed either not at all or to a very slight extent.

Occurrence. Ordovician: Vauréal (3), cape Henry.

Ctenobolbina hammelli (Miller and Faber)

Beyrichia hammelli Miller and Faber, Jour. Cincinnati Soc. Nat. Hist., vol. XVII, p. 156, Pl. VIII, fig. 26 (1894); Miller, N. Amer. Geol. and Pal. Soc. App., p. 787, text fig. 1458 (1897); *Ctenobolbina hammelli* Ulrich and Bassler, Proc. U.S. Nat. Mus., vol. XXXV, p. 310 (1908); *C. ciliata* var. *hammelli* Cumings, Dept. Geol. and Nat. Res. Indiana, 32nd Ann. Rept., p. 1045, Pl. LIII, fig. 8 (1908).

Several specimens of a *Ctenobolbina* apparently agreeing in all respects with *C. hammelli* were noted in zones 2 and 3 of the English Head formation at Dry point.

Occurrence. Ordovician: English Head (2, 3), Dry point.

Beyrichia parallela (Ulrich)

Primitia? (Beyrichia) parallela Ulrich, Geol. Surv., Canada, Cont. Micro-Pal., pt. 2, p. 51, Pl. IX, fig. 7 (1889); *Beyrichia (Primitia?) parallela* Ulrich, Jour. Cincinnati Soc. Nat. Hist., vol. XIII, p. 125, Pl. X, fig. 15 (1890); *B. parallela* Ulrich and Bassler, Proc. U.S. Nat. Mus., vol. XXXV, p. 319, fig. 64 (1908).

An average specimen is 0·8 mm. long, 0·4 mm. high, and the greatest convexity of the valves is 0·13 mm. The general shape is subquadrate. The ends are subequal with the posterior more blunt than the anterior. A well-marked sulcus extends from about the middle of the dorsal line to about the centre of the valve.

Occurrence. Ordovician: Vauréal (3), cape Henry.

Beyrichia diffusa Jones

Beyrichia diffisa Jones, Quart. Jour. Geol. Soc. London, vol. XLVI, p. 546; Pl. XXI, fig. 7 (1890).

No specimens agreeing with the figure of this species have been found in the large collections examined. This in connexion with the fact that the type is broken apparently by pressure against the *Atrypa* causes a suspicion that the split lobe characteristic of the species is only an accidental fracture. It is very probable that *Beyrichia diffisa* Jones and *B. venusta* Billings refer to the same species.

Occurrence. Silurian: Jupiter (4-6), Jupiter river.

Bolbibollia labrosa Ulrich and Bassler

Bolbibollia labrosa Ulrich and Bassler, Maryland Geol. Surv., Silurian vol., pp. 299, 301, figs. 16-18, p. 298 (1923).

This interesting, small ostracod, which occurs not uncommonly on slabs of the Jupiter River formation, is distinguished by its general Bollia-like outline, but with the males and females distinct, the latter bearing a well-defined brood pouch. In this particular species the yoke-like loop is small and low and its axis is oblique to the hinge-line. The cardinal angles are very obtuse and a thick, false border occurs around the ventral half.

Occurrence. Silurian: Jupiter (10), Jumpers.

Chilobolbina punctata Ulrich and Bassler

Chilobolbina punctata Ulrich and Bassler, Maryland Geol. Surv., Silurian vol., p. 516, Pl. XXXVII, figs. 10-12 (1923).

Valves rather strongly convex, somewhat asymmetrical, highest in posterior half, swung slightly backward, the anterior cardinal angle sharper than the posterior; sulcus median in position, short and narrow, gently curved around the anterior side of the low swelling that corresponds to the median lobe of the Beyrichiacea; surface minutely puncto-reticulate. Frill wide on ventral side, narrowing toward the cardinal angles, radially striated, concave to a sharp rim from which the surface descends abruptly into the ventral groove; pouch long, subelliptical, prominently convex, clearly defined, smooth. Length about 1·25 mm.; greatest height, excluding frill, 1·65 mm.; greatest width of frill, 0·17 mm.

Occurrence. Silurian: Jupiter (2), East cliff.

Chilobolbina billingsi (Jones)

Primitia billingsi Jones, Quart. Jour. Geol. Soc. London, vol. XLVI, p. 547, Pl. XXI, fig. 10 (1892); *Chilobolbina billingsi* Ulrich and Bassler, Maryland Geol. Surv., Silurian vol., p. 218, Pl. XXXVII, figs. 4-6 (1923).

Average length about 2·0 mm.; height 1·25 mm. Ends subequal, the antero-cardinal angle rectangular, the posterior angle broader. Valves rather strongly convex, highest in the ventral half, with a low, curved swelling on either side of the middle along the cardinal edge; surface puncto-reticulate, with a large, smoothly bordered ovate and sharply outlined median pit, two-thirds of which lies within the ventral half; midway between the pit and the base of the frill is a narrow, impressed line curved so as to parallel the ventral edge. Frill concave, striated, evidently wide though imperfectly preserved on all of the specimens so far observed. Brood pouch not seen in the material from lake Huron, the collection either containing only valves of males, or if any are female, the pouch has been broken away with the frill. That the species is a true *Chilobolbina* is clearly established by collections from the Gun River and Jupiter River formations in the island of Anticosti. The pouch in these specimens is large and higher than in *C. punctata*, but not so elongate.

The identification of these specimens with *Primitia billingsi* Jones is not entirely satisfactory, the figure and description given by Jones being indefinite in various particulars. His type of the species may really belong to a species of *Apatobolbina* that is not an uncommon fossil in the Gun River and Jupiter formations.

Compared with other species, *C. billingsi* is distinguished at once from *C. punctata* by its more nearly equal-ended, almost symmetrical carapace, more definitely outlined and wider median pit, and the curved impressed line between the pit and the base of the frill. The low swellings along the cardinal edge also are wanting in that species.

Occurrence. Silurian: Gun River (3, 4); Jupiter (1-4), Jupiter river.

Apatobolbina granifera Ulrich and Bassler

Apatobolbina granifera Ulrich and Bassler, Maryland Geol. Surv., Silurian vol., p. 522, Pl. XXXVII, figs. 17-19 (1923).

Length with frill 1·75 mm., height 1·3 mm. Valves rather strongly convex, moderately asymmetrical, highest in posterior half, oblique, the postero-cardinal angle barely distinguishable, the anterior more distinct and commonly distinctly though obtusely angular; frill radially striated, moderately wide in post-ventral region, narrowing toward the cardinal angles; umbilical spot not depressed, smooth, rounded, situated a little forward and beneath middle of valve; posterior cardinal fourth with a thick, undefined, submarginal, smooth swelling; middle and ventral slopes of valve with small and rather loosely arranged granulation. Brood pouch of female a large, very prominent, oval bulb that extends upward on the post-ventral slope and downward across and beyond the edge of the frill. On our specimen it is longitudinally traversed by fine lines.

Occurrence. Silurian: Jupiter (10), Jumpers.

Apatobolbina acuta n. sp.

Apatobolbina acuta Ulrich and Bassler, Maryland Geol. Surv., Silurian vol., p. 523 (1923).

This species differs from *A. granifera* Ulrich and Bassler, with which it is associated, in lacking the surface granulations and in having a longer hinge-line with the antero-cardinal angle slightly produced and sharply angular.

Occurrence. Silurian: Jupiter 10), Jumpers.

Primitiella canadensis n. sp.

Aparchites unicornis var. Ulrich, Geol. Surv., Canada, Cont. Micro-Pal., pt. II, p. 50, Pl. IX, fig. 11 (1889).

This species has hitherto been regarded as a variety of *Primitiella unicornis*, a very abundant fossil of the Fulton (Utica) shale at Cincinnati, Ohio, but it seems to the author that sufficient differences between the two exist to warrant a new specific name. Comparing the Richmond and Utica forms carefully, *P. canadensis* will be noted to have the two ends less equal and the spine more strongly developed and less well-defined. The valves of *P. unicornis* are almost equal ended and the spine is small, but sharply defined. The mesial depression in *P. canadensis*, although slight, is more strongly marked than in the Utica species.

Occurrence. Ordovician: Vauréal (3), cape Henry.

Ulrichia nodosa (Ulrich)

Primitia nodosa Ulrich, Jour. Cincinnati Soc. Nat. Hist., vol. XIII, p. 134, Pl. X, figs. 11a, 11b (1890); *Ulrichia nodosa* Ulrich, ibid., p. 203 (gen. ref.), 1891.

This species is represented in the parts of the Anticosti section noted by typical examples.

Occurrence. Ordovician: English Head (4), nid de Corbeau; Vauréal (3), cape Henry.

Bollia semilunata Jones

Bollia semilunata Jones, Quart. Jour. Geol. Soc. London, vol. XLVI, p. 548, Pl. XXI, figs. 9a, 9b (1890).

An average specimen is 0·68 mm. long, 0·54 mm. high, and 0·32 mm. thick. The outline is nearly two-thirds of an irregular disk with the hinge-line the truncated edge. The horse-shoe lobe is nearly symmetrical, relatively strong, and not reaching below the middle of the valve, but touching each end of the hinge-line.

Occurrence. Ordovician: Vauréal (2-5), as a rule common; Ellis Bay (1, 2), Junction cliff and Ellis bay.

Zygobolba decora (Billings)

Beyrichia decora and *B. venusta* Billings, Geol. Surv., Canada, Cat. Sil. Foss., Anticosti, pp. 68, 69, 1866; *Zygobolba decora* Ulrich and Bassler, Maryland Geol. Surv., Silurian vol., p. 537, Pl. XXXIX, figs. 15-22; Pl. XL, figs. 11-14; Pl. LXIV, figs. 21-25 (1923).

Length of an average carapace of the male form about 2 mm., height of same 1·27 mm. Dimensions of largest male valve observed, 2·75 mm. by 1·75 mm. Females commonly exceed males in size, the length of the largest seen about 3·10 mm.

Billings did not illustrate specimens of his species *Beyrichia decora* and *B. venusta*, nor is it known that he marked any specimens as types of them. In the circumstances we are compelled to depend solely upon his descriptions in identifying the forms referred to by him in material collected at the same places as those from which his specimens were procured. Localities particularly mentioned by Billings are East cliff and Jumpers. In determining which, of a number of congeneric forms found at those two places, is the most likely to be the same as the species mainly used by him in describing *B. decora* and *venusta* we must choose the one most plentiful at the places mentioned. The selection then was made in accordance with this probability.

In studying the descriptions of *Beyrichia decora* and *B. venusta* it soon appeared that the former was founded on valves of females, the latter on those of males of the same species. At the time Billings wrote these descriptions the discrimination of the sexes in specimens of *Beyricheacea* was not appreciated as at present, and as the two commonly look very unlike, no particular blame attaches to Billings on account of his failure to recognize the specific identify of the two forms described by him. Aside from the fact that in the mature female the brood pouch covers most of the post-ventral quarter of the valve, whereas in the male this pouch is wanting, the valves in the two sexes are practically alike.

It may be well to direct attention to the exceeding constancy in size, form, and details of lobation displayed by these specimens. It may be added that a like degree of fidelity to type is maintained by all the other species, of which many specimens have been collected. This statement is perhaps required to convince those palæontologists who have not made extensive studies of fossil *Ostracoda* that their separation into numerous species and the subsequent recognition of the latter is a practicable undertaking.

Occurrence. Silurian: Jupiter (10), Jumpers.

Zygobolba anticostiensis Ulrich and Bassler

Zygobolba anticostiensis Ulrich and Bassler, Maryland Geol. Surv., Silurian vol., p. 557, Pl. LXIV, figs. 3-7 (1923).

A widely distributed and usually abundant species, with somewhat longer valves, thicker and more prominent lobes, thicker and higher rim, and deeper concave border than *Z. curta.* Also related to *Z. decora* (Billings), the most common and characteristic of the species of the overlying Jupiter River ostracod zone, but differing in its shorter form, less unequal ends, longer posterior lobe, and deeper, as well as longer, median sulcus.

Occurrence. Silurian: Jupiter (2), East cliff.

Zygobolba excavata Ulrich and Bassler

Zygobolba excavata Ulrich and Bassler, Maryland Geol. Surv., Silurian vol., p. 557, Pl. LXIV, figs. 8-13; Pl. LXV, fig. 6 (?) (1923).

The extraordinarily wide and deeply excavated border and the steepness and evenness of the anterior slope are characteristic. These features, together with its larger size, the more broadly curved ventral part of the loop, and longer posterior lobe and sulcus, distinguish the species from the associated and supposedly nearest relative *Z. anticostiensis.*

The female form of the species has not been observed unless, as is strongly suspected, the specimen doubtfully referred to *Z. twenhofeli* actually belongs here.

Occurrence. Silurian: Jupiter (2), East cliff.

Zygobolba robusta Ulrich and Bassler

Zygobolba robusta Ulrich and Bassler, Maryland Geol. Surv., Silurian vol., p. 558, Pl. LXIV, figs. 18-19 (1923).

Allied to *Z. prolixa* Ulrich and Bassler from the Lower Clinton of New York and Virginia, but has higher valves, thicker and more bulbous median lobe, the anterior limb of the loop more erect, a wider border, and a much deeper and wider depression between the posterior lobe and the elevated border. In some of these respects the species resembles *Z. excavata*, a Gun River species, but is readily distinguished by its larger size, more oblong shape, more convex anterior slope, and less carinate loop. Other closely related species are *Z. rectangula*, which differs in outline and in having a longer loop, and *Z. twenhofeli*, which has a thinner and narrower rim, more diverging loop, and ventrally fuller posterior lobe.

Occurrence. Silurian: Jupiter (10), Jumpers.

Zygobolba intermedia Ulrich and Bassler

Zygobolba intermedia Ulrich and Bassler, Maryland Geol. Surv., Silurian vol., p. 559, Pl. LXIV, fig. 20 (1923).

This form is intermediate in most of its characters between *Z. excavata* and *Z. robusta.* However, it is somewhat shorter than either, the limbs of the loop are more nearly parallel and their passage into the connecting ventral part is more abrupt. Further, the ventral part of the outline is more convex and the anterior slope steeper and not broadly convex as in *Z. robusta.* In the latter respects it is like *Z. excavata,* but the posterior lobe and sulcus are both narrower and the submarginal excavation is neither so broad nor so deep as in that species.

As *Z. intermedia* occurs associated with *Z. decora* at the two places where it has been found, collectors will be more concerned with its separation from that exceedingly abundant species than from the really closer allies with which it has been compared. In the collections now available *Z. intermedia* is much less common than *Z. decora.* The former also is a trifle larger. But the main and most constant as well as the most striking differences between them are in the shapes of their valves, the rate of divergence of the limbs of the loop, and the strength and elevation of the rim. Thus in *Z. intermedia* the valves are relatively shorter and the loop longer, the limbs of the loop are more erect and subparallel and never diverge so much as in *Z. decora,* in which the loop commonly is more V-shaped than U-shaped, the ends of the valves are more nearly equal in height, and the anterior end is never distinctly narrower than the posterior, and the rim, especially on the ventral side, is not so thick nor so high as in *Z. decora.*

Occurrence. Silurian: Jupiter (10), Jumpers.

Zygobolba rectangula Ulrich and Bassler

Zygobolba rectangula Ulrich and Bassler, Maryland Geol. Surv., Silurian vol., p. 560, Pl. LXV, figs. 1-4 (1923).

This species is characterized particularly by the length and vertical disposition of the limbs of the loop, the nearness of the base of the loop to the ventral border, the rectangular and strong antero-dorsal angle, thickness of the rim, the relatively strong inflation of the posterior limb of the loop, and the unusual fulness of the ventral third of the anterior lobe. These characters will serve in distinguishing the species from *Z. robusta,* in which also the depression between the posterior lobe and the elevated rim is larger. *Z. twenhofeli,* with which *Z. rectangula* is found in Anticosti, is not so easily separated. The difficulty is occasioned mainly by the fact that there are two intermediate varieties; one having the antero-dorsal angle sharp and rectangular as in this species, whereas the other characters are as they should be in *Z. twenhofeli;* the other resembling *Z. rectangula* in the ventral reduction of the posterior lobe. In typical examples of *Z. twenhofeli* the anterior extremity of the hinge is somewhat obtusely angular, the rim is rather thin, and the loop on the whole is thinner and its lower end farther removed from the ventral edge, and the lower third of half of the posterior lobe fuller than in *Z. rectangula.* The female form of the species has not been positively identified.

Occurrence. Silurian: Jupiter (2), East cliff.

Zygobolba twenhofeli Ulrich and Bassler

Zygobolba twenhofeli Ulrich and Bassler, Maryland Geol. Surv., Silurian vol., p. 560, Pl. LXV, figs. 5, 7-9 (?) (1923).

This species is approximately of the same size, associated with, and structurally most closely related to, *Z. rectangula*. In size the two exceed the average for the genus and are larger than all others of the family found in Anticosti. Recognition of the species on the slabs of Jupiter limestone, therefore, requires unusual care only in distinguishing it from *Z. rectangula* which commonly is found with it. Typical specimens of *Z. twenhofeli* are easily separated by the relative thinness of their rims, the inferior inflation of the posterior limb of the loop, and the unusual fullness of the ventral third of the posterior lobe. As a rule, too, the limbs of the loop diverge more, the anterior limbs especially being less nearly vertical than in *Z. rectangula*. The loop is, also, somewhat shorter and its ventral extremity farther removed from the edge of the valve. Unfortunately the slabs containing the types of the two species also exhibit occasional specimens that fail in one or more respects to maintain the normal distinctions between the two. In one the specimen is normal for *Z. twenhofeli* in every respect except that the ventral part of the posterior lobe lacks the fullness that it should have. The other two specimens are normal in this and all other respects except that the antero-dorsal is too sharp, thus being like *Z. rectangula*. However, when specimens are many, and all are conscientiously compared, such departures from type are to be expected.

Occurrence. Silurian: Jupiter (2), East cliff.

Zygobolba inflata Ulrich and Bassler

Zygobolba inflata Ulrich and Bassler, Maryland Geol. Surv., Silurian vol., p. 562, Pl. LXV, figs. 12-27 (1923).

This is a rather variable and usually small species, which is more closely allied to *Z. rectangula* than to any of the other species described in this work. Both have rectangular antero-cardinal extremities, a long loop with only slightly diverging limbs and rather strongly inflated posterior limbs, and broadly sloping anterior lobe. But the two certainly are not the same species, *Z. inflata* being constantly smaller, more delicate and emaciated in appearance, with thinner though higher rim and ventrally less convex body. It should be observed that, as is usually the case, the ridges appear thinner and sharper in the specimens that are preserved in shale than in the testiferous examples.

Occurrence. Silurian: Jupiter (2), East cliff.

Krausella anticostiensis (Jones)

Bairdia anticostiensis Jones, Quart. Jour. Geol. Soc. London, vol. XLVI, p. 548, Pl. XXI, figs. 3a, b (1890); *Krausella anticostiensis* Ulrich, Geol. and Nat. Hist. Surv., Minn., Final Rept., vol. III, pt. 2, p. 691 (1894).

The elongate, smooth, subrhomboidal valve with the spinous process serves to distinguish this species. This process is confined to the right valve, however, the left valve being much like associated species of *Bytho-*

cypris. In all probability *Bythocypris obtusa* is founded on the left valve of *K. anticostiensis*.

Occurrence. Ordovician: English Head (2, 3), English head; Vauréal (3, 4), common.

Bythocypris cylindrica (Hall)

Leperditia (Isochilina) cylindrica Hall, New York State Cab. Nat. Hist., Twenty-fourth Rept., p. 231, Pl. VIII, fig. 12 (1872); *L. cylindrica* Miller, Cincinnati Quart. Jour., vol. I, p. 122 (1874); *L. (Isochilina) cylindrica* Hall and Whitfield, Geol. Surv., Ohio, Pal. II, p. 101, Pl. IV, figs. 5 (1875); *L. cylindrica* Miller, Cincinnati Quart. Jour. Sci., vol. II, p. 351 (1875); *Primitia minuta* (part) Jones, Quart. Jour. Geol. Soc. London, vol. XLVI, p. 7, Pl. III, figs. 18, 19 (not figs. 21-23) (1890); *Bythocypris cylindrica* Ulrich, Geol. and Nat. Hist. Surv., Minn., Final Rept., Pal. III, pt. 2, p. 687, Pl. XLIV, figs. 29-35 (1894); Ulrich, Geol. Surv., Canada, Cont. Micro-Pal., pt. 2, p. 48, Pl. IX, fig. 6 (1889); Ruedemann, New York State Mus., Bull. No. 49, p. 86, Pl. VII, figs. 26, 28 (1901).

A small, subcylindrical ostracod of the genus *Bythocypris*, occurring in the Anticosti collections, is so similar in general shape and outline to the wide-ranging *B. cylindrica* (Hall) that it can be referred only to that species. The shape and overlapping of the valves will distinguish this from other ostracoda, whereas all of the associated species of *Bythocypris* are larger and of different outline.

Occurrence. Ordovician: Vauréal (3), cape Henry.

Bythocypris lindstroemi Jones

Bythocypris? lindstroemi Jones, Quart. Jour. Geol. Soc. London, vol. XLVI, p. 548, Pl. XXI, figs. 11a-c (1890).

An average specimen is 1·2 mm. long, 0·6 mm. high, and 0·48 mm. thick. It is said to closely resemble *B. symmetrica* Jones.

Occurrence. Ordovician: English Head (2-4), Vauréal (1-5), commonly present; Ellis Bay (1, 2), commonly present.

Bythocypris obtusa Jones

Bythocypris? obtusa Jones, Quart. Jour. Geol. Soc. London, vol. XLVI, p. 549, Pl. XXI, figs. 4a-b (1890).

As noted under the description of *Krausella anticostiensis*, *B. obtusa* in all probability represents only the left valve of the former species.

Occurrence. Ordovician: English Head (2-4); Vauréal (2-4), generally common.

Macrocypris subcylindrica Jones

Macrocypris? subcylindrica Jones, Quart. Jour. Geol. Soc. London, vol. XLVI, p. 549, Pl. XXI, figs. 5a-b (1890).

An average specimen is 1·6 mm. long, 0·5 mm. high, and 0·6 mm. thick. The outline is subcylindrical and nearly straight above and below.

Occurrence. Ordovician: English Head (2-4), English head.

DESCRIPTION OF THE PLATES

(All figures are natural size except where otherwise stated.)

The trilobite *Triarthrus becki macastyensis* was drawn by Mr. G. S. Markentin, and he has also retouched some of the photographs. Most of the photographs were made by the official photographer of the Geological Survey, Canada; a few were made by Mr. A. M. Vinje of Madison, Wisconsin, and Dr. M. E. Diemer of the University of Wisconsin. The illustrations of the bryozoa were prepared by Dr. R. S. Bassler. The illustrations of cephalopods were made by Dr. A. F. Foerste. (V) or (Y) after a description denotes in the former instance that the specimen figured is in the National Museum of Canada and the latter that it is in Peabody Museum.

PLATE I

FIGURE 1. *Lockeia anticostiana* n. sp. Holotype.
Near White brook. Zone 4, English Head formation. (Y). (Page 99).

FIGURE 2. *Hyalostelia anticostiana* n. sp. Holotype.
Jupiter cliff. Zone 6, Jupiter formation. (Y). (Page 103).

FIGURE 3. *Dictyonema insulare* n. sp. Holotype.
Stated to have come from Ellis bay: if so, probably from zone 4, Ellis Bay formation. (V). (Page 107).

FIGURE 4. *Dictyonema insulare* n. sp.
Portion of the holotype. X 5. (Page 107).

FIGURE 5. *Dictyonema jupiterense* n. sp. Holotype.
Jumpers. Zone 10, Jupiter formation. One side of a cone on the exterior of which the entire circumference of the organism is shown. X 3. (Page 108).

FIGURE. 6. *Zaphrentis anticostiensis* n. sp. Paratype.
Cape Sandtop bay. Zone 4, Gun River formation. Longitudinal section. (Y). (Page 114).

FIGURE 7. *Zaphrentis anticostiensis* n. sp.
Same locality and zone as paratype. Transverse section of another specimen, made about mid-length. (Y). (Page 114).

FIGURE 8. *Zaphrentis anticostiensis* n. sp. Holotype.
Same locality and zone as paratype. Side view. (Y). (Page 114).

FIGURE 9. *Ischadites? insularis* (Billings). Holotype.
Ellis Bay formation, Ellis bay. (V 2228). X 2. (Page 102).

FIGURE 10. *Cyclocrinites intermedius* (Billings)
One of the cotypes, cape MacGilvray, zone 3 of Gun River formation. (V 813i) (Page 102).

Plate I

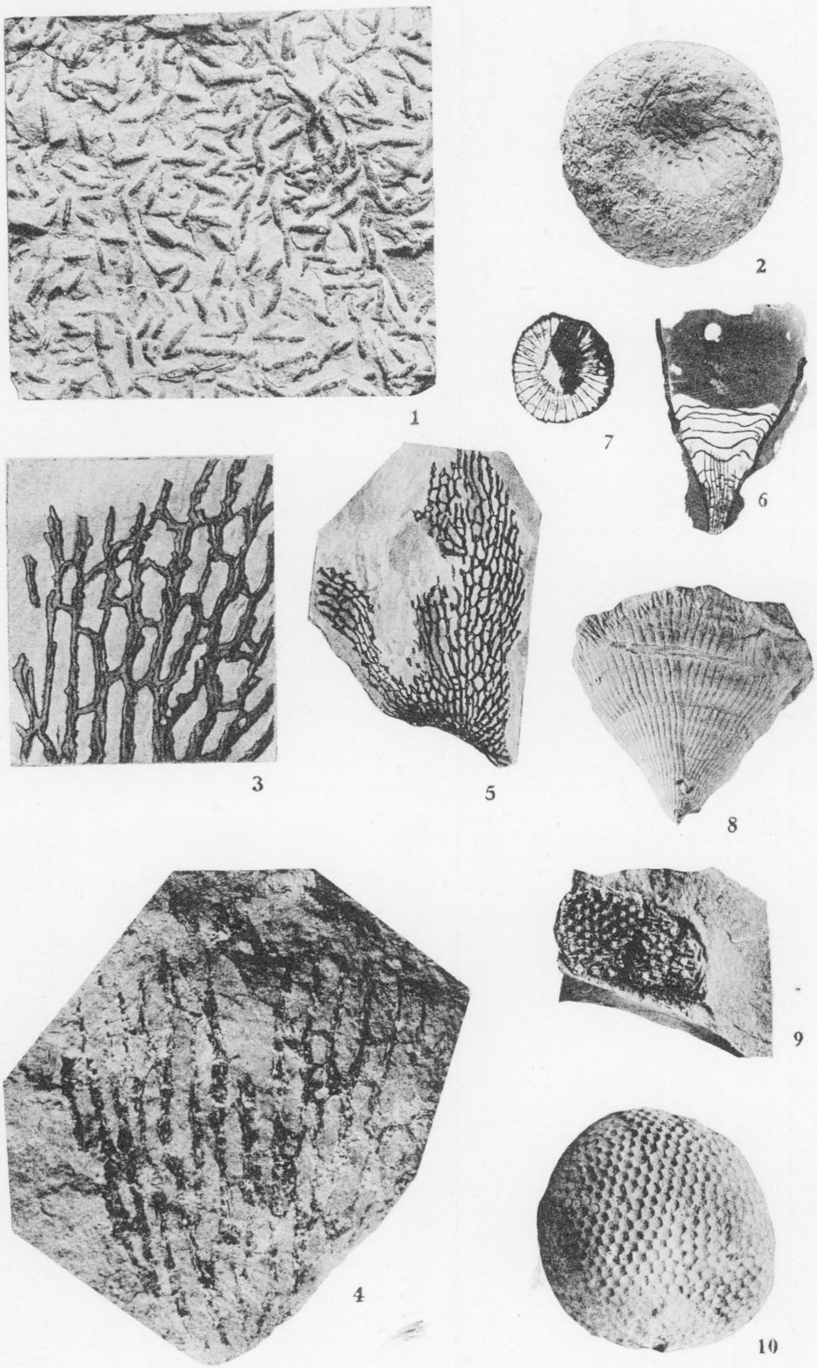


PLATE II

FIGURE 1. *Climacograptus jupiterensis* n. sp. Holotype.
Jupiter cliff. Zone 4, Jupiter formation. (Y). (Page 108).

FIGURE 2. *Climacograptus jupiterensis* n. sp. Holotype.
X 3. (Page 108).

FIGURE 3. *Climacograptus typicalis* var. *magnificus*. Holotype.
Macasty shale. (Y). X 3. (Page 109).

FIGURE 4. *Climacograptus typicalis* var. *magnificus*. Holotype. (Page 109).

FIGURE 5. *Climacograptus typicalis* var. *atlanticus* n. var. Holotype.
Wreck beach. Zone 3, Becscie formation. (Y). (Page 109).

FIGURE 6. *Climacograptus typicalis* var. *atlanticus* n. var. Holotype.
X 3. (Page 109).

FIGURE 7. *Climacograptus typicalis* var. *atlanticus* n. var.
Portion of holotype. X 5. (Page 109).

FIGURE 8. *Zaphrentis hannah* n. sp. Paratype.
Hannah cliff. Zone 2, Gun River formation. Longitudinal section. (Y). (Page 115).

FIGURE 9. *Zaphrentis hannah* n. sp. Holotype, side view; also a section specimen showing septa. Hannah cliff. Zone 3, Gun River formation. (Y). (Page 115).

FIGURE 10. *Cyathophyllum ellisense* n. sp. Holotype.
Ellis bay. Zone 8, Ellis Bay formation. Side view. (Y). (Page 119).

FIGURE 11. *Cyathophyllym ellisense* n. sp. Paratype.
Same locality and zone as holotype. Longitudinal section. (Y). X $1\frac{1}{2}$. (Page 119).

FIGURE 12. *Cyathophyllum ellisense* n. sp.
Another specimen. Same locality and zone as holotype. Cross-section. (Y). X $1\frac{1}{2}$. (Page 119).

FIGURE 13. *Cyathophyllum ellisense* n. sp.
Young specimen showing calicinal budding. Same locality and zone as holotype. (Y). (Page 119).

FIGURE 14. *Aulopora ellisensis* n. sp. Holotype.
West side Ellis bay. Zone 4, Ellis Bay formation. X 2. (Page 124).

Plate II

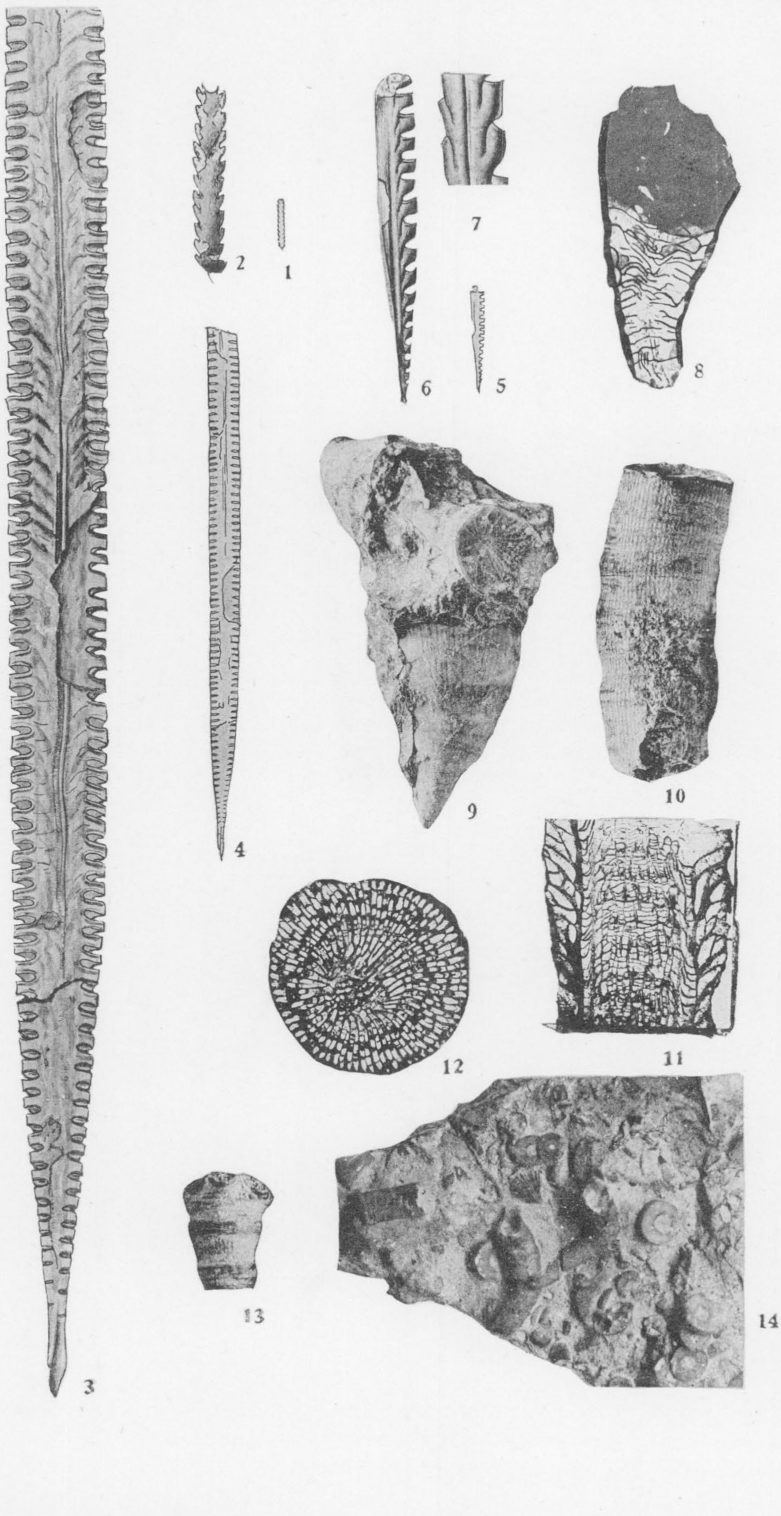


Plate III

Figure 1. *Zaphrentis vaurealensis* n. sp. Holotype.
Vauréal River section. Zone 7, Vauréal formation. Vertical section. X $\frac{11}{13}$. (Page 116).

Figure 2. *Cyathophyllum cormorantense* n. sp.
Cormorant point. Zone 5, Jupiter formation. Side view showing the rapid tapering and great depth of the calyx. (Y). (Page 118).

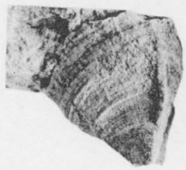
Figure 3. *Cyathophyllum cormorantense* n. sp.
Same locality and zone as holotype. Transverse section; the septa have been strengthened. (Y). X 2. (Page 118).

Figure 4. *Cyathophyllum cormorantense* n. sp.
Same locality and zone as holotype. Longitudinal section; the septa have been strengthened. (Y). (Page 118).

Figure 5. *Streptelasma angulatum* (Billings)
Side view of a specimen from English head, zone 3 of the English Head formation. (V 1984). (Page 111).

Figure 6. *Protarea tenuis* (Billings)
Portion of the surface of a colony growing on *Lophospira ? papillosa*. One-half mile east of Junction cliff, zone 4, Ellis Bay formation. (V 2236). X 2. (Page 136).

Plate III



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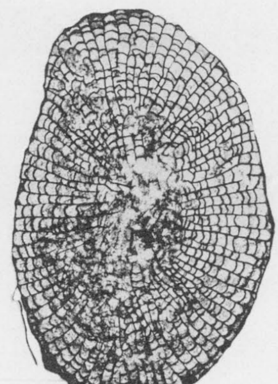

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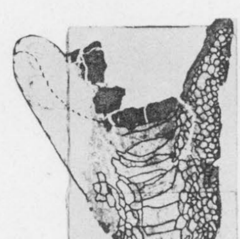

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Plate IV

Figure 1. *Columnaria(?)* (*Palaeophyllum*) *vaurealensis* n. sp. Holotype.
Vauréal River section. Zone 6, Vauréal formation. (Page 122).

Figure 2. *Cladopora anticostiensis* n. sp. Holotype.
Pointe des Morts. Zone 2, Chicotte formation. X 2. (Page 130).

Figure 3. *Dimerocrinus elegans* n. sp.
Iron river. Zone 9, Jupiter formation. Posterior of complete crown. (Page 138).

Figure 4. *Periechocrinus latus* n. sp.
Southwest point. Zone 2, Chicotte formation. Posterior of calyx. (Page 138).

Figure 5. *Periechocrinus latus* n. sp.
Dorsal view of specimen of figure 4. (Page 138).

Figure 6. *Dendrocrinus minutus* n. sp.
Carleton point. Zone 4, English Head formation. Lateral view of crown with part of stem attached. X 3. (Page 137).

Figure 7. *Hudsonaster rugosus* (Billings)
Photograph of the oral side, cliff one-half mile east of Caplan river, zone 4, English Head formation, Twenhofel collection. X 3. (Page 141).

Plate IV

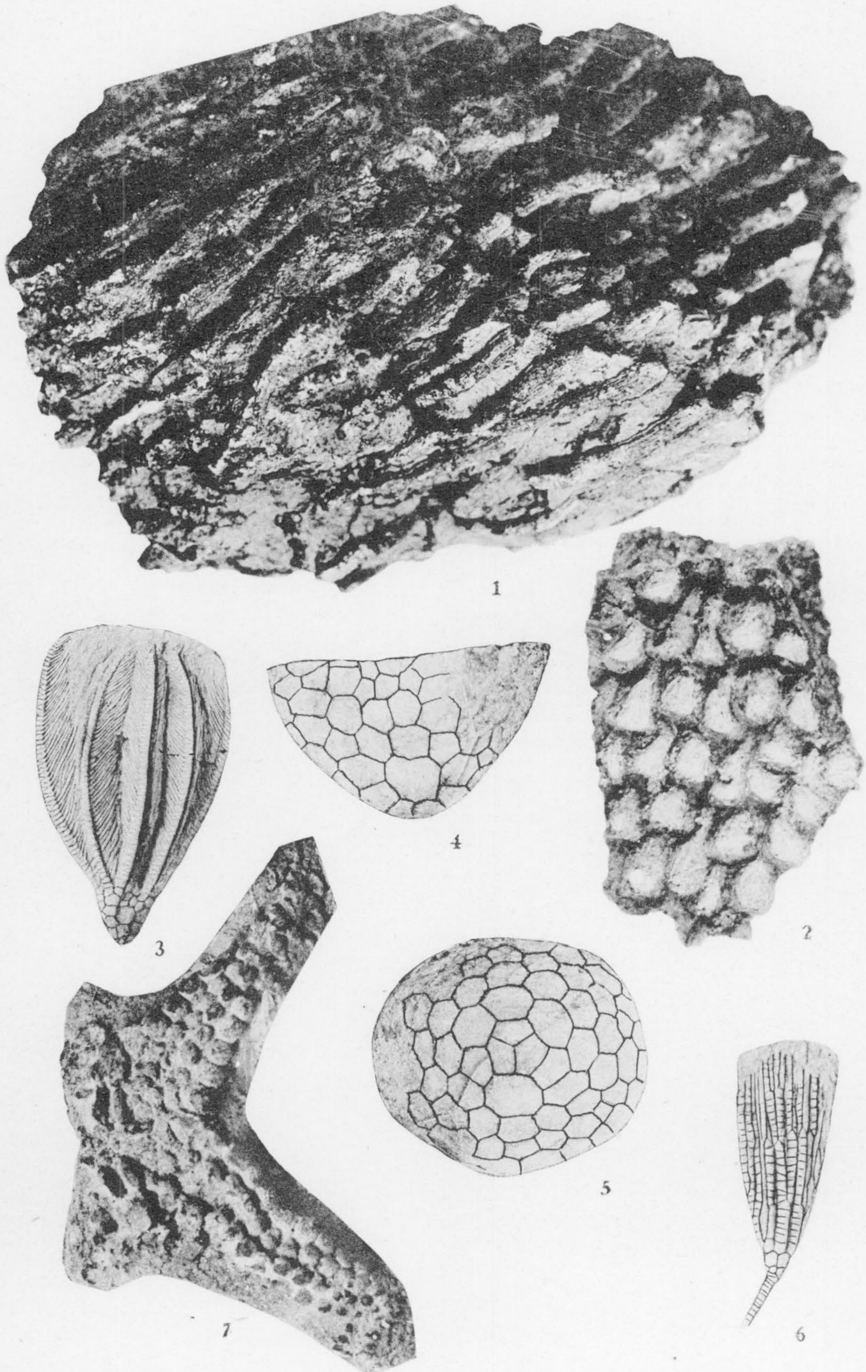


PLATE V

FIGURE 1. *Lyellia nummulosa* n. sp.
Junction cliff. Zone 2, Ellis Bay formation. Transverse section of a very young colony with the tubules just beginning to develop. (Y). X 5. (Page 135).

FIGURE 2. *Lyellia nummulosa* n. sp.
Junction cliff. Zone 2, Ellis Bay formation. Under surface of a young corallum. (Y). X 2. (Page 135).

FIGURE 3. *Lyellia nummulosa* n. sp.
Upper surface of specimen of figure 2. X 2. (Page 135).

FIGURE 4. *Lyellia nummulosa* n. sp.
Ellis bay. Zone 4, Ellis Bay formation. Longitudinal section of a specimen a little older than that of figure 3. X 2. (Page 135).

FIGURE 5. *Lyellia nummulosa* n. sp.
Longitudinal section corresponding to the stage of the specimens of figures 1, 2, and 3. X 2. (Page 135).

FIGURE 6. *Stomatopora siluriana* n. sp.
See also Plate VI, figure 2. Ellis bay. Ellis Bay formation. Portion of type specimen. X 9. (Page 144).

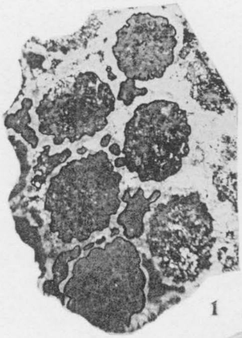
FIGURE 7. *Mitoclema (?) minutum* n. sp.
Middletown, Ohio. Richmond group. Arnheim formation. A group of zoarial fragments. X 9. (Page 147).

FIGURE 8. *Ceramopora niagarensis* var. *germana* n. var.
See also Plate VI, figures 3, 4. West side of Ellis bay. Zone 4, Ellis Bay formation. Surface of type. X 9. (Page 147).

FIGURE 9. *Atactoporella spicata* n. sp.
See also Plate VI, figures 5, 6, 7. Type specimen. Ellis bay. Zone 4, Ellis Bay formation. Illustrating the great development of acanthopores. X 9. (Page 148).

FIGURE 10. *Atactaporella spicata* Bassler
Same as figure 9. X 20. (Page 148).

Plate V



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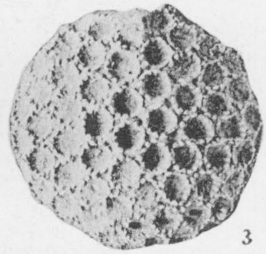

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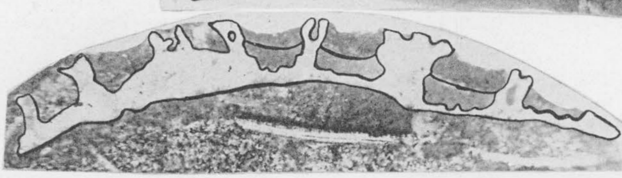

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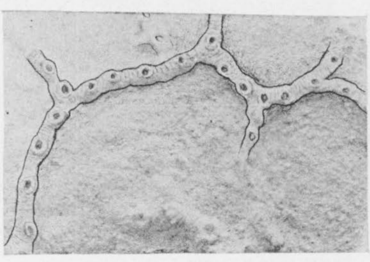

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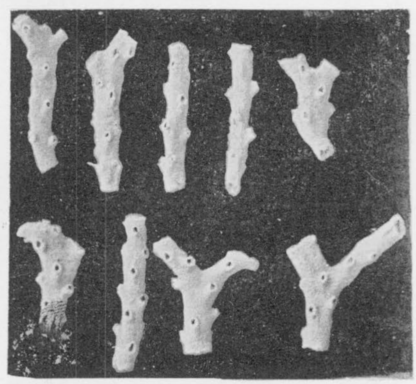

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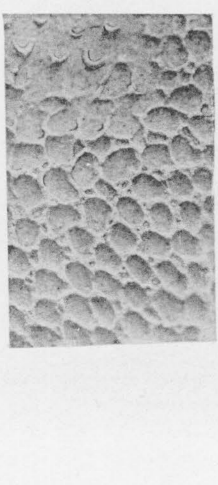

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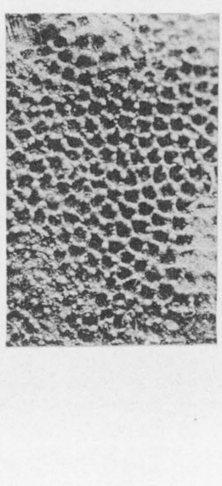

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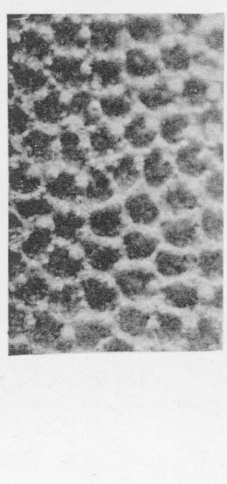

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Plate VI

Figure 1. *Allonema curtum* n. sp.
Cliff of Jupiter river. Zone 1, Jupiter formation. Portion of type specimen encrusting a brachiopod. X 12. (Page 144).

Figure 2. *Stomatopora siluriana* n. sp.
See also Plate V, figure 6. Ellis bay. Zones 4 and 5, Ellis Bay formation. A portion of the type specimen illustrating wrinkles of the walls. X 12. (Page 144).

Figure 3. *Ceramopora niagarensis* var. *germana* n. sp.
See also Plate V, figure 8. West side of Ellis bay. Zone 4, Ellis Bay formation. Vertical section exhibiting the peculiar spongy wall structure of the mature zone. X 20. (Page 147).

Figure 4. *Ceramopora niagarensis* var. *germana* n. var.
Same locality and horizon as figure 4. Tangential section showing the rather regular arrangement of the zooecia and the irregular shape of the mesopores. X 20. (Page 147).

Figure 5. *Atactoporella spicata* n. sp.
See also Plate V, figures 9, 10. West side of Ellis bay. Zone 4, Ellis Bay formation. Tangential section through the outer part of the mature zone. X 20. (Page 148).

Figure 6. *Atactoporella spicata* n. sp.
See figure 5, several zooecia of the same section exhibiting the thick walls, large acanthopores, and numerous smaller acanthopores or granules. X 35. (Page 148).

Figure 7. *Atactoporella spicata* n. sp.
See figure 6. Vertical section showing the development of cystiphragms in the early part of the mature region, and the thickening of the walls and introduction of large acanthopores in the later stages of the same region. X 30. (Page 148).

Figure 8. *Homotrypa anticostiensis* n. sp.
See also Plate VII, figures 1, 2, 3. Carleton point. Zone 4, English Head formation. Vertical section showing distribution of diaphragms and cystiphragms. X 20. (Page 148).

Figure 9. *Leptotrypa crassa* n. sp.
See also Plate VII, figure 5. English head. Zone 2, English Head formation. Tangential section of type specimen. X 20. (Page 150).

Figure 10. *Leptotrypa crassa* n. sp.
Part of section of figure 9 exhibiting minute structure of the thick walls and large acanthopores. X 35. (Page 150).

Figure 11. *Leptotrypa crassa* n. sp.
Vertical section of type specimen, showing mature and immature regions. X 20. (Page 150).

Figure 12. *Chilotrypa circe* (Billings)
Tangential section, passing through a portion of a macula. X 20. (Page 148).

Figure 13. *Chilotrypa circe* (Billings)
Vertical section, through the zooecial layer making up the hollow, cyclindrical branches of this species. Specimens of figures 12 and 13 from Jupiter formation, zone 9, one mile west of Box brook. X 20. (Page 148).

Figure 14. *Trematopora irregularis* (Billings)
Small portion of a tangential section, showing irregular, rounded zooecia with numerous granular acanthopores and large, irregular mesopores. Jupiter formation, zone 5, cape Jupiter. X 20. (Page 155).

Figure 15. *Trematopora irregularis* (Billings)
Vertical section, showing characteristic tabulation. X 20. (Page 155).

Plate VI

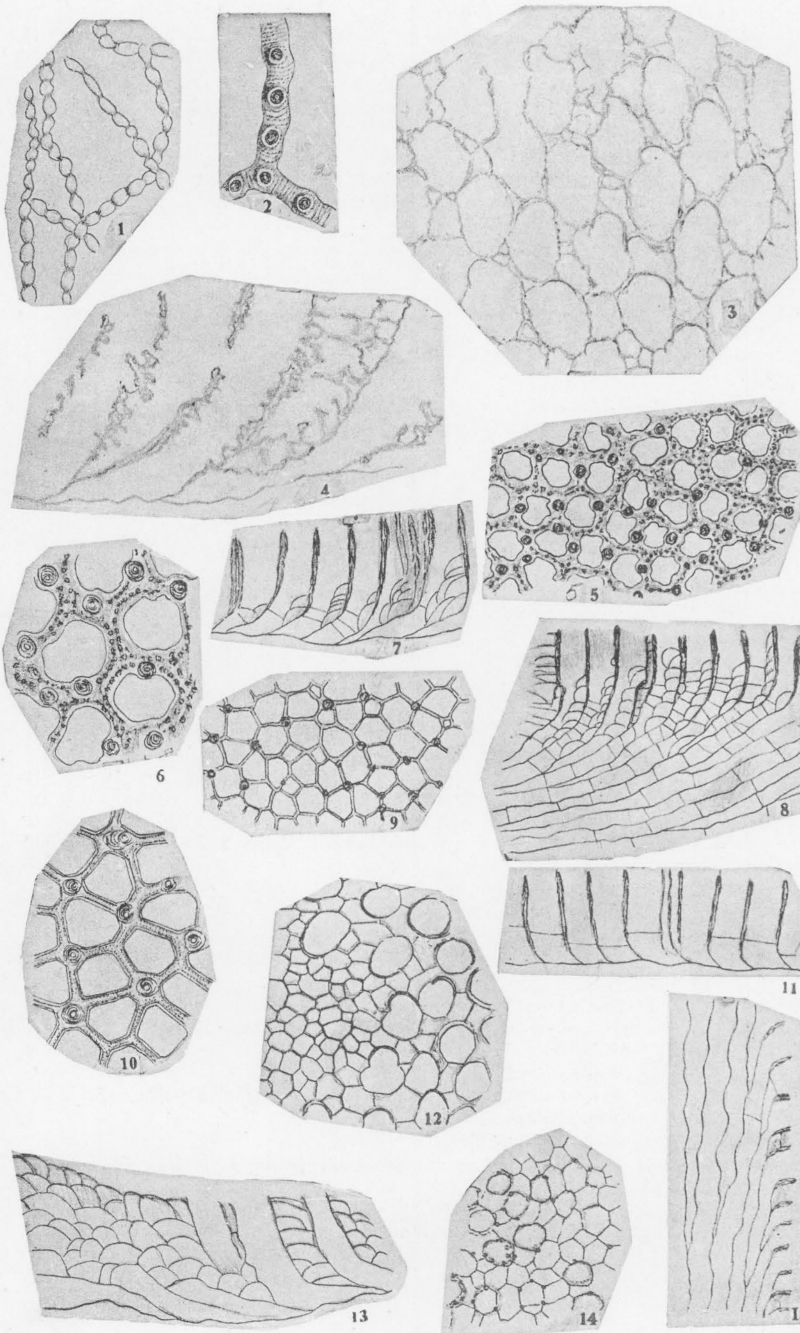

Plate VII

Figure 1. *Homotrypa anticostiensis* n. sp.
See also Plate VI, figure 8. Carleton point. Zone 4, English Head formation. Fragment of zoarium. (Page 148).

Figure 2. *Homotrypa anticostiensis* n. sp.
Surface of fragment of figure 1. X 14. (Page 148).

Figure 3. *Homotrypa anticostiensis* n. sp.
Tangential section illustrating the thick, ring-like walls and the occurrence of mesopores. X 20. (Page 148).

Figure 4. *Aspidopora siluriana* n. sp.
See also Plate VIII, figures 4, 5. Junction cliff. Zone 1 or 2, Ellis Bay formation. Surface of type specimen. X 6. (Page 149).

Figure 5. *Leptotrypa crassa* n. sp.
See also Plate VI, figures 9, 10, 11. English head. Zone 2, English Head formation. Type specimen. (Page 150).

Figure 6. *Cyphotrypa polygona* n. sp.
See also Plate VIII, figures 6, 7. Junction cliff. Zone 1, Ellis Bay formation. Surface of type specimen showing portion of a macula with large zooecia and the adjoining polygonal apertures. X 9. (Page 151).

Figure 7. *Nicholsonella parvula* n. sp.
See also Plate IX, figures 1, 2. One-half mile east of Junction cliff. Zone 4, Ellis Bay formation. Surface of type specimen. X 14. (Page 151).

Figure 8. *Dianulites insueta* n. sp.
See also Plate IX, figures 3, 4, 5. English head. Zone 3, English Head formation. Surface of type specimen. X 6. (Page 151).

Figure 9. *Hallopora enodis* n. sp.
See also Plate X, figures 3, 4, 5. West side Vauréal bay. Zone 4, Vauréal formation. Surface of type specimen. X 6. (Page 154).

Figure 10. *Hallopora gracilens* n. sp.
See also Plate X, figures 6, 7, 8. Battery point. Zone 4, Vauréal formation. A group of zoarial fragments. (Page 154).

Figure 11. *Hallopora gracilens* n. sp.
Surface of zoarium. X 6. (Page 154).

Figure 12. *Batostoma billingsi* n. sp.
See also Plate XI, figure 3. Battery point. Zone 4 Vauréal formation. A characteristic fragment. (Page 155).

Figure 13. *Batostoma billingsi*
Surface of zoarium. X 6. (Page 155).

Figure 14. *Phaenopora twenhofeli* n. sp.
See also Plate XI, figures 3, 4. Wreck beach. Zone 3 Becscie formation. Type specimen. (Page 164).

Figure 15. *Phaenopora twenhofeli* n. sp.
Surface of type specimen. X 14. (Page 164).

Figures 16 and 17. *Lichenalia utricula* n. sp.
Junction cliff. Zone 1, Ellis Bay formation. The two type specimens. X 2. (Page 168).

Figure 18. *Cyphotrypa bulbosa* (Billings)
The type specimen, showing the smooth, globular zoarium. Junction cliff, zone 1, Ellis Bay formation. (Page 150).

Figure 19. *Ptilodictya canadensis* (Billings)
Type specimen, parted along the mesial lamina. Carleton point. Zone 4, English Head formation. (Page 161).

Figure 20. *Nematopora lineata* (Billings)
Type specimen of *Helopora lineata*. Schooner point, Ellis Bay formation. X $1\frac{1}{2}$. (Page 160).

Figure 21. *Nematopora lineata* (Billings)
Specimen of figure 20. X 30. (Page 160).

Plate VII

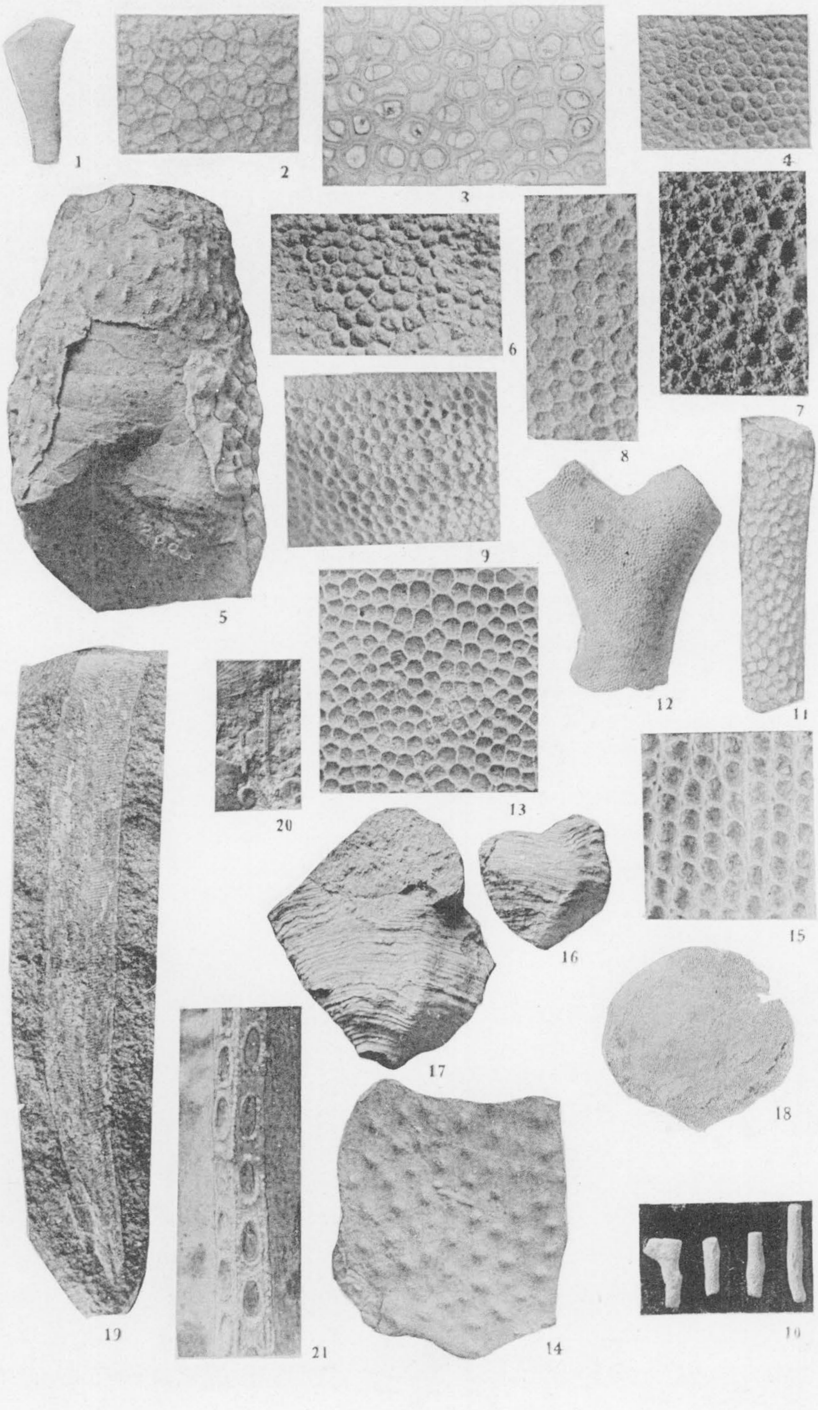

Plate VIII

Figure 1. *Prasopora canadensis* n. sp.
White cliff. Zone 1, Vauréal formation. Tangential section cutting part of a macula. X 20. (Page 149).

Figure 2. *Prasopora canadensis* n. sp.
A part of the same section as figure 1. X 35. (Page 149).

Figure 3. *Prasopora canadensis* n. sp.
Vertical section through one-half of a branch. X 20. (Page 149).

Figure 4. *Aspidopora siluriana* n. sp.
See also Plate VII, figure 4. Junction cliff. Zone 1 or 2, Ellis Bay formation. Tangential section, showing usual aspect of the species. X 20. (Page 149).

Figure 5. *Aspidopora siluriana* n. sp.
Vertical section, illustrating the disposition of the diaphragms and cystiphragms. X 20. (Page 149).

Figure 6. *Cyphotrypa polygona* n. sp.
See also Plate VII, figure 6. Junction cliff. Zone 1, Ellis Bay formation. Tangential section of type specimen. X 20. (Page 151).

Figure 7. *Cyphotrypa polygona* n. sp.
Same specimen as figure 6. Vertical section, illustrating distribution of diaphragms. X 20. (Page 151).

Figure 8. *Cyphotrypa bulbosa* (Billings)
Tangential section of the type specimen, illustrating extreme thinness of zooecial walls and small size of acanthopores. X 20. (Page 150).

Figure 9. *Cyphotrypa bulbosa* (Billings)
Vertical section of type specimen, passing through two successive mature and immature regions. X 20. (Page 150).

Figure 10. *Lioclema variporum* (Billings)
Tangential section, showing the angular zooecia, separated by numerous, thin-walled mesopores. Jupiter formation, zone 5, cape Jupiter. X 20. (Page 153).

Figure 11. *Lioclema variporum* (Billings)
Vertical section, showing characteristic tabulation of both zooecia and mesopores, the latter shaded. X 20. (Page 153).

Plate VIII

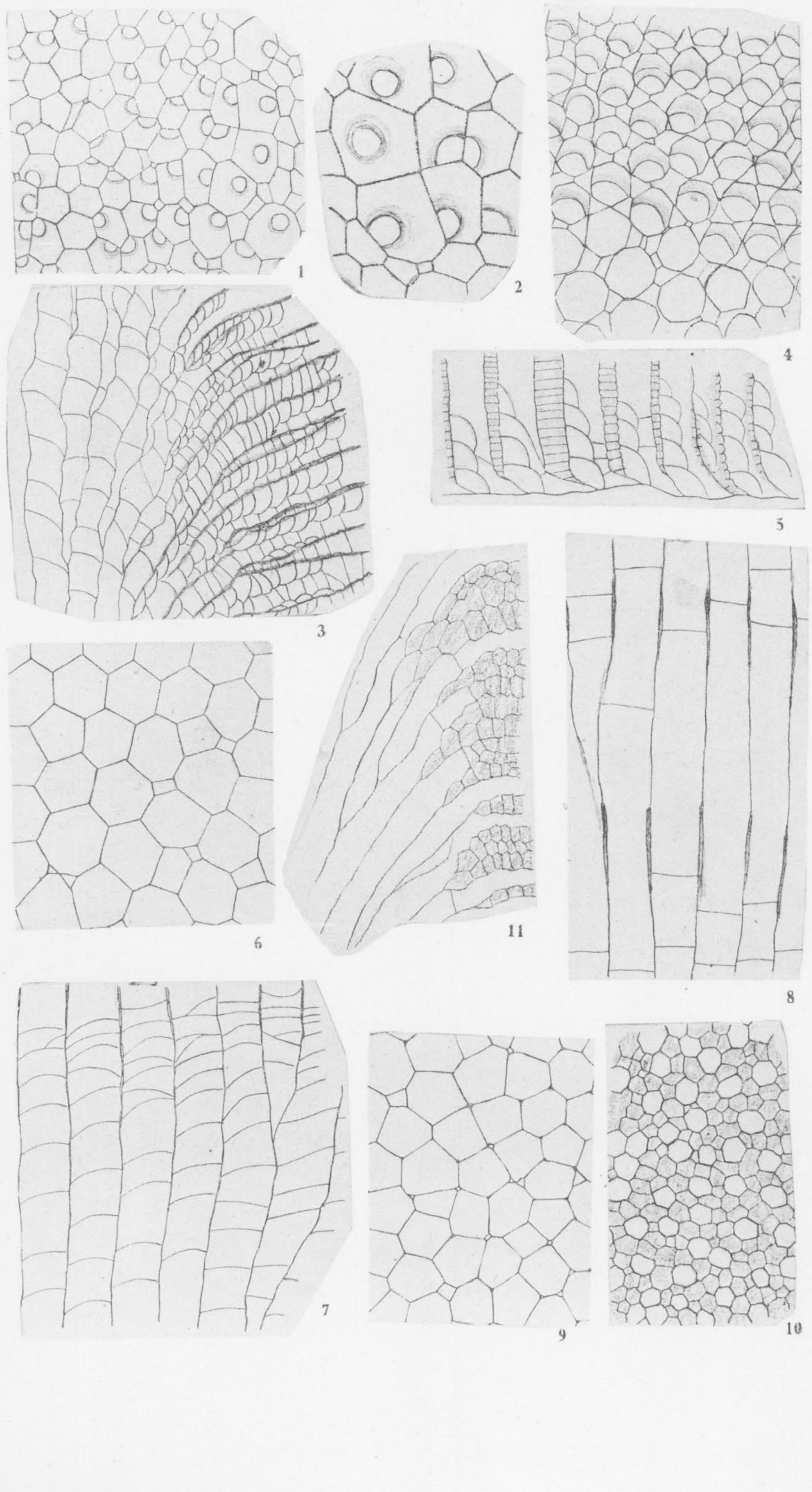

Plate IX

Figure 1. *Nicholsonella parvula* n. sp.
See also Plate VII, figure 7. One-half mile east of Junction cliff. Zone 4, Ellis Bay formation. Tangential section showing the small zooecia, numerous large mesopores, and the granular acanthopores of the zooecial walls. X 35. (Page 151).

Figure 2. *Nicholsonella parvula* n. sp.
Vertical section illustrating the tabulation and granular wall structure. X 20. (Page 151).

Figure 3. *Dianulites insueta* n. sp.
See also Plate VII, figure 8. English head. Zone 3, English Head formation. Tangential section. X 20. (Page 151).

Figure 4. *Dianulites insueta* n. sp.
Vertical section showing tabulation in both zones. X 10. (Page 151).

Figure 5. *Dianulites insueta* n. sp.
Vertical section showing part of the mature zone. X 20. (Page 151).

Figure 6. *Dianulites globularis* n. sp.
West side of Ellis bay. Zone 4, Ellis Bay formation. Tangential section showing numerous acanthopores, the granular wall structures, and the radiating granules preserved in the section of a diaphragm. X 20. (Page 152).

Figure 7. *Dianulites globularis* n. sp.
Vertical section illustrating distribution of diaphragms. X 10. (Page 152).

Figure 8. *Dianulites globularis* n. sp.
Small portion of another vertical section exhibiting peculiar structure of walls. X 20. (Page 152).

Figure 9. *Ptilodictya canadensis* Billings
Tangential section, prepared from the type section. X 20. (Page 161).

Figure 10. *Phaenopora superba* (Billings)
Tangential section, prepared so as to show the regularly arranged zooecia, with their terminal mesopores characteristic of the early part of the mature region, and the less regular zooecia and more numerous mesopores of the older stage. The latter portion shows the indentations of the zooecial walls due to the spinous processes. Becscie formation, zone 4, west Becscie River cliff. X 20. (Page 164).

Figure 11. *Phaenopora superba* (Billings)
Vertical section, with the superior and inferior hemisepta well shown. X 20. (Page 164).

Figure 12. *Lioclema variporum* (Billings)
Several fragments, Jupiter formations, zone 9, Shallop river. (Page 153).

Figure 13. *Lioclema variporum* (Billings)
Surface of a specimen. X 14. (Page 153).

Figure 14. *Trematopora irregularis* (Billings)
The type specimen, Jupiter formation, zone 9, Shallop river.

Figure 15. *Trematopora irregularis* (Billings)
Surface of the type specimen. X 14.

Plate IX

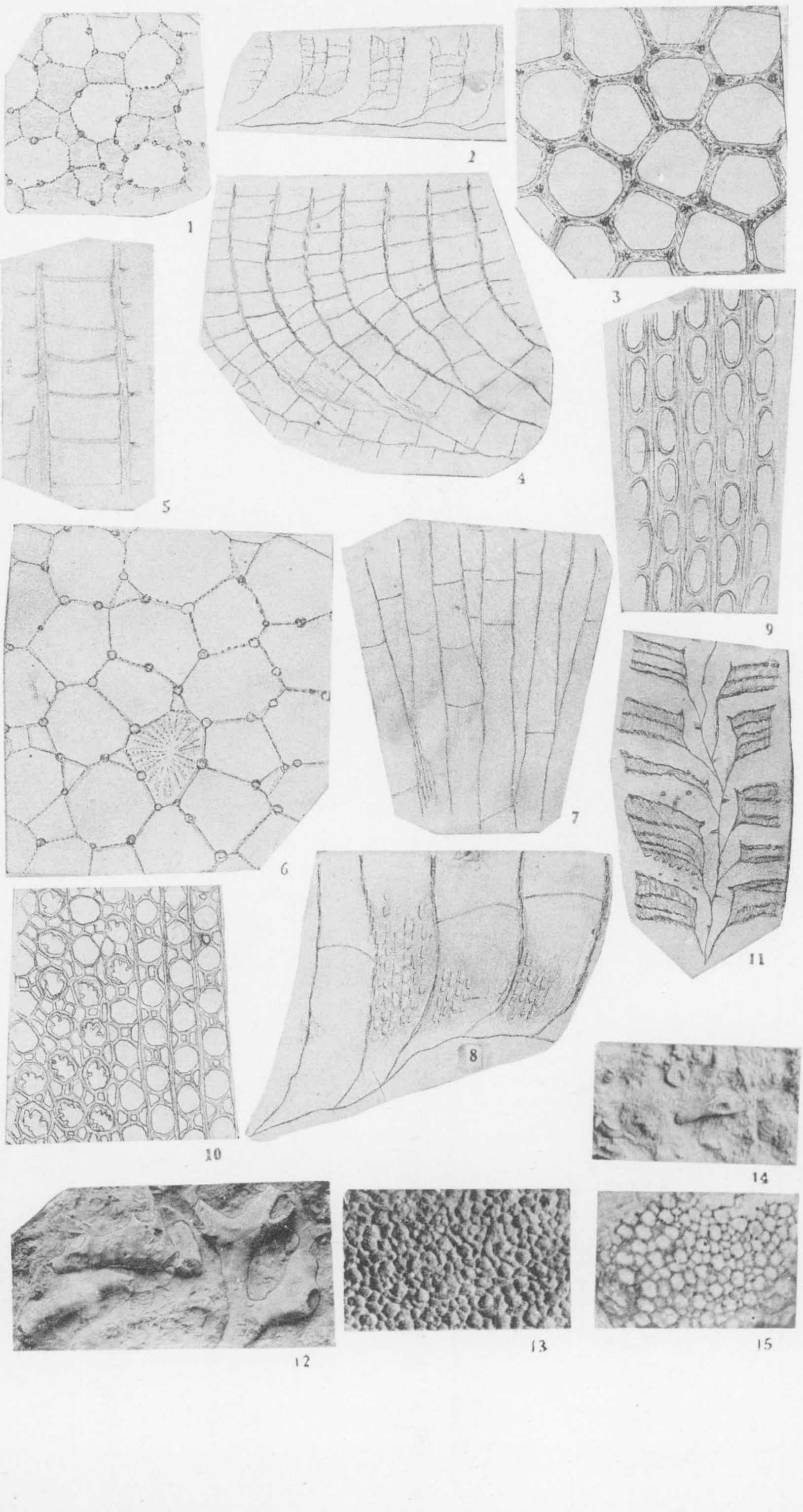

Plate X

Figure 1. *Hallopora elegantula prolifica* n. var.
West side of Ellis bay. Ellis Bay formation. Tangential section. X 20. (Page 153).

Figure 2. *Hallopora elegantula prolifica* n. var.
Vertical section illustrating occurrence of numerous tabulæ in both zooecia and mesopores. X 20. (Page 153).

Figure 3. *Hallopora enodis* n. sp.
See also Plate VII, figure 9. West side Vauréal bay. Zone 4, Vauréal formation. Fragment. (Page 154).

Figure 4. *Hallopora enodis* n. sp.
Tangential section. X 20. (Page 154).

Figure 5. *Hallopora enodis* n. sp.
Vertical section of same specimen as figure 4. X 20. (Page 154).

Figure 6. *Hallopora gracilens* n. sp.
See also Plate VII, figures 11, 12. Battery point. Zone 4, Vauréal formation. Tangential section. X 20. (Page 154).

Figure 7. *Hallopora gracilens* n. sp.
Vertical section. X 20. (Page 154).

Figure 8. *Hallopora gracilens* n. sp.
Part of transverse section. X 20. (Page 154).

Figure 9. *Ptilodictya sulcata* Billings
One of the type specimens, Jupiter formation, zone 10, Jumpers. X 1½. (Page 162).

Figures 10 and 11. *Ptilodictya sulcata* Billings
Surface of the type specimen. X 6, and X 14. (Page 162).

Figure 12. *Ptilodictya gladiola* Billings
The original type specimens. Jupiter formation, zone 2, East cliff. X ½. (Page 162).

Figure 13. *Ptilodictya gladiola* Billings
Surface of one of the type specimens. X 14. (Page 162).

Figure 14. *Helopora lineopora* Billings
The type specimen. Jupiter formation, zone 1, 2 miles west of Jupiter river. X 1½. (Page 159).

Figure 15. *Helopora lineopora* Billings
Basal portion of the type specimen, shows the zooecia replaced by elongate, pore-like striæ. X 6. (Page 159).

Figure 16. *Helopora lineopora* Billings
A specimen from Ellis bay, zone 9 of Ellis Bay formation, showing the usual aspect of the elongate zooecia and mesopores. X 14. (Page 159).

Plate X

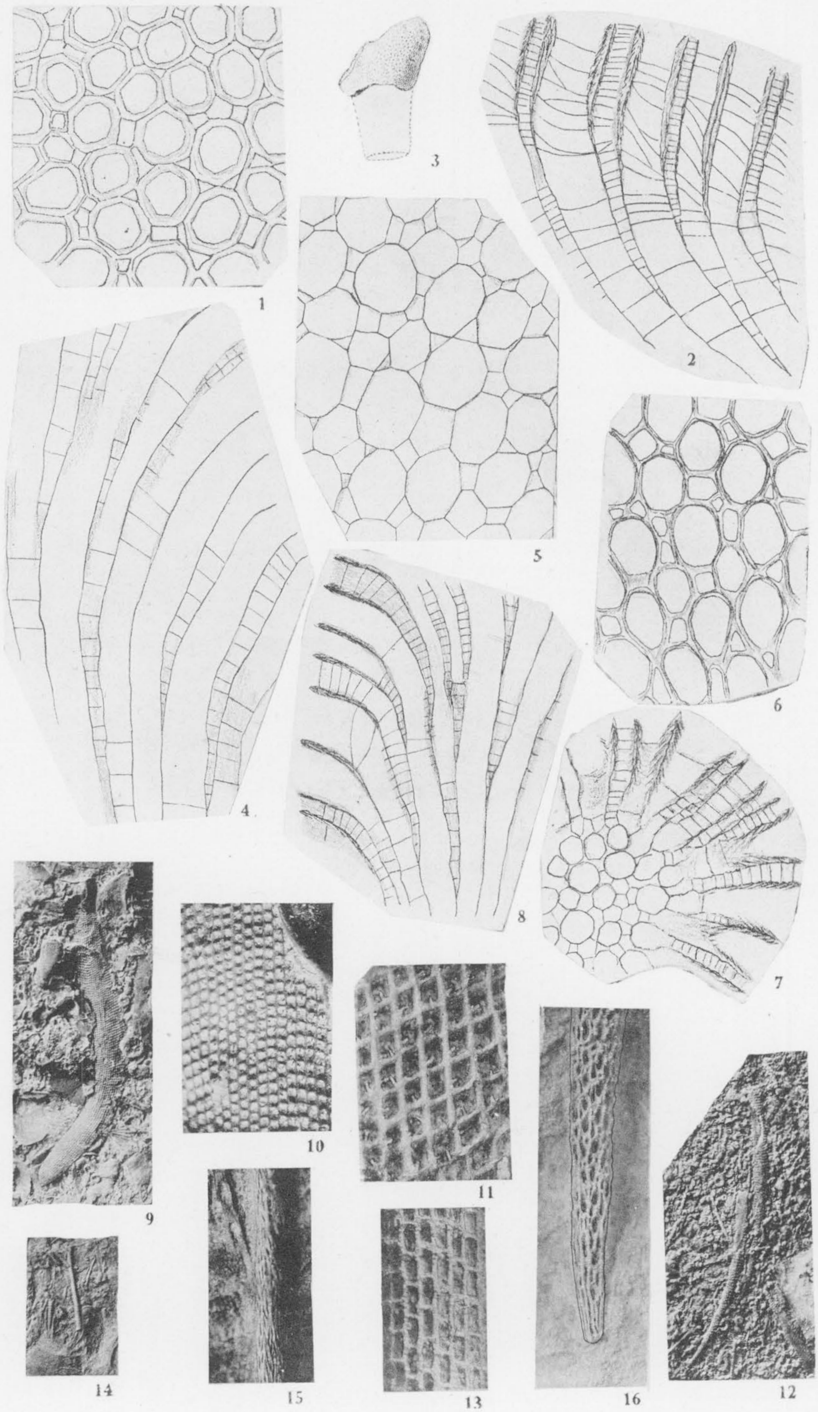

Plate XI

Figure 1. *Batostoma billingsi* n. sp.
See also Plate VII, figures 12, 13. Battery point, zone 4, Vauréal formation. Tangential section through the mature zone exhibiting the angular zooecia and few mesopores. X 20. (Page 155).

Figure 2. *Batostoma billingsi* n. sp.
Vertical section. X 20. (Page 155).

Figure 3. *Phaenopora twenhofeli* n. sp.
See also Plate VII, figures 14, 15. Wreck beach, Zone 3, Becscie formation. Tangential section exhibiting the comparative scarcity of mesopores. X 20. (Page 164).

Figure 4. *Phaenopora twenhofeli* n. sp.
Vertical section of same specimen as figure 4. X 20. (Page 164).

Figure 5. *Helopora armata* Billings
View of a specimen supposed to belong to this species. Jupiter formation, zone 9, cliff west of Iron river. X 10. (Page 158).

Figure 6. *Phaenopora superba* (Billings)
The original type of the species, parted along the mesial lamina, Becscie formation, cliffs west of Becscie river. (Page 164).

Figure 7. *Phaenopora superba* (Billings)
Specimen from the same locality as figure 6, showing the pointed basal extremity. (Page 164).

Figure 8. *Phaenopora superba* (Billings)
Surface of a zoarium, showing the conspicuous monticules, Becscie formation, zone 4, Becscie river. (Page 164).

Figure 9. *Phaenopora superba* (Billings)
A clay concretion encrusted with several spreading bases of this species. Gun River formation, zone 2, Hannah cliff. (Page 164).

Figure 10. *Chilotrypa circe* (Billings)
Fragment of a zoarium, Jupiter formation, zone 9, west of Box brook. X 2. (Page 148).

Figure 11. *Chilotrypa circe* (Billings)
Surface of the specimen of figure 1. X 14. (Page 148).

Figure 12. *Semicoscinium pretiosum* n. sp.
Slab showing the type specimens. Gun River formation, zone 3, cliffs up Gun river. (Page 157).

Figure 13. *Fenestella anticostiensis* n. sp.
The type specimen, Jupiter formation, zone 10, Jumpers. (Page 156).

Figure 14. *Fenestella jupiterensis* n. sp.
One of the type specimens, natural size, Jupiter formation, zone 9, one mile west of Box brook. (Page 157).

Plate XI

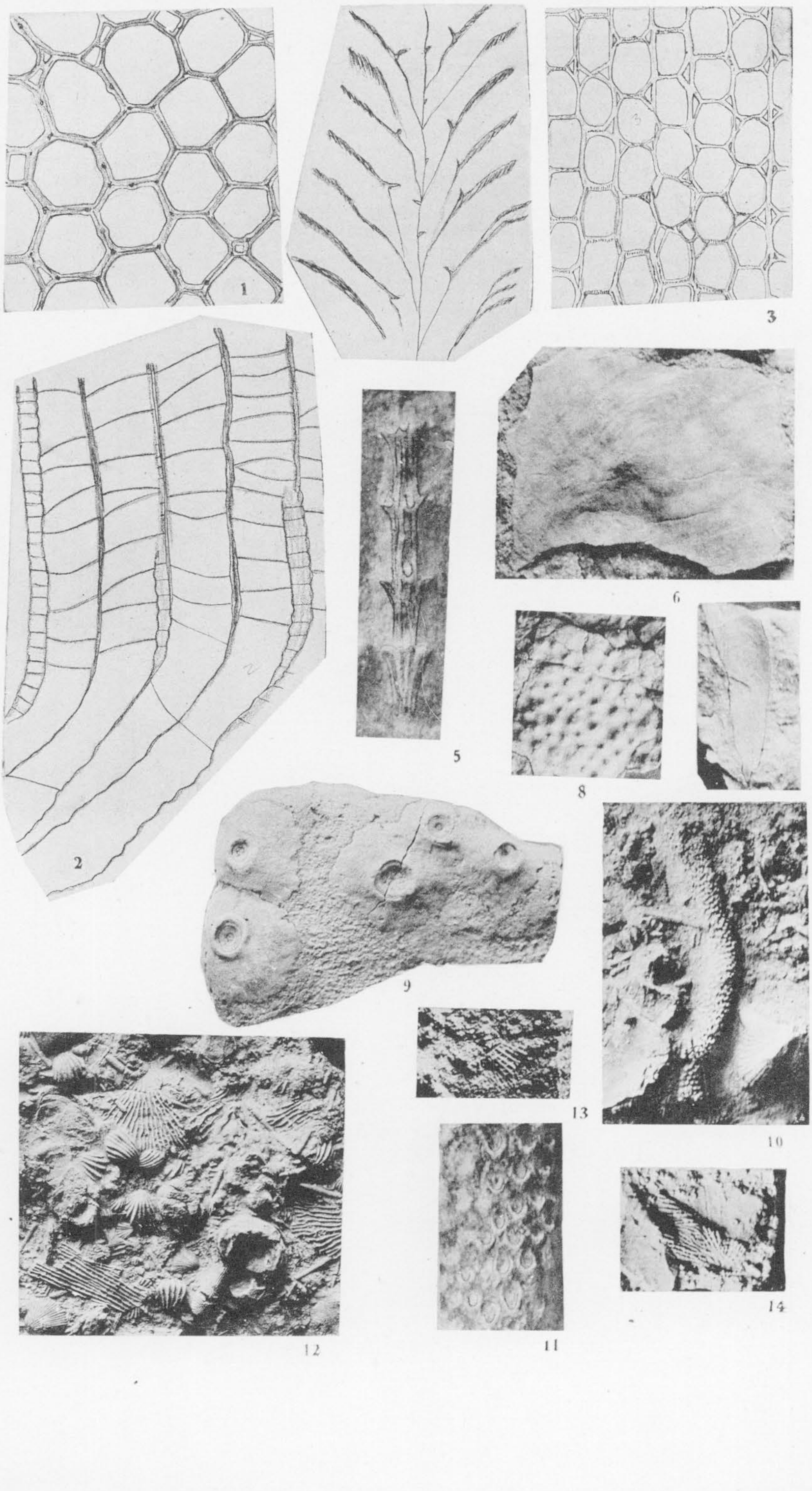

Plate XII

Figure 1. *Fenestella bella* n. sp.
Two miles west of Chicotte river. Zone 2, Chicotte formation. Enlargement of type specimen. Calcite crystals occupy some of the fenestrules. X 9. (Page 156).

Figure 2. *Fenestella bella* n. sp.
The type specimen. (Page 156).

Figure 3. *Phaenopora aperta* n. sp.
Surface of the type specimen, illustrating the large mesopores and thick walls between rows of zooecia. East of cape Ottawa, zone 9, Jupiter formation. X 20. (Page 165).

Figure 4. *Dinobolus laurentinus* n. sp.
English head. Zone 3, English Head formation. Holotype. (Y). X 1½. (Page 168).

Figure 5. *Dinobolus laurentinus* n. sp.
Gutta-percha cast of specimen of figure 7. X 1½. (Page 168).

Figure 6. *Dinobolus laurentinus* n. sp.
Impression of interior of dorsal valve. X 1½. (Page 168).

Figure 7. *Dinobolus laurentinus* n. sp.
Impression of interior of ventral valve. X 1½. (Page 168).

Figure 8. *Dinobolus laurentinus* var. *ellisensis* n. var.
Ellis bay. Zone 7, Ellis Bay formation. Holotype. Impression of dorsal interior. (Y). (Page 169).

Figure 9. *Lingula anticostiensis* n. sp.
Jupiter cliff. Zone 3, Jupiter formation. Holotype and paratype. (Y). X 1½. (Page 170).

Figure 10. *Lingula ? jupiterensis* n. sp.
Jupiter cliff. Zone 4, Jupiter formation. Holotype. (Y). X 2. (Page 171).

Figure 11. *Trematis ottawaensis* var. *anticostiensis* n. var.
Probably Makasti bay. Zone 4, English Head formation. Holotype. Ventral valve. (V). X 1¼. (Page 172).

Figure 12. *Trematis ottawaensis* var. *anticostiensis* n. var.
Junction cliff. Zone 1, Ellis Bay formation. Paratype. Dorsal valve. (Y). X 1½. (Page 172).

Figure 13. *Lingula forbesi* Billings
An average specimen. (V 2251). Ellis Bay formation, Ellis bay. X 1½. (Page 170).

Figure 14. *Pseudolingula elegantula* (Shaler)
Photograph of a well-preserved specimen. (V 2013-a). Ellis Bay formation, zone 4, Ellis bay. X 1½. (Page 172).

Plate XII

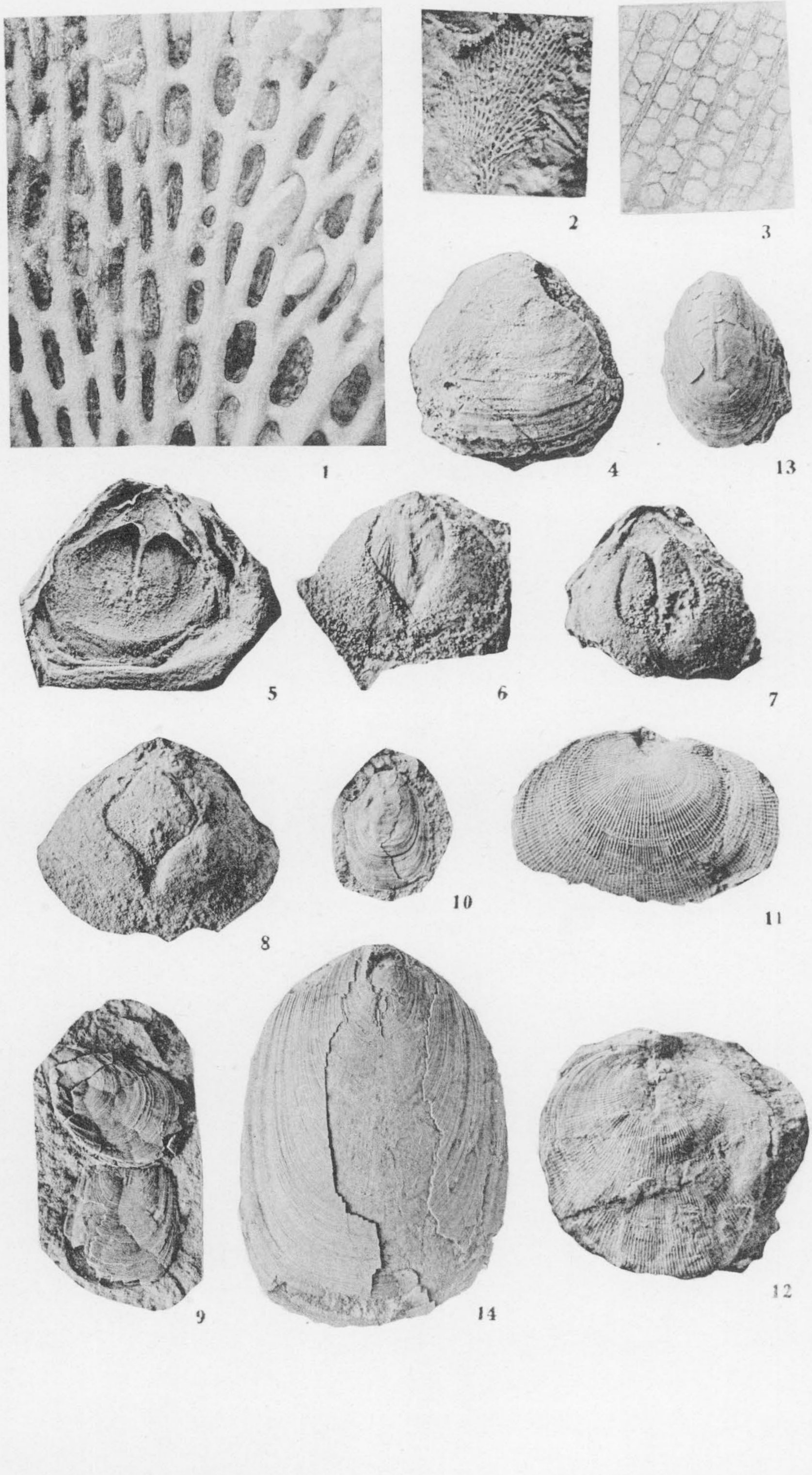

Plate XIII

Figure 1. *Fenestella anticostiensis* n. sp.
Jumpers. Zone 10, Jupiter formation. Surface of type specimen. X 19. (Page 156).

Figure 2. *Fenestella jupiterensis* n. sp.
One mile west of Box brook. Zone 9, Jupiter formation. The celluliferous surfaces. Type specimen. X 9. (Page 157).

Figure 3. *Fenestella jupiterensis* n. sp.
Same locality and horizon. Non-celluliferous side of surface of another specimen. X 14. (Page 157).

Figure 4. *Semicoscinium pretiosum* n. sp.
Cliffs on Gun river. Zone 3, Gun River formation. One of type specimens showing the high carina of the celluliferous side. X 4. (Page 157).

Figure 5. *Semicoscinium pretiosum* n. sp.
Part of same specimen as figure 4, showing a few of the zooecia. X 9. (Page 157).

Figure 6. *Saerichnites abruptus* Billings
Portion of the slab containing the types. Zone 5, English Head formation. (V 2226-a). X $\frac{1}{7}$. (Page 100).

Figure 7. *Hormotoma gigantea* (Billings)
A plesiotype showing the slit band. (V 2331). Ellis Bay formation, zone 8, Ellis bay. X $\frac{2}{5}$. (Page 242).

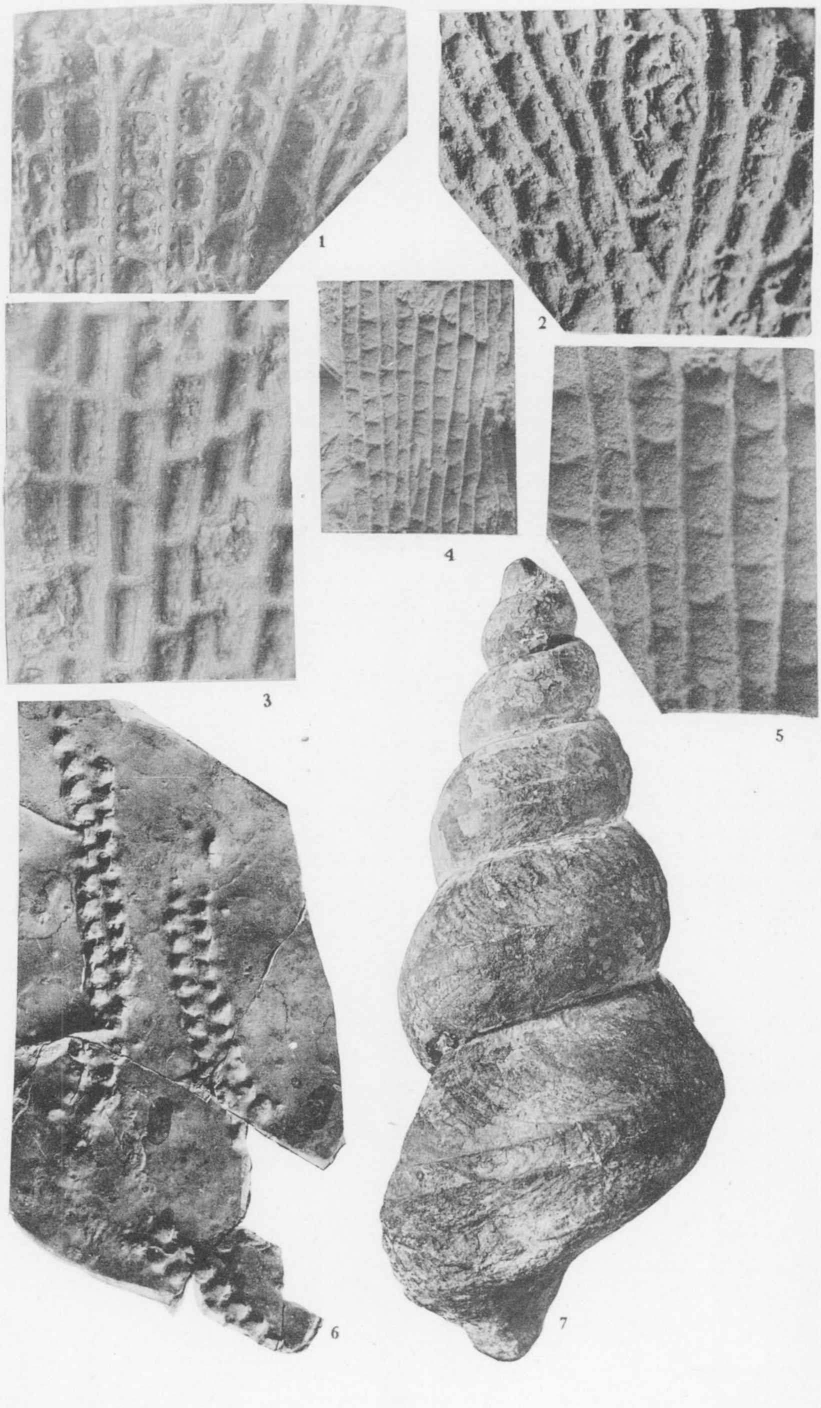
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Plate XIV

Figure 1. *Helopora formosa* Billings
Type specimen, showing the long, slender segment with its pointed lower extremity. Jupiter formation, zone 2, East cliff. X 1½. (Page 158).

Figure 2. *Helopora formosa* Billings
Lower portion of specimen of figure 1, showing the base pointed for articulation and the characteristic granules of the ridges between the cells. X 20. (Page 158).

Figure 3. *Helopora formosa* Billings
Portion of another segment, showing the mature condition. *H. bellula* is on the left. X 6. (Page 158).

Figure 4. *Helopora bellula* Billings
The type specimen. Jupiter formation, zone 2, East cliff. (V 2434). X 1½. (Page 159).

Figure 5. *Helopora bellula* Billings
Basal expansion of this species, showing the aborted zooecia composing a part of the zoarium and the central depression which received the pointed end of the first segment. X 20. (Page 159).

Figure 6. *Helopora bellula* Billings
Surface of the type, showing the oval zooecial apertures, large terminal apertures, and small interzooecial apertures. X 20. (Page 159).

Figure 7. *Helopora concava* Billings
A portion of the type specimen, showing the narrow, elongate zooecia elevated at the posterior end. (V 2355). Jupiter formation, 2 miles east of Jupiter river. X 20. (Page 158).

Figure 8. *Glauconome strigosa* (Billings)
The celluliferous side of a typical specimen. The three smaller fragments are of the externally, quite similar *Nematopora lineata* Billings. Vauréal formation. X 9. (Page 161).

Figure 9. *Glauconome strigosa* (Billings)
Non-celluliferous side of a branching example. A few of the zooecia may be seen on the upper end of the branch. X 9. (Page 161).

Figure 10. *Phaenopora excellens* (Billings)
The type specimen. Ellis Bay formation, zone 10, point Laframboise. X 1½. (Page 163).

Figure 11. *Phaenopora excellens* (Billings)
Surface of the type specimen, showing the two mesopores at the end of each zooecium. X 12. (Page 163).

Figure 12. *Dicranopora fragilis* (Billings)
The type specimen. Ellis Bay formation, zone 2, Junction cliff. X 2. (Page 166).

Figure 13. *Dicranopora fragilis* (Billings)
Surface of the type specimen. X 12. (Page 166).

Figure 14. *Rhinidictya nitidula* (Billings)
Several fragments, associated with a solid ramose bryozoan (Hallopora) and a brachiopod. English Head formation, zone 4, Carleton point. X 2. (Page 165).

Figure 15. *Rhinidictya nitidula* (Billings)
Surface of a fragment. X 12. (Page 165).

Figure 16. *Thamniscus striatopora* (Billings)
The type specimen of *Helopora striatopora* Billings, Jupiter formation, zone 6, 4 miles west of Southwest point. X 1½. (Page 157).

Figure 17. *Thamniscus striatopora* (Billings)
Surface of the type specimen, showing the non-celluliferous side with its characteristic pore-like striae. (V 3435). X 6. (Page 157).

Plate XIV

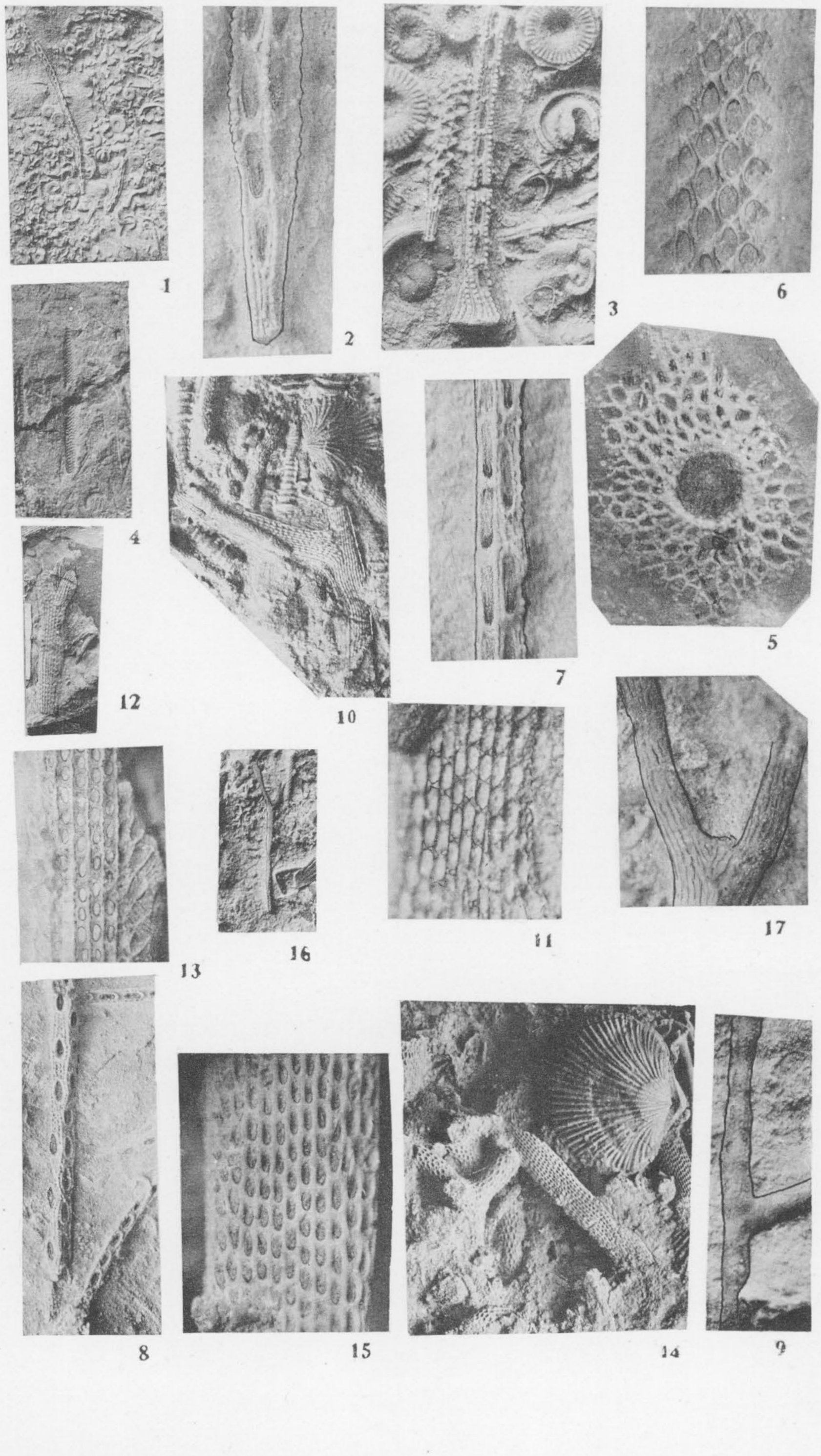

Plate XV

Figure 1. *Crania anticostiana* n. sp.
Wreck beach. Zone 3, Becscie formation. Holotype. Dorsal valve. Reproduces ornamentation of the host, *Camarotoechia glacialis.* (Y). X 2. (Page 173).

Figure 2. *Crania anticostiana* n. sp.
Same locality and horizon. Ventral valve of another specimen. X 2. (Page 173).

Figure 3. *Pholidops gamachiana* n. sp.
High cliff. Zone 2, Vauréal formation. Holotype. (Y). X 4. (Page 173).

Figure 4. *Orthis davidsoni* var. *pyramidalis* n. var.
Lousy cove. Zone 9, Ellis Bay formation. Holotype. Dorsal valve. (Y). X 1½. (Page 174).

Figure 5. *Orthis davidsoni* var. *pyramidalis* n. var.
Holotype. Ventral valve. X 1½. (Page 174).

Figure 6. *Orthis davidsoni* var. *pyramidalis* n. var.
Holotype. Outline view. X 1½. (Page 174).

Figure 7. *Orthis ? lamellosa* Twenhofel
Ellis bay. Zone 7, Ellis Bay formation. Holotype. Ventral valve. (Y). X 3. (Page 175).

Figure 8. *Orthis ? lamellosa* Twenhofel
Holotype. Dorsal valve. X 3. (Page 175).

Figure 9. *Orthis ? lamellosa* Twenhofel
Holotype. Outline view. X 3. (Page 175).

Figure 10. *Platystrophia regularis* var. *globata* n. var.
Table hill. Zone 7, Ellis Bay formation. Holotype. Outline view. (Y). X 1½. (Page 177).

Figure 11. *Platystrophia regularis* var. *globata* n. var.
Holotype. Dorsal valve. X 1½. (Page 177).

Figure 12. *Platystrophia regularis* var. *globata* n. var.
Holotype. Ventral valve. X 1½. (Page 177).

Figure 13. *Platystrophia camerata* n. sp.
Prinsta bay. Zone 7, Ellis Bay formation. Outline view. (Y). X 1¼. (Page 178).

Figure 14. *Platystrophia camerata* n. sp.
Dorsal valve same specimen as figure 13. X 1¼. (Page 178).

Figure 15. *Platystrophia camerata* n. sp.
Ventral valve same specimen as figure 13. X 1¼. (Page 178).

Figure 16. *Pholidops implicata* (Sowerby)
Small slab showing the great abundance of this species Cliffs of Gun river, Gun River formation, zone 3. X 4. (Page 174).

Figure 17. *Orthis laurentina* Billings
Ventral valve of the typical example. (V 2775). Ellis Bay formation, zone 2, Junction cliff. X 1½. (Page 176).

Figure 18. *Orthis laurentina* Billings
Dorsal valve of the same specimen. X 1½. (Page 176).

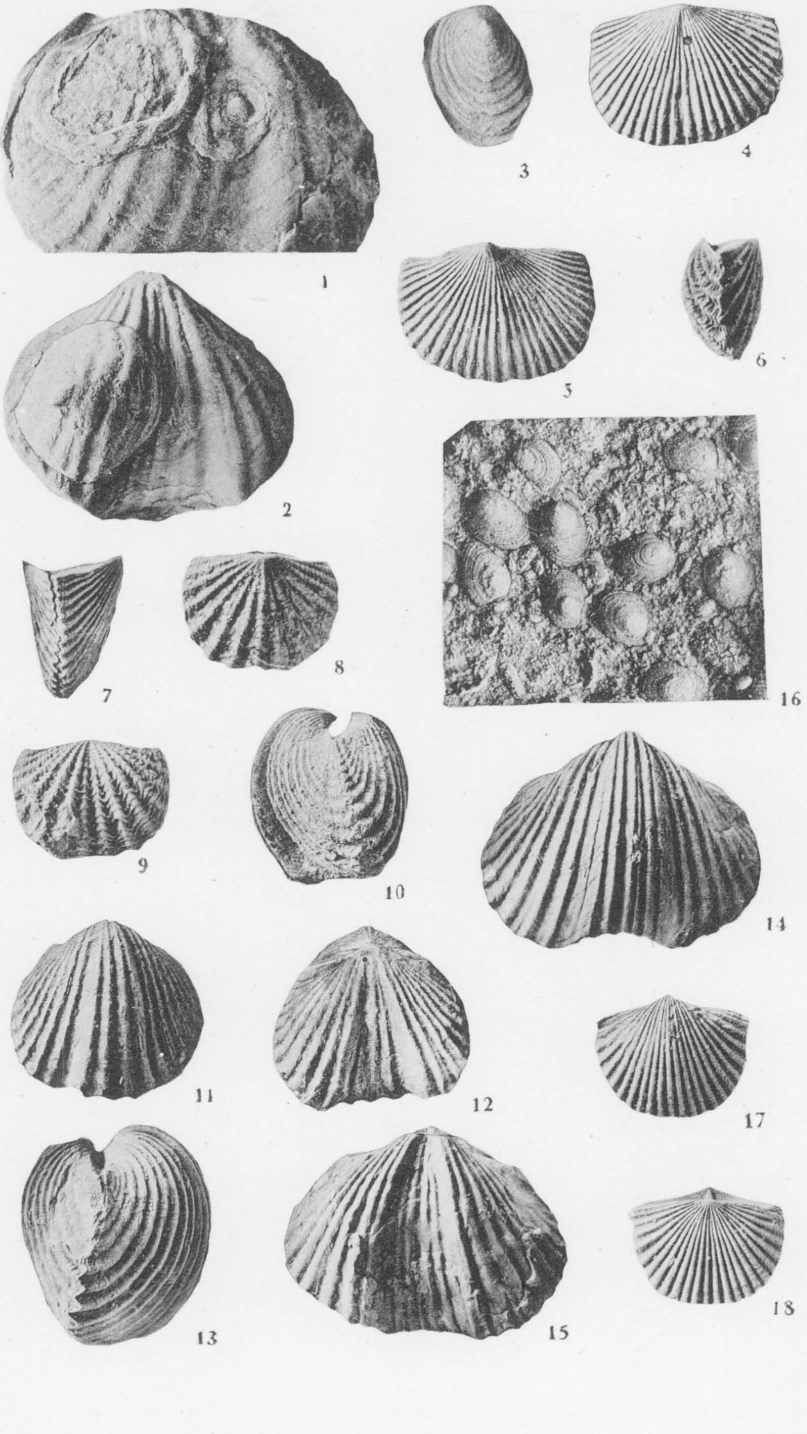
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Plate XVI

Figure 1. *Dalmanella concavoconvexa* n. sp.
South point. Zone 9, Jupiter formation. Holotype. Dorsal valve. (Y). X 2. (Page 179).

Figure 2. *Dalmanella concavoconvexa* n. sp.
Holotype. Ventral valve. X 2. (Page 179).

Figure 3. *Dalmanella concavoconvexa* n. sp.
Holotype. Outline view. X 2. (Page 179).

Figure 4. *Dinorthis carletona* n. sp.
Carleton point. Zone 4, English Head formation. Paratype. Dorsal interior. (Y). (Page 182).

Figure 5. *Dinorthis carletona* n. sp.
Holotype. Same locality and horizon. Outline view. (V). (Page 182).

Figure 6. *Dinorthis carletona* n. sp.
Holotype. Ventral valve. (Page 182).

Figure 7. *Dinorthis carletona* n. sp.
Ventral interior. (Page 182).

Figure 8. *Dinorthis carletona* n. sp.
Holotype. Dorsal valve. (Page 182).

Figure 9. *Leptaena ? gracilis* n. sp.
White brook, north side. Zone 4, English Head formation. Holotype. Ventral valve. (Y). X $1\frac{1}{3}$. (Page 185).

Figure 10. *Leptaena ? vaurealensis* n. sp.
Carleton point. Zone 4, English Head formation. Holotype. Ventral valve. (V). X $1\frac{1}{2}$. (Page 186).

Figure 11. *Leptaena ? vaurealensis* n. sp.
Holotype. Outline view. X $1\frac{1}{2}$. (Page 186).

Figure 12. *Brachyprion robustum* n. sp.
Little River cliff. Zone 9, Jupiter formation. Interior of ventral valve showing the denticulations. (Y). X $1\frac{1}{2}$. (Page 190).

Figure 13. *Brachyprion robustum* n. sp.
Same locality and horizon. Ventral exterior. X $1\frac{1}{2}$. (Page 190).

Figure 14. *Brachyprion robustum* n. sp.
Wreck beach. Zone 3, Becscie formation. Ventral exterior of a variety with exceedingly alate cardinal angles. (Y). X $1\frac{1}{2}$. (Page 190).

Figure 15. *Brachyprion robustum* n. sp.
Outline of specimen of figure 13. X $1\frac{1}{2}$. (Page 190).

Figure 16. *Plectambonites striatacostatus* n. sp.
Cliff 1 mile west of Jupiter river. Zone 1, Jupiter formation. Paratype. Interior of dorsal valve. (Y). X 3. (Page 191).

Figure 17. *Plectambonites striatacostatus* n. sp.
Same locality and horizon. Holotype. Ventral valve. X 3. (Page 191).

Figure 18. *Brachyprion elegantulum* n. sp.
Jumpers. Zone 10, Jupiter formation. Ventral exterior of species described by Shaler as *Plectambonites arca*. (V). X 2. (Page 189).

Figure 19. *Platystrophia regularis* Shaler
Ventral valve of an average specimen. Ellis Bay formation, zone 4, cliff one-half mile east of Junction cliff. X $1\frac{1}{2}$. (Page 177).

Figure 20. *Platystrophia regularis* Shaler
Dorsal valve of the specimen of figure 19. X $1\frac{1}{2}$. (Page 177).

Figure 21. *Dalmanella ruida* (Billings)
Ventral valve of the holotype. (V 2273). Ellis Bay formation, zone 7, Ellis bay. X $1\frac{1}{2}$. (Page 180).

Figure 22. *Dalmanella ruida* (Billings)
Dorsal valve of the holotype. X $1\frac{1}{2}$. (Page 180).

Plate XVI

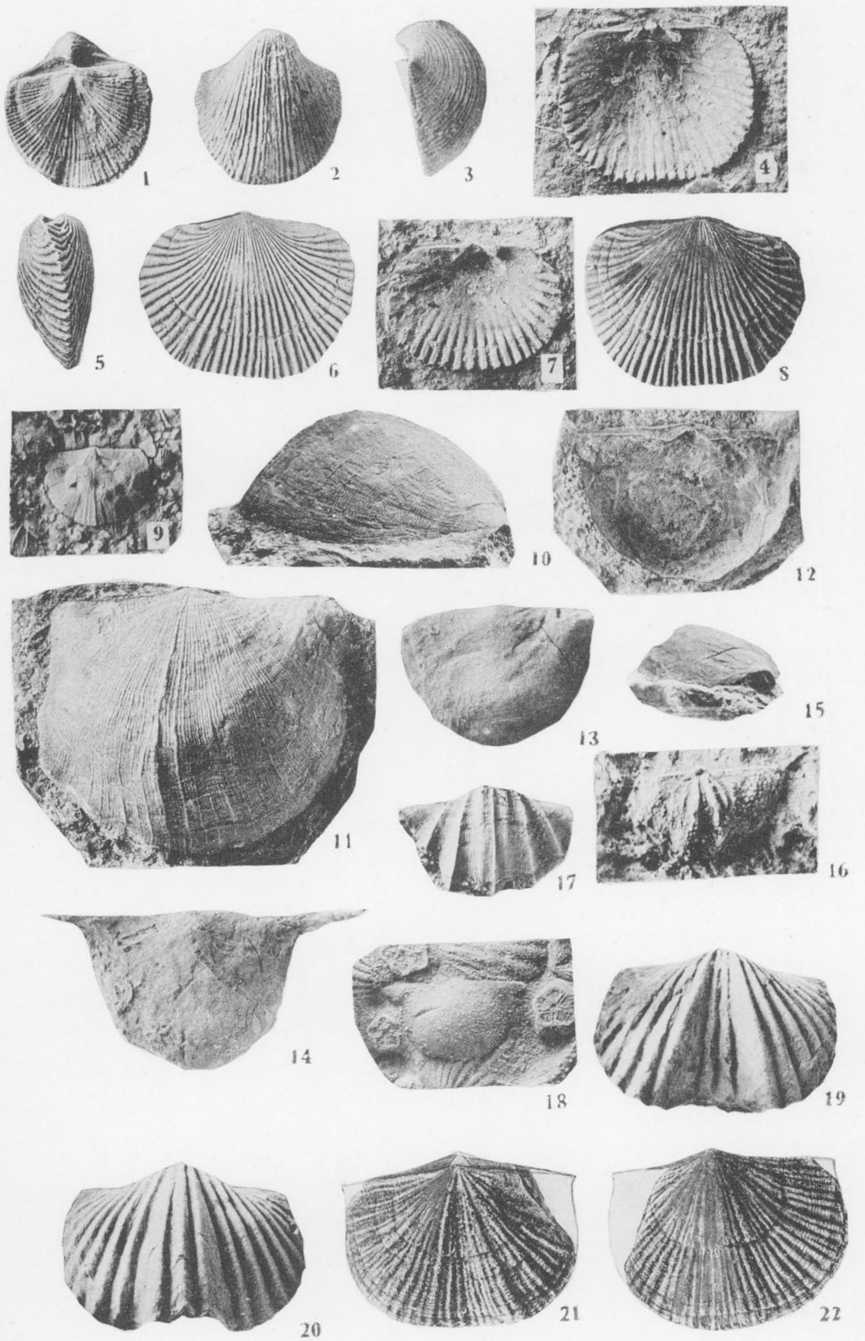

Plate XVII

Figure 1. *Strophomena radiireticulata* n. sp.
Near Jupiter river. Zone 6, Jupiter formation. Dorsal exterior. (Y). X $1\frac{1}{4}$. (Page 192).

Figure 2. *Strophomena radiireticulata* n. sp.
Same locality and horizon. Ventral exterior. (Y). X $1\frac{1}{2}$. (Page 192).

Figure 3. *Strophomena radiireticulata* n. sp.
East of Jupiter river. Probably from zone 8, Jupiter formation. Dorsal valve. (V). (Page 192).

Figure 4. *Strophomena planocorrugata* n. sp.
Carleton point. Zone 4, English Head formation. Paratype. Exterior of ventral valve. (Y). (Page 194).

Figure 5. *Strophomena planocorrugata* n. sp.
Same locality and horizon. Ventral valve interior. (Y). (Page 194).

Figure 6. *Strophomena planocorrugata* n. sp.
Baie Ste. Claire. Zone 2, English Head formation. Dorsal valve interior. (Y). X $1\frac{1}{4}$. (Page 194).

Figure 7. *Rafinesquina ellisensis* n. sp.
Ellis bay. Zone 8, Ellis Bay formation. Ventral valve. X $1\frac{1}{8}$. (Page 195).

Figure 8. *Rafinesquina ellisensis* n. sp.
Same locality and horizon. Ventral valve of another specimen. X $1\frac{1}{8}$. (Page 195).

Figure 9. *Schuchertella gamachiana* n. sp.
Ellis bay. Zone 8, Ellis Bay formation. Dorsal valve. (V). (Page 197).

Figure 10. *Rhipidomella sola* (Billings)
Ventral valve of holotype. (V 8134). Vauréal formation, zone 4, Battery point. X 2. (Page 181).

Figure 11. *Rhipidomella sola* (Billings)
Dorsal valve of a specimen from Observation cliff. Vauréal formation, zone 1. (Y). X 2. (Page 181).

Figure 12. *Rhipidomella uberis* (Billings)
Ventral interior. Ellis Bay formation, zone 4, cliff one-half mile east of Junction cliff. (Y). X 2. (Page 181).

Figure 13. *Rhipidomella uberis* (Billings)
Dorsal interior. (Y). X 2. (Page 181) .

Figure 14. *Rhipidomella uberis* (Billings)
Exterior of dorsal valve. Ellis Bay formation, zone 4, Ellis bay. (V 2272-a). X 2. (Page 181).

Figure 15. *Rhipidomella uberis* (Billings)
Ventral valve of specimen of figure 14. X 2. (Page 181).

Figure 16. *Leptaena? ceres* (Billings)
Ventral aspect of holotype. (V 2018). English Head formation, zone 4, Carleton point. (Page 185).

Figure 17. *Leptaena? ceres* (Billings)
Interior of dorsal valve. Vauréal formation, near High cliff, zone 2. X $1\frac{1}{2}$. (Page 185).

Figure 18. *Leptaena? ceres* (Billings)
Outline view of holotype. (Page 185).

Figure 19. *Leptaena? nitens* (Billings)
Interior of dorsal valve. Vauréal formation, zone 3, east side of Vauréal bay. (Y). X 2. (Page 186).

Plate XVII

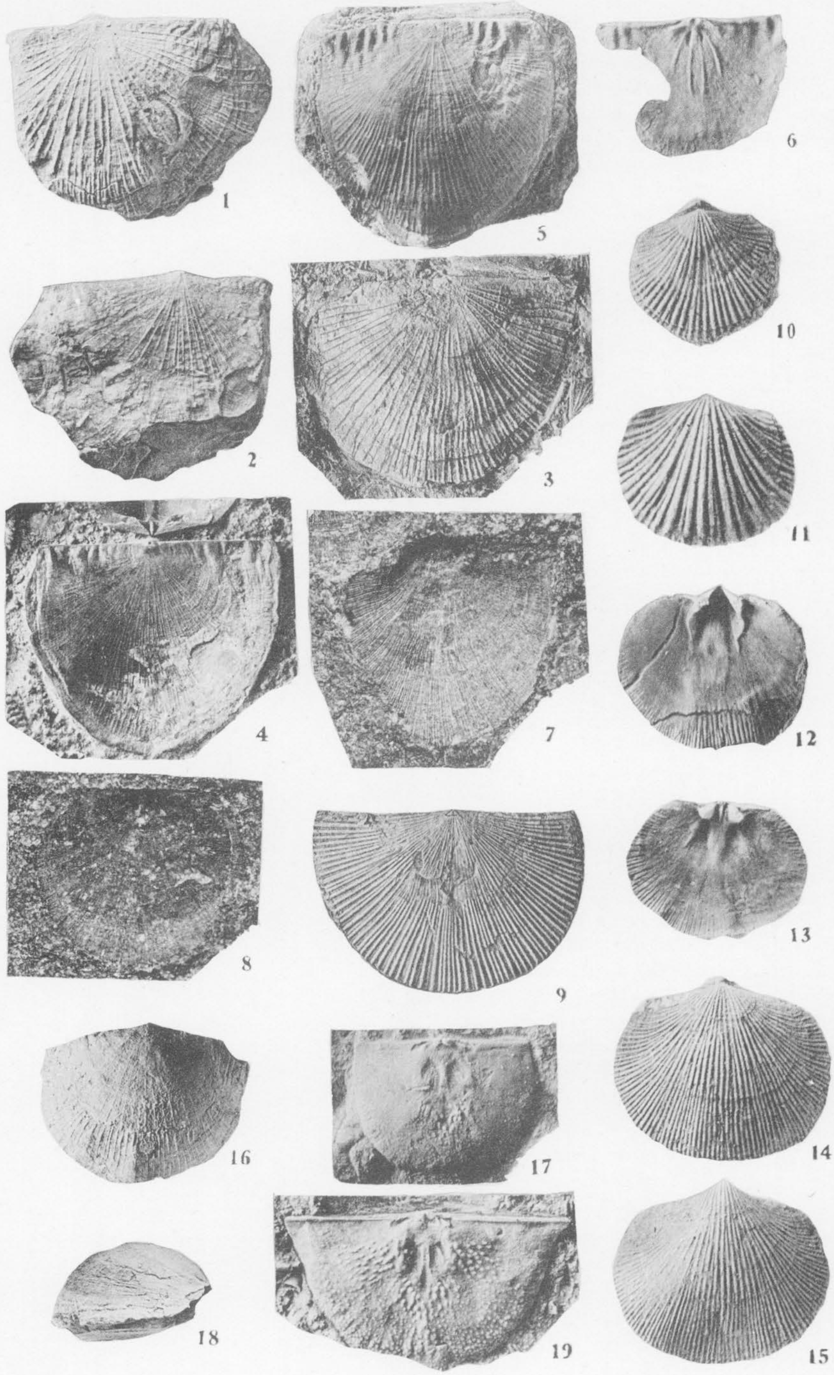

Plate XVIII

Figure 1. *Triplecia insularis* var. *anticostiensis* Twenhofel
Cliff 1 mile west of Jupiter river. Zone 1, Jupiter formation. Holotype. (Page 198).

Figure 2. *Triplecia insularis* var. *anticostiensis* Twenhofel
Holotype. Ventral valve. (Page 198).

Figure 3. *Triplecia insularis* var. *anticostiensis* Twenhofel
Same locality and horizon. Paratype. Cardinal process and teeth. (Y). X 2. (Page 198).

Figure 4. *Triplecia insularis* var. *anticostiensis* Twenhofel
The specimen of figure 3 viewed posteriorly. X 2. (Page 198).

Figure 5. *Triplecia insularis* var. *anticostiensis* Twenhofel
Dorsal view of the holotype. (Page 198).

Figure 6. *Chonetes (Eodevonaria) primigenius* Twenhofel
Jumpers. Zone 10, Jupiter formation. Paratype. Ventral valve. (Y). X 2½. (Page 199).

Figure 7. *Chonetes (Eodevonaria) primigenius* Twenhofel
Cape Henry. Zone 3, Vauréal formation. Paratype. Ventral valve. X 2. (Page 199).

Figure 8. *Chonetes (Eodevonaria) primigenius* Twenhofel
Wreck beach. Zone 3, Becscie formation. The holotype (largest specimen) and two paratypes. (Y). X 2. (Page 199).

Figure 9. *Stricklandinia davidsoni* var. *striata* n. var.
Southwest point. Probably zone 8 or 9 of Jupiter formation. Dorsal valve. (Y). (Page 202).

Figure 10. *Clorinda becsciensis* n. sp.
Bear cliff. Zone 1, Becscie formation. Holotype. Dorsal valve. (Y). X 1¼. (Page 204).

Figure 11. *Clorinda becsciensis* n. sp.
Holotype. Outline view. X 1¼. (Page 204).

Figure 12. *Clorinda becsciensis* n. sp.
Holotype. Ventral valve. X 1¼. (Page 204).

Figure 13. *Leptaena? nitens* (Billings)
Interior of ventral valve. (Y). English Head formation, zone 3, English head. (Page 186).

Figure 14. *Leptaena? nitens* (Billings)
Ventral valve showing striations and prominent mid striation. (V 2019). English Head formation, zone 4, Carleton point. (Page 186).

Figure 15. *Dinorthis anticostiensis* (Shaler)
Dorsal valve of an average specimen. Ellis Bay formation, zone 1, Junction cliff. (Y). X 1¼. (Page 183).

Figure 16. *Dinorthis anticostiensis* (Shaler)
Ventral valve of the specimen of figure 15. X 1¼. (Page 183).

Plate XVIII

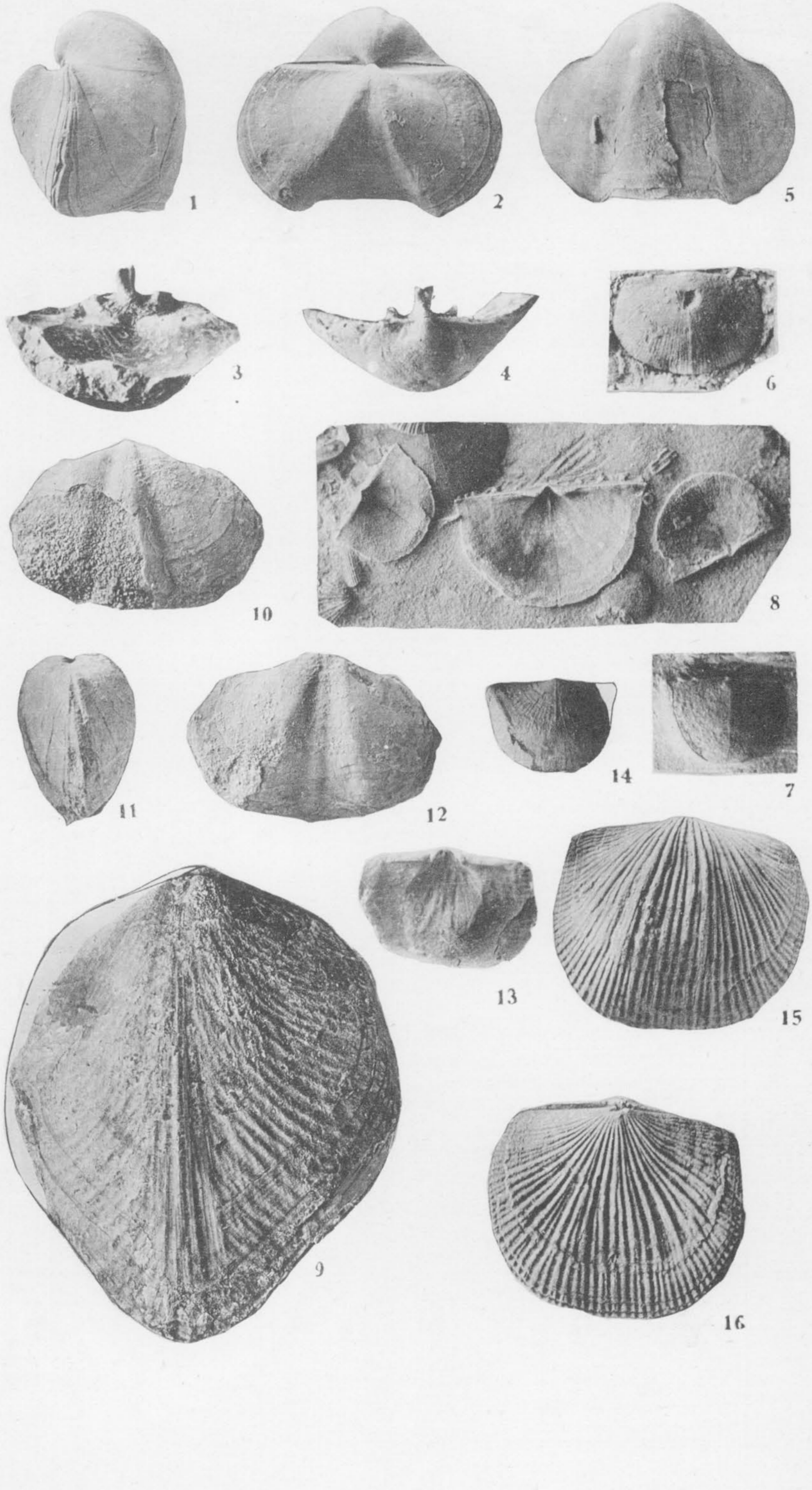

Plate XIX

Figure 1. *Virgiana barrandei* var. *anticostiensis* n. var.
Bear cliff. Zone 1, Becscie formation. Holotype. Dorsal valve. (Y). X 1½ (Page 206).

Figure 2. *Virgiana barrandei* var. *anticostiensis* n. var.
Holotype. Ventral valve. X 1½. (Page 206).

Figure 3. *Virgiana barrandei* var. *anticostiensis* n. var.
Holotype. Outline view. X 1½. (Page 206).

Figure 4. *Rhynchotrema prinstanum* n. sp.
Prinsta bay. Zone 7, Ellis Bay formation. Holotype. Outline view. (Y). X 2. (Page 208).

Figure 5. *Rhynchotrema prinstanum* n. sp.
Holotype. Dorsal valve. X 2. (Page 208).

Figure 6. *Rhynchotrema prinstanum* n. sp.
Holotype. Ventral valve. X 2. (Page 208).

Figure 7. *Camarotoechia peneborealis* n. sp.
Jumpers. Zone 10, Jupiter formation. Ventral valve. (Y). X 1½. (Page 211).

Figure 8. *Camarotoechia peneborealis* n. sp.
Dorsal valve of specimen of figure 7. X 1½. (Page 211).

Figure 9. *Camarotoechia peneborealis* n. sp.
Same specimen. Outline view. X 1½. (Page 211).

Figure 10. *Zygospira recurvirostris aequivalvis* n. sp.
Carleton point. Zone 4, English Head formation. Holotype. Dorsal valve. (V). (Page 214).

Figure 11. *Zygospira recurvirostris aequivalvis* n. sp.
Holotype. Outline view. (Page 214).

Figure 12. *Zygospira recurvirostris aequivalvis* n. sp.
Holotype. Ventral valve. (Page 214).

Figure 13. *Zygospira jupiterensis* n. sp.
Jupiter river. Zone 4, Jupiter formation. Holotype. Ventral valve. (V). X 3. (Page 215).

Figure 14. *Zygospira jupiterensis* n. sp.
Holotype. Outline view. X 3. (Page 215).

Figure 15. *Zygospira jupiterensis* n. sp. Holotype.
Dorsal valve. X 3. (Page 215).

Figure 16. *Atrypina arenacea* n. sp.
Sand cliff, Jupiter river. Zone 4, Jupiter formation. Holotype. Dorsal side. X 3. (Page 217).

Figure 17. *Atrypina arenacea* n. sp.
Holotype. Ventral side. X 3. (Page 217).

Figure 18. *Camarotoechia glacialis* (Billings)
Ventral valve of the holotype. (V 2371). Becscie formation, zone 3, Wreck beach. X 1½. (Page 210).

Figure 19. *Camarotoechia glacialis* (Billings)
Dorsal valve of the holotype. X 1½. (Page 210).

Figure 20. *Camarotoechia glacialis* (Billings)
Outline of the holotype. X 1½. (Page 210).

Figure 21. *Camarotoechia vicina* (Billings)
Dorsal valve of the holotype. (V 2518). Chicotte formation, zone 1, Southwest point. X 2. (Page 211).

Figure 22. *Camarotoechia vicina* (Billings)
Ventral valve of the holotype. X 2. (Page 211).

Figure 23. *Camarotoechia vicina* (Billings)
Outline of the holotype. X 2. (Page 211).

Plate XIX

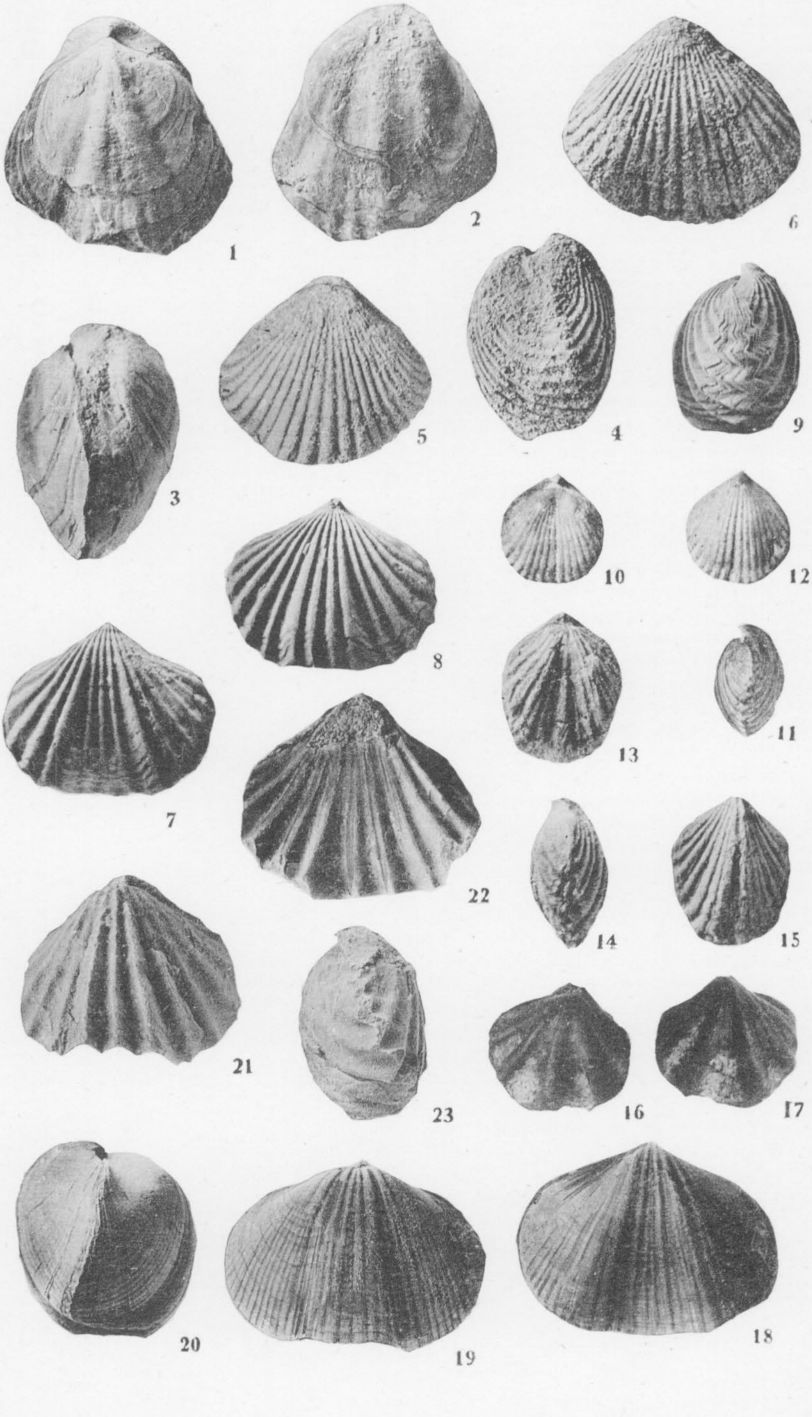

Plate XX

Figure 1. *Homeospira anticostiana* n. sp.
East cliff. Zone 1, Jupiter formation. Holotype. Dorsal valve. (Y). X 2. (Page 220).

Figure 2. *Homeospira anticostiana* n. sp.
Holotype. Ventral view. X 2. (Page 220).

Figure 3. *Homeospira anticostiana* n. sp.
Holotype. Outline view. X 2. (Page 220).

Figure 4. *Hyattidina carletona* Twenhofel
Carleton point. Zone 4, English Head formation. Holotype. Dorsal view. (Y). X 4. (Page 223).

Figure 5. *Hyattidina carletona* Twenhofel
Holotype. Outline view. X 4. (Page 223).

Figure 6. *Hyattidina carletona* Twenhofel
Holotype. Ventral valve. X 4. (Page 223).

Figure 7. *Atrypina ? gamachiana* n. sp.
Ellis bay. Zone 9, Ellis Bay formation. Holotype. Dorsal valve. (Y). X 4. (Page 217).

Figure 8. *Atrypina ? gamachiana* n. sp.
Holotype. Ventral valve. X 4. (Page 217).

Figure 9. *Atrypina ? gamachiana* n. sp.
Holotype. Outline view. X 4. (Page 217).

Figure 10. *Catazyga anticostiensis* (Billings)
Outline of an average specimen. (V 8133). English Head formation, zone 3, English head. X 1½. (Page 215).

Figure 11. *Catazyga anticostiensis* (Billings)
Ventral valve of the specimen of figure 10. X 1½. (Page 215).

Figure 12. *Catazyga anticostiensis* (Billings)
Dorsal valve of the specimen of figure 10. X 1½. (Page 215).

Figure 13. *Cyrtia exporrecta myrtea* Billings
Dorsal valve of the holotype. (V 2522-a). Chicotte formation, zone 2, Southwest point. X 1½. (Page 219).

Figure 14. *Cyrtia exporrecta myrtea* Billings
Outline of the holotype. X 1½. (Page 219).

Figure 15. *Whitfieldella? julia* (Billings)
Ventral valve of the holotype. (V 2525). Jupiter formation, zone 10, Jumpers. X2. (Page 221).

Figure 16. *Whitfieldella? julia* (Billings)
Outline of the holotype. X 2. (Page 221).

Figure 17. *Whitfieldella? julia* (Billings)
Dorsal valve of the holotype. X 2. (Page 221).

Figure 18. *Whitfieldella? lara* (Billings)
Ventral valve of one of the types. (V 2375). Becscie formation, zone 3, Wreck beach. X 2. (Page 222).

Figure 19. *Whitfieldella? lara* (Billings)
Outline of the specimen of figure 18. X 2. (Page 222).

Figure 20. *Whitfieldella? lara* (Billings)
Dorsal valve of the specimen of figure 18. X 2. (Page 222).

Figure 21. *Hindella umbonata* (Billings)
Ventral aspect showing the strongly developed umbo. (V 2282). Ellis Bay formation, zone 4, Ellis bay. (Page 221).

Figure 22. *Hindella umbonata* (Billings)
Dorsal valve of the specimen of figure 21. (Page 221).

Figure 23. *Hindella umbonata* (Billings)
Outline of the specimen of figure 21. (Page 221).

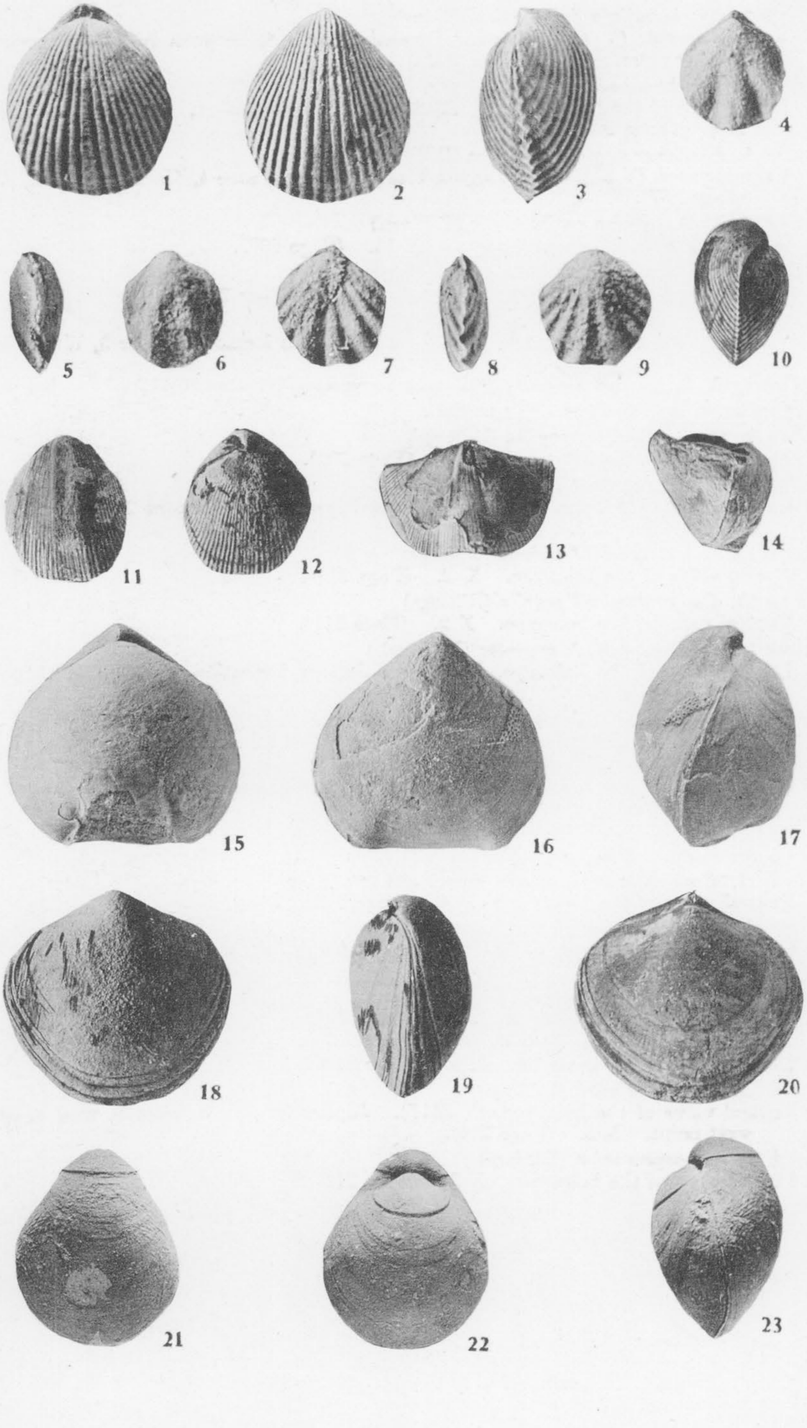
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PLATE XXI

FIGURE 1. *Stricklandinia melissa* Billings
Photograph of the holotype. (V 2581). Jupiter formation, zone 9?, Southwest point. (Page 203).

FIGURE 2. *Stricklandinia davidsoni* (Billings)
Ventral aspect. (V 2513). Jupiter formation, zone 8, between Southwest point and Jupiter river. X $\frac{4}{5}$. (Page 202).

FIGURE 3. *Stricklandinia salteri* Billings
Photograph of the holotype. (V 2528). Jupiter formation, zone 3, Heath point. X $\frac{4}{5}$. (Page 203).

FIGURE 4. *Rhynchotrema anticostiense* (Billings)
Ventral valve. (V 2232-d). English Head formation, zone 4, Carleton point. X $1\frac{1}{2}$. (Page 207).

FIGURE 5. *Rhynchotrema anticostiense* (Billings)
Outline of the specimen of figure 4. X $1\frac{1}{2}$. (Page 207).

FIGURE 6. *Rhynchotrema anticostiense* (Billings)
Dorsal valve of the specimen of figure 4. X $1\frac{1}{2}$. (Page 207).

FIGURE 7. *Camarotoechia fringilla* (Billings)
Ventral valve of the holotype. (V 2370-a). Becscie formation, zone 3, Wreck beach. (Page 209).

FIGURE 8. *Camarotoechia fringilla* (Billings)
Outline of the holotype. (Page 209).

FIGURE 9. *Camarotoechia fringilla* (Billings)
Dorsal valve of the holotype. X 2. (Page 209).

FIGURE 10. *Camarotoechia? pyrrha* (Billings)
Outline of the holotype. (V 2068-c). Gun River formation, zone 2, one mile east of Otter river. X 2. (Page 211).

FIGURE 11. *Camarotoechia? pyrrha* (Billings)
Dorsal valve of the holotype. X 2. (Page 211).

FIGURE 12. *Camarotoechia? pyrrha* (Billings)
Ventral valve of the holotype. X 2. (Page 211).

FIGURE 13. *Camarotoechia? argentea* (Billings)
Dorsal valve of the holotype. (V 2516). Jupiter formation, zone 3, Heath point. X $1\frac{1}{2}$. (Page 208).

FIGURE 14. *Camarotoechia? argentea* (Billings)
Ventral valve of the holotype. X $1\frac{1}{2}$. (Page 208).

FIGURE 15. *Protozeuga anticostiana* Twenhofel
Outline of the holotype. (Y). English Head formation, zone 4, Makasti cliff. X 4. (Page 213).

FIGURE 16. *Protozeuga anticostiana* Twenhofel
Dorsal valve of holotype. X 4. (Page 213).

FIGURE 17. *Protozeuga anticostiana* Twenhofel
Ventral valve of the holotype. X 4. (Page 213).

FIGURE 18. *Zygospira paupera* Billings
Outline of the holotype. (V 3584). Jupiter formation, zone 4, Jupiter river. X 3. (Page 214).

FIGURE 19. *Zygospira paupera* Billings
Ventral valve of the holotype. X 3. (Page 214).

FIGURE 20. *Zygospira paupera* Billings
Dorsal valve of the holotype. X 3. (Page 214).

FIGURE 21. *Zygospira mica* (Billings)
Ventral valve of the holotype. (V 2517). Jupiter formation, zone 9, west of Southwest point. X 3. (Page 214).

FIGURE 22. *Zygospira mica* (Billings)
Dorsal valve of the holotype. X 3. (Page 214).

Plate XXI

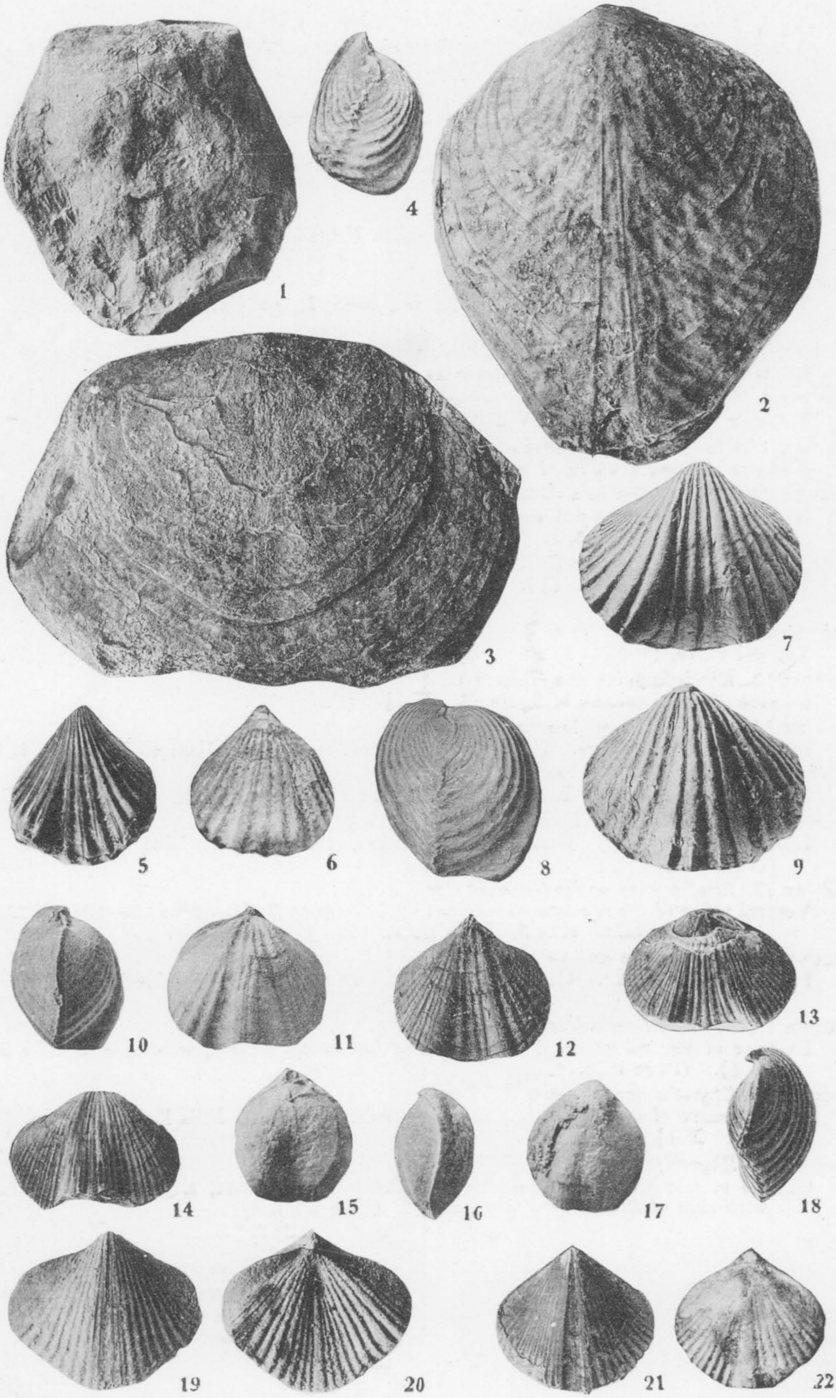

Plate XXII

Figure 1. *Leptaena julia* (Billings)
Dorsal interior of one of the types. (V 2506). Jupiter formation, zone 10, Jumpers. X $1\frac{1}{2}$. (Page 184).

Figure 2. *Leptaena julia* (Billings)
Ventral exterior of another of the type specimens. (V 2506-a). Jupiter formation, zone 10, Jumpers. X $1\frac{1}{2}$. (Page 184).

Figure 3. *Strophomena fluctuosa* Billings
Ventral interior. (Y). English Head formation, zone 4, Carleton point. (Page 193).

Figure 4. *Strophomena fluctuosa* Billings
Dorsal interior. English Head formation, zone 4, nid de Corbeau. (Y). X $1\frac{1}{2}$. (Page 193).

Figure 5. *Strophomena fluctuosa* Billings
Exterior of dorsal valve. (V 2017). English Head formation, zone 4, Carleton point. (Page 193).

Figure 6. *Schuchertella alterniradiata* Shaler
Dorsal interior. (Y). Jupiter formation, zone 7, east of Jupiter river. X $1\frac{1}{2}$. (Page 196).

Figure 7. *Schuchertella alterniradiata* Shaler
Ventral interior. (Y). Occurrence as in figure 6. X $1\frac{1}{4}$. (Page 196).

Figure 8. *Schuchertella alterniradiata* Shaler
Exterior of ventral valve. (V 2363). Occurrence as before. X $1\frac{1}{2}$. (Page 196).

Figure 9. *Schuchertella alterniradiata* Shaler,
Exterior of dorsal valve of specimen of figure 8. X $1\frac{1}{2}$. (Page 196).

Figure 10. *Brachyprion leda* (Billings)
Ventral exterior, striæ not visible. (Y). Jupiter formation, zone 1, 3 to 4 miles west of Jupiter river. X 2. (Page 188).

Figure 11. *Brachyprion leda* (Billings)
Interior of dorsal valve. (Y). Jupiter formation, zone 9, Iron River cliffs. X 2. (Page 188).

Figure 12. *Hindella prinstana* (Billings)
Ventral valve. (V 2285). Ellis Bay formation, Prinsta bay. X $1\frac{1}{2}$. (Page 220).

Figure 13. *Hindella prinstana* (Billings)
Outline of the specimen of figure 12. X $1\frac{1}{2}$. (Page 220).

Figure 14. *Brachyprion philomena* (Billings)
Interior of dorsal valve. (Y). Jupiter formation, zone 2, East cliff. (Page 189).

Figure 15. *Brachyprion anticostiense* Shaler
Ventral interior. (Y). Becscie formation, zone 3, Wreck beach. X $1\frac{1}{2}$. (Page 188).

Figure 16. *Brachyprion anticostiense* Shaler
Dorsal interior. (Y). Gun River formation, zone 4, cape MacGilvray. X $1\frac{1}{2}$. (Page 188).

Figure 17. *Brachyprion anticostiense* Shaler
Ventral valve of the specimen identified by Billings as *Rafinesquina alternata*. (V 2360). Jupiter formation, zone 3, Heath point. X $1\frac{1}{2}$. (Page 188).

Figure 18. *Brachyprion anticostiense* Shaler
Dorsal exterior. (Y). Gun River formation, zone 4, cape MacGilvray. X $1\frac{1}{4}$. (Page 188).

Figure 19. *Leptaena? reticulata* (Shaler)
Exterior of ventral valve. (Y). Ellis Bay formation, zone 4, west side of Ellis bay. X $1\frac{1}{2}$. (Page 187).

Figure 20. *Rhynchotrema janeum* (Billings)
Ventral valve of one of the original specimens. (V 2279). Ellis Bay formation, Ellis bay. X $1\frac{1}{2}$. (Page 207).

Figure 21. *Rhynchotrema janeum* (Billings)
Outline of the specimen of figure 20. Compare the short, slightly inturned beak with that of *R. anticostiensis*. X $1\frac{1}{2}$. (Page 207).

Plate XXII

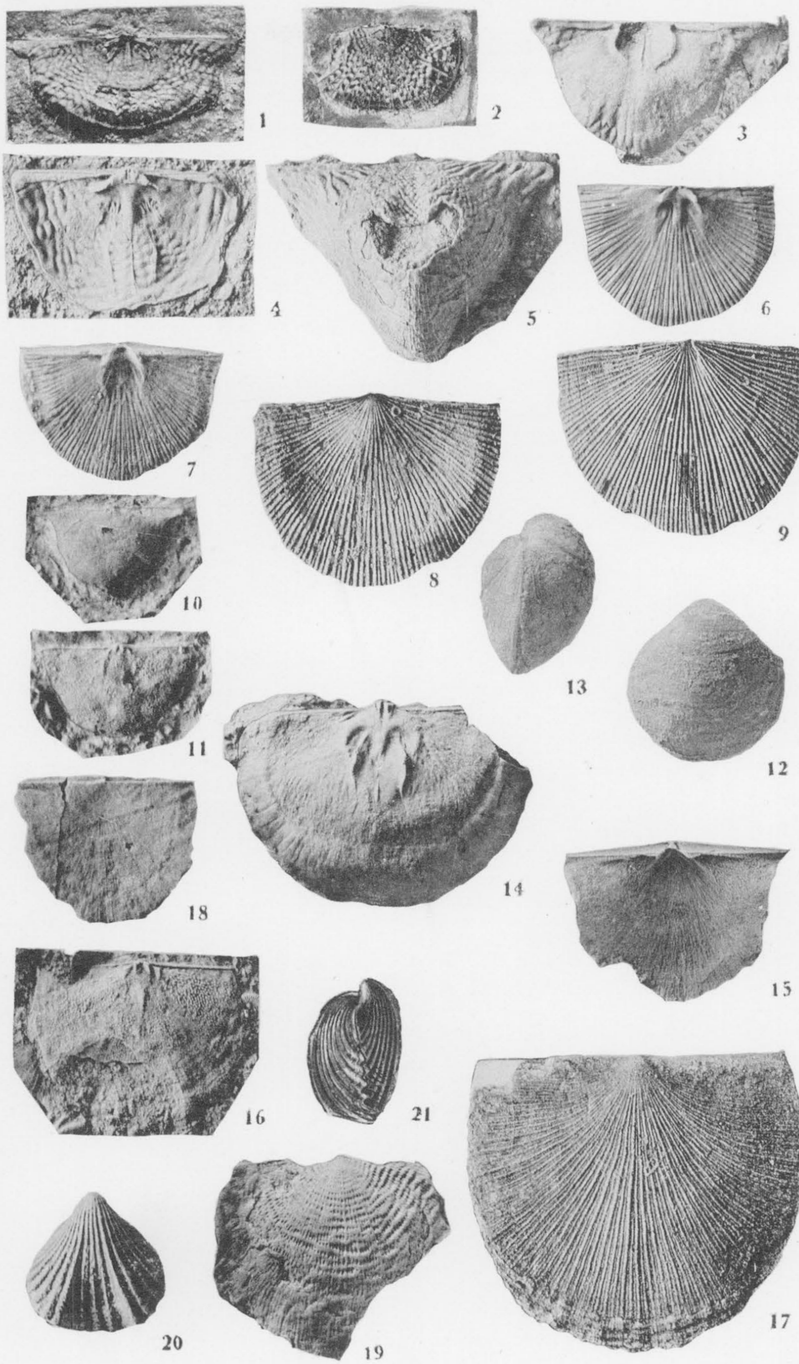

Plate XXIII

Figure 1. *Strophomena hecuba* Billings
Ventral interior. (Y). English Head formation, zone 4, Carleton point. (Page 194).

Figure 2. *Strophomena hecuba* Billings
Outline of holotype. (V 2016). English Head formation, zone 4, Carleton point. (Page 194).

Figure 3. *Strophomena hecuba* Billings
Dorsal valve of holotype. (Page 194).

Figure 4. *Strophomena semiovalis* Shaler
Outline of a typical specimen. (Y). Ellis Bay formation, zone 4, cliff one-half mile east of Junction cliff. (Page 194).

Figure 5. *Strophomena semiovalis* Shaler
Dorsal valve of the specimen of figure 4. (Page 194).

Figure 6. *Strophomena arcuata* Shaler
Dorsal valve. (Y). Ellis Bay formation, zone 4, west side of Ellis bay. (Page 193).

Figure 7. *Strophomena arcuata* Shaler
Outline of the specimen of figure 6. (Page 193).

Figure 8. *Brachyprion philomena* (Billings)
Outline of a typical specimen. (Y). Jupiter formation, zone 3, Heath point. (Page 189).

Figure 9. *Brachyprion philomena* (Billings)
Ventral valve of the specimen of figure 8. (Page 189).

Figure 10. *Brachyprion philomena* (Billings)
Ventral interior. (Y). Jupiter formation, zone 3, Heath point. (Page 189).

Figure 11. *Clitambonites diversus* (Shaler)
Dorsal interior of a typical example. (Y). Ellis Bay formation, zone 1, Junction cliff. (Page 200).

Figure 12. *Clitambonites diversus* (Shaler)
Outline view. (Y). Ellis Bay formation, zone 4, cliff one-half mile east of Junction cliff. (Page 200).

Figure 13. *Clitambonites diversus* (Shaler)
Ventral valve of the specimen of figure 12. (Page 200).

Figure 14. *Clitambonites diversus* (Shaler)
Dorsal valve of the specimen of figure 12. (Page 200).

Figure 15. *Stricklandinia brevis* Billings
Ventral valve of the holotype. Jupiter formation, zone 10, Jumpers. (Page 201).

Figure 16. *Stricklandinia brevis* Billings
Dorsal valve of the holotype. (Page 201).

Figure 17. *Stricklandinia brevis* Billings
Interior of a ventral valve. (V 1339-e). Jupiter formation, zone 10, Jumpers. X 1½. (Page 201).

Figure 18. *Rhynchonella? nutrix* (Billings)
Ventral valve of the holotype. (V 2278). Ellis Bay formation, Ellis bay. X 1½. (Page 213).

Figure 19. *Rhynchonella? nutrix* (Billings)
Dorsal valve of the holotype. X 1½. (Page 213).

Figure 20. *Rhynchonella? nutrix* (Billings)
Outline of the holotype. X 1½. (Page 213).

Plate XXIII

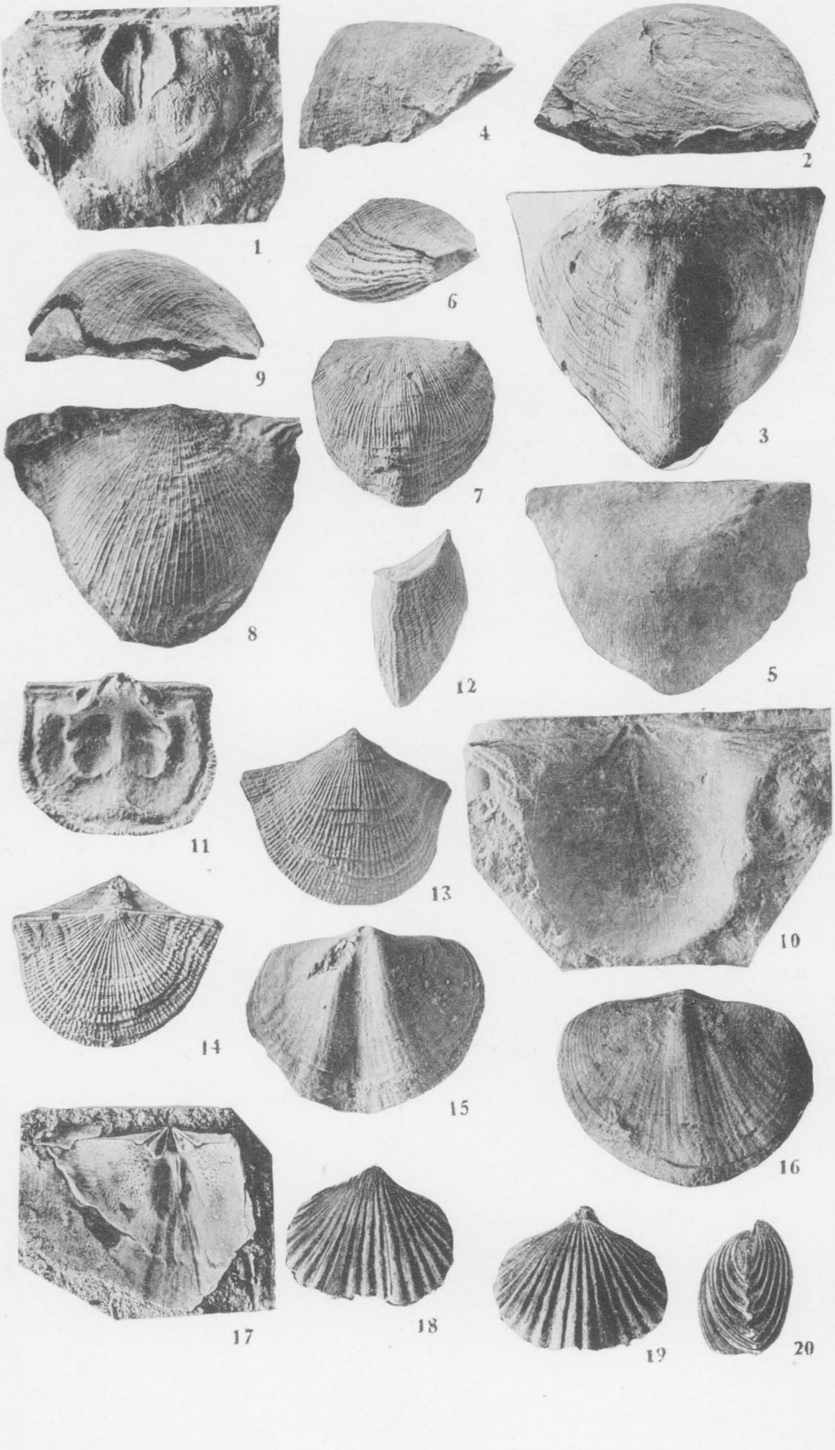

Plate XXIV

Figure 1. *Modiolopsis miser* n. sp.
Jupiter River cliff. Zone 3, Jupiter formation. Holotype. Left valve of a specimen in collections of the National Museum of Canada, bearing the above name. (V). (Page 232).

Figure 2. *Modiolopsis miser* n. sp.
Same locality. Right valve of a larger specimen. (Y). X $1\frac{1}{2}$. (Page 232).

Figure 3. *Rhytimya prinstana* n. sp.
Prinsta bay. Zone 6, Ellis Bay formation. Holotype. Anterior view. (Y). X $\frac{3}{4}$. (Page 233).

Figure 4. *Rhytimya prinstana* n. sp.
Holotype. Right valve. X $\frac{3}{4}$. (Page 233).

Figure 5. *Cuneamya anticostiana* n. sp.
Anterior outline. (Y). Ellis Bay formation, zone 5, cape Eagle in Ellis bay. (Page 225).

Figure 6. *Cuneamya anticostiana* n. sp.
Right valve of specimen of figure 5, holotype. (Page 225).

Figure 7. *Pterinea laurentina* n. sp.
Photograph of the left valve of holotype. (Y). Becscie formation, zone 3, Wreck beach. X 2. (Page 229).

Figure 8. *Byssonychia anticostiana* n. sp.
Left valve of holotype. Ellis Bay formation, zone 4, west side of Ellis bay. (Page 231).

Figure 9. *Byssonychia anticostiana* n. sp.
Outline of the holotype. (Page 231).

Figure 10. *Cyrtodonta harrietti* Billings
Right valve of supposed type. (V 2089). English Head formation, English head. (Page 227).

Figure 11. *Cyrtodonta anticostiensis* Billings
Left valve of one of the types. (V 2090). English Head formation, English head. (Page 226).

Figure 12. *Vanuxemia ungulata* (Billings)
Right valve of holotype. (V 2108). English Head formation, zone 4, Makasti bay. (Page 227).

Figure 13. *Vanuxemia ungulata* (Billings)
Anterior outline of holotype. (Page 227).

Figure 14. *Vanuxemia acutumbona* (Billings)
Right valve of holotype. (V 2295). Ellis Bay formation, zone 4, cliff one-half mile east of Junction cliff. (Page 227).

Figure 15. *Whitella plebia* (Billings)
Anterior outline of the holotype. (V 2091-a). English Head formation, zone 4, Carleton point. (Page 228).

Figure 16. *Whitella plebia* (Billings)
Left valve of holotype. (Page 228).

Plate XXIV

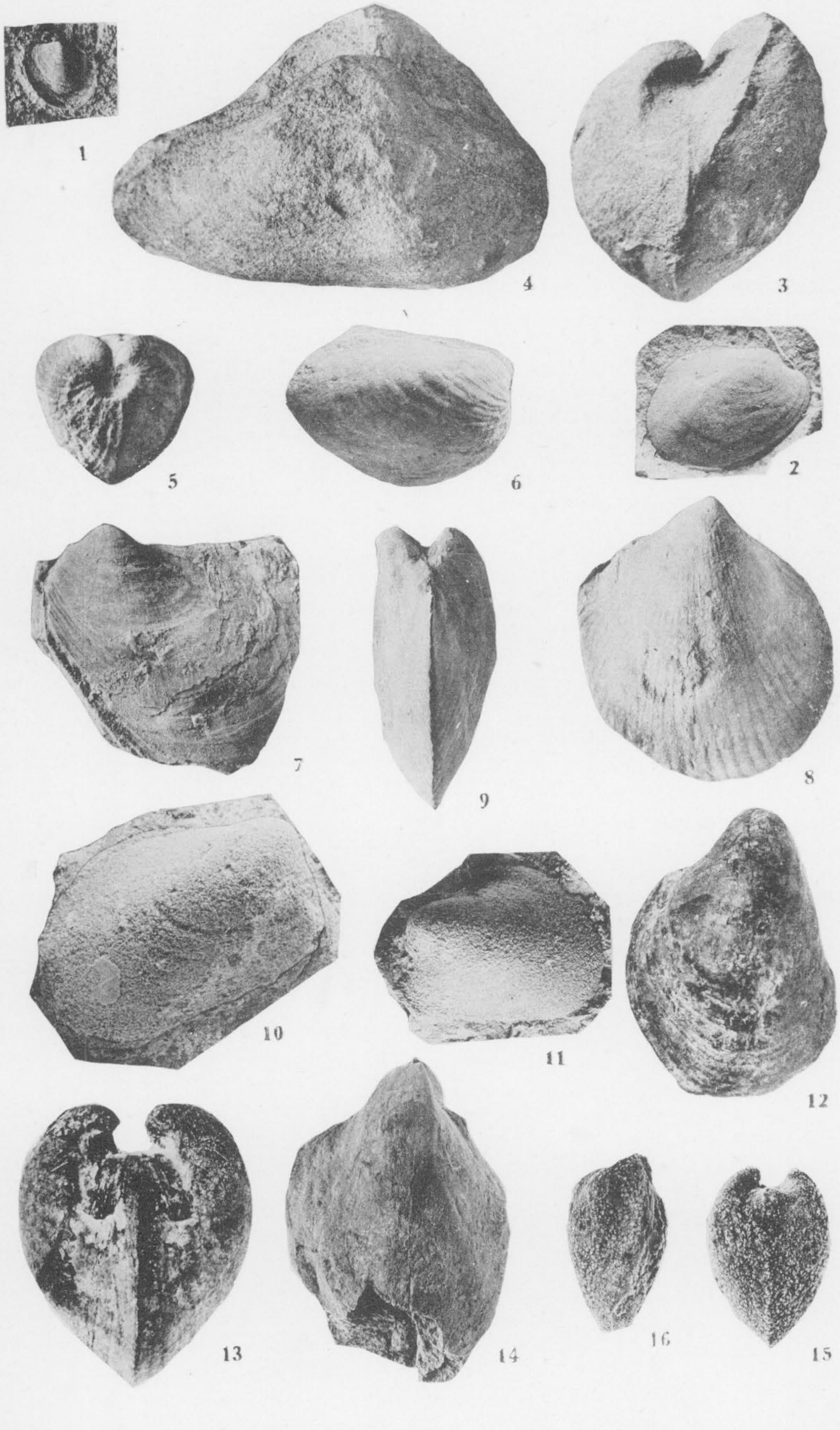

PLATE XXV

FIGURE 1. *Raphistoma vaurealense* n. sp.
Mouth of Vauréal river. Zone 3, Vauréal formation. Holotype. Upper surface. (Y). X 2.

FIGURE 2. *Raphistoma vaurealense* n. sp.
Holotype. Side view. X 2.

FIGURE 3. *Lophospira acutocarinata* n. sp.
West cliff. Zone 2, Vauréal formation. Holotype. (Y). X 2. (Page 237).

FIGURE 4. *Lophospira gamachiana* n. sp.
Ellis bay. Zone 5, Ellis Bay formation. Holotype. (V). (Page 237).

FIGURE 5. *Spirorapha ? corrugata* n. sp.
Cormorant point. Zone 5, Jupiter formation. Holotype. Side view of a squeeze. (Page 240).

FIGURE 6. *Schizolopha gigantea* n. sp.
Cape Eagle, Ellis bay. Zone 5, Ellis Bay formation. Holotype. View showing open slit preserved by the overgrowth of *Protarea tenuis*. (Y). (Page 240).

FIGURE 7. *Bellerophon laurentinus* n. sp.
Near White cliff on north shore. Zone 1, Vauréal formation. Holotype. Side view. (Y). (Page 244).

FIGURE 8. *Bellerophon laurentinus* n. sp. Holotype.
View on the keel showing the probable apertural sinus and ornamentation. (Page 244).

FIGURE 9. *Bucania ellisensis* n. sp.
Cliff one-half mile east of Junction cliff. Zone 4, Ellis Bay formation. Holotype. Side view. (Y). X 1½. (Page 244).

FIGURE 10. *Bucania ellisensis* n. sp.
Holotype, showing keel and ornamentation. (Page 244).

FIGURE 11. *Oxydiscus giganteus* n. sp.
Ellis bay. Zone 4, Ellis Bay formation. Holotype. (V). (Page 245).

FIGURE 12. *Oxydiscus giganteus* n. sp.
Holotype, showing keel. (Page 245).

FIGURE 13. *Oxydiscus tenuis* n. sp.
English head. Zone 3, English Head formation. Holotype, showing keel. (Y). X 1½. (Page 246).

FIGURE 14. *Oxydiscus tenuis* n. sp.
Holotype. X 1½. (Page 246).

FIGURE 15. *Eccyliomphalus nitida* n. sp.
Cliff one-half mile east of Junction cliff. Zone 4, Ellis Bay formation. View of a part of a shell supposed to be this species, showing surface ornamentation. (V). (Page 248).

FIGURE 16. *Eccyliomphalus nitida* n. sp.
Same locality and horizon. Holotype. (V). (Page 248).

FIGURE 17. *Palaeacmaea anticostiensis* n. sp.
Upper surface of holotype. Ellis Bay formation, zones 6 and 7, Prinsta bay. (V). (Page 234).

FIGURE 18. *Palaeacmaea anticostiensis* n. sp.
Outline of holotype. (Page 234).

FIGURE 19. *Lophospira modesta* (Billings)
One of the cotypes? (V 2132). English Head formation, zone 3, English head. (Page 238).

Plate XXV

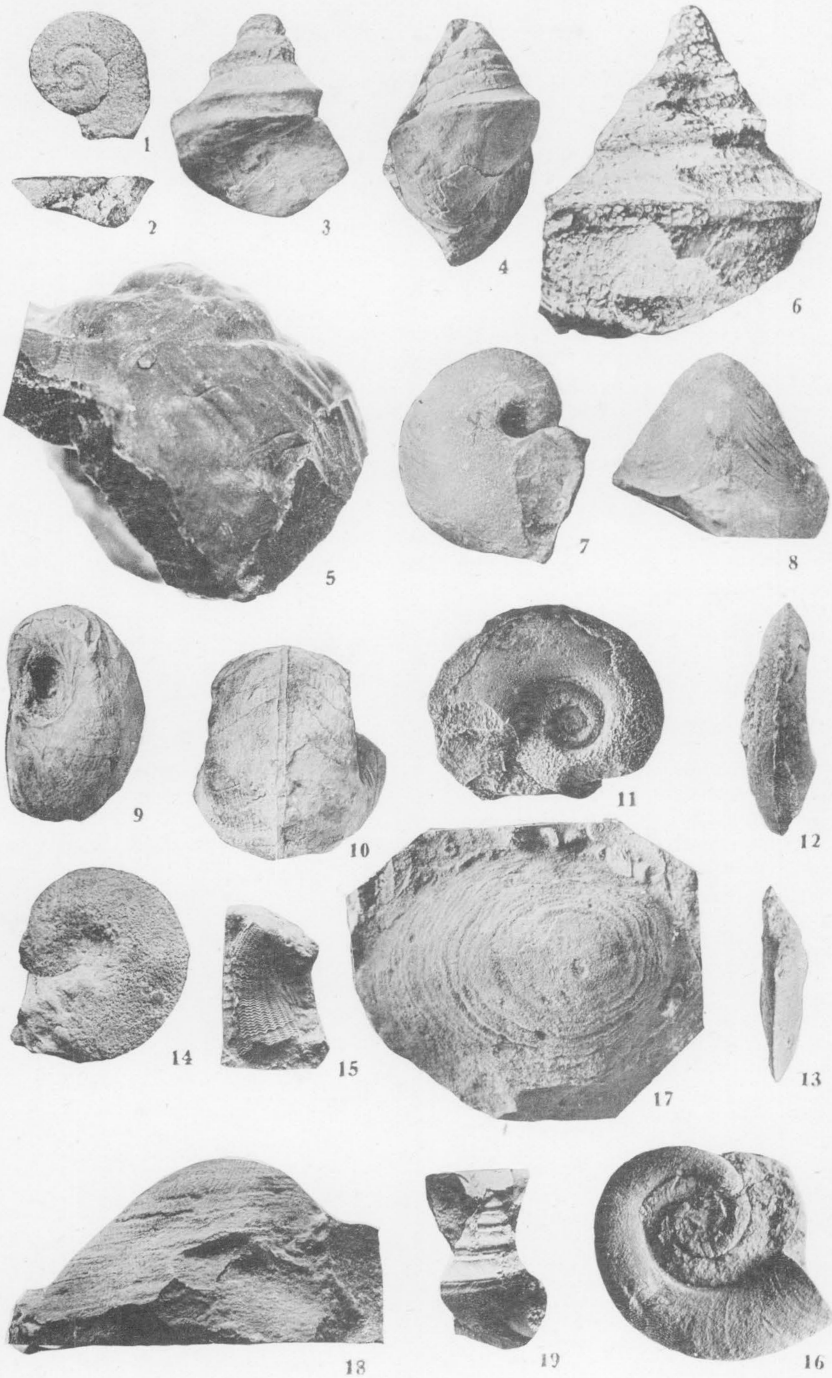

Plate XXVI

Figure 1. *Salpingostoma orientalis* n. sp.
Heath point. Zone 3, Jupiter formation. Holotype showing the broadly ribbed apertural expansion. (Y). (Page 248).

Figure 2. *Salpingostoma orientalis* n. sp.
Holotype, side view showing umbilicus and that the whole shell is concealed by the apertural expansion. (Page 248).

Figure 3. *Euomphalus (?) anticostiensis* n. sp.
Cape MacGilvray. Zone 4, Gun River formation. Holotype. (Y). (Page 249).

Figure 4. *Euomphalus (?) anticostiensis* n. sp.
Holotype. (Page 249).

Figure 5. *Cyclonema varispirum* n. sp.
Indian harbour. Zone 1, Vauréal formation. Holotype. (Y). X 1½. (Page 250).

Figure 6. *Holopea vaurealensis* n. sp.
Vauréal River section, zone 23. Zone 5, Vauréal formation. Holotype. X 2⅛. (Page 251).

Figure 7. *Subulites ellisensis* n. sp.
Ellis bay. Zone 7, Ellis Bay formation. Holotype. (V). (Page 253).

Figure 8. *Pterotheca anticostiana* n. sp.
Baie Ste. Claire. Zone 4, Vauréal formation. Holotype. (Y). (Page 255).

Figure 9. *Conularia batteryensis* n. sp.
Battery point. Zone 4, Vauréal formation. Holotype, showing the angle and the alternation of the transverse ridges of the median ridge and in the depression on the angle. (Y). X 2. (Page 255).

Figure 10. *Palaeacmaea magnifica* n. sp.
Upper surface of the holotype. English Head formation, zone 4, Three Brook (Trois Ruisseaux) bay. (Y). (Page 235).

Plate XXVI

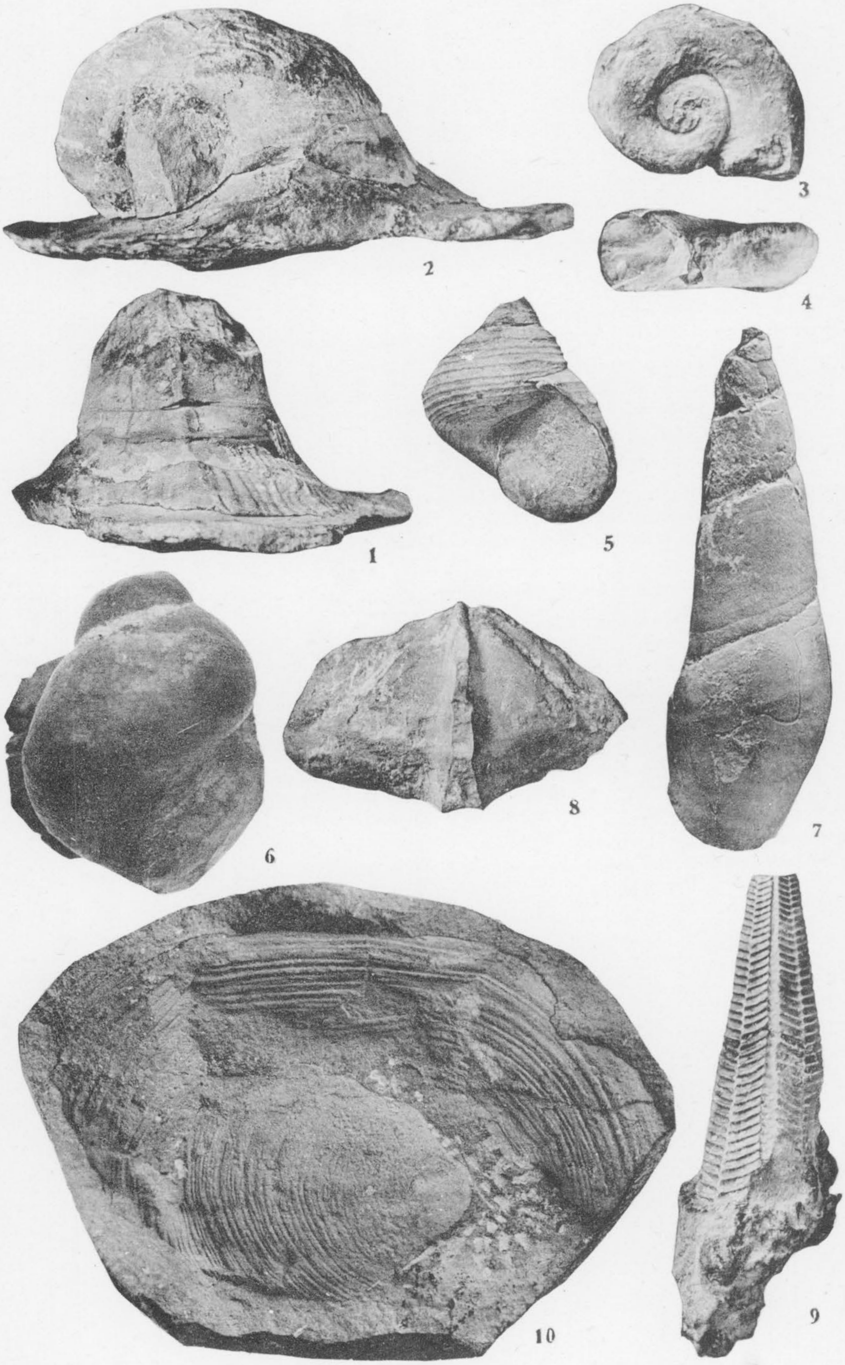

Plate XXVII

Figure 1. *Billingsites elongatus* sp. nov.
Locality unknown. Dorsal view. Specimen No. 2321, Mus. Comp. Zool., Harvard University. (Page 260).

Figure 2. *Billingsites elongatus* sp. nov.
Same specimen as Figure 1. Lateral view. (Page 260).

Figure 3. *Orthoceras chicottense* sp. nov.
West side of Southwest point. Zone 1, Chicotte formation. Vertical section through the siphuncle. (Y). (Page 262).

Figure 4. *Orthoceras ferecylindricum* sp. nov.
Bell river. Zone 8, Jupiter formation. Ventral view. (Y). (Page 262).

Figure 5. *Orthoceras ferecylindricum* sp. nov.
Same specimen as figure 4. Lateral view, the dorsal side weathered flat, basal part cut dorsoventrally exposing the septal necks. (Page 262).

Figure 6. *Donacoceras bellense* sp. nov.
Bell river. Zone 8, Jupiter formation. Siphuncle. (Page 263).

Figure 7. *Polygrammoceras ellisensis* sp. nov.
Ellis bay. Zone 7, Ellis Bay formation. Lateral view of specimen with about 70 vertical ribs. (Y). (Page 264).

Figure 8. *Polygrammoceras ellisensis* sp. nov.
Same specimen as figure 7. Vertical section through siphuncle. (Page 264).

Figure 9. *Conularia splendida* Billings
Photograph of the holotype showing the median ridge crossed by the transverse lines, and the groove on the angles with the transverse lines continuous across it. English Head formation, zone 4, Carleton point. (V 2157). X 2. (Page 256).

Figure 10. *Conularia asperata* Billings
Photograph of the holotype. English Head formation, zone 4, Makasti point. (V 2156). X 2. (Page 255).

Plate XXVII

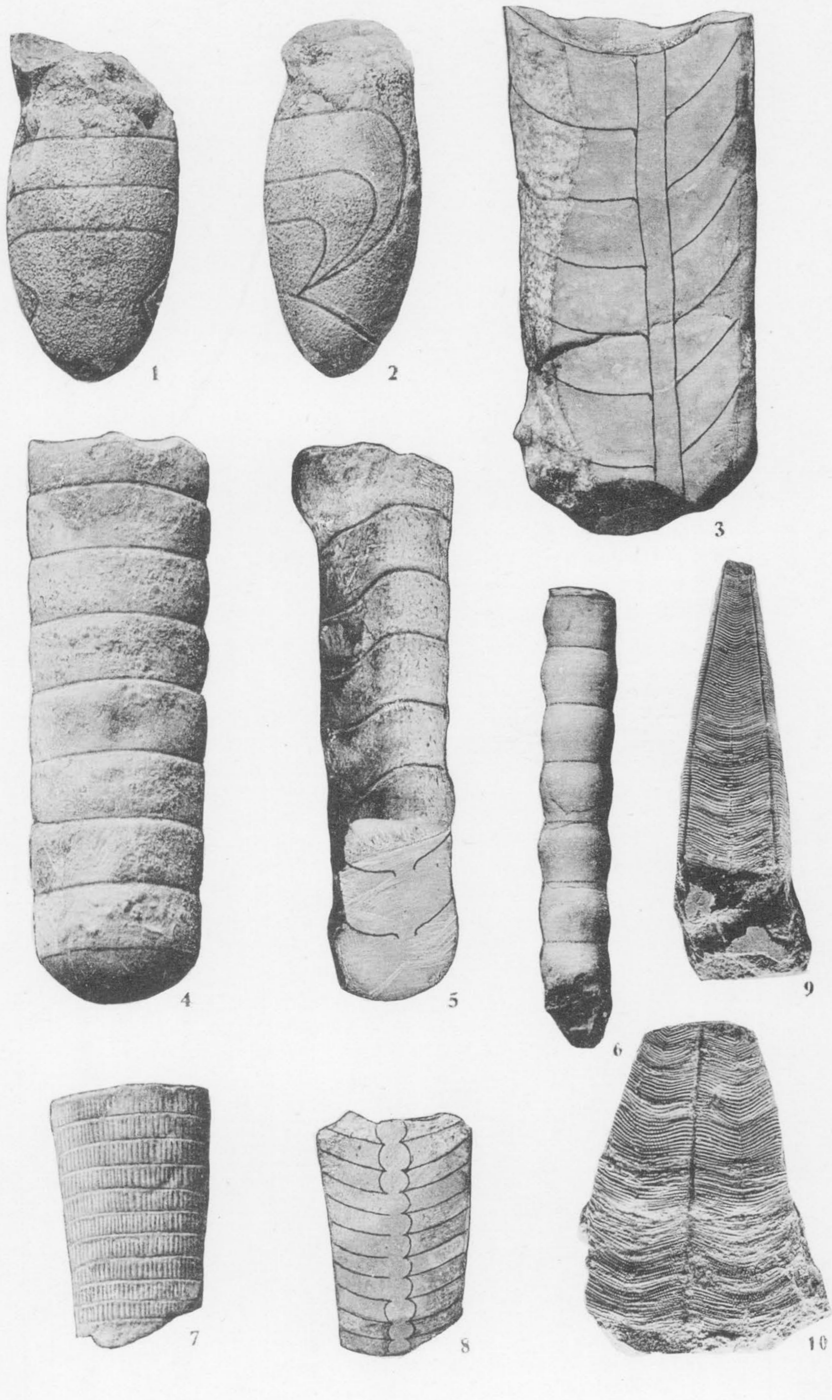

Plate XXVIII

Figure 1. *Billingsites acutus* sp. nov.
English head. Zone 2, English Head formation. Dorsal view. (Y). (Page 261).

Figure 2. *Billingsites acutus* sp. nov.
Same specimen as figure 1. Lateral view. (Page 261).

Figure 3. *Billingsites acutus* sp. nov.
Same specimen as figure 1. Ventral view. (Page 261).

Plate XXVIII

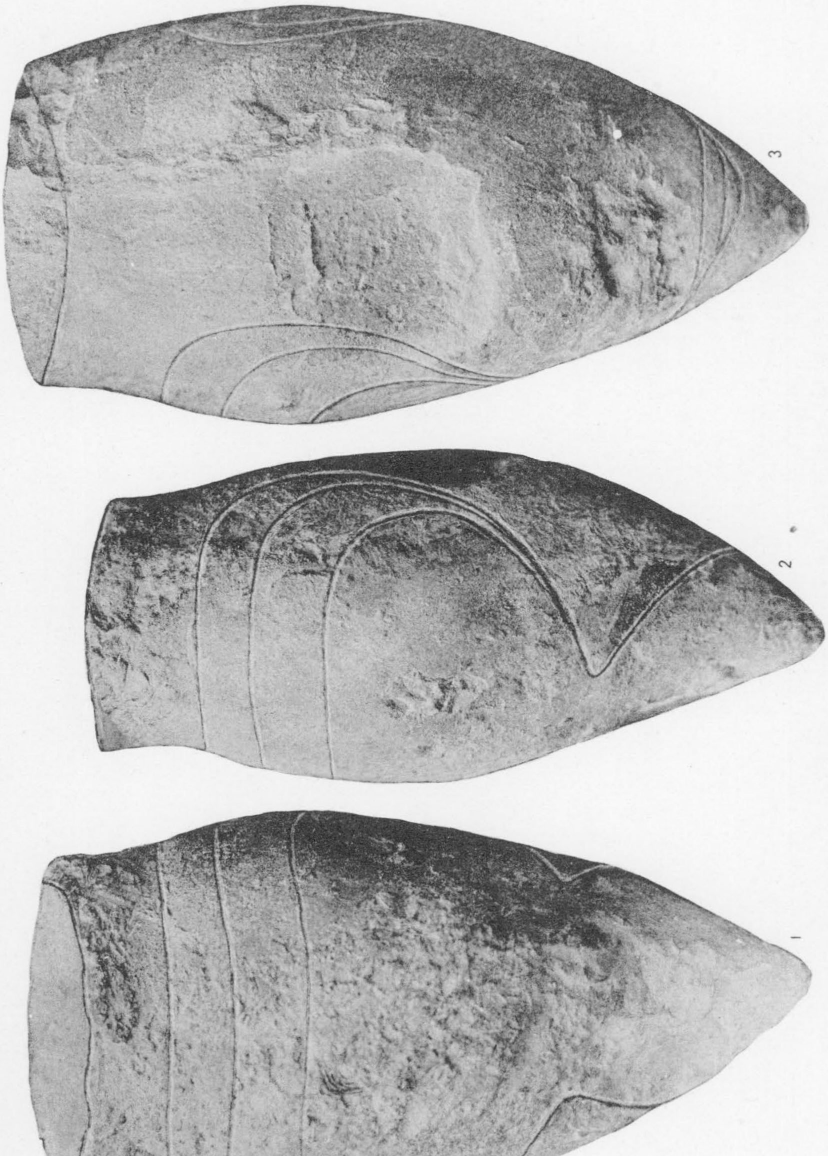

Plate XXIX

Figure 1. *Geisonoceras ellisense* sp. nov.
Strongly weathered surface, sectioned vertically in dorso-ventral direction through centre of siphuncle. Ellis Bay formation, zone 7, west side of Ellis bay. (Y). (Page 263).

Figure 2. *Polygrammoceras latolineatum* sp. nov.
Vertical section of holotype in lateral direction through siphuncle. (V). Ellis Bay formation, zone 2, Junction cliff. (Page 265).

Figure 3. *Polygrammoceras twenhofeli* sp. nov.
Lateral view. Ellis Bay formation, zone 1, Junction cliff. (Page 264).

Figure 4. *Polygrammoceras twenhofeli* sp. nov.
Vertical dorso-ventral section through siphuncle at base of the same specimen of fig. 3. (Page 264).

Figure 5. *Conocardium elegantulum* Billings
Posterior outline of the holotype. (V 2537). Chicotte formation, zone 1, Southwest point. X 2. (Page 232).

Figure 6. *Conocardium elegantulum* Billings
Left valve of the holotype. X 2. (Page 232).

Figure 7. *Cyclonema percingulatum* Billings
Electotype, Twenhofel collection. Jupiter formation, zone 2, Sand cliff. X 2. (Page 250).

Figure 8. *Pterinea* (?) *striata* (Billings)
Left valve of the holotype. (V 2286). Ellis Bay formation, zone 1, Junction cliff. (Page 230).

Figure 9. *Pterinea bellilineata* Billings
Left valve of holotype. (Y). Ellis Bay formation, zone 4, cliff one-half mile east of Junction cliff. (Page 228).

Figure 10. *Metoptoma? alceste* (Billings)
Photograph of the holotype, showing the ridge on the east of the interior. (V 2138). English Head, zone 3, English head. (Page 234).

Figure 11. *Metoptoma? alceste* (Billings)
Side view of holotype. (Page 234).

Plate XXIX

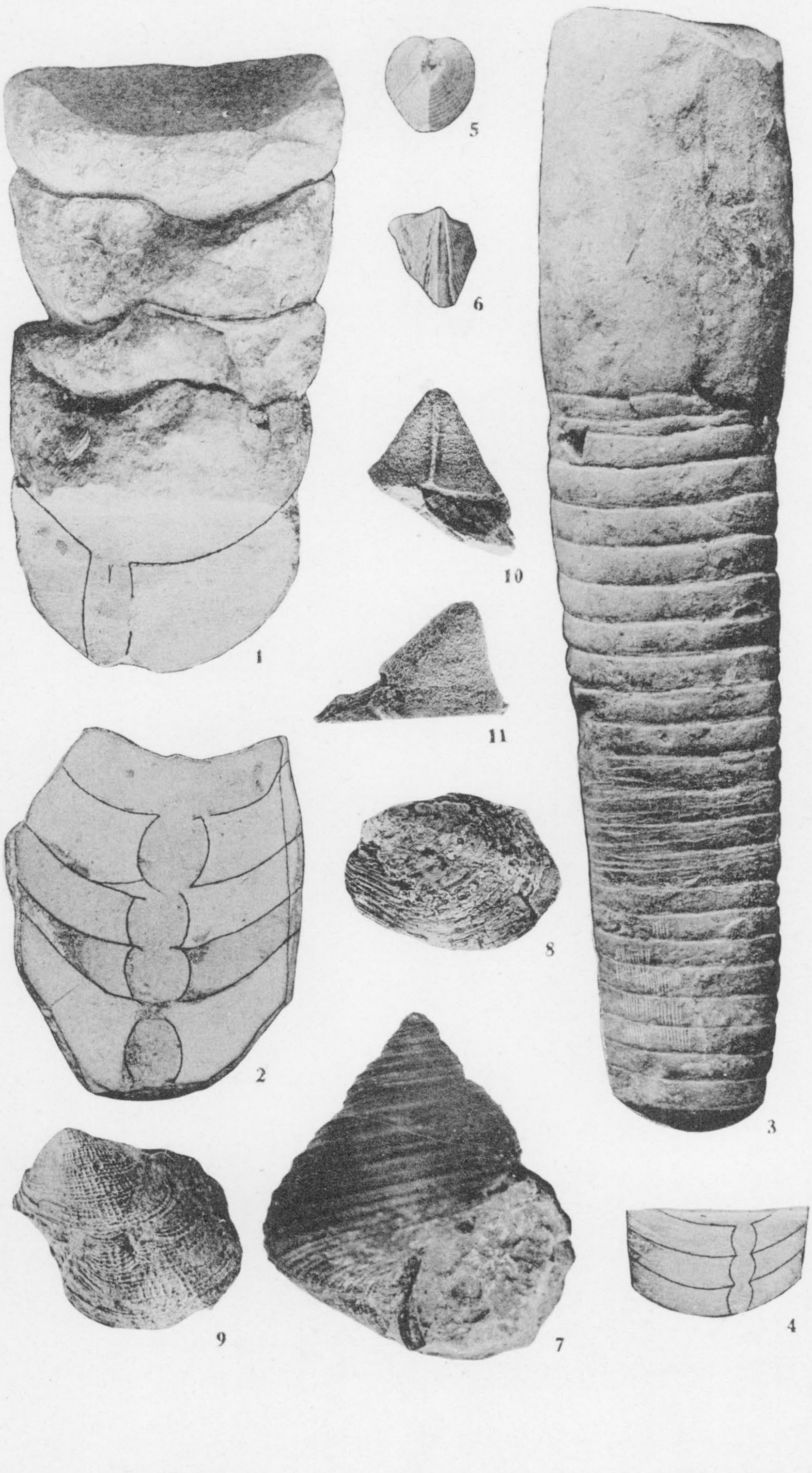

Plate XXX

Figure 1. *Kionoceras bellense* sp. nov.
Upper part sectioned vertically through siphuncle. (Y). Jupiter formation, zone 8 or 9, cliff west of Iron river. (Page 269).

Figure 2. *Kionoceras bellense* sp. nov.
Opposite of specimen of figure 1, showing the alternating prominent and less prominent ribs. The more prominent ribs number 31. (Page 269).

Figure 3. *Polygrammoceras latolineatum* sp. nov.
Later view with the fifth and sixth cameræ from the base restored. (Y). Ellis Bay formation, zone 7, Ellis bay. (Page 265).

Figure 4. *Hyattidina congesta junea* (Billings)
Ventral valve. (V 2734). Gun River formation, zone 2, Hannah cliff. X 2. (Page 223).

Figure 5. *Hyattidina congesta junea* (Billings)
Dorsal valve of the specimen of figure 4. X 2. (Page 223).

Figure 6. *Hyattidina congesta junea* (Billings)
Outline of the specimen of figure 4. X 2. (Page 223).

Figure 7. *Whitfieldella? solitaria* (Billings)
Dorsal valve of the holotype. (V 2523). Chicotte formation, Southwest point. X 1½. (Page 221).

Figure 8. *Whitfieldella? solitaria* (Billings)
Outline of the holotype. X 1½. (Page 221).

Figure 9. *Whitfieldella? solitaria* (Billings)
Ventral valve of the holotype. X 1½. (Page 221).

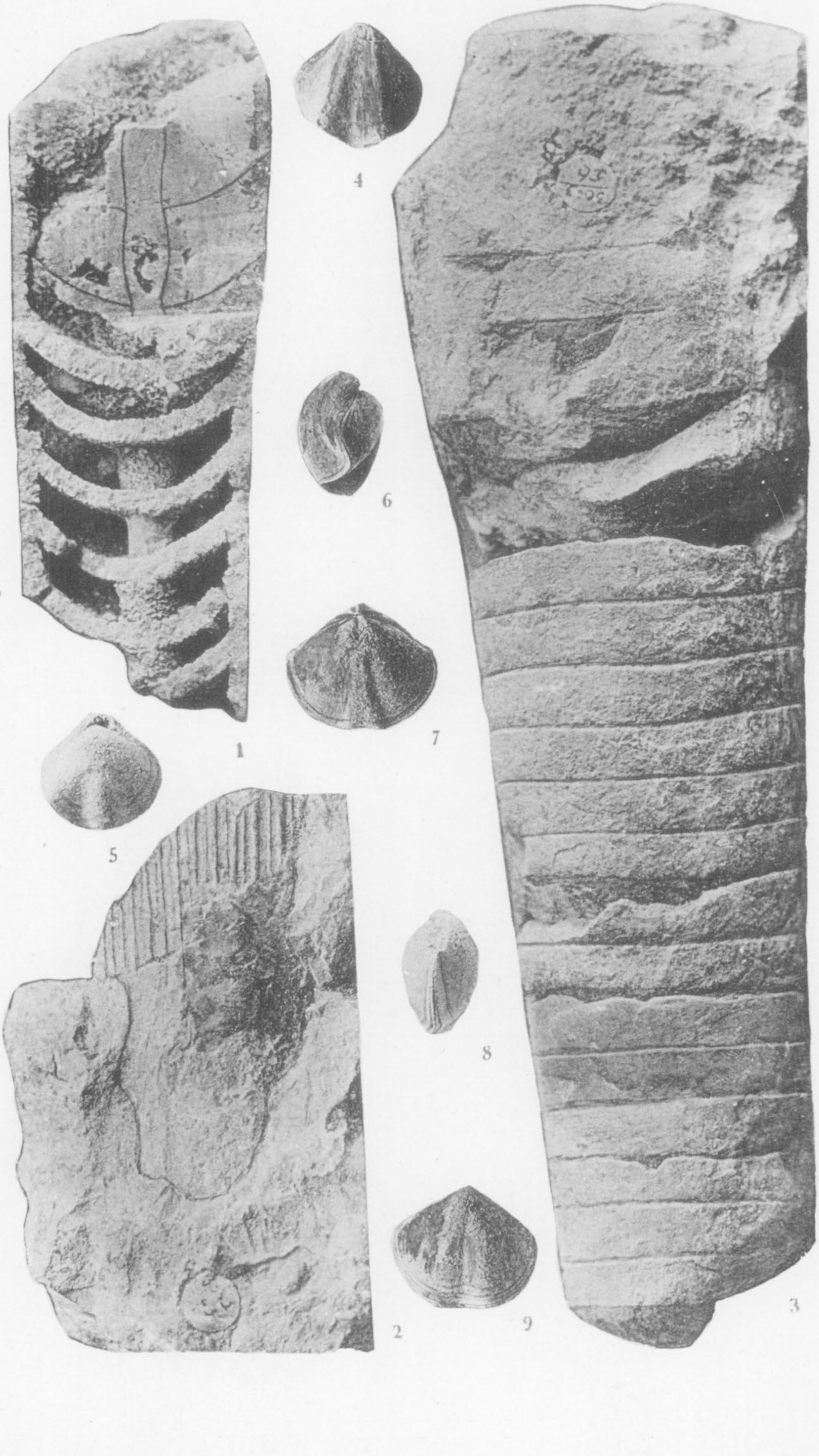

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Plate XXXI

Figure 1. *Polygrammoceras chicottense* sp. nov.
See also Plate XXXII, figure 1, and Plate XXXIII, figures 1, 2. One mile west of Box brook. Zone 8, Jupiter formation. Type specimen showing ornamentation of surface, sutures of septa, and proximity of vertical cylindrical body to wall of specimen. Rear of specimen exposes two segments of the siphuncle similar to those shown on Plate XXX. (Y). (Page 266).

Figure 2. *Polygrammoceras chicottense* sp. nov.
Same specimen as figure 1. Vertical section in lateral direction through centre of vertical cylindrical body, this section forms the rear of the fragment of lower right corner of figure 1. (Page 266).

Figure 3. *Spyroceras microcancellatum* sp. nov.
Showing the fine, numerous, vertical and transverse striæ of about equal prominence. Ellis Bay formation, zone 1, Junction cliff. (Page 275).

Figure 4. *Pterinea bellilineata* Billings
Left valve showing wing. (Y). English Head formation, zone 4, Makasti bay. (Page 228).

Figure 5. *Rhytimya emma* (Billings)
Right valve of holotype. (V 2098-v). English Head formation, zone 3, English head. (Page 233).

Figure 6. *Mytilarca nitida* (Billings)
Right valve of holotype. (V 2458). Jupiter formation, zone 3, Jupiter cliff. (Page 233).

Figure 7. *Mytilarca nitida* (Billings)
Outline of the holotype. (Page 233).

Figure 8. *Archinacella estella* (Billings)
Rostral side of the holotype. (V 2140). English Head formation, zone 3, English head. X 2. (Page 235).

Figure 9. *Archinacella estella* (Billings)
Side view of the holotype. X 2. (Page 235).

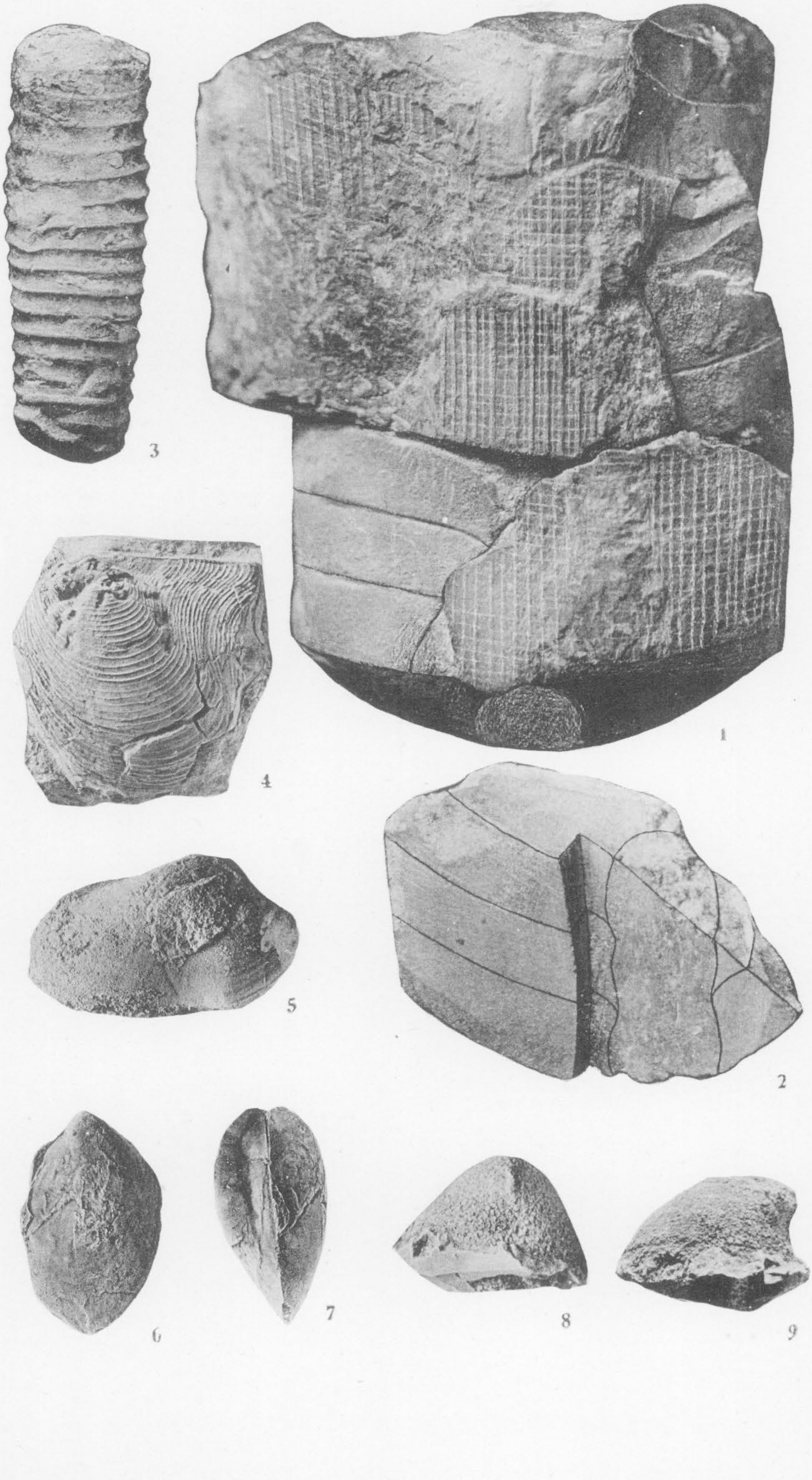
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Plate XXXII

Figure 1. *Polygrammoceras chicottense* sp. nov.
See also Plate XXXI, figures 1, 2; Plate XXXIII, figures 1, 2. Goose point. Zones 6 to 8, Jupiter formation. Shows surface ornamentation of one side, on the rear the ornamentation is like that of upper part of figure 1, Plate XXVIII. On right margin is the large, vertical, cylindrical body. The suture of the septum, exposed at mid-height, descends toward the right; the shell beneath this suture is cracked transversely. Four segments of the siphuncle are visible. (Page 266).

Figure 2. *Pterinea curiosa* Billings
Right valve of the holotype. (V 2460). Jupiter formation, zone 4, Jupiter river. (Page 229).

Figure 3. *Pterinea curiosa* Billings
Left valve of holotype. (Page 229).

Plate XXXII

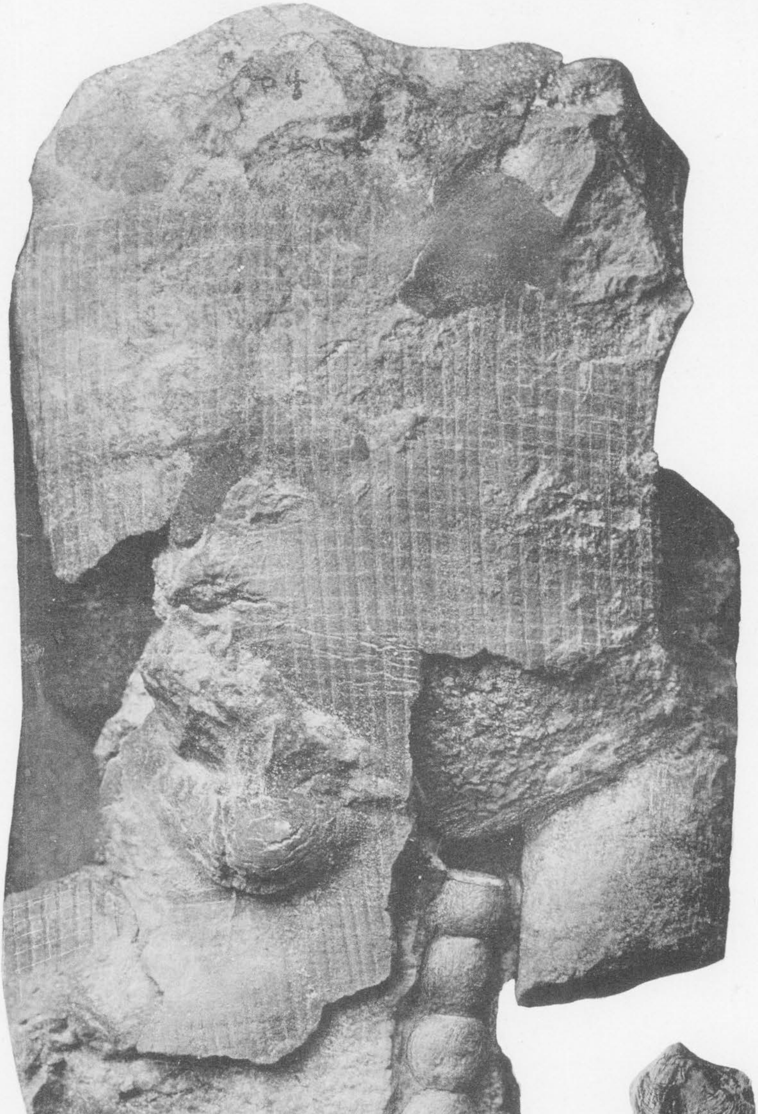

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Plate XXXIII

Figure 1. *Polygrammoceras chicottense* sp. nov.
Transverse section, the vertical cylindrical body at "A", the siphuncle at "B". X $\frac{1}{2}$. (Page 266).

Figure 2. *Polygrammoceras chicottense* sp. nov.
Based on the same specimen as figure 1. The vertical cylindrical body at "A", the siphuncle at "B". (Page 266).

Figure 3. *Actinoceras serum* sp. nov.
Dorso-ventral vertical section. (Page 290).

Figure 4. *Ephippiorthoceras plicatulum* sp. nov.
Lateral view of obliquely flattened specimen, lower part encrusted by bryozoan producing conspicuous ridges. English Head formation, zone 4, White cliff. (Page 271).

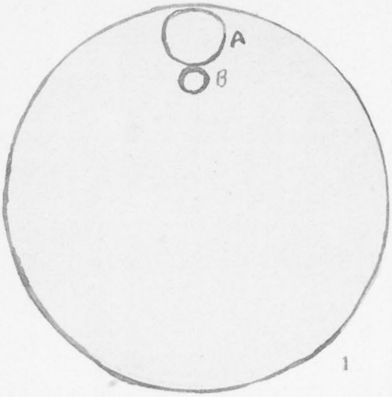
Figure 5. *Ephippiorthoceras plicatulum* sp. nov.
Opposite side of specimen of figure 5. (Page 271).

Figure 6. *Pterinea thisbe* Billings
Right valve of one of the types. (V 2459). Jupiter formation, zone 9, Shallop river. (Page 230).

Figure 7. *Pterinea thisbe* Billings
Left valve of another one of the types. (V 2459). Same occurrence. (Page 230).

Figure 8. *Pterinea* (?) *striata* (Billings)
Left valve of one of the types. (V 2286). Ellis Bay formation, zone 2, Junction cliff. (Page 230).

Plate XXXIII



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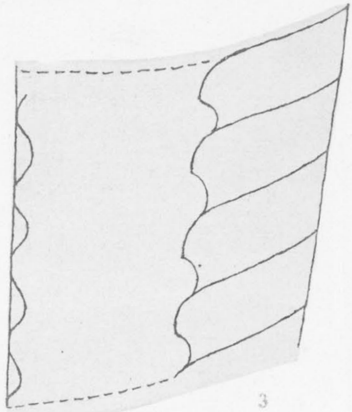
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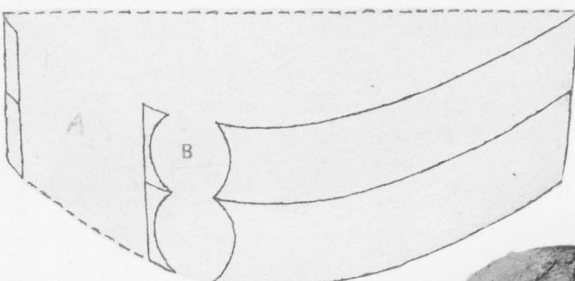

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Plate XXXIV

Figure 1. *Protokionoceras anticostiense* sp. nov.
Southwest point. Zone 2, Jupiter formation. Type specimen. Lateral view showing surface striæ. (Page 267).

Figure 2. *Protokionoceras anticostiense* sp. nov.
Southwest point. Zone 8, Jupiter formation. Lateral view showing sutures of septa and traces of surface striæ. (Y). (Page 267).

Figure 3. *Spyroceras tenuiclathratum* sp. nov.
Specimen with numerous vertical striæ separated by flat interspaces; transverse striæ more numerous and less prominent, vertical section at base through siphuncle. (Y). Gun River formation, zone 3 or 4, cliff west of Wreck beach. (Page 275).

Figure 4. *Spyroceras chicottense* sp. nov.
Showing relatively faint transverse and vertical striæ, the latter nearly obsolete; vertical section at base through siphuncle. Chicotte formation, zone 2, pointe des Morts. (Page 276).

Figure 5. *Pterinea prolifica* Billings
Left valve of a typical example. (V 2106-b). English Head formation, zone 4, Makasti bay. (Page 230).

Plate XXXIV


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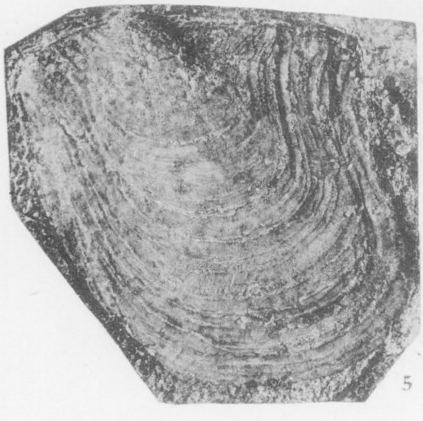
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Plate XXXV

Figure 1. *Ephippiorthoceras schucherti* sp. nov.
Junction cliff. Zone 2, Ellis Bay formation. Diagonal view, showing chiefly one side; at top, traces of narrow vertical ribs with spaces between occupied by 6 or 7 fine vertical striæ. (Y). (Page 272).

Figure 2. *Phragmolites pannosus* (Billings)
Outline showing keel. (V 2145). English Head formation, Carleton point, zone 4. (Page 247).

Figure 3. *Phragmolites pannosus* (Billings)
View showing umbilicus, same specimen as figure 2. (Page 247).

Figure 4. *Phragmolites desideratus* (Billings)
The supposed type of the species. This specimen does not seem to be of this species and may not have come from Anticosti. (V 2145). X 1½. (Page 247).

Figure 5. *Phragmolites desideratus* (Billings)
A specimen considered to be of this species. (Y). Ellis Bay formation, zone 6, cape James. X 1½. (Page 247).

Figure 6. *Loxonema* (?) *rugosum* (Billings)
Specimen showing the transverse ornamentation. (V 2135). Ellis Bay formation, zone 8, Ellis bay. (Page 252).

Plate XXXV

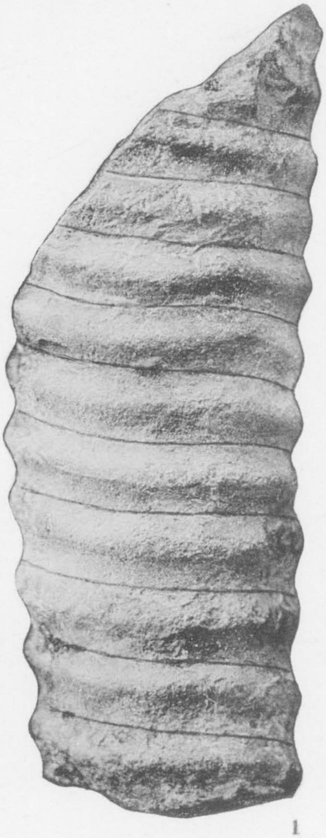
Plate XXXVI

Figure 1. *Spyroceras microlineatum* sp. nov.
See also Plate XXXVII, figures 1, 2. Cape Henry. Zone 3, Vauréal formation. Lateral view. (Y). (Page 274).

Figure 2. *Spyroceras microlineatum* sp. nov.
Same specimen as figure 1. Dorsal view. (Page 274).

Figure 3. *Apsidoceras magnificum major* var. nov.
See also Plate XXXVIII, Makasti cliff. Zone 4, English Head formation. Dorsal view. (Y). (Page 281).

Figure 4. *Apsidoceras magnificum major* var. nov.
Same specimen as figure 3. Lateral view. Cut dorso-ventrally at base to show siphuncle. (Page 281).



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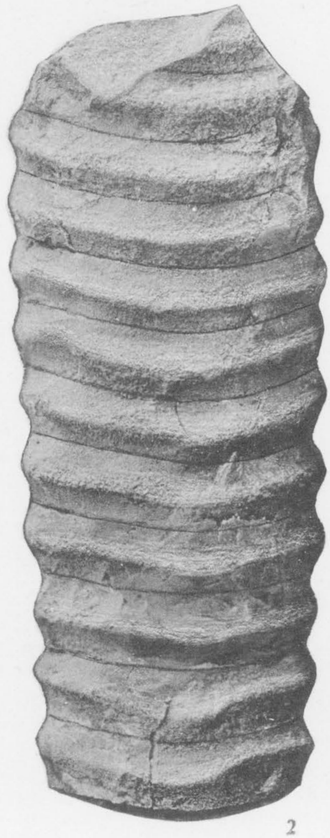

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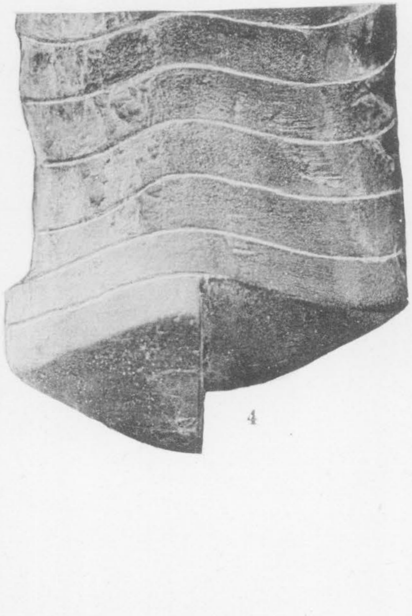

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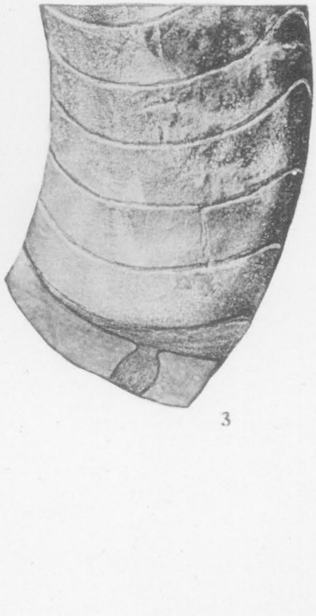

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Plate XXXVII

Figure 1. *Spyroceras microlineatum* sp. nov.
Vertical section through siphuncle of figure 2, Plate XXXVI. (Page 274).

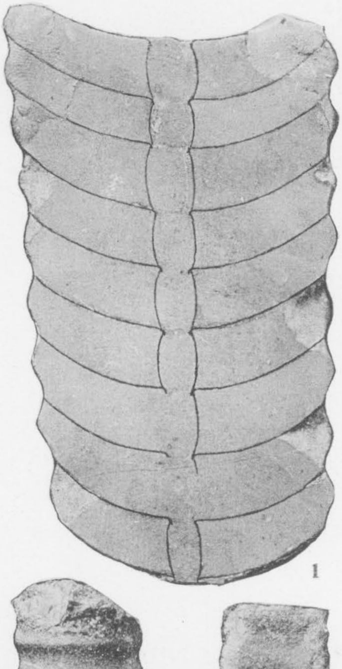
Figure 2. *Ephippiorthoceras altocameratum* sp. nov.
Lateral view. (Y). English Head formation, zone 3 or 4, English head. (Page 273).

Figure 3. *Ephippiorthoceras altocameratum* sp. nov.
Same specimen of figure 2. Vertical section half-way between dorso-ventral and lateral directions, passing through centre of siphuncle of upper two cameræ (Page 273).

Figure 4. *Spyroceras anticostiense* sp. nov.
Dorsal side of specimen retaining the living chamber. Cast of interior with primary ribs only shown, number of ribs 50. English Head formation, zone 3, reef at English head. Twenhofel collection. (Page 277).

Figure 5. *Spyroceras anticostiense* sp. nov.
Natural section of an immature specimen. (V). English Head formation, zone 4, English head. (Page 277).

Figure 6. *Spyroceras vaurealense* sp. nov.
Specimen with 80 vertical striæ. Vauréal formation, zone 2 or 3, cliff on east side of Metallic bay. Twenhofel collection, type. (Page 277).



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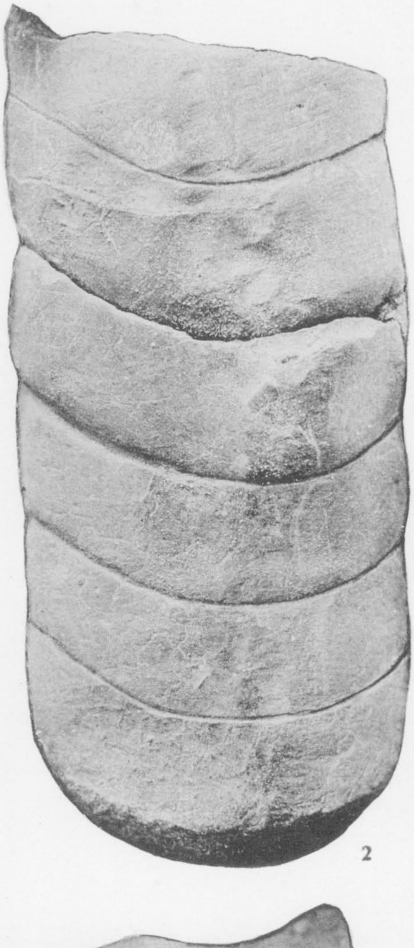

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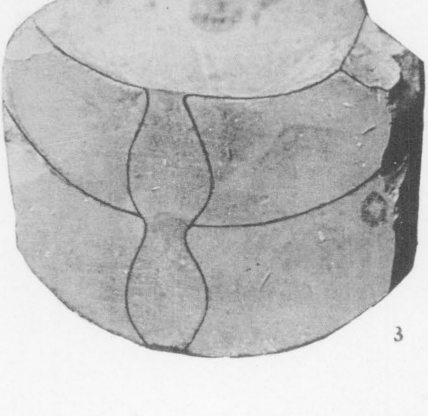

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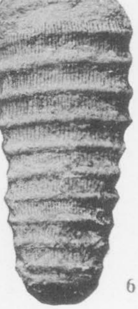

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Plate XXXVIII

Figure 1. *Goniotrochoceras twenhofeli* sp. nov.
Acute outer margin of volution. Vauréal formation, zone 1, Girard harbour. X $\frac{7}{8}$. (Page 285).

Figure 2. *Goniotrochoceras twenhofeli* sp. nov.
Ventral view of the same specimen as figure 1. X $\frac{7}{8}$. (Page 285).

Figure 3. *Apsidoceras magnificum major* var. nov.
Lateral view. English Head formation, zone 4, White cliff. X $\frac{7}{8}$. (Page 281).

Figure 4. *Apsidoceras magnificum major* var. nov.
Ventral view of the specimen of figure 3. X $\frac{7}{8}$. (Page 281).

Plate XXXVIII

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PLATE XXXIX

FIGURE 1. *Apsidoceras magnificum altum* var. nov.
Table hill. Zone 8 or 9, Ellis Bay formation. Lateral view. (Y). X $\frac{9}{10}$. (Page 282).

FIGURE 2. *Apsidoceras magnificum multicameratum* var. nov.
One mile south of Junction cliff. Zone 4, Ellis Bay formation. (V). X $\frac{9}{10}$. (Page 283).

FIGURE 3. *Salpingostoma canadensis* (Billings)
Side view of the holotype. Specimen from which the original drawing was made. (V). English Head formation, zone 4, Makasti bay. X $\frac{9}{10}$. (Page 247).

Plate XXXIX

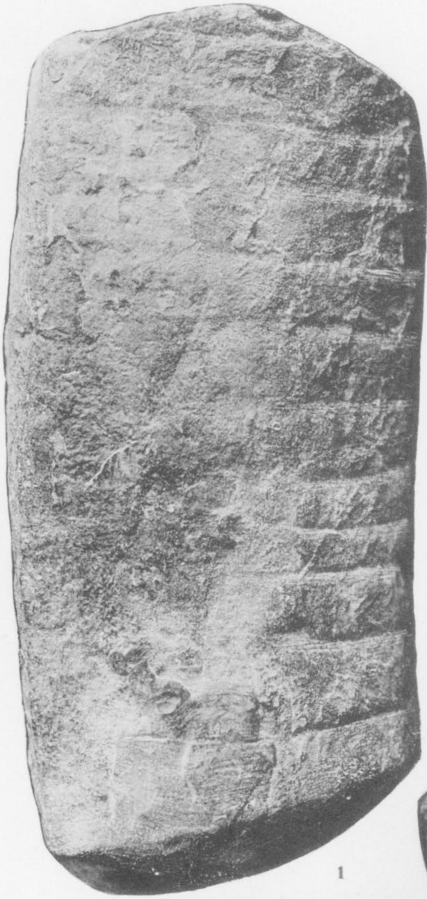

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Plate XL

Figure 1. *Kionoceras magnisulcatum* (Billings)
Specimen estimated to have had 14 vertical ribs; surface striæ not preserved; suture of septum at base of specimen descending strongly to right. (V 2168). English Head formation, zone 4. Carleton point. (Page 268).

Figure 2. *Orthoceras desideratum* (Billings)
Type, exposing a vertical section passing about one-third the distance from the wall to centre of conch, no trace of siphuncle exposed. (V 2539). Chicotte formation, zone 2, Southwest point. (Page 261).

Figure 3. *Billingsites canadensis* (Billings)
Lateral view of a typical example, Twenhofel collection. English Head formation, zone 4, rivière à l'Huile. (Page 260).

Figure 4. *Billingsites newberryi* (Billings)
Lateral view of a typical example, Twenhofel collection. English Head formation, zone 4, upper half of North cliff. (Page 258).

Figure 5. *Billingsites anticostiensis* (Billings)
Lateral view. (V 2334-82). Ellis Bay formation, zone 7, Ellis bay near Bear point. (Page 259).

Figure 6. *Spyroceras balteatum* (Billings)
Specimen with very fine and sharp vertical striæ separated by much broader, flat interspaces. (V 2162). English Head formation, zone 4, English head. (Page 274).

Figure 7. *Spyroceras ferum* (Billings)
Selected type. (V 2319). Ellis Bay formation, zone 4, one mile east of Junction cliff. (Page 278).

Figure 8. *Discosorus infelix* (Billings)
Lateral view of siphuncle of type. (V 2545–a). Jupiter formation, zone 8, near Southwest point. (Page 302).

Figure 9. *Hercocyrtoceras amator* (Billings)
Ventral view of the holotype. (V 2358). Chicotte formation, zone 2, Southwest point. (Page 313).

Figure 10. *Hercocyrtoceras amator* (Billings)
Lateral view of holotype. (Page 313).

Figure 11. *Beloitoceras fragile* (Billings)
Lateral view of topotype. (Y). Ellis Bay formation, zone 5, top of White cliff, Ellis bay. (Page 305).

Figure 12. *Beloitoceras fragile*, ventral view of topotype. (Page 305).

Plate XL

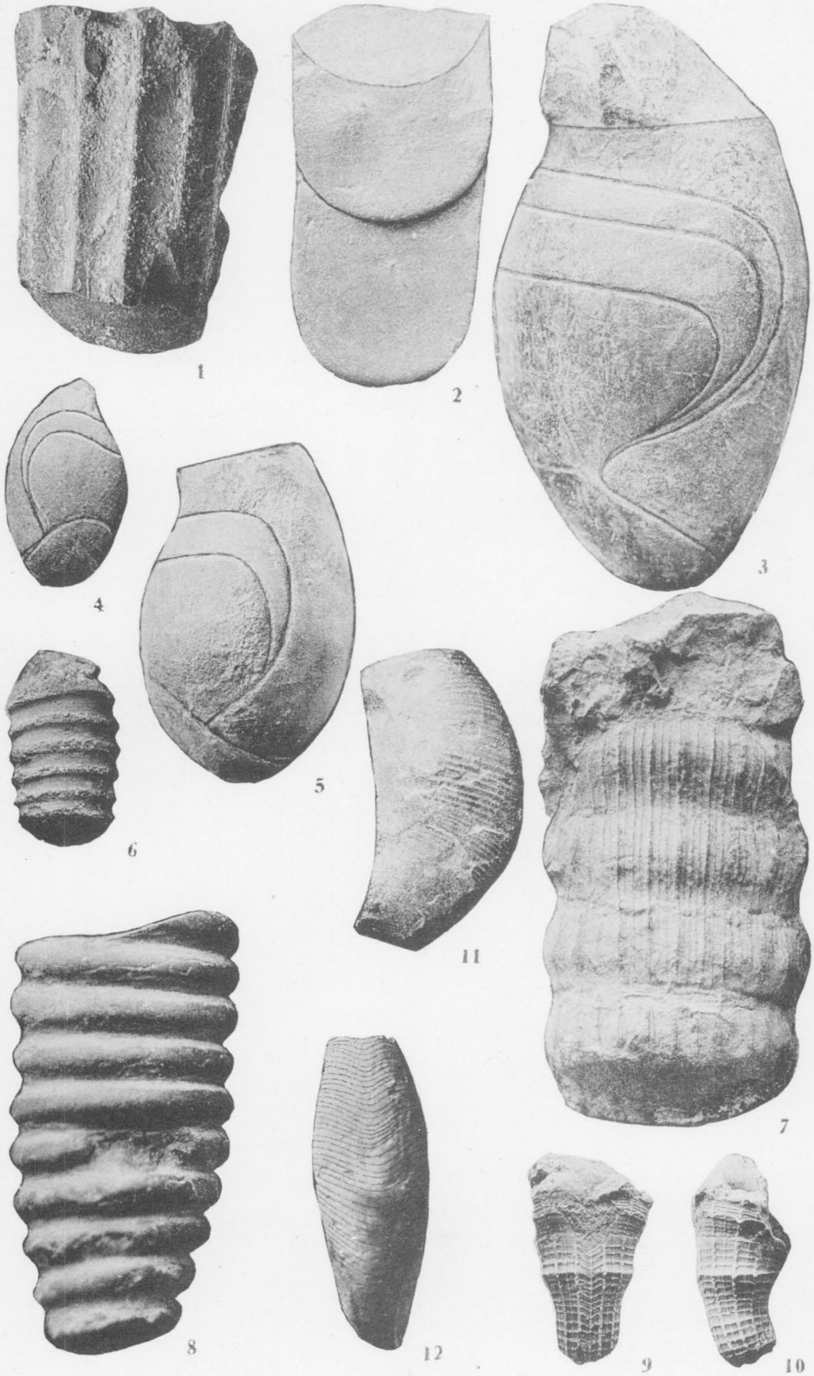

Plate XLI

Figure 1. *Sphyradoceras (?) anticostiense* sp. nov.
Dorsal side of volution. (Y). Vauréal formation, zone 1, White brook. (Page 284).

Figure 2. *Sphyradoceras (?) anticostiense* sp. nov.
Lateral view with dorsal side on left of same specimen as in figure 1. (Page 284).

Figure 3. *Sphyradoceras (?) anticostiense* sp. nov.
Ventral side of specimen of figure 1. (Page 284).

Figure 4. *Actinoceras serum* sp. nov.
Ventral side with median part section to expose siphuncle. Chicotte formation, zone 1, Jumpers. (Page 290).

Figure 5. *Actinoceras serum* sp. nov.
Lateral view of specimen of figure 4, ventral outline restored with clay. (Page 290).

Figure 6. *Leuronotoceras anticostiense* sp. nov.
Dorsal side, imperfect on right. (Y). English Head formation, zone 3 or 4, English head. (Page 283).

Figure 7. *Leuronotoceras anticostiense* sp. nov.
Lateral view of specimen of figure 6. (Page 283).

Figure 8. *Actinoceras gamachense* sp. nov.
Vertical dorso-ventral section through siphuncle with ventral side left. Ellis Bay formation, zone 5, Ellis bay. (Page 290).

Figure 9. *Salpingostoma canadensis* (Billings)
Photograph of the holotype, showing the strongly ribbed apertural expansion. (V 2136). English Head formation, zone 4, Makasti bay. (Page 247).

Plate XLI

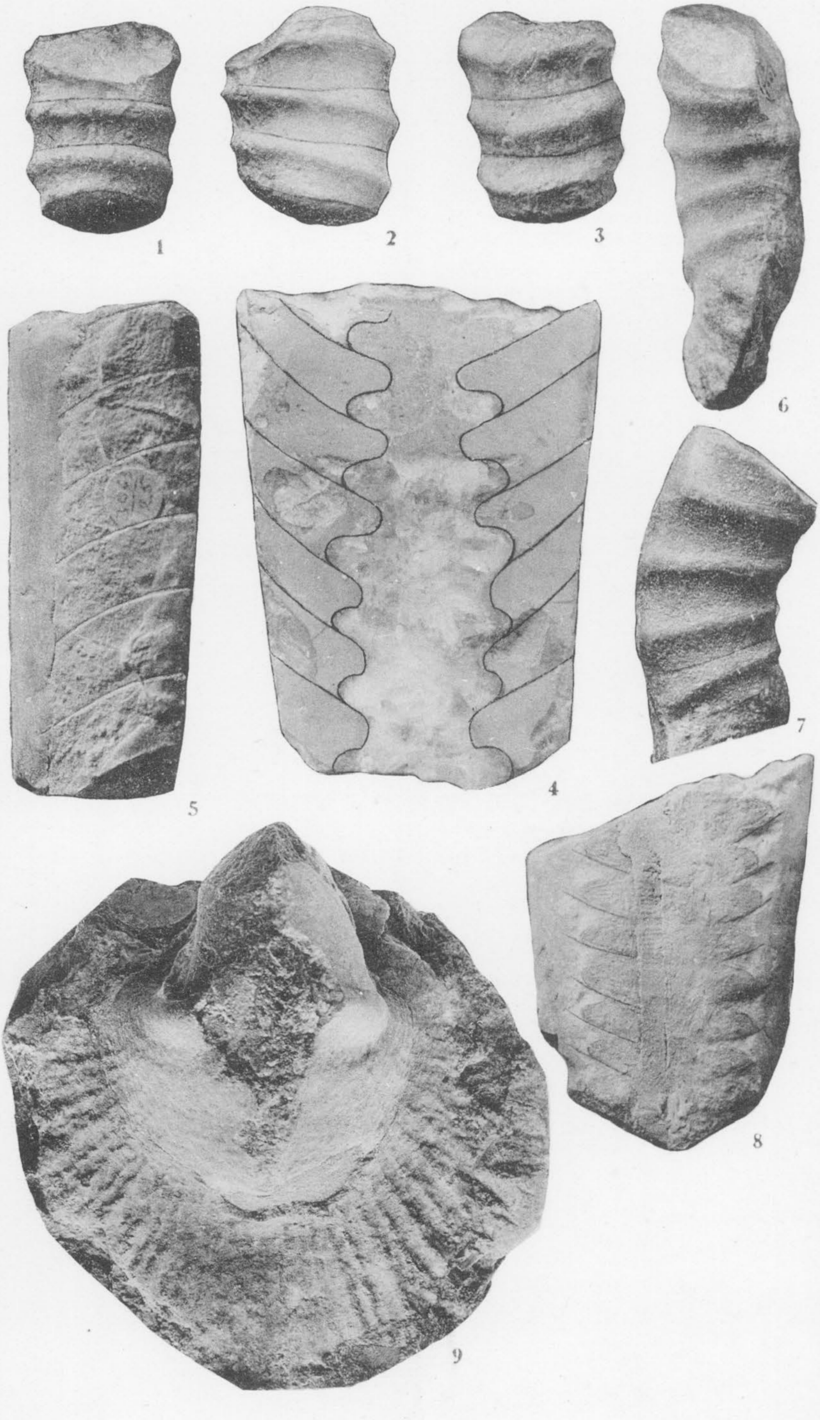

Plate XLII

Figure 1. *Actinoceras gamachense* sp. nov.
See also Plate XLI, figure 7. Transverse section. (Page 290).

Figure 2. *Actinoceras gamachense* sp. nov.
Dorso-ventral vertical section. (Page 290).

Figure 3. *Actinoceras carletonense* sp. nov.
See also Plate XLIII, figures 1, 2, 3. Dorso-ventral vertical section of ventral side. (Page 291).

Figure 4. *Ormoceras prinstaense* sp. nov.
See also Plate XLIV, figures 1, 2, 3. Transverse section. (Page 292).

Figure 5. *Ormoceras morrisi* sp. nov.
See also Plate XLIV, figures 4, 5. Transverse section. (Page 292).

Figure 6. *Armenoceras excentrale* sp. nov.
See also Plate XLVI, figures 1, 2. Dorso-ventral vertical section of ventral side. (Page 294).

Figure 7. *Armenoceras jupiterense* sp. nov.
See also Plate XLVII, figures 1, 2, 3. Vertical section of siphuncle. (Page 296).

Figure 8. *Hormotoma ? turricula* (Billings)
The side opposite the aperture, showing slit band and ornamentation. (V 2535-a). Jupiter formation, zone 10, Jumpers. X 2. (Page 243).

Figure 9. *Hormotoma ? turricula* (Billings)
Apertural side of the specimen of figure 8. X 2. (Page 243).

Figure 10. *Cyclonema decorum* Billings
Holotype, showing ornamentation. (V 2129). Chicotte formation, zone 2, Southwest point. X 2. (Page 249).

Figure 11. *Cyclonema decorum* Billings
Apertural side of holotype. X 2. (Page 249).

Figure 12. *Cyclonema thalia* (Billings)
Holotype. (V 2129). Ellis Bay formation, zone 2, Junction cliff. (Page 250).

Figure 13. *Diaphorostoma humile* (Billings)
Holotype (?) from the side opposite aperture. (V 2531-a). Jupiter formation, zone 10, Jumpers. (Page 254).

Figure 14. *Diaphorostoma humile* (Billings)
Apertural side of holotype. (Page 254).

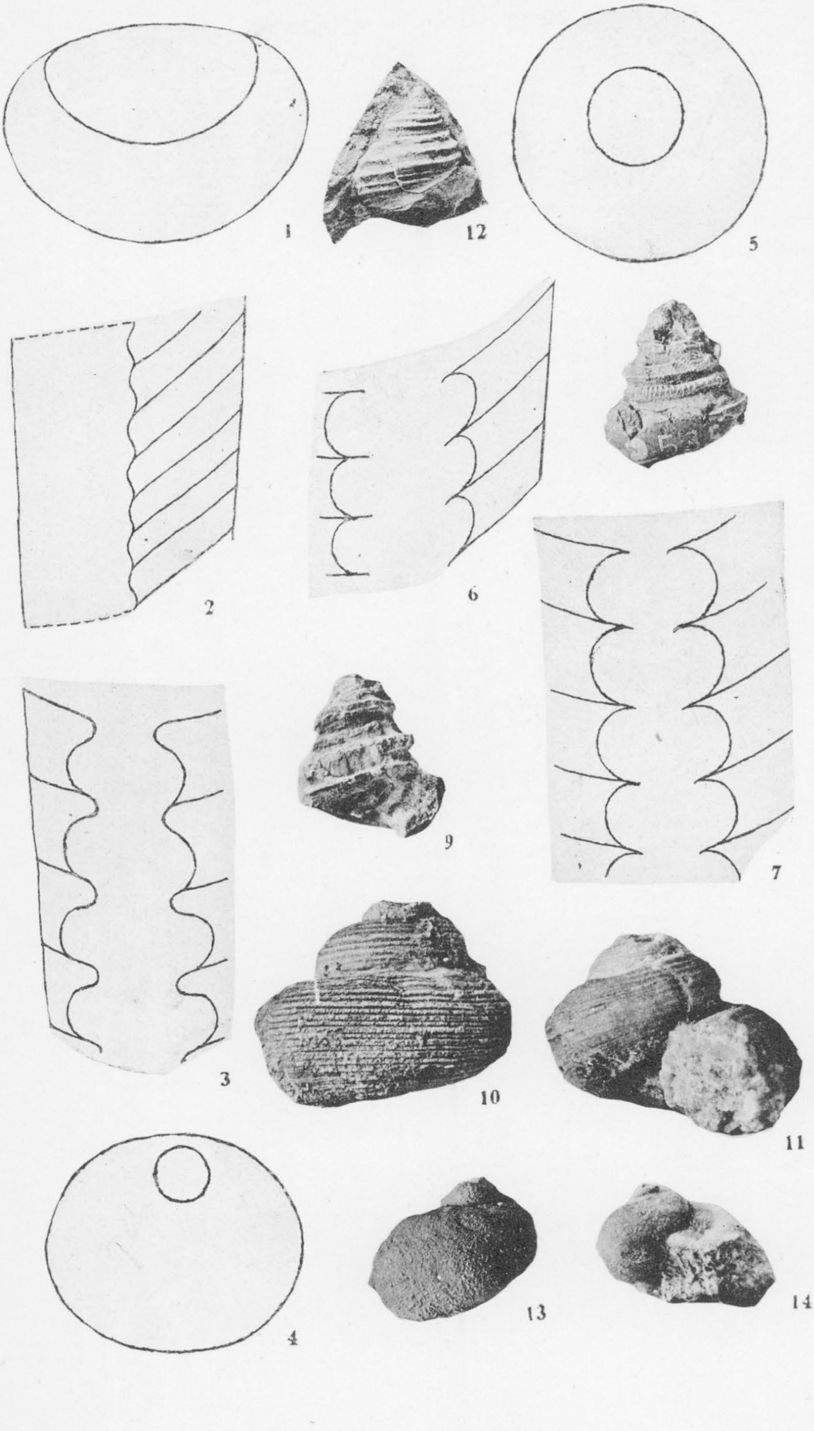
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Plate XLIII

Figure 1. *Actinoceras carletonense* sp. nov.
Ventral side. English Head formation, zone 4, Carleton point. (Page 291).

Figure 2. *Actinoceras carletonense* sp. nov.
Dorso-ventral section through siphuncle, ventral side on left. Same specimen as in figure 1. (Page 291).

Figure 3. *Ormoceras prinstaense* sp. nov.
Lateral view. (Y). Ellis Bay formation, zone 8, east side of Ellis bay. (Page 292).

Figure 4. *Ormoceras prinstaense* sp. nov.
Lower half of the specimen of figure 3 with the ventral side cut in a lateral direction to show siphuncle. (Page 292).

Figure 5. *Ormoceras ellisense* sp. nov.
Lateral view, ventral side on left. Ellis Bay formation, zone 1, Junction cliff. (Page 291).

Figure 6. *Ormoceras ellisense* sp. nov.
Vertical dorso-ventral section with siphuncle cut obliquely, only upper two segments cut through centre. (Page 291).

Figure 7. *Cyclonema varians* Billings
Side opposite aperture. (V 2533). Chicotte formation, zone 1, Southwest point. (Page 251).

Figure 8. *Cyclonema varians* Billings
Aperture of the specimen of figure 7. (Page 251).

Figure 9. *Cyclonema bellulum* Billings
One of the types, showing spire and side opposite aperture. (V 2532-a). Jupiter formation, zone 10, Jumpers. X 2. (Page 249).

Figure 10. *Cyclonema bellulum* Billings
Aperture of the specimen of figure 9. X 2. (Page 249).

Figure 11. *Holopea mediocris* (Billings)
Holotype showing apertural side. (V 2461). Jupiter formation, zone 6, 4 miles west of Southwest point. X $1\frac{1}{2}$. (Page 251).

Plate XLIII

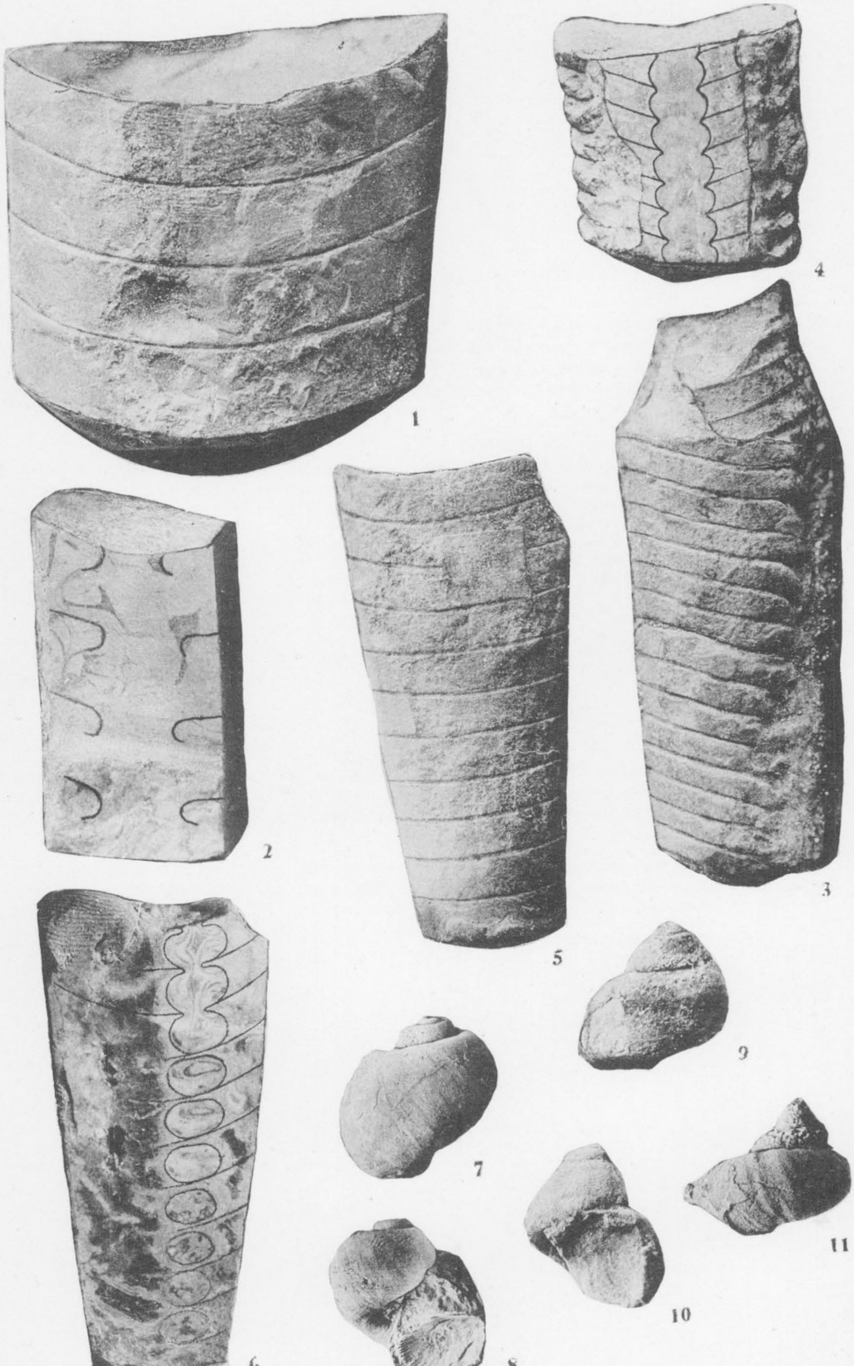

Plate XLIV

Figure 1. *Huroniella persiphonata* (Billings)
Selected type. Lateral view with ventral side on the right; at mid height, the ventral side of the conch and part of one of the septa are exposed. This septum is adnate to the lower lateral side of one of the segments. (V 2465). Jupiter formation, zone 5, Cormorant point. X $\frac{3}{4}$. (Page 298).

Figure 2. *Sactoceras bucklandi* (Billings)
Vertical section in lateral direction through siphuncle; the latter contracts toward the top; no calcareous deposits within the siphuncle. (V 2542). Chicotte formation, zone 2, Southwest point. X $\frac{3}{4}$. (Page 279).

Figure 3. *Sactoceras lyelli* (Billings)
View of that side toward which the sutures rise with vertical section at base through siphuncle. (V 2165). Vauréal formation, zone 4, east of Salmon river. X $\frac{3}{4}$. (Page 280).

Figure 4. *Armenoceras raptor* (Billings)
Selected type, showing siphuncle whose location appears to be subcentral, its structure uncertain. (V 2383). Jupiter formation, zone 1, 3 miles west of Jupiter river. X $\frac{3}{4}$. (Page 295).

Figure 5. *Kionoceras bellatulum* (Billings)
Selected type. Specimen with 34 vertical ribs, ending abruptly at the base of the angular constriction of the interior of the upper part of living chamber; spaces between the ribs occupied by about 5 very faintly preserved vertical striæ. (V 2466). Jupiter formation, zone 8 or 9, 3 miles east of Shallop river. X $\frac{3}{4}$. (Page 269).

Figure 6. *Armenoceras medon* (Billings)
Type, exposing siphuncle, sectioned at base through centre of siphuncle. (V 2543). Chicotte formation, zone 2, Southwest point. X $\frac{3}{4}$. (Page 296).

Figure 7. *Diestoceras obesum* (Billings)
Lateral view with ventral side on right. (V 2172). English Head formation, zone 4, Carleton point. X $\frac{3}{4}$. (Page 315).

Plate XLIV

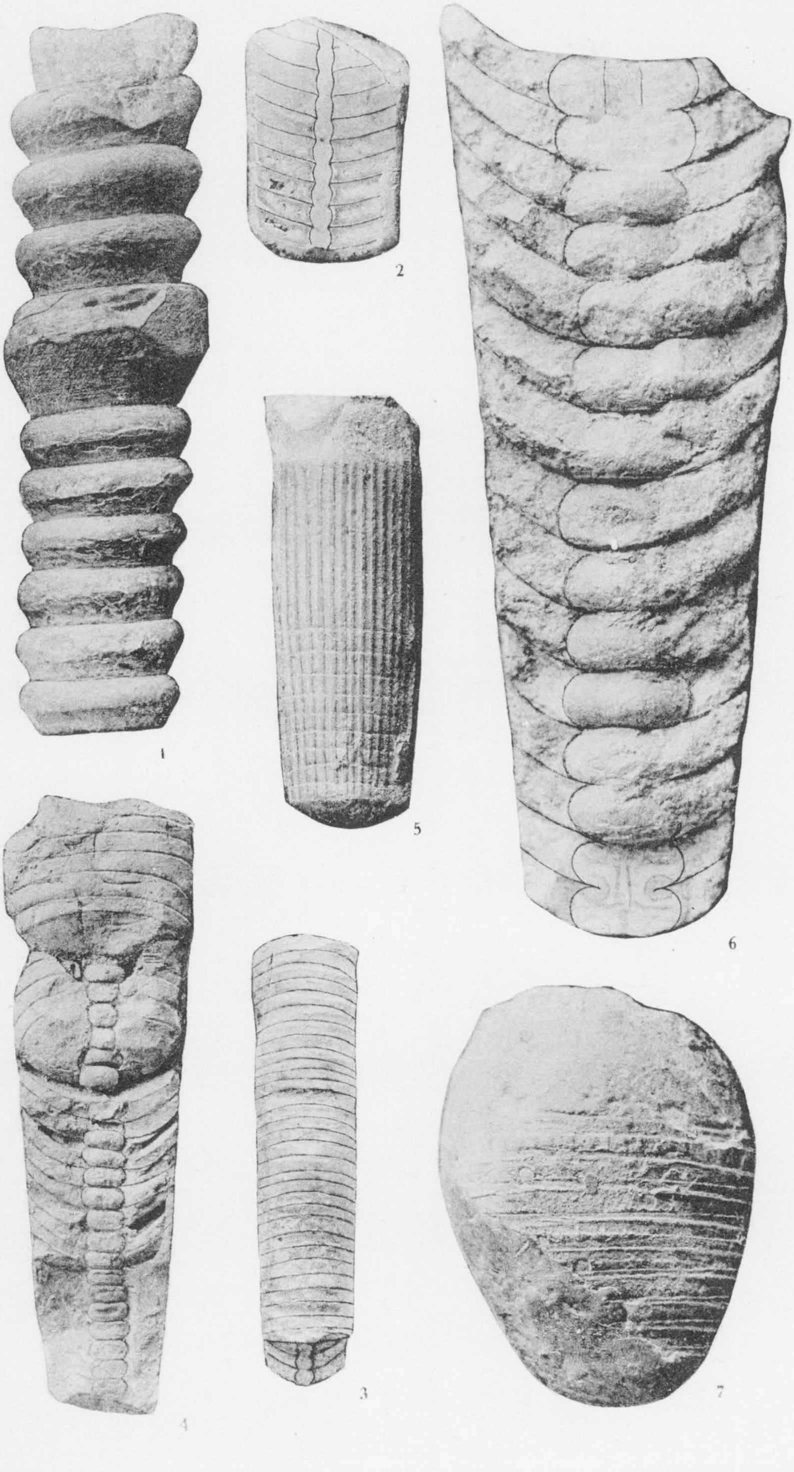

PLATE XLV

FIGURE 1. *Armenoceras chicottense* sp. nov.
Side, showing ornamentation. Jupiter formation, zone 8 or 9, cliff west of Iron river. (Page 294).

FIGURE 2. *Armenoceras chicottense* sp. nov.
Vertical section of the upper half of specimen of figure 1. (Page 294).

FIGURE 3. *Ormoceras morrisi* sp. nov.
Photograph of specimen, lower 10 cameræ not distorted, increasingly distorted toward top. (V). Gun River formation, zone 3 or 4, one mile east of Otter river. (Page 292).

FIGURE 4. *Ormoceras morrisi* sp. nov.
Lower part of specimen of figure 3, sectioned in a lateral direction through siphuncle. (Page 292).

FIGURE 5. *Lophospira ? papillosa* (Billings)
One of the types showing side opposite aperture. (V 2303). Ellis Bay formation, zone 4, near Junction cliff. X 1½. (Page 238).

FIGURE 6. *Lophospira ? papillosa* (Billings)
Top view of the specimen of figure 5. X 1½. (Page 238).

FIGURE 7. *Lophospira ? papillosa* (Billings)
Apertural side of specimen of figure 5. X 1½. (Page 238).

Plate XLV

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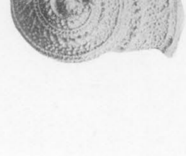

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Plate XLVI

Figure 1. *Armenoceras excentrale* sp. nov.
Weathered specimen showing siphuncle. Jupiter formation, zone 8, Iron river. (Page 294).

Figure 2. *Armenoceras excentrale* sp. nov.
Ventral view of specimen of figure 1. (Page 294).

Figure 3. *Discosorus gunensis* sp. nov.
Ventral aspect of siphuncle. Gun River formation, zone 3, Gun river. (Page 301).

Figure 4. *Liospira helena* (Billings)
Top of a typical specimen. (V 2122). Ellis Bay formation, zone 6, Prinsta bay. (Page 236).

Figure 5. *Liospira helena* (Billings)
Side of the specimen of figure 4. (Page 236).

Figure 6. *Lophospira varians* (Billings)
A specimen referred to this species. (Y). English Head formation, zone 2, English head. (Page 239).

Plate XLVI

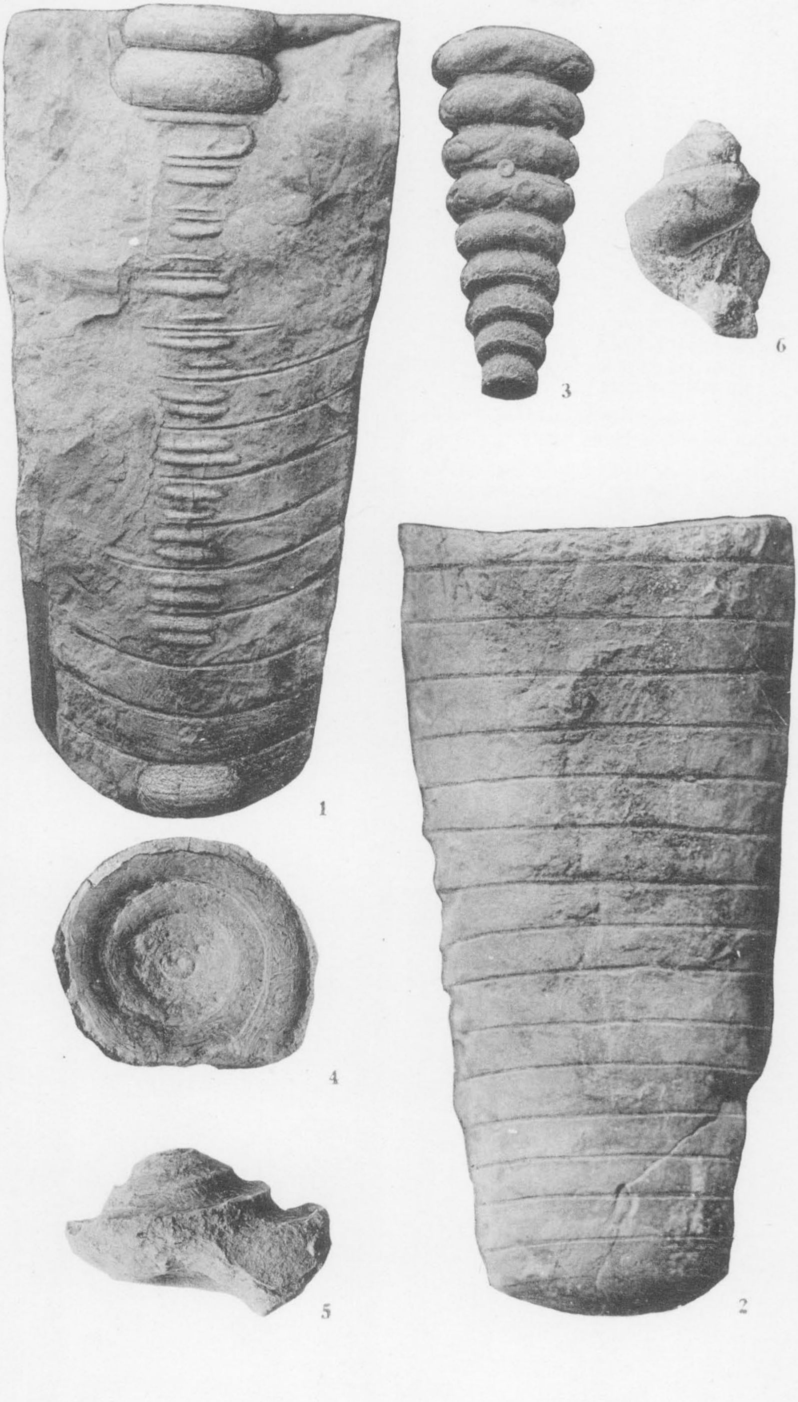

Plate XLVII

Figure 1. *Armenocras jupiterense* sp. nov.
See also Plate XLII, figure 7. West of Heath Point fault. Zone 4, Jupiter formation. Lower part of a weathered specimen exposing side of siphuncle facing interior of conch. (Page 296).

Figure 2. *Armenoceras jupiterense* sp. nov.
Same specimen as in figure 1. Ventral side. (Page 296).

Figure 3. *Armenoceras jupiterense* sp. nov.
Vertical section in lateral direction through centre of siphuncle of that part of the specimen which belongs immediately above the part represented in figures 1 and 2. (Page 296).

Figure 4. *Cyrtorizoceras ellisense* sp. nov.
Cliff near Bear cliff. Zone 7, Ellis Bay formation. Lateral view. (Y). (Page 304).

Figure 5. *Lophospira sybellina* (Billings)
Top of the holotype. (V 2300). Ellis Bay formation, Ellis bay. (Page 239).

Figure 6. *Lophospira sybellina* (Billings)
Side view of the holotype. (Page 239).

Figure 7. *Spirorapha cryptata* (Billings)
One of the types, reported from near Shallop creek, zone 8, Jupiter formation (2462). (Page 239).

Plate XLVII

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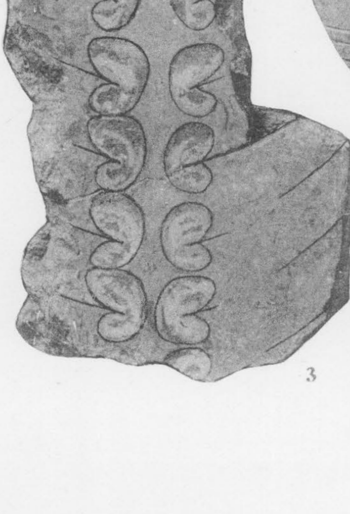

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Plate XLVIII

Figure 1. *Armenoceras angustum* sp. nov.
Jumpers. Zone 10, Jupiter formation. Imperfect specimen showing a single segment of the siphuncle at the top. Lower half sectioned through middle of siphuncle. (Y). (Page 297).

Figure 2. *Huronia chicottense* sp. nov.
Southwest point. Zone 2, Chicotte formation. Diagonal view, more nearly ventral than lateral. (Page 300) .

Figure 3. *Beloitoceras (?) jamesense* sp. nov.
See also Plate L, figure 2. Cape James bay. Zones 1, 2, 3, or 4, Ellis Bay formation. Lateral view, ventral side to right. (Y). (Page 308).

Figure 4. *Beloitoceras (?) jamesense* sp. nov.
Cape James bay. Zones 1, 2, 3, or 4. Ellis Bay formation. Lateral view, ventral side to right. (Y). (Page 308).

Plate XLVIII

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Plate XLIX

Figure 1. *Discosorus gunensis* sp. nov.
See also Plate XLVI, figures 3, 4. Gun river, zone 3, Gun River formation. Diagonal view of conch, showing the siphuncle; ventral side much nearer observer than dorsal side. The siphuncle curves convexly lengthwise, but owing to position of specimen the curvature in the view presented is reversed in direction. (Page 301).

Figure 2. *Megadiscosorus crassisegmentatus orientalis* var. nov.
Jumpers. Zone 10, Jupiter formation. Siphuncle facing interior of conch. (Y). (Page 303).

Figure 3. *Megadiscosorus crassisegmentatus orientalis* var. nov.
Same specimen as in figure 2. Lateral view, ventral side to right. (Page 303).

Figure 4. *Beloitoceras percurvatum* sp. nov.
One mile south of Junction cliff. Zone 4, Ellis Bay formation. Type specimen. Lateral view. (V). (Page 305).

Figure 5. *Beloitoceras percurvatum* sp. nov.
West side of Ellis bay. Zone 6, Ellis Bay formation. Lateral view. (Y). (Page 305).

Figure 6. *Whitella sigmoidea* (Billings)
Left valve. (V 2095). Vauréal formation, zone 3, West point. (Page 228).

Figure 7. *Subulites richardsoni* Billings
View of a type. (V 2117). English Head formation, zone 4, Carleton point. (Page 253).

Plate XLIX

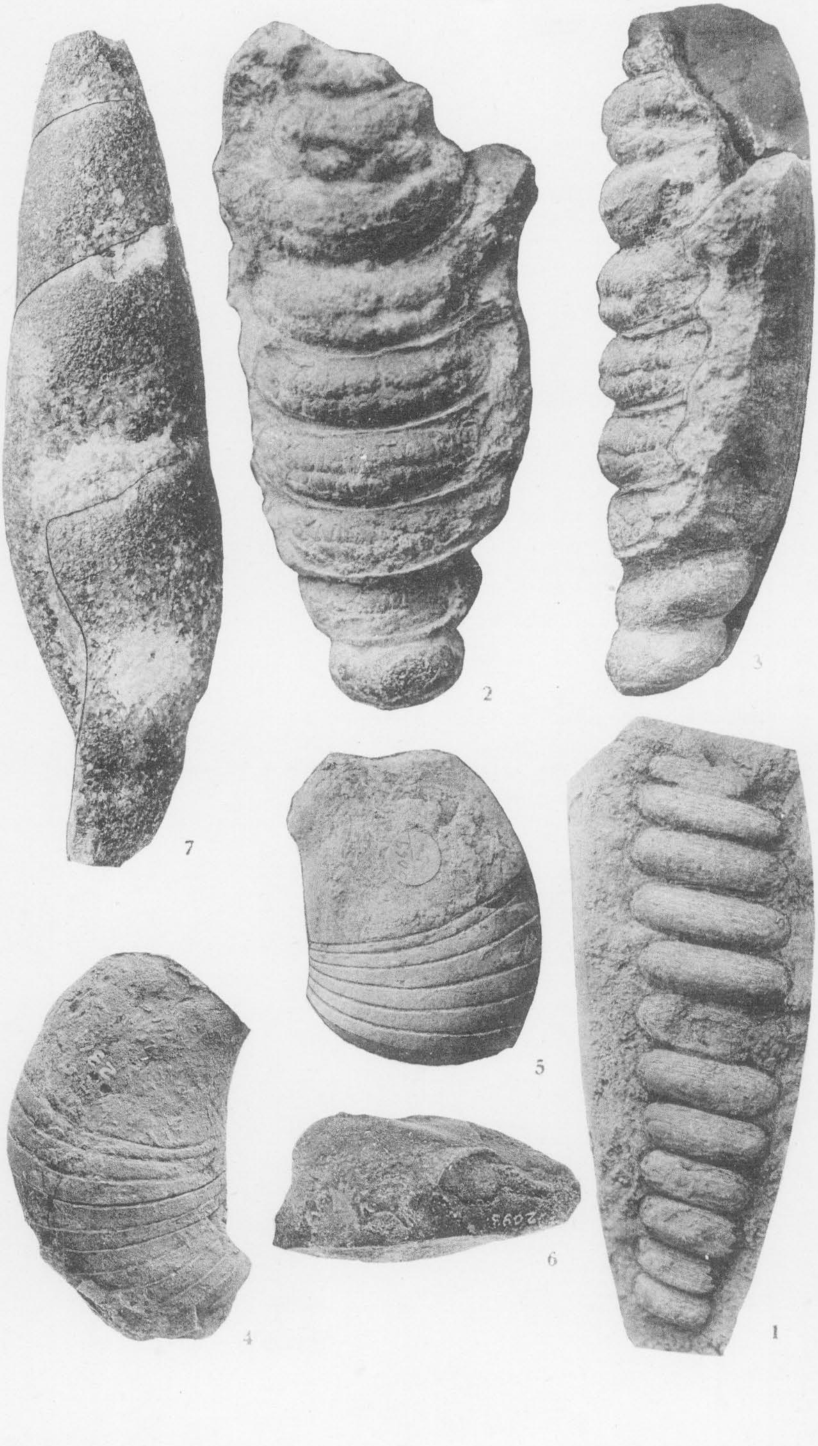


Plate L

Figure 1. *Beloitoceras accultum* sp. nov.
See also Plate LI, figure 1. MacDonald river. Zone 3, English Head formation. (Page 306).

Figure 2. *Beloitoceras (?) jamesense* sp. nov.
See also Plate XLVIII, figure 3. Cape James bay. Zones 1, 2, 3, or 4, Ellis Bay formation. Dorsal view of specimen of figure 3, Plate XLVIII. (Page 308).

Figure 3. *Beloitoceras (?) fererectum* sp. nov.
See also Plate LI, figure 3. Cape James. Zones 1, 2, 3, or 4, Ellis Bay formation. Lateral view, ventral side on right. (Y). (Page 309).

Figure 4. *Beloitoceras (?) fererectum* sp. nov.
Same specimen as figure 3. Dorsal side. (Page 309).

Figure 5. *Oncoceras carletonense* sp. nov.
See also Plate LI, figure 4. Carleton point. Zone 4, English Head formation. Lateral view, ventral side on left. (Y). (Page 309).

Figure 6. *Oncoceras (?) curvicameratum* sp. nov.
Cape James bay. Zones 1, 2, 3, or 4, Ellis Bay formation. Lateral view, ventral side on right, lower right margin restored in clay. (Y). (Page 310).

Figure 7. *Amphicyrtoceras gunense* sp. nov.
See also Plate LI, figures 5, 6. East cliff. Zone 4, Vauréal formation. Ventral side. (Y). (Page 312).

Figure 8. *Amphicyrtoceras gunense* sp. nov.
Same specimen as in figure 7. Ventral side, enlarged. (Page 312).

Figure 9. *Cyrtospira notata* (Billings)
Apertural side of a typical specimen. (Y). Ellis Bay formation, zone 4, one-half mile east of Junction cliff. X 1¼. (Page 253).

Figure 10. *Cyrtospira notata* (Billings)
One of the types. (V 2296). Ellis Bay formation, zone 4, Ellis bay. (Page 253).

Figure 11. *Phacops* (*Portlockia*) *orestes* (Billings)
Upper surface of the cephalon of one of the types. (V 2472-a). Jupiter formation, zones 6, 7, east of Jupiter river. (Page 335).

Figure 12. *Phacops* (*Portlockia*) *orestes* (Billings)
Pygidium of a small specimen. (V 2472). Occurrence as in figure 11. (Page 335).

Figure 13. *Pseudosphaerexochus canadensis* (Billings)
Photograph of the upper surface of holotype. (V 2557-a). Chicotte formation, zone 2, Southwest point. X 1½. (Page 335).

Plate L

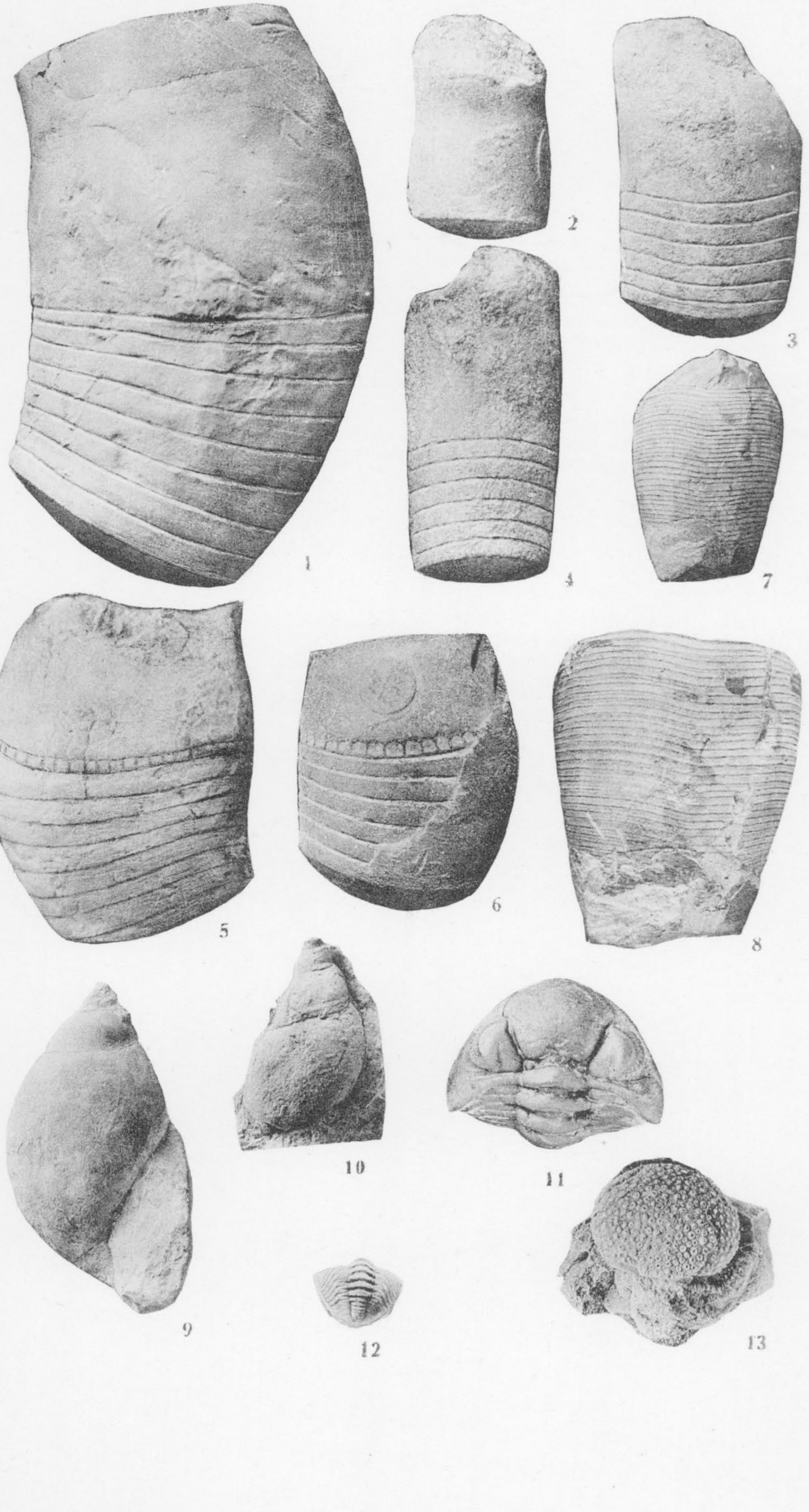


Plate LI

Figure 1. (Within figure 2). *Beloitoceras accultum* sp. nov.
See Plate L, figure 1. Transverse section. (Page 306).

Figure 2. (Enclosing figure 1). *Beloitoceras magisterium* sp. nov.
See Plate LII. Maximum transverse section of conch, and outline of aperture (dotted line). (Page 307).

Figure 3. *Beloitoceras (?) fererectum* sp. nov.
See Plate L, figures 3, 4. Transverse section. (Page 309).

Figure 4. *Oncoceras carletonense* sp. nov.
See Plate L, figure 5. Dorso-ventral vertical section, with siphuncle represented only in two lower segments. (Page 309).

Figure 5. *Eotrimeroceras jupiterense* sp. nov.
Outline of aperture. X 2. (Page 320).

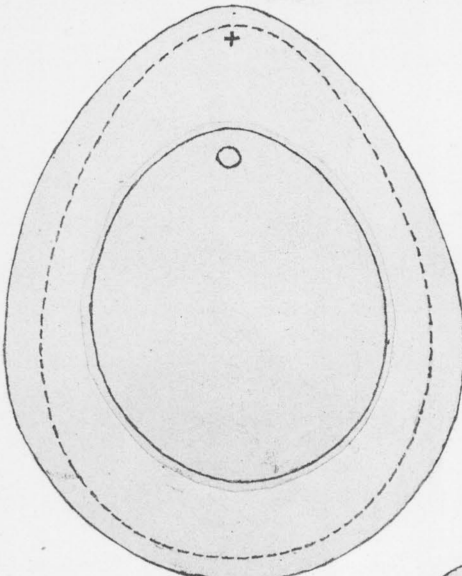
Figure 6. *Sphaerocoryphe salteri* Billings
Head of a small individual, one of the types. (V 2328). Ellis Bay formation, Ellis bay. X 3. (Page 331).

Figure 7. *Sphaerocoryphe salteri* Billings
Another somewhat larger type specimen. (V 2328-a). Ellis Bay formation, Ellis bay. X 3. (Page 331).

Figure 8. *Proetus alaricus* Billings
Holotype. (V 2198). English Head formation, zone 4, Carleton point. (Page 325).

Figure 9. *Illaenus grandis* Billings
Dorsal surface of a nearly entire specimen. (Y). Jupiter formation, zone 4, cape Ottawa. (Page 321).

Plate LI



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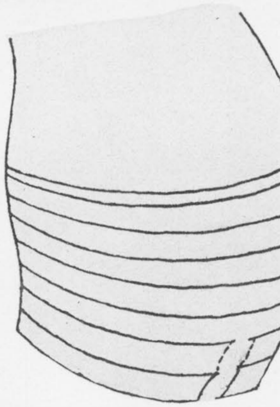

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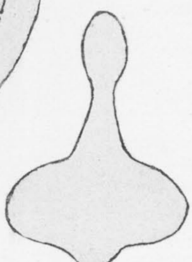

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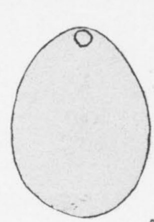

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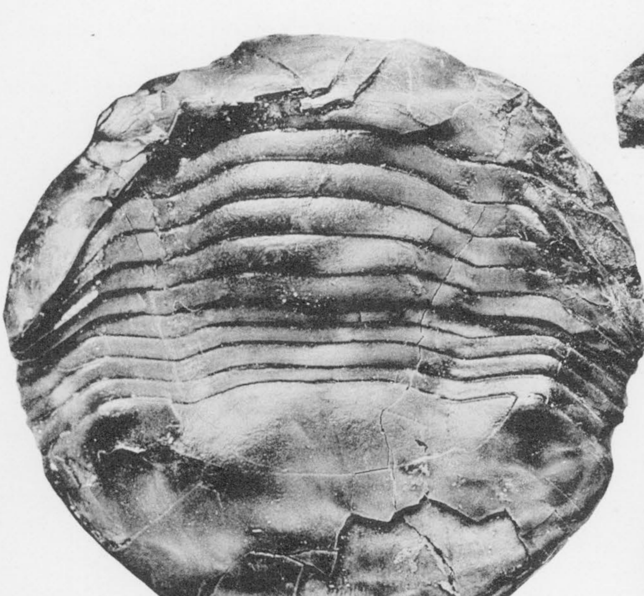

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PLATE LII

FIGURE 1. *Beloitoceras magisterium* sp. nov.
See also Plate LI, figure 1. West Cliff creek. Zone 1 or 2, Vauréal formation. Lateral view. Not the type specimen, but one retaining more of the apical portion of the conch. X $\frac{5}{7}$. (Page 307).

FIGURE 2. *Beloitoceras obstructum* sp. nov.
Girard harbour. Zone 2, Vauréal formation. Dorsal view. (Y). X $\frac{5}{7}$. (Page 307).

FIGURE 3. *Beloitoceras obstructum* sp. nov.
Same specimen as in figure 2. Lateral view showing construction of interior of living chamber on dorsal side. X $\frac{5}{7}$. (Page 307).

Plate LII

Plate LIII

Figure 1. *Orchadoceras incertum* sp. nov.
Cliff east of Jupiter river. Zone 8, Jupiter formation. View of side assumed to be ventral. (Y). (Page 312).

Figure 2. *Eotrimeroceras jupiterense* sp. nov.
See also Plate LI, figure 5. Two miles east of Jupiter river. Zone 4, Jupiter formation. Ventral view showing hyponomic sinus. (Page 320).

Figure 3. *Eotrimeroceras jupiterense* sp. nov.
Same specimen as in figure 2. Lateral view, hyponomic sinus on right; one of the lateral lobes of the aperture near left. (Page 320).

Figure 4. *Eotrimeroceras jupiterense* sp. nov.
A second specimen from same locality and horizon. Lateral view, ventral side on left; one of the lateral lobes of the aperture on the right. (Page 320).

Figure 5. *Eotrimeroceras jupiterense* sp. nov.
Same specimen as in figure 4. Dorsal view showing dorsal lobe on the ventral side of the aperture. (Page 320).

Figure 6. *Eotrimeroceras jupiterense* sp. nov.
A third specimen from same locality and horizon. Dorsal view showing distinctly the lateral lobes of the aperture. (Page 320).

Plate LIII

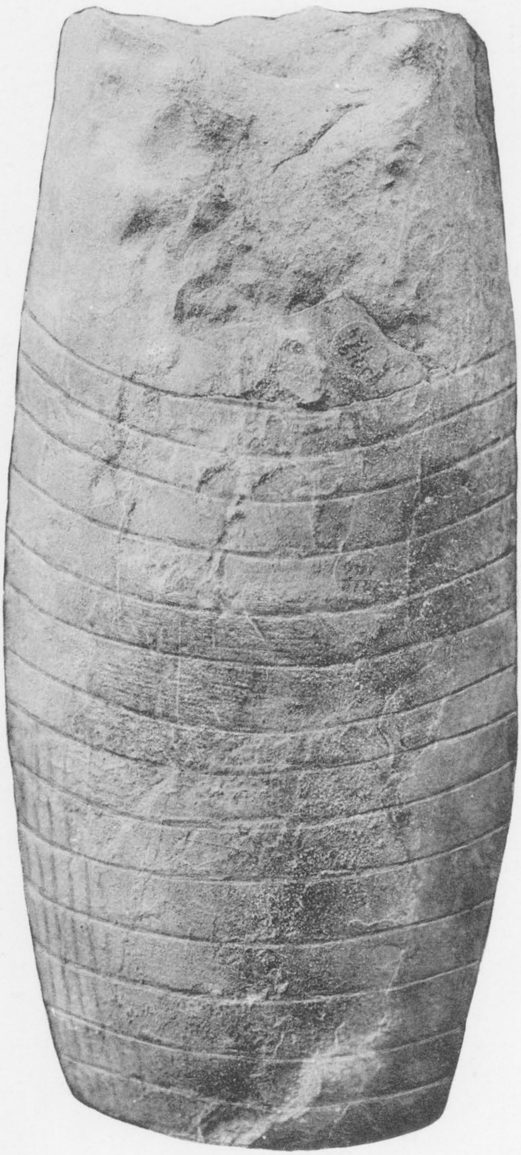

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Plate LIV

Figure 1. *Hyperoceras twenhofeli* sp. nov.
Carleton point. Zone 4, English Head formation. Lateral view, ventral side on left. (Y). (Page 315).

Figure 2. *Hyperoceras twenhofeli* sp. nov.
Same specimen as in figure 1. Ventral side; sectioned at base through centre of siphuncle. (Page 315).

Figure 3. *Diestoceras vagum* sp. nov.
White cliff. Zone 4, English Head formation. Lateral view. (Y). (Page 318).

Figure 4. *Diestoceras carletonense* sp. nov.
Carleton point. Zone 4, English Head formation. Lateral view. (Y). (Page 318).

Figure 5. *Cheirurus nuperus* Billings
Dorsal surface of a nearly entire example. The pygidium with the pair of long, lateral spines is reminiscent of Ceraurus. (Y). Jupiter formation, zone 1, cliff about one mile west of Jupiter river. (Page 333).

Figure 6. *Cheirurus nuperus* Billings
Specimen showing the cephalon. (Y). Same occurrence as specimen of figure 5. (Page 333).

Figure 7. *Cheirurus nuperus* Billings
Specimen identified by Billings as *C. insignis*. (V 2553). Chicotte formation, zone 2, Southwest point. X 1½. (Page 333).

Figure 8. *Harpes consuetus* Billings
Holotype and only known specimen. (V 2550). Chicotte formation, zone 1, Southwest point. (Page 321).

Figure 9. *Goldius insularis* (Billings)
Holotype and only known specimen. (V 2558). Chicotte formation, zone 2, Southwest point. X 1½. (Page 327).

Plate LIV

Plate LV

Figure 1. *Diestoceras arenicolum* sp. nov.
Cape James bay, zone 3 or 4, Ellis Bay formation. Lateral view; ventral side on right. (Y). (Page 316).

Figure 2. *Diestoceras arenicolum* sp. nov.
Same specimen as in figure 1. Viewed from above, ventral side at lower margin. (Page 316).

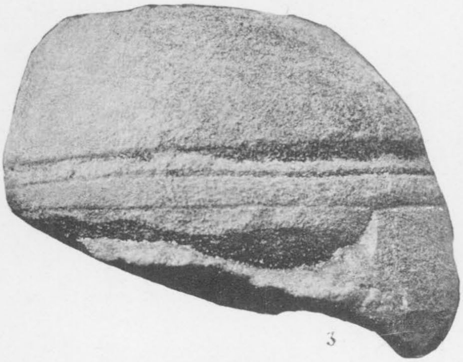
Figure 3. *Diestoceras arenicolum* sp. nov.
Same specimen as in figure 1. Ventral side showing slight hyponomic sinus and location of siphuncle in contact with, or very close to, ventral wall of conch. (Page 316).

Figure 4. *Diestoceras anticostiense* sp. nov.
West end lighthouse. Zone 4, Vauréal formation. Lateral view, ventral side on right. (V). (Page 319).

Figure 5. *Diestoceras anticostiense* sp. nov.
Same specimen as in figure 4. Ventral side. (Page 319).

Figure 6. *Triarthrus becki* var. *macastyensis* Twenhofel
Makasti bay. Drawing of the holotype. (Y). X 2. (Page 324).

Figure 7. *Triarthrus becki* var. *macastyensis* Twenhofel
Same locality. Drawing of the glabella of a paratype, showing the divergence of the facial sutures as they reach the front margin. (Y). X 2. (Page 324).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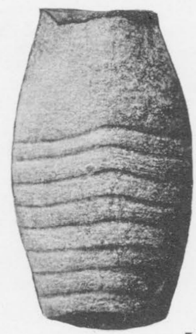
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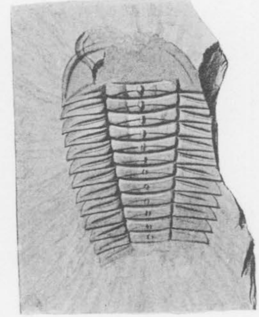
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Plate LVI

Figure 1. *Diestoceras scalare* sp. nov.
Near West end lighthouse. Zone 4, Vauréal formation. Vertical dorso-ventral section through the siphuncle. (B). (Page 317).

Figure 2. *Eoharpes ottawaensis anticostiensis* n. var.
English head. Zone 3, English Head formation. Specimen showing the glabella. (V). (Page 321).

Figure 3. *Eoharpes ottawaensis anticostiensis* n. var.
Same locality and horizon. Specimen showing the border. (V). (Page 321).

Figure 4. *Encrinurus elegantulus* (Billings)
Lateral view of a perfect specimen. (T). Jupiter formation, zone 10, Jumpers. X 3. (Page 330).

Figure 5. *Encrinurus elegantulus* (Billings)
Top of specimen of figure 4. X 3. (Page 330).

Figure 6. *Ischyrina winchelli* Billings
One of the types, a cast of the interior. (V 2114). English Head formation, zone 4, Makasti bay. (Page 339).

Figure 7. *Ischyrina winchelli* Billings
Right valve of another of the type specimens, showing exterior of right valve. (V 2114-a). Same occurrence as specimen of figure 6. (Page 339).

Figure 8. *Technophorus plicata* (Billings)
Right valve of the holotype. (V 2291). Ellis Bay formation, zone 2, Junction cliff. X 2. (Page 340).

Plate LVI

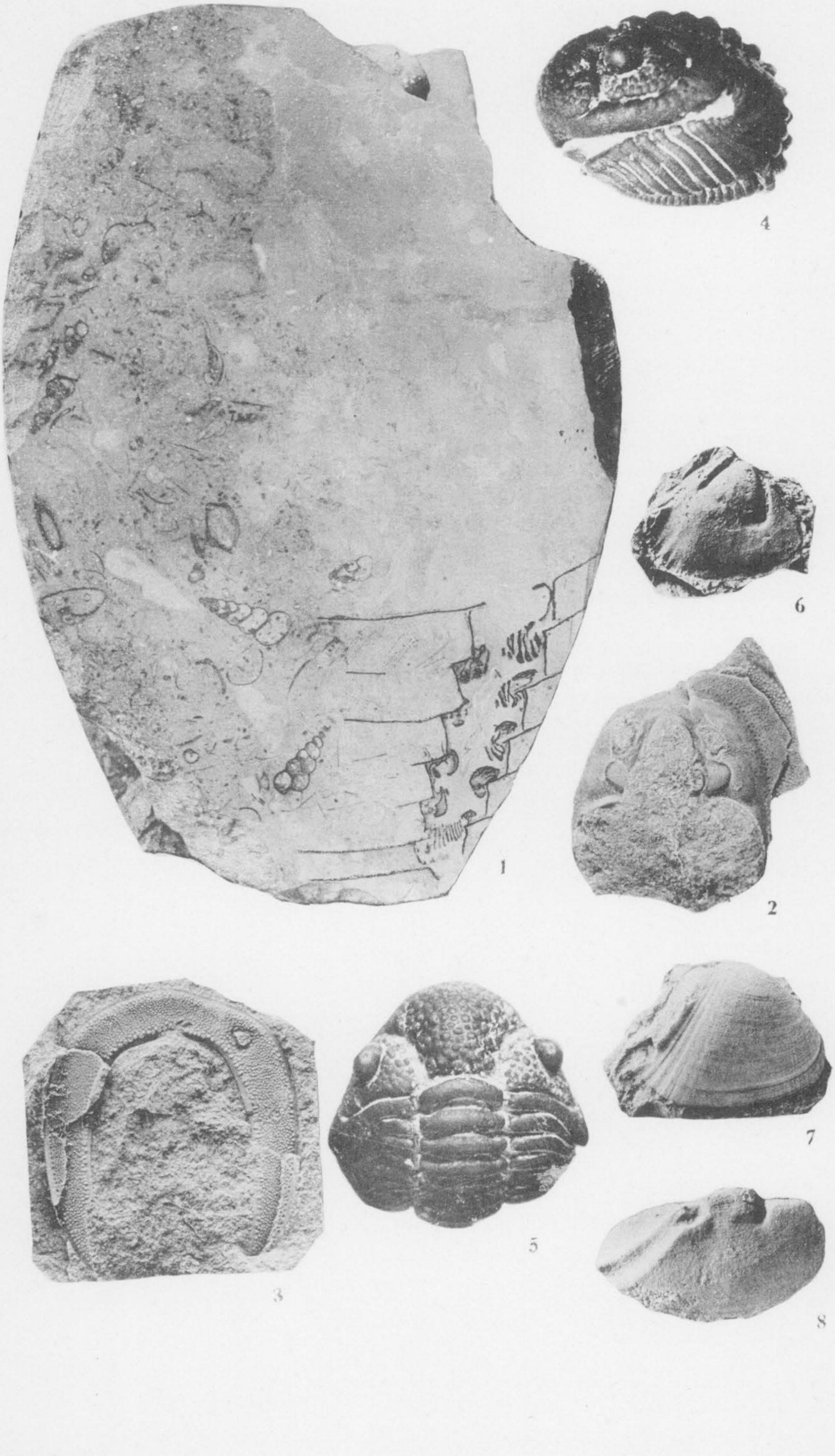

Plate LVII

Figure 1. *Diestoceras strangulatum* sp. nov.
Cliff half mile west of camp site, De Puyjalon cliff. Zone 1, Vauréal formation. Lateral view. (Page 317).

Figure 2. *Diestoceras strangulatum* sp. nov.
Same specimen as in figure 1. Viewed from above. (Page 317).

Figure 3. *Cyphaspis anticostiensis* n. sp.
Ellis bay. Zone 7, Ellis Bay formation. Holotype. (Y). X 3. (Page 325).

Figure 4. *Cyphaspis borealis* n. sp.
Gun river. Zone 4, Gun River formation. X $2\frac{1}{2}$. (Page 326).

Figure 5. *Cyphaspis borealis* n. sp.
White cliff near head of east side of Ellis bay. Zone 4, Ellis Bay formation. Holotype. X $2\frac{1}{2}$. (Page 326).

Figure 6. *Amphilichas shallopensis* n. sp.
Shallop creek. Zone 9, Jupiter formation. Holotype. (V). (Page 328).

Figure 7. *Amphilichas borealis* n. sp.
English head. Zone 3, English Head formation. Holotype. (Y). X 2. (Page 328).

Figure 8. *Amphilichas borealis* n. sp.
Same specimen as in figure 7. Front view. X 2. (Page 328).

Figure 9. *Amphilichas canadensis* (Billings)
One of the types. (V 2471). Jupiter formation, zone 2, East cliff. (Page 327).

Figure 10. *Brachyaspis alacer* (Billings)
Front view of holotype. (V 2179). English Head formation, zone 4, Carleton point. X $1\frac{1}{2}$. (Page 323).

Figure 11. *Brachyaspis alacer* (Billings)
Cephalon of holotype. X $1\frac{1}{2}$. (Page 323).

Figure 12. *Brachyaspis alacer* (Billings)
Holotype restored. X $1\frac{1}{2}$. (Page 323).

Plate LVII

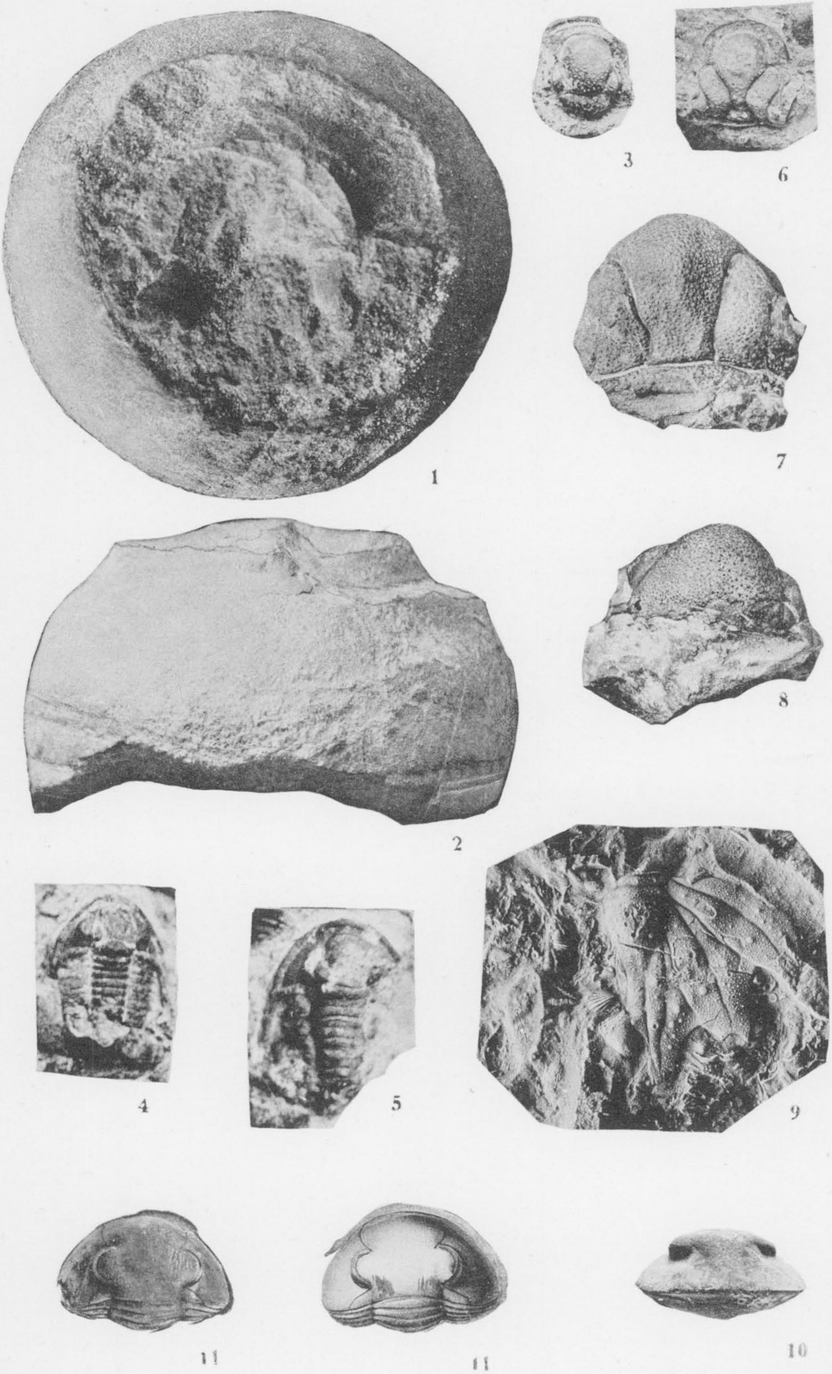

Plate LVIII

Figure 1. *Phragmoceras anticostiense* sp. nov.
West side of Southwest point. Zone 1, Chicotte formation. Lateral view, ventral side on right. (Y). (Page 320).

Figure 2. *Asaphiceras schucherti* sp. nov.
East cliff. Zone 2, Jupiter formation. Lateral view, ventral side on left. (Y). (Page 314).

Figure 3. *Asaphiceras schucherti* sp. nov.
Same specimen as in figure 2. Ventral side, sectioned at base through middle of siphuncle. (Page 314).

Plate LVIII

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PLATE LIX

FIGURE 1. *Amphilichas arenaceus* n. sp.
Brook on west side of Cape Sandtop bay. Zone 4, Gun River formation. Pygidium of holotype. (Page 327).

FIGURE 2. *Encrinurus laurentinus* n. sp.
Junction cliff. Zone 2, Ellis Bay formation. Holotype. (V). (Page 328).

FIGURE 3. *Encrinurus laurentinus* n. sp.
Same locality and horizon. Pygidium of a paratype. (V). (Page 328).

FIGURE 4. *Encrinurus laurentinus* n. sp.
East of Junction cliff. Zone 4, Ellis Bay formation. Head of another example. (Y). X 2. (Page 328).

FIGURE 5. *Encrinurus laurentinus* n. sp.
Junction cliff. Zone 2, Ellis Bay formation. Specimen showing part of thorax. (Y). (Page 328).

FIGURE 6. *Encrinurus anticostiensis* n. sp.
East cliff. Zone 1, Jupiter formation. Specimen showing the head. (Y). X 1½. (Page 330).

FIGURE 7. *Encrinurus anticostiensis* n. sp.
West of Jupiter river. Zone 1, Jupiter formation. Hypostome. (Y). X 1½. (Page 330).

FIGURE 8. *Encrinurus anticostiensis* n. sp.
East cliff. Zone 1, Jupiter formation. Pygidium showing spine. X 1½. (Page 330).

FIGURE 9. *Encrinurus anticostiensis* n. sp.
Cliff west of Jupiter river. Zone 1, Jupiter formation. Holotype. (Y). (Page 330).

FIGURE 10. *Encrinurus anticostiensis* n. sp.
Sand cliff, Jupiter river. Zone 4, Jupiter formation. Top of a nearly perfect specimen showing the pedunculate eyes and long genal spine. X 3. (Page 330).

Plate LIX

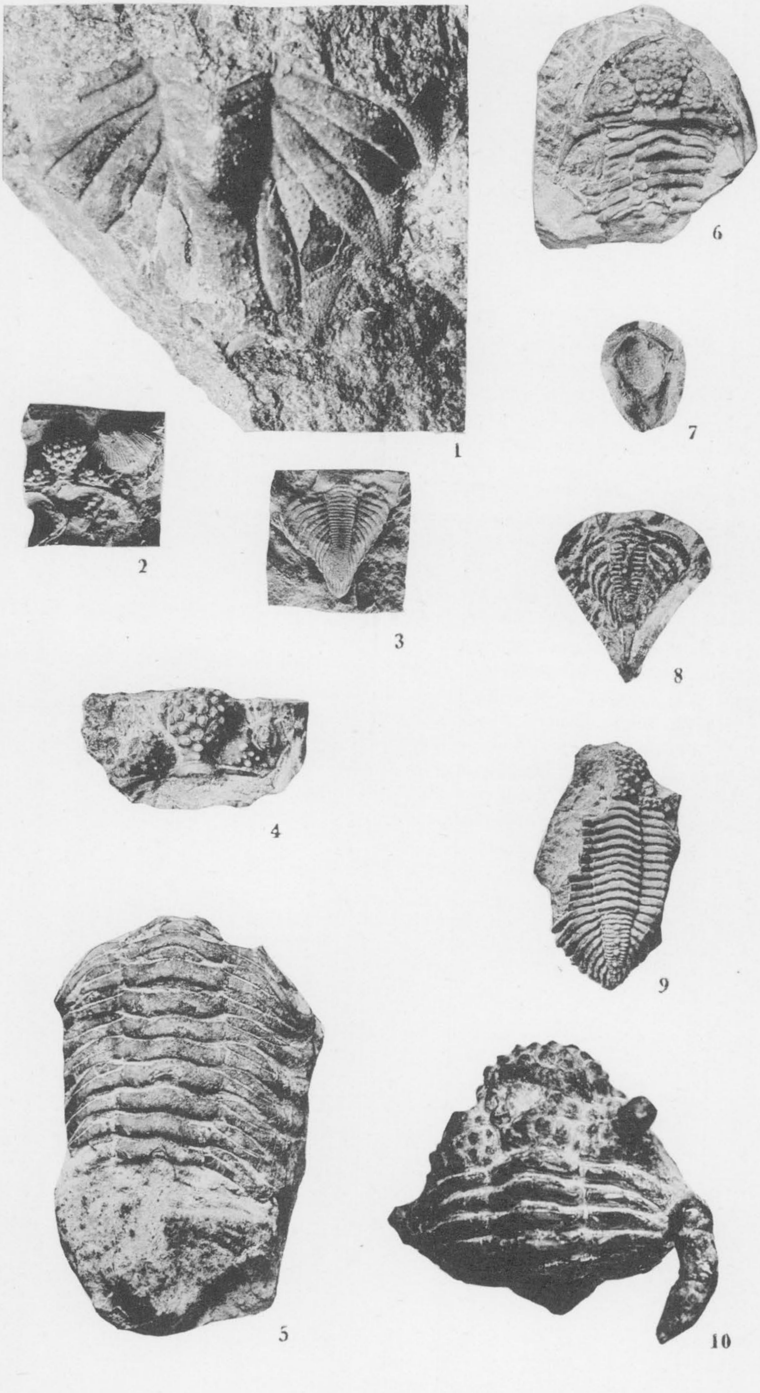


Plate LX

Figure 1. *Calymene schucherti* n. sp.
Jupiter river. Zone 4, Jupiter formation. Holotype. The front margin and genal angles have been restored from other specimens. (Y). (Page 332).

Figure 2. *Dalmanites caudatus jupiterensis* n. var.
Cliffs east of Jupiter river. Zone 7, Jupiter formation. Cephalon of the holotype. (Y). (Page 335).

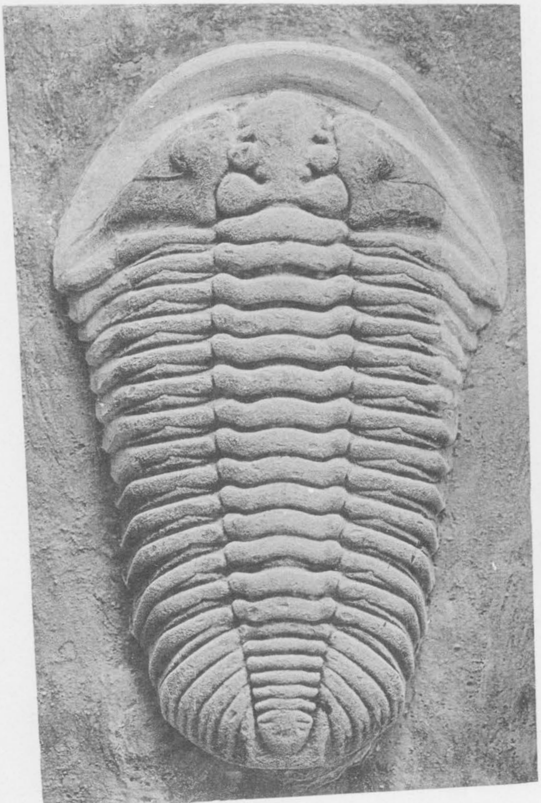
Figure 3. *Chasmops anticostiensis* n. sp.
East of Junction cliff. Zone 4, Ellis Bay formation. Holotype. (V). (Page 336).

Figure 4. *Chasmops anticostiensis* n. sp.
Same locality and horizon. Pygidium of another specimen. (Page 336).

Figure 5. *Chasmops occidentalis* n. sp.
English head. Zone 3, English Head formation. Photograph of the holotype and a paratype. (V). X 2. (Page 338).

Figure 6. *Isochilina vaurealensis* n. sp.
Zone 10 of Vauréal River section. Near top of Vauréal formation. Left side of holotype. X 3. (Page 341).

Plate LX



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