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Applied Image Inc.
THE ANTICOSTI ISLAND FAUNAS

by

W. H. Twenhofel
Canada
Geological Survey
Museum Bulletin No. 3.
GEOLOGICAL SERIES, No. 19.

The Anticosti Island Faunas.
By W. H. Twenhofel.

INTRODUCTION.

The study of the Anticosti Island section was undertaken by the writer in the summer of 1909, the field work being done under the auspices of Peabody Museum of Yale University. The results derived from the field work and the preliminary study of the collections, were presented by Schuchert and Twenhofel at the Boston Meeting of the Geological Society of America and, later, published in the Bulletin of the Society. Subsequently the Geological Survey of Canada generously assumed the expense connected with the study of the faunas and a memoir will ultimately be published in which the palaeontology and everything pertaining to the geology will be exhaustively treated. The many questions arising from the study of the faunas have made further field work desirable, if not actually necessary, and this will be undertaken before final publication, although the manuscript and plates of the work as originally planned are now completed. In the meantime, it has not appeared wise that the information gained and the conclusions reached should be withheld and the present paper is an attempt to give a summary of the chief results. It is hoped that their publication will elicit comment and give the writer the benefit of suggestion and advice.
from other workers in equivalent strata. Throughout the entire study of the collections the writer has had the critical advice of Professor Charles Schuchert and the generous co-operation of the officers and scientists of the Geological Survey of Canada. Doctor R. S. Bassler assured the study of the bryozoa and ostracoda and the identifications of all such species are his. A large number of other scientists have given advice and assistance. To them acknowledgment will be made in the final publication.

The study of the Anticosti faunas and the section have developed five facts of importance. They are as follows: (1) Billings' statement that the section is complete from base to summit and contains no stratigraphic break is sustained; (2) many of the species have ranges through greater thicknesses than the same species have in other regions; (3) the faunas of the north and south shores show great differences which in every instance correspond to differences in lithology and hence to differences in the eologic conditions at the time of sedimentation; (4) the section is much thicker on the north shore than on the south, contains fewer corals and no coral reefs, and the sediments are less calcareous, but far more shaly and sandy; (5) the rocks of the Anticosti section once extended far inland on the Laurentides and much higher rock once overlay the highest rocks now present.

The absence of stratigraphic breaks in part explains the long vertical ranges of many of the species, since they occur in the strata which are wanting in equivalent sections of other regions.

While the faunas of the north and south shores are markedly different in many of the zones, it is also true that they are almost absolutely identical in those zones wherein the sediments of both shores are the same. These faunal differences are rendered more conspicuous by the absence on one shore of species to which great diagnostic value has been given, but which are present on the other shore. One of the most striking examples of this fact is the presence of *Rhychoiurea perlamellosa* in great abundance and with a considerable range in the northern outcrops of the Charleton formation, while to date no collector has obtained a single specimen of this species from the south shore, although the equivalent beds are most certainly exposed and less than twenty
The number of such species is quite large and will be given in the final work. These faunal differences of the two shores leads to the conclusion that the faunas of the Anticosti seas were at least partly controlled by the depth of water and the character of the sediments. There is nothing new or strange in this conclusion since similar conditions always obtain in the case of modern waters. The fact, however, has great importance in correlation; but by many writers it appears to have been almost wholly ignored and differences of fauna have been explained in other ways. Exhaustive treatment of this phase of the stratigraphy is ultimately contemplated.

Anticosti island consists of a part of a cuesta on an ancient coastal plain which probably began to develop in the Devonian and existed until the time of the post-glacial submergence. It will be called the Anticosti cuesta. About twenty miles to the north the Mingan islands fringe the Quebec shore and consist of the remnants of a parallel cuesta. This will be named the Mingan cuesta. Between the two cuestas lay an inner lowland which near the west end of Anticosti was crossed by a north-south divide from which streams drained east and west, the former being the longer. North of the Mingan cuesta is another lowland. The latter will be called the Laurentide lowland and the former the Channel lowland.
FAUNAL SUMMARY OF THE SECTION.

Introduction.

The lithic characters of the zones were given in the earlier paper and repetition at this time is unnecessary. The complete faunas of each formation will be given but not zonally.

Two systems are represented in the Anticosti Island succession: Ordovician and Silurian. The basal division of the Anticosti Ordovician cannot be seen in place; but fragments in the shore material for about fifteen miles on the western end of the north shore show its presence at no great depth below the surface of the water. Since the material is most abundant and in the largest pieces near the buried divide of the Channel lowland, it is probable that the parent rock outcreeps over a considerable extent on this ridge. It has been called the Macasty black shale. The rock consists of a soft, highly bituminous black shale and carries a small biota of five species as follows: Climaciograptus spiniferus, C. typicus magnificus, Leptobolus insignis, Triarthrus becki macastyensis and Orthoceras sp. Both lithology and fauna are in harmony with correlation with the Utica as developed at Ottawa and elsewhere in eastern Canada.

Ordovician System, Richmond Series.

English and Formation. The lowest rocks of this formation meet the waters of the North channel at the edge of the reef near English head on the northwest end of the island, and the summit is placed at the top of the so-called "track bed," a bed marked by peculiar impressions which Billings considered as probably the tracks of cephalopods. The fauna consists of one hundred and seven species of which seventy-nine pass into higher formations. Brachiopods are the most numerous, both in species and individuals, with the gastropods vying with them in each

respect. The latter have an aspect somewhat more ancient than is generally found in equivalent strata, but, as they are associated with many typical Richmond species, they are considered survivors of older deposits and given little weight. The formation has a thickness of 229 feet. The complete fauna of the formation is as follows:

1. Lycophytes formosum
2. L. deltoiun
3. L. vacans
4. Sarcodites abruptus
5. Katapella cf. filosa
6. Calapostia canadensis
7. Mesosaurus patilus
8. Paleoceras apsere
9. Streptoceras angulatum
10. S. rusticum
11. Periglyptoceras sp.
12. Cymatites flexuosus
13. Arthrodema angulare
14. Diamantes sp.
15. Dictyopora fragilis
16. Phrocopora perimast
17. Pliobaculites magna
18. P. whitei
19. Sceptropora fauci
20. Catacopia anticoastiensis
21. Dalmatella testudinaria
22. Dinobolus n. sp. 1
23. Diornthia n. sp.
24. Heterocella mara
25. Lepidoceras ? ceres
26. L. ? nitens
27. Lingula forbesi
28. Parastromosia lenticularis
29. Pliodipsa n. sp.
30. Plectambonites sericeus
31. Protoezega anticoastiane
32. Gondongula elegantula
33. Rhinecostephanus n. sp.
34. Rhyrichtrema anticoastiensis
35. R. undulatum
36. Strophomena fluctuosa
37. S. huncula
38. S. n. sp.
39. Trematicia ottawaensis n. var.
40. Zygaena recurvispira n. var.
41. Byssotrichia n. sp.
42. Cyrtodonta anticoastiensis
43. C. harrieti
44. C. ? insularis
45. Pterinea bellifera
46. P. prolificus
47. Rhyniaea emma
48. Vanamentia angulata
49. Whittella pelich
50. W. sigmondica
51. Archinarella estella
52. Bellerophontes freternis
53. B. ? messer
54. B. ? solifera
55. B. ? sp. n.
56. Clathrodes subconica
57. Hornotoma graciilis
58. H. panderiana
59. Lophospira ? circe
60. L. ? modesta
61. L. ? varians
62. Metopoma alba
e
63. Oxyceras n. sp.
64. Paraceras n. sp.
65. Phragmoteles desiderata
66. P. pannosa
67. Rachysoma n. sp.
68. Solenostomina canadensis
69. Similites cf. bifrons
70. Trochomina umbilicata
71. Guianaasperata
72. Pseudoecia n. sp.
73. Actinoceras anticoastiensis
74. A. seidewitici
75. Apsicheras magnificentum
76. As coceras n. sp.
77. Bilingites canadensis
78. B. newberryi
79. Cycloceras crocusr
80. C. cf. nicolleti
81. Endoceras praeforme
82. Orthoceras solobii
83. Perotoceras solicum
84. Spyriceras bilineatum
85. S. forum
86. Tristroceras xiphium
87. Bulla seminifera
88. Bythoceras lingus
89. B. obtusus
90. Krausea anticoastiensis
91. Macrocystis subhyalinopis
92. Schmidtella subhyalinopis
93. Amphielas n. sp.
Charleton Formation. The English Head formation is succeeded without lithologic or stratigraphic break by the Charleton formation. The faunas are likewise continuous and typical Richmond species which are introduced in the former become exceedingly abundant in the latter. A fact of some importance for geography and stratigraphy is the greatly increased thickness of the formation in the northern outcrops, the thickness of the south shore consisting of 730 feet, while that of the north exceeds 900 feet. The lithology of the north shore is also quite different from that of the south, the latter consisting largely of limestones and shales with the former predominating, while on the north shore shales are far more important and toward the top much sand is present, although a real sandstone is not developed.

Corals which occur quite commonly in the English Head formation, here become abundant, particularly on the south side, where heads of nearly three feet diameter occur. Through a considerable thickness near the middle of the formation the peculiar hydroid, Beatricia, lies around on the reef like logs in a swamp, or, slightly salient in the cliffs, projects like guns from a battery. Gastropods are not nearly so important as in the English Head, while the brachiopods play a greater rôle. The complete fauna consists of one hundred and sixty species of which seventy-five have come from the English Head. Sixty species are confined to the formation and fifty-six pass into succeeding formations, twenty-eight of which have come from the English Head. The species of the formation are:—

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<th>No.</th>
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<tr>
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<td>Brachyaspis altilis</td>
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<td>95</td>
<td>B. notans</td>
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<td>96</td>
<td>Bumastes orbiculatus</td>
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<tr>
<td>97</td>
<td>Ceraurus numitor</td>
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<tr>
<td>98</td>
<td>C. pleurexanthemus</td>
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<td>99</td>
<td>Ceraurinus icarus</td>
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<td>100</td>
<td>Encrinurus multisegmentatus</td>
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<tr>
<td>101</td>
<td>Eoharpes ottawaensis</td>
</tr>
<tr>
<td>102</td>
<td>Isotellus gigas</td>
</tr>
<tr>
<td>103</td>
<td>I. cf. maximus</td>
</tr>
<tr>
<td>104</td>
<td>Pterygometopus n. sp.</td>
</tr>
<tr>
<td>105</td>
<td>Ischyrina winchelli</td>
</tr>
</tbody>
</table>

1 Lockcia n. sp.
2 Lyrophyucus vagans
3 Rupophyclus tabulatum
4 Hinde fibrosa
5 Kauffelia cf. hlosa
6 Beatricia nodulosa
7 B. undulata
8 Calapezia canadensis
9 Columnaria alveolata
10 Halysites ctenulatus
11 Lycella affinis
12 Lyopora goldfussi
13 Palaeolavosites aspera
14 P. aspera n. var.
Anticosti Island Faunas.

15 Streptelasma angulatum
16 S. rusticum
17 Zaphrentis affinis
18 Caradocinella tuberculata
19 Cupulocinella tubulbranchiata
20 Dendrocinella? tener
21 Hudonaster rugosus
22 Pleurocystites anticoesiensis
23 Retorcinella simplex
24 Cornulites flexuosus
25 C. richmondensis
26 Archaeodraco angulare
27 Birostrina n. sp.
28 Bythofellina striata
29 Chasmatoceratina canniariata
30 Corynocyrtina dissimilis
31 Cyphopyrga bulboidea
32 C. n. sp.
33 Dieranopora enicera
34 D. fragilis
35 Eridotrypa simulatrix
36 Glauconema strigosa
37 Gonothyrella planula
38 Hallopora n. sp. 1
39 H. n. sp. 2
40 Helopora imbricata
41 Helonpyrga n. sp.
42 Leiodemella nitida
43 Mitocella? n. sp.
44 Nematotheca lineata
45 Pachychitonica firma
46 P. hexagonalis
47 Prasopyrga n. sp.
48 Protopsicytina exigua
49 Ptilodraco canadiensis
50 P. flagellum
51 P. magnifica
52 P. whiteavesi
53 Rhinodraco nitidula
54 Sceptrotheca facula
55 Cataygko anticoesiensis
56 Chonetes primitivus
57 Citronianites vermeili diversus
58 Crynia n. sp.
59 Dalmanella testudinaria
60 Dinobolus n. sp. 1
61 Dinocrinella n. sp.
62 Eichwaldella? anticoesiensis
63 Haberella maria
64 Hyattoceras charletona
65 Leptoceras? cerasi
66 L. ? nitens
67 L. ? reticulata
68 L. ? n. sp.
69 Lingula ? canadiensis
70 L. ? forbesi
71 Orthis davidsoni var.
72 Parastrophina lenticularis
73 Pholiops n. sp.
74 Phlebalomites sericeus
75 Protogona anticoesiensis
76 Pseudosphinctella elegans
77 Rafinesquina n. sp.
78 Rhinocyclina sola
79 Rhynchotrematina anticoesiensis
80 R. perkinsi
81 Schizocystis filosa
82 Schuchertiella pecten
83 Strophomena anticoesiensis
84 S. ? archbusa
85 S. ? florinosa
86 S. inacuta
87 S. n. sp.
88 Trematis ottawangensis n. var.
89 Zygospira recurvirostra n. var.
90 Byssonychta n. sp.
91 Ctenodonta cf. obliqua
92 Cyrtodonta anticoesiensis
93 C. harrisoni
94 Pterina heliconia
95 P. prolifica
96 P. variariata
97 Rhytima emina
98 Whiteops plechia
99 W. signicosta
100 Bellerophon n. sp.
101 Clathrospira subhastata
102 Cyclonema thalii
103 C. n. sp.
104 Hormotoma gracilis
105 H. multivolvus
106 H. tertiforfmis
107 Liospira americana
108 L. n. sp.
109 Lophospira molestata
110 L. n. sp. 1
111 L. n. sp. 2
112 Phragmolites punxu
113 Raphistoma n. sp.
114 Salpingocysta canadiensis
115 Sinuities cf. bilobata
116 Sublites richardsonii
117 Conulina splendida
118 C. n. sp.
119 Pterolucina n. sp.
120 Anticoesiella anticoesiensis
121 A. ? fulgor
122 A. mckewicki
123 Billingsites canadensis
124 B. newberryi
125 Cycloceras cf. nicolleti
126 Cyrtoceras n. sp.
On the north shore the sandy shales of the Charleton formation give place without stratigraphic break to the basal Ellis Bay sands; but on the south shore the sequence is continued with limestones and shales, the latter becoming more important near the middle. The formation is excellently and extensively exposed in Ellis bay on the south shore and Prinstie bay on the north. On the south side the thickness is 180 feet, but in the northern outcrops it greatly exceeds this figure.

This formation is placed in a series distinct from the Richmond, the ground being taken that it is younger than any division assigned to that series. On the other hand it is considered older than any North American formation referred to the Silurian. The great number of Richmond species which continue into this formation and the total absence of any evidence for a break of any kind are considered good reasons for its retention in the Ordovician. It is to be noticed, however, that twenty-four of the twenty-six species of Charleton bryozoa become extinct with that formation and that of the twenty-two species of Ellis Bay bryozoa, twenty species are introduced with the Ellis Bay formation. Furthermore, the Ellis Bay bryozoa have their closest affinities with Silurian faunas, although fifteen of the species become extinct within the formation.
The fauna is one of the largest of any of the island's formations and nearly every species is represented by numerous individuals, although their vertical ranges are generally not extensive. Near the top occurs the first coral reef of the Anticosti section, but it is found only in the southern outcrops. It is about ten feet thick and formed almost wholly of *Paleofavosites*, *Lyellia*, and *Halysites*. On the present wave cut reef the coral masses rise as small mounds and in the cliffs the reef appears as a structureless mass with the superjacent beds over-arch ing it, giving rise to an appearance of folding. Also near the top, but below the coral reef, is the second Beatricia zone and here they are equally as numerous as in the Charleton zone. The total fauna consists of one hundred and forty-two species of which thirty-five originate in the English Head formation and twenty-three in *Pleurodictyum* voesicolls. Fifty-eight species are confined to the formation and one hundred and seven species—nearly eighty per cent of the fauna—become extinct therein.

The species are:

1. *Cyttocrinites halli*
2. *Ischadites insularis*
3. *Hindia fibrosa*
4. Rauffella cf. *filosa*
5. *Beatricia nodulosa*
6. *B. undulata*
7. *Calapedia canadense*
8. *Chlathrodictyon vesiculosum*
9. *Columnaria alveolata*
10. *Dictyonema n. sp. (doubtful as to its having been collected here)*
11. *Favosites forbesi*
12. *Halysites catenulatus*
13. *Lyellia affinis*
14. *L. exigua*
15. *L. speciosa*
16. *Mastigophragus cf. simplex*
17. *Paleofavosites aspera*
18. *P. aspera n. var.*
19. *Protocysta tenuis*
20. *P. vetusta*
21. *Streptelasma selectum*
22. *Strombodes diffusus (doubtful as to its having been collected here)*
23. *Zaphrentis affinis*
24. *Z. n. sp.*
25. *Cornulites richmondensis*
26. *Allonema botellus*
27. *Atectoporella n. sp.*
28. *Ceramopora niagaraensis n. var.*
29. *Chasmatpora angulata*
30. *Corymatrypia dissimilis*
31. *Cypriotrya bullawa*
32. *C. polygona*
33. *Dianulites n. sp.*
34. *Glaucoloma striosa*
35. *Halopeora elegansis n. var.*
36. *H. magnipora*
37. *Helopora lineopora*
38. *Lichina affinis*
39. *Lioelema varioporum*
40. *Nematopora lineata*
41. *Nicholsonella parvula*
42. *Pachydictya crassa*
43. *Phanopora ensiformis*
44. *P. excellens*
45. *Ptilodictya gladiola*
46. *Stromatopora siluriana*
47. *S. arachnoidea*
48. *Atrypa marginalis*
49. *Atrypina n. sp.*
BULLETIN NO. 3.

50 Chonetes primogenius
51 Chlorambonites verneuil diver-
sus
52 Crania n. sp.
53 Dalmanella rufida
54 D. testudinaria novelli
55 Dinolobus n. sp. 1 n. var.
56 Dinarthia anticoextensis
57 Herbertella maria
58 Hindella primstana
59 H. umbonata
60 Leptaena rhomboidalis
61 L. ? ceras
62 L. ? nitens
63 L. ? reticulata
64 L. ? n. sp.
65 Lingula forbesi
66 L. insularis
67 Orthis davidsoni n. var.
68 O. laurentina
69 O. lenticulosa
70 Parastrophia lenticularis
71 P. reversa
72 Phololops n. sp.
73 Platystrophia dentata
74 P. demata n. var.
75 P. fissicostata
76 Plectambonites sericus
77 Pseudoligula elegansula
78 Rhapidomeola aberris
79 R. uberis rhycho-
nolliformis
80 Rhychoptrema anticoextensis
81 R. janea
82 R. n. sp.
83 Rhychoonella ? nitrix
84 Schuchertella pecen
85 Strophomena fluctuosa
86 S. fluctuosa n. var.
87 S. hecuba
88 S. semibovisa
89 Trematis ottawaensis n. var.
90 Breysonychia n. sp.
91 Chitoncha ? superba
92 Ctenodonta cf. simulatrix
93 Cuneamay n. sp. 1
94 C. n. sp. 2
95 Pterinea striata
96 P. variostriata
97 Vanuxemia accutobona
98 Bucania n. sp.
99 Clathropsida subconica
100 Cyclonema thulia
101 Cystospira notata
102 Diaphorostoma humilis
103 Ecelyphomphalus n. sp.
104 Hornemotoma gigantea
105 H. gracilis
106 Liospria americana
107 L. helena
108 L. n. sp.
109 Lophospira ? papillosa
110 L. ? sybellina
111 L. n. sp. 1
112 L. n. sp. 2
113 Lonxonea rugosa
114 Oxythyris n. sp.
115 Paleacmea n. sp.
116 Phragmoites desiderata
117 Salpingostoma camadiensis
118 Schizoflora n. sp.
119 Simulites cf. fillobbera
120 Subulites richardsoni
121 S. n. sp.
122 Tetanota n. sp. obsoluta
123 Actic scoras "sagwicki
124 A. ?-scoras magnificum?
125 Fillingites newberryi
126 Cyrtoceras scuras
127 Oncoceras fragile
128 Orthoceras formosum
129 O. n. sp.
130 Poterioceras n. sp.
131 Brachyspis alacer
132 B. notans
133 Bumastes orbiculadatus
134 Calymene calliphosa
135 Cerasus plicreanthes
136 Cearinus icirus
137 Chasmospites truncato-cau-
datus
138 C. n. sp.
139 Cyphaspis n. sp.
140 Encrinus multisegmenta-
tus
141 Isoete' gigas
142 L. f. maximus
143 Sphaerocorys salteri
144 Technophorus plicata
ANTICOSTI ISLAND FAUNAS.

Silurian System, Anticosti Series.

Becsie River Formation. The passage from the Ellis Bay to the Becsie River formation witnesses the extinction of about eighty per cent of the Ellis Bay fauna and the major portion of this extinction takes place in the upper three zones, which in their rapid lithic and faunal changes presage the initiation of a new geologic cycle; but beginning with the first zone of the Becsie River formation, stability of sedimentation and fauna is again instituted. Beyond the faunal evidence, there is none other, either structural or depositional, suggesting a stratigraphic break and the faunal change can not be taken to indicate any interruption of deposition, since it can as readily be explained by a change in ecology which may have been brought about by some physical event in a region comparatively distant, and until more is known of the factors that determine the characters of faunas, the causes of their local extinction and the replacement of one by another, it appears to the writer to be idle to assume that faunal changes are indicative of breaks unless they are accompanied by other evidence. Since no stratigraphic break has been ascertained, the base of the Becsie River formation and the Silurian has been somewhat arbitrarily placed where there is the most decided faunal and lithic change.

In the earlier paper by Schuchert and Twenhofel, the writers were inclined to the opinion that the early Silurian beds of Anticosti could be embraced within the series term Niagaran. This view has now been abandoned, since it appears that it would give the term too great an extension beyond its original application.

Savage has lately proposed the series term Alexandrian for certain early Silurian deposits of southwestern Illinois and eastern Missouri, the series to embrace all deposits between theOrdovician and the Clinton. In 1857, Billings proposed to place all the Anticosti section above what is now designated as the Charleton formation in a new group which he proposed to call the Anticosti group, considering this portion of the Anticosti section as holding a position intermediate between the Ordovician and the Clinton. In 1857, Billings proposed to place all the Anticosti section above what is now designated as the Charleton formation in a new group which he proposed to call the Anticosti group, considering this portion of the Anticosti section as holding a position intermediate between the Ordovician and the Clinton.

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\footnote{1\textsuperscript{Savage, P. L. Geol. Soc. Am. Vol. 24, 1913, p. 355.}}
vician (Hudson River beds) and the Niagara limestone. It has since been learned that he erred in including too much since the lowest division of his Anticosti group belongs to the Ordovician and the upper two divisions to the Clinton and higher formations (Niagara). The future employment of Billings' term requires its emendation and it appears to the writer that this should be done, since Billings gave the term its proper significance, erring only in including too much, and also in that the Anticosti section is far more complete and hence far more representative of this time than any other on the North American continent. This course has been followed in the present paper. In the final paper the matter will be more adequately treated.

Silurian deposition was initiated by the formation of a yellowish-white limestone in which is recorded the almost complete disappearance of the species which had been so abundant in the Ellis Bay formation. The tabulate corals, however, form an exception, since they continue in almost undiminished numbers. The number of species decreases to thirty-nine, of which nineteen have come from below, consisting for the most part of the Anticosti and generally well-known long ranging corals and brachiopods. In the lower half of the formation the number of species is few and none is abundantly represented, but in the upper portion there are more species and most are extremely abundant in individuals. Nineteen of the thirty-nine species are brachiopods. The thickness of the formation is 188 feet. The species present are:

1 Cyclocrinites halli
2 Clathrodictyon vesiculorum
3 Cyathophyllum wahlenbergi
4 Diphysiphylum caseptosum
5 Favostites forbesi
6 F. gothlandicus
7 Halyites catenulatus
8 Lycella affinis
9 Paleofavosites aspera
10 Zaphrentis stokesi
11 Helopora coneava
12 H. formosa
13 Pachydicyya crassa
14 Phanopora superba
15 Ptilodictya gladiola
16 Atrypa marginalis
17 Brachypire lida
18 B. n. sp.
19 Camarotochita neglecta
20 Clorinda undata n. var.
21 Carolspira planoconvexa
22 Crania n. sp.
23 Hindella pristina
24 H. umlonata
25 Orthis davidsonii n. var.
26 O. ? flabellites
27 Parastrophia lenticularis

1 Billings, Rept. Progress 1853-1856, Geol. Surv. of Canada, 1857, p. 250.
Gun River Formation. Corals play a greater role in the Gun River than in any previous formation, but the common species are the same as those of lower horizons. Two large reefs occur in the southern outcrops, one at St. Ann cliff and the other at East cliff. They are not, however, in the same horizon and there is none on the north side. Fossils are abundant in almost every zone and the vertical range of each species is generally quite extensive. The total fauna consists of one hundred and thirty species of which forty-eight are brachiopods and these constitute fully eighty per cent of the individuals. Of the entire fauna eighty-seven originate in this formation and forty-four are derived from lower horizons. The formation has a thickness of 500 feet. The species are:

1. Bathotrophiscf. gracilis
2. Rusophycus bilobatum
3. Cyclocrinites gregarius
4. C. intermedius
5. Ischadites kenvi
6. Aulopora cf. precius
7. Clathroidictyon vesiculosum
8. Clinothiagrupus typicalis n. var.
9. Cyathophyllum euryone
10. C. wahlenbergi
11. Cystiphylumn niagarensense
12. Diphyllophllum carpusitum
13. Favorsites forbesi
14. F. gothlandicus
15. Halysites catenulatus
16. Helvetites subtilubulata
17. Lyellia affinis
18. Paleofavorsites aspera
19. P. aspera n. var.
20. Petraia pygnea
21. Streptelasma latusulum
22. Strombodes diffusus
23. Syringopora verticillata
24. Zaphrentis stokesi
25. Z. n. sp. 1
26. Z. n. sp. 2
27. Cornulites richmondensis
28. C. serpularius
29. Allonema curtum
30. Ascodictyon n. sp.
31. Ceramopora niagarensis n. var.
32. Corynotrypa disimilis
33. C. elongata
34. Diplolecia sparsum
35. Helopora bellula
36. H. concava
37. H. formosa
38. H. lineopora
39. Pachydictya crassa
40. Phanopora entsiformis
41. P. excellens
42. P. n. sp.
43. P. n. sp.
44. Prilodictya giancoli
45. P. sulcata
46. Semnocoecium n. sp.
47. Vinella radiciformis
48. Att. pa reticularis
49. Bulobites hiboba
50. Brachyprion lida
51. B. philomena
52. B. n. sp. 1

[1] It does not seem necessary to go too much into the details of the gradual changes to the fauna in the lower and higher horizons, but it is of interest to note that Billings' list is almost identical with the one proper to the Gun River Formation, and it is in that order that the fauna is treated in this paper.
Jupiter River Formation. With progress upward the Gun River formation becomes more shaly and this culminates in the second zone of the Jupiter River formation which is almost entirely so, though carrying a small proportion of sand. Following the shale zone the sediments become more calcareous. The above statements apply only to the western outcrops of the south shore. In the eastern outcrops, both the upper Gun River and the Jupiter River formations consist of alternating shales and limestones. The thickness in the western outcrops is 562 feet, that in the eastern is unknown.

In the western outcrops the ecologic conditions at the time of deposition provided a facies favourable for graptolites and tri-
lobites and such are present in considerable abundance. The fauna consists of one hundred and forty-seven species of which forty-six are brachiopods. Sixty-five species are introduced in the formation and, one hundred and twelve species do not appear in the succeeding division. The apparently local extinction of this great number of species has no great significance since it was probably determined by the entrance of the reef coral-erioïd faunas which were in complete possession of the parts of the Anticosti sea bottom whose preserved deposits now constitute the Chicotte formation. To what factors these faunas owe their entrance cannot be said and speculation appears idle. The species of the Jupiter River formation are:

1. Buthotrepis gracilis
2. Hyaloscela 2a sp.
3. Alveolites labechi
4. Chonophyllum canadense
5. Clathratites variolare
6. C. folium
7. Climacograptus n. sp.
8. Cuenites labrosus
9. C. lunatus
10. Cyathophyllum anticostrisense
11. C. n. sp.
12. Cystophyllum niagarensis
13. Dictyonema n. sp.
14. Favositites favosus
15. F. forbesi
16. F. gothlandicus
17. F. hispigeri
18. Halysites catenulatus
19. Heleolites interstincta
20. H. subulata
21. Lyellia
22. Monograptus clintonensis
23. Paleofavositites aspera
24. Petriola pygmaea
25. Phenocrora pediformis
26. Stegopodium latisculum
27. Spinograptus verticillata
28. Zapheirens pateii
29. Z. stokesi
30. Z. gr. sp.
31. Crotalicrinus sp.
32. Eucalyptocrinus sp.
33. Cornulites serpularius
34. Allomena bohlias
35. Aspidicyon n. sp.
36. Chibotria cinc.
37. Diplobela sparsum
38. Fenestella sp. 1
39. F. n. sp. 2
40. Helopora bellula
41. H. concava
42. H. formosa
43. Liolema varioporum
44. Pachydictya crassii
45. Phanopora sp. n.
46. Pileolax sp. gladiola
47. P. subulata
48. Thaumiscus sp.
49. Trematopora irregularis
50. Vinella multiradiata
51. V. radiiformis
52. Atypa rectangularis
53. Bilobites biloba
54. Brachyprion ledia
55. B. philomena
56. B. n. sp. 1
57. B. n. sp. 2
58. Camarotheca argentea
59. C. decemplicata?
60. C. gloriae
61. C. neokreta
62. Chonetes primogenius
63. C. rugosa
64. C. homophorica
65. C. crassa
66. Dianamella elegansulmedias
67. D. n. sp.
68. Dosirifer radiatus
69. Homospita n. sp.
70. Leptolema gutta
71. L. rhomboidalis
72. Lingula sp.
73. L. n. sp. 1
74. Lissatrypa atherodes
75. Orthis p. dialabiales
76. Pentamerus oblongus
77 Pholidops implicata
78 Plectambonis traversalis
79 P. n. sp.
80 Rhipidoclla iberis
81 R. iberis rhynchonella melliformis
82 Rhynchonella ? nutrix
83 Schuchertella pecten
84 Stricklandinia brevis
85 S. whitei
86 S. davidsoni
87 S. davidsoni n. var.
88 S. melissa
89 S. palanae
90 S. n. sp.
91 Strophomena antiquata
92 Strophophrion genericalarum
93 Triplectia insularis n. var.
94 Whitheldia ? julia
95 W. ? lara
96 Zygospira nica
97 Z. pauperica
98 Conocardium elegantulum
99 Cerodonta cf. socialis
100 Molobolosia miser
101 Mytilus cf. nuttalliformis
102 M. n. sp.
103 Petirnea curiosa
104 P. emaculata
105 P. punctatus
106 P. ? isthie
107 Cyclonema communis
108 C. percinctulata
109 Diaphorostoma humilis
110 D. niagaraensis
111 Hormotoma ? furcata
112 H. ? furcata
113 H. ?? turricula
114 Holopora mediocris
115 Pleurotomaria ? cryptata
116 Salpingostoma n. sp.
117 Conularia niagaraensis
118 Tentaculites cf. minutus
119 T. ornatus
120 Actinoceras n. sp.
121 A. whitei
122 Glossoceras ? desiderata
123 Huromia persiphonaria
124 I. vertebrales
125 Kionoceras bellatulum
126 Oncoceras furile
127 Orthoceras n. sp. 1
128 O. n. sp. 2
129 ?A. minutissima
130 B. venusta
131 E. ? velhina
132 D. ? antica
133 L. antica
134 Macrocorys subcylindrica
135 Calymene niagaraensis
136 C. ? vogesiana
137 Cheirurus nuperus
138 Cyphaspis ? christyi
139 Cybele elegantulum
140 Dalmanites celticrus
141 Encrinurus ? punctatus
142 E. ? punctatus n. var.
143 E. ? n. sp.
144 Illigeria grandis
145 Lichas n. sp.
146 Phacopidella ? orrestes
147 Proetus ? perplexa

**Chicotte Formation.** The Chicotte facies was one of the development of reef corals and crinoids and the entrance of these faunas and the ecologic conditions to which the entrance was due, drove the mud loving animals of the Jupiter River extinction or to other parts of the sea bottom. The thickness of the formation is 73 feet, the greater part of which consists either a structureless mass of corals plastered over each other, or a breccia formed of the broken stems of crinoids. In some places the rock is so highly crystalline as to constitute a marble.

The fauna consists of fifty-five species of which nineteen are introduced in the formation. This is the only one of the Anticosti formations in which the corals outnumber the brachiopods in species and individuals; in respect to species the ratio
two to one and in respect to individuals there is no comparison.

The species are:

1. Chonophyllum canadense
2. Clathrodictyon variolare
3. C. vesiculosum
4. C. Linneus
5. Cyathophyllum antostostiense
6. C. articularum
7. Echinocystis fasciata
8. E. Brachiens
9. E. oblongus
10. E. elegans
11. Halysia radiata
12. H. striata
13. H. marginata
14. H. actinoceras
15. Lyellia marginata
16. L. compressa
17. Palaeoceras compressum
18. Phyllopsis compressum
19. Zaphrentis n. sp. 20. Z. n. sp. 21. Crotalides n. sp. 22. Femostella n. sp. 23. Pachydictyon cassia
24. Atrypa marginata
25. A. variabilis
26. Canumorpha canadensis
27. Cyrtina ex pentagustinata

28. Dalmanella elegans
29. Eospirifer radiatus
30. Lepetina rhomboidalis
31. Parastrophe frondosa
32. Pectenotus oblongus
33. Rhaphidophorina n. sp.
34. Conocardium elegans
35. Cycloneura communis
36. C. variabilis
37. C. variabilis
38. Platyceras n. sp.
39. Actinoceras lanceolatus
40. A. megalodus
41. Heterotrochus vertebralis
42. Onoceratina amator
43. Orthoceras hicklandi
44. O. variabilis
45. Plioceras grandis
46. Plioceras canadensis
47. Plioceras n. sp.
48. Plioceras n. sp.
49. Plioceras n. sp.
50. Plioceras n. sp.
51. Plioceras n. sp.

CORRELATION.

The English Head and Antelope formations are correlated directly with the Travertine, Interior Richmond and are considered the almost equivalent and the great number of species common to the two formations and the order of their vertical occurrence renders the correlation practically positive and leading to the inference that a direct and open communication prevailed between the two formations during the time of deposition of at least the upper portion of the English Head formation and the whole of the Travertine. The common species are:

1. Ruspophycus biloba
2. R. biporae
3. R. nodulosa
4. B. undulata
5. Calopeza canadensis
6. Columnaria alveolata
7. Lyopora goldiana
8. Mesogaptes parvus
9. Streptelasma rhomboidalis
10. Conus richmondenis
11. Arthoceras angustus
12. Bythopora striata
It is significant of the above list that it embraces some of the most common of the English Head and Charleton species, but that many common forms of the Interior are wanting. So nearly all the forms considered belong to the benthos in adults, but plankton in the early stages when distribution is affected by currents, it is suggested that the Anticosti Richmond faunas of North Atlantic origin and were carried into the Mississippian sea by westward-trending currents which made it almost impossible for Interior species to reach Anticosti.

One of the most striking examples of the parallelism between the Richmond faunas of the Interior and those of Anticosti that afforded by the outcrops at Stony mountain in Manitoba where out of a total of fifty-three identifiable forms, there are thirty which are present in the Anticosti rocks, and of the thirty species, no less than twenty-two are considered in the fossils to the Richmond. The distribution of the species is similar to that in the Anticosti beds, so that a correlation can be made with zones 3, 4 and 5 of the Charleton formation that is practically positive.
The faunas of the Ellis Bay formation are partly derivative from those of the previous formations, partly indigenous, and partly migrants from European seas. Most of the species consist of forms not elsewhere known in America, or not in a horizon so low as this. That there is a decided Richmond aspect is clearly evident; but the assemblage is not identifiable with that of any interior deposit. This suggests that the interior was free from marine waters, or that all paths permitting migration to the interior were closed. The former view is adopted and it is hence concluded that the Ellis Bay formation has no equivalent in North America.

The lack of recent comprehensive works on British stratigraphy and palaeontology renders correlation with British sections difficult and this is particularly true for the English Head and Charleton formations; but the evidence indicates that these two formations find an equivalence high up in the Bala series. The Ellis Bay formation contains eleven species which are also found in the English Bala, of which seven are considered diagnostic by reason of their first appearance or limited vertical distribution, and a correlation based on the common presence of these species would assign at least the lower portion of the Ellis Bay to the upper Bala.

In the Kristiana region of Norway, the Ordovician and Silurian have lately been exhaustively studied by Professor Kjaer. He erects a number of divisions and the Ellis Bay formation and the upper Charleton correlate fairly well with his stage 5.¹

In Baltic Russia, the Lyckholm and Borkholm formations are the equivalents of the lower parts of the Ellis Bay and parts of the English Head and Charleton formations. The Borkholm carries eighteen species of great diagnostic value which in the Anticosti section occur chiefly in the Ellis Bay and Charleton formations, and it is considered that the Borkholm holds about the same stratigraphic position as the lower zones of the former and the higher of the latter.

The Bescie River fauna shows its nearest relationships with

that of the cataract formation of Schuchert; but if the long range species be not considered, there are only three species common to the two formations, while most of the Cataract species make their first appearance in strata higher in the Anticosti section than the Becsia River formation, and, since the general expression of the Cataract formation is younger, it is concluded that there is a basis for equivalence and that the Cataract should probably be correlated with the lower portion of the succeeding formation.

A fauna holding a stratigraphic position somewhat similar to that of the Becsia River is that of the Alexandrian series of Illinois and eastern Missouri; but of the total fauna of that series, there are only nine species which also occur in the Anticosti section, and, since they are mostly species of extended vertical distribution, their presence affords no basis for correlation. However, since four of the nine species do not appear in the Anticosti formation until the upper zone of this, or the succeeding formation also, since the general appearance of the fauna is younger than that of the Becsia River, it is believed that it will find a proper equivalence with the upper portion of this and some parts of the succeeding formation.

The highest zone of the Gun River formation shows the appearance of typical Clinton species, but the Clinton faunal assemblage does not attain full development until the succeeding Jupiter River. Since the Jupiter River fauna correlates best with the higher New York Clinton, the Williamson shale, and the Inquoit limestone, this being particularly true for that part above zone 2, it is considered probable that the lower zone 4 of the New York Clinton, the Sodus shale, Furnaceville or beds below the Walcott limestone, find representation in the lowest zones of the Jupiter River and the highest zone of the Gun River, especially as the Walcott limestone carries the same diagnostic fossils as does zone 5 of the Gun River formation. It is further considered probable that the middle and lower zones of the Gun River formation are the Anticosti equivalents of the Cataract of southern Ontario and the Brassfield of the Ohio valley. An apparent reminder of the Brassfield appears in zone 5 of the Gun River formation in the occurrence of *Triplectia insularis anticosti*, which then extends until zone 3 of the Jupiter River. In a previ
The long ranging faunas common to these species make their expression of the section than the expression of the section that there is little difference that would probably be found in the Gun River formation.

However, it shows what similar to the Gun River section of Illinois that many faunas, at series, there are common features of the Anticosti section but the vertical distribution is different. However, the Anticosti section shows a similarity, and, especially if younger than the Gun River, we find a closer resemblance in the parts of the section.

This shows the apparent faunal assemblage of the preceding Jupiter River section. The best with the Gun River section and the Irondequiot-Rochester is that part lying between the lower zones of the Gun River and the upper zones of the Jupiter River, especially the Anticosti faunal fossils as the Gun River "horizon" or considered the Anticosti embayment of southern Illinois. An apparent faunal assemblage of the Gun River section and the Anticosti fauna. In a previous paper considerable emphasis was placed on the presence of this species, there considered a variety of T. ortoni; but further study has shown that it is specifically distinct from that species and only varietally different from the Old World T. insularis.

The Chicotte formation carries a pronounced coral fauna of which most of the species are those which are common in the coral zones of lower horizons. The writer does not consider that the stratigraphic position of the coral fauna means anything in relation to correlation, for the Anticosti section proves without question that coral deposits are not necessarily of great horizontal striation and may recur again and again with the faunal components practically the same. On stratigraphic grounds it is correlated for the present with the Irondequiot-Rochester of the New York section.

Elsewhere in the Anticosti embayment there are extensive Silurian deposits; but they are either somewhat younger than those of Anticosti or present a different type of sedimentation. Thus the Black Cape section of Chaleur bay, recently described by Clarke, begins with what appears to be the probable equivalent of the upper Jupiter River or the Chicotte, while the Arisaig section begins with a black shale lithology with a corresponding faunal assemblage, the result being that few species are common to the two series or deposits. These indicate that the Arisaig section begins with the equivalent of the upper portion of the Gun River formation and then continues upward nearly to the Devonian.

In terms of the European section, stratigraphic grounds would assign the Beecie River and Gun River formations to the Lower Llandovery; but, excepting the upper zones of the Gun River, the fauna gives little support. The upper zones of the Gun River record the appearance of Pentamerus oblongus, Clorinda liguifera, Coelosperma hemispherica, Stricklandinia davidsoni (represented in Europe by S. lens) which make their appearance in the Lower Llandovery, but become abundant in the Upper Llandovery. These and other species and their vertical

References:
distribution lead to the assignment of the upper zones to the Lower Llandovery and hence that which lies before has similarly placed, although it is possible that the Beecie River may have no representation in the British section.

The greater portion of the Jupiter River formation is Upper Llandovery, in which no less than thirty-nine identical or closely related species of Jupiter River forms occur—nearly thirteen percent of the Jupiter River fauna. The vertical distribution of many of the species sustains the correlation. *Triplectia insularis* has its last time in zone 3 of the Jupiter River formation. *Pentamerus oblongus* is rare in the Gun River, but very abundant in the Jupiter River. In England, it is rare in the Lower Llandovery, but abundant in the Upper Llandovery. Many other species show the same distribution.

The English Wenlock carries a large coral fauna and in respect is like the Chicotte, but in the writer’s judgment this resemblance has no correlative value, as the Anticosti section teaches that a coral reef formation may recur again and again and locally lie at many different horizons. The English Wenlock, however, has forty-nine species which have representation by identical or closely related forms in the Upper Jupiter River Chicotte formations and these facts make it extremely probable that these Anticosti strata have a time equivalence with the English Wenlock.

In the Kristiana region, the Silurian (Lower Llandovery of Wenlock) of the Ringerike section, there is a facies somewhat similar to that of Anticosti, and has thirty-seven species which represented by identical or closely related forms in the Anticosti Silurian. The Lower Llandovery, Kier’s etage 6, correlates fairly well with the Gun River and the upper portion of the Beecie River; while etage 7 or the Upper Llandovery, exhibits a close parallelism with the Jupiter River, and etage 8, or Wenlock, shows close faunal equivalence with the upper Jupiter River and the Chicotte formations.
NEW GENERA AND SPECIES OF FOSSILS FROM ANTICOSTI ISLAND.

The postponement of publication of the complete faunas of the Anticosti Island section until the completion of further field work, is the excuse for the present appearance of the descriptions that are given on the pages which follow. Since one of the generic terms has already been referred to by Professor T. E. Savage and there is a prospect that another will soon be used by another student, it has seemed desirable and wise that their definitions and those of a few others of the more important forms be given. Bibliographies will be omitted as far as possible, leaving this to the complete description of the faunas.

Phylum, COELENTERATA.
Class, HYDROZOA HUXLEY.
Order, GRAPTOLOIDEA LAPWORTHI.
Suborder, AXONOPHORA FRECH.
Genus, CLIMACOGRAPTUS HALL.

CLIMACOGRAPTUS TYPICALIS TUR. MAGNIFICUS N. TUR.

A common form in the Macasty black shales 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 eleven to fourteen thecae in 10 mm. It differs from C. typicalis in being longer and wider.

Horizon and Locality. Ordovician; the specimens were collected at Macasty bay from a large block of the Macasty shale. The writer has collected similar specimens of almost the same size from the Utica black shale on the banks of the Rideau river at Ottawa, Canada.

The holotype is in Peabody Museum, Yale University.

CLASS, ACTINOZOA.
Order, MADREPORARIA MILNE-EDWARDS.

Sub-order, Tabulata Milne-Edwards and Haime.
Family, Favositidae Milne-Edwards and Haime.
Genus, Pallofavarostes new genus.

From the Ordovician and Silurian rocks of Anti-Billings described Favosites prolificus and F. capax, the former having the pores at the angles and the former having none. It has since been learned that the two species are identical also as F. aspera d'Orbigny and F. aleolaris Goldie, the four species having the common character of having the pores at the angles with none on the sides. It is proposed to include corals of this type under the above generic name. As defined the species will have for its genotype, F. aspera d'Orbigny. The only other form to be included is a new one to be described from the Anticosti section.

Phylum, Mollusca
Class, Brachiopoda Dumeril.
Order, Prototremata Beuchet.
Super-family, Orthacea Walcott and Schuchert.
Genus, Orthis Dalman (s. str.)
Orthis? lamellosa new species.
(Plate 1, figures 1-3)

Outline semielliptical, greatest width about halfway from beak to border where it is 8 mm.; 7 mm. wide at the hinge, thickness 4 mm.; length 6 mm. Sides of the shell straight almost parallel, gently and uniformly curving around the anterior-lateral margins; anterior margin for about half the width almost straight. Dorsal valve shallow with a broad median sinus, beak slightly incurved. Ventral valve pyramidal, but highest portion, not incurved; no fold to correspond to dorsal sinus; surface slopes uniformly from the beak to the anterior and lateral margins. The cardinal area as long as the hinge line 2.5 mm. wide on the ventral valve, almost perpendicular to the plane of the lateral margins. Area of the dorsal valve less than 0.25 mm. wide and in the same plane as the lateral 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.

This species finds its nearest relative in *O. bouchardi* Davidson, from the Wenlock of England and Scotland, from which it differs in having no ventral sinus, the sides of the foramen 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.

Horizon and Locality. Ordovician; Ellis bay in zone 5 of the Ellis Bay formation.

The holotype is in Peabody Museum, Yale University. Only a single specimen has been collected.

Superfamily, Strophomenacea Schuchert.

*Strophoprian* new subgenus.

The above subgeneric term is proposed for those resupinate forms of the Strophomenidae which are like *Strophonella* except that they have some ten or a dozen denticulations along the hinge line instead of a completely denticulated hinge margin. That is, these forms mark the inception of the *Strophonella* stock, *Strophoprian* holding the same relation to *Strophonella* that *Brachyprion* does to *Stropheodonta*. In one line of development there are *Strophonema—Strophoprian—Strophonella;* in the other *Rafinesquina—Leptaena* (cere—nitens stock, not rhomboidal)—*Brachyprion—Stropheodonta*. The type of *Strophoprian* is *Strophoprian geniculatum* (Shaler) (*Brachyprion geniculatum* Shaler, Bull. Mus. Comp. Zool., vol. 1, No. 4, p. 63, 1865).
Genus, *Triplegia* Hall.

**Triplegia insularis** var. **Anticostiensis** new var.


The discovery of this somewhat widely ranging European species, in the lowest Clinton deposits of the Anticosti section, is a matter of considerable interest, since it has previously been definitely recognized in America although its probable presence in the Anticosti rocks was mentioned by Davidson. It is somewhat larger than the European form and has a deeper ventral sinus.

**Horizon and Locality.** Silurian; Gun River (5), a mile west of Jupiter River; Jupiter River (3), Jupiter

The holotype and plesiotypes are in Peabody Museum.

Genus, *Chonetes* Fisher.

**Chonetes (Eodevonaria) Primigenius** new species.

(Plate I, figures 4-5).

The shell of this new species closely resembles that of *Brachyprion leda* (Billings) and was at first mistaken for the same species. Hinge line greatest width, average 9 to 12 mm., average length 6 to 8 mm. Ventral valve moderately convex, but nearly so much so as in *Plectambonites*. In the Ellis Bay formation specimens were found attached by the dorsal valve of the shells of other brachiopods, but whether this has any significance or not is unknown. There are four small spinules on each side of the beak. The surface of each valve is coarsely ridged with numerous fine striae—about one hundred and fifty to each valve—and in the centre of the ventral valve is a single strong stria, very much stronger than any other, such as occurs in *Lepta*...
This is the earliest known appearance of this genus and since it is already a fully developed Chonetes it follows that it originated still earlier in the Ordovician. From its decided resemblance to Brachypiron leda it is extremely probable that both came from the same stock, viz.; a small leptaeoid with a narrow muscle scar, fine plications, and a single central plication of large size. In the Anticosti measures Lepidella nitens answers to this description.

C. prynigenius is smaller than the European C. striatella and more finely striate; it is larger than C. cornutus from the New York Clinton; it is about the same size and shape as C. tenuestriatus from the Arisaig Silurian, but that shell does not appear to have the prominent mid striation and is less finely striate.

**Horizon and Locality.** Ordovician and Silurian. The species first appears on the north side of Anticosti in zone 3 of the Charlton formation. Its next appearance is at Ellis Bay in the Ellis Bay formation and again at Wreck beach in the Gun River formation. A single specimen was collected at the Jumpers in zone 9 of the Jupiter River formation.

The holotypes and paratypes are in Peabody Museum.

**Superfamily, Pentamerana Schuchert.**

*Genus, Virgiana new genus.*

(Virgie, proper name.)

The generic name of Clorinda was proposed by Barrande for shells of which casts of the interior showed a series of strong ridges radiating from the umboonal ridge of the pedicle valve, these being produced by the vascular or ovarian sinuses. He stated that his two species were pentameroids not unlike C. linguifera. For this group Hall and Clarke proposed the generic name of Barrandella, the genus including shells which externally are moderately transverse, ventral valve the larger, moderately galeiform, with a sinus on the ventral valve and a fold on the dorsal. In the Beesie River formation of the Anticosti section occurs the shell described by Billings as *Pentamerus barrandei* which in its young stages has all the characters of a true Clorin-
With maturity, however, the shell attains large size, becomes decidedly elongate, narrow, and pronouncedly toriform and the fold and sinus become reversed, the latter obliterated and transformed into a fold by the development of an axial rib and the former disappearing through bifurcation of the initial fold producing a sinus at the margin. The latter is that of *Clorinda*.

For this type of clorindoid the generic name of *Virgina* was proposed: the genus to include *V. barrendei*—the genus *Cocinnus*—and two varieties of that species.

**Order, Protremata Beecher.**

**Superfamily, Rhyynchonellacea Schuchert.**

**Genus, Camarotoechia Hall and Clarke.**

**Camarotoechia decemplicata (Sowerby).**


This shell was described by Billings in 1866, as *Rhyynchonella eva*. Subsequently (1900) Doctor John M. Clarke figured a specimen with a size somewhat above the norm, from the same collection at Harvard. It came from East cliff, Anticosti, and had been collected by the Harvard expedition of 1861. Clarke was not able to identify any of the descriptions of Billings and finding that it bore considerable resemblance to his *Anabaia parva* 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 Victoria Memorial Museum, these were identified as *Rhyynchonella eva*. They were compared with the holotype of *A. anticostiana* and the species were found to be identical. The genus *Anabaia* was a spire bearing and is referred to the Coelospiridae. More than a dozen specimens of *R. eva* were studied by grinding and etching with hydrochloric acid and no traces of anything resembling...
sires 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 rhyynchonelloid and as no vestige of a cardinal process appears to be present the species apparently is to be referred to the genus Camarotreta. Through the kindness of Professor Johan Kiaer the writer was able to obtain specimens of Rhyynchonella decemplicate from etage 6 (Zone, with Rhyynchonella 10-plicate) of the Silurian Ringerike section of the Kristiana region and the identity of the two species was clearly shown. As the European name has priority by over twenty-five years, the American name must yield.

Horizon and Locality. Silurian; Gun River (4-5), Cape Sand Top bay, East cliff, and west of Jupiter river. In Norway the species is limited to Kiaer's zone c of etage 6, the topmost zone of the Lower Llandovery.

Anticosti plesiotypes of this species are in both the Victoria Memorial (No. 2449) and Peabody Museums.

Superfamily, Terebratulacea Waagen.
Division, Terebratuloids Schuchert.
Family, Protozeugidae new family.

Primitive Terebratuloids with loops like that of Magellania but developing without metamorphosis. The shells are small, smooth, biconvex with the ventral valve subcarinate and the dorsal with a sinus.

Protozeugta new genus.
(Proto, first; zeugos, a yoke).


This new genus is proposed to include a group of small Palaeozoic brachiopods which constitute the oldest known terebratulids and which are characterized by the possession of a long loop sinus to the matured structure seen in Waldheima or Magellania to which these little shells have been erroneously referred.
Diagnosis of the Genus. Shells extremely small; generally longer than wide; anterior margin straight or reentrant; ventral valve very convex, subcarinate with a narrow median groove in the anterior margin; dorsal valve only slightly convex at the anterior end, but concave with a deep sinus at the anterior margin, and in this sinus there may be a small rib; surface of both valves smooth. Dorsal hinge plate with a distinct cardinal plate from which an elevated median ridge extends almost to the anterior margin. The crura are slender, short, almost horizontal, giving off two triangular crural apophyses which converge posteriorward and ventrward almost to the point of meeting, principal lamellae extend forward to within a short distance of the front and are then reflected posteriorly to form the lobe which is not angular, but uniformly curved; it rises from the primary lamella until its apex is on a level with the apophyses, having been reflected a distance equal to about one third the length of the primary lamella. Shell structure plentiful but not thickly punctate (this was demonstrated by treating the shell with hydrochloric acid and specimens so treated being studded with small needle-like elevations) Genotype Waldheimia mawii Davidson.

The matured loop of this genus is very like that of the metamorphosed form as developed in Waldheimia or Magellania, but the resemblance is one of parallelism. In Protozoega the loop develops direct and without metamorphosis in a way similar to that of the Devonian Centronellidae, while in Waldheimia or Magellania the mature loop is the final stage of a great series of developmental changes. This character and others given in the diagnosis show Protozoega to be a primitive type of terebra whose systematic position is near the Centronellidae; but family distinct theretrom, the Protozeugidae. To this genus are referred Waldheimia mawii; W.? glassii Davidson, a somewhat larger form whose brachial apparatus has not yet been described, both from the upper Wenlock of Shropshire; W. bicarinata Angelin from Gotland, considered by Davidson as identical with W. mawii; Protozoega sulcomarginata Savage from Girardeau Limestone of Illinois and Missouri (Bull. Geol. Mo., vol. 24, p. 359, 1913); and the new species from Ant, described as Protozoega anticostiana.
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 is 5 mm. long, 4 mm. wide, depth of both valves 2.25 mm., 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 to a flat-topped fold which at the anterior margin is replaced by a sulcus; slopes to the lateral margins quite steep and at the cardinal angles the surface is slightly concave. Beak small, narrow, truncated by a small foramen, incurved and over-arching 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 sulcus.

This shell closely resembles *Protozeusa mawii* (Davidson), but is slightly larger and proportionately wider. It occurs in much older strata and, while its brachial apparatus has not been demonstrated, its strong resemblance to the ab species shows it to be congeneric.

**Horizon and Locality.** Ordovician; English Head (2-3), English head; Charleton (2-3), English bay and White cliff of the north shore.

The holotype and paratypes are in Peabody Museum.

**Superfamily.** Spiriferacea WAGEN.

**Family.** Atrypidae GILL.

**Subfamily.** Lissatrypinae new subf. ind.

Smooth atrypoids with the external aspect of *Nucleospira*.

**Genus.** Lissatrypa new g. .

(Lissos, smooth: atrypa).

In 1866 Billings described from Gull cape (Wreck beach),
Anticosti, a smooth brachiopod to which he gave the name *Athyris lara*. He called attention to the fact that some specimens have a faint indication of a mesial sinus in the ventral but are generally without either fold or sinus.

In 1882 Davidson stated that Mr. Glass had been able to expose the spirals of *Athyris lara* and that these "entirely resemble those of *Atrypa*, the apex of each vertical cone being directed towards the middle of the bottom of the dorsal valve." Shells were collected by Doctor G. J. Hinde near Jupiter and it is now known that they were not correctly identified.

Specimens of *Athyris lara* which were collected at the locality and compared with the proterotypes show that they are true meristellid and probably to be referred to the genus *Atrypa* fieldia*. This leaves the shells whose structure was worked out by Mr. Glass without a name. The writer has also developed the internal structure of several of the Jupiter River specimens and there is no question but that their spirals are of the atrypa type. Externally they have the expression of *Nuclei*, but lack the hirsute exterior. For atrypoids having these characters the generic name of *Lissatrypa* is proposed.

*Diagnosis.* Shell of medium size, lenticular, subovate, subpentagonal in outline, greatest width near the margin of both valves of nearly the same convexity, a faint sinus in specimens at the anterior margin of the ventral valve, a corresponding small fold in the dorsal, in some specimens the anterior margin slightly linguate; hinge short, gently curved; no beak and umbones small, surface smooth with concentric lamellae; shell structure fibrous and on exfoliation it has a silky lustre.

Beak of ventral valve closely incurved and in contact with the dorsal valve; foramen triangular, extending to the line, no covering observed; teeth relatively large, diverging at an angle of about 135 degrees, summits rounded and slightly toward the centre of the shell; they rise from the slopes of the interior and are unsupported by lamellae; no impressions apparently very faint.

Dorsal valve with a faint sinus at the umbo; hinge composed of two diverging processes meeting at the angle about 60 degrees; each has two longitudinal grooves.
the name of the genus Whitfieldia, as in some specimens the ventral valve, although similar, was entirely resemb-
like the dorsal valve. It is well to remark that the genus Whit-
fieldia has been established for a long time, and that the ventral valve, as worked out by many authors, was also developed to a certain extent in the Jupiter River shells as a group, which are named Nucleospira, cited by Dohmayr, as some of the atrypoid species. This genus, as we have seen, having these characters, is also classified under the name of Nucleospira, and has been selected to call attention to the fact that the shell resembles in Athrys (Athyris; oidos, like). According to Profs. Schuchert, the genotype is Lissatryspata athloidea, the specific name being selected to call attention to the fact that the shell resembles an Athrys (Athyris: oidos, like). According to Profs. Schuchert (personal communication) Lissatryspata athloidea is also to be referred to this genus.

LISSATRYPAT ATHLOIDEA new species.
(Athyris, oidos, like)
(Plate 1, figures 11-15)

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 mistaken for Whitfieldia turca (Billings), a mistake which has already been made. For final determination it is necessary to see the character of the spiral Whitfieldia turca, however, has a somewhat more prominent ventral beak, is slightly larger, less often has the ventral sinus and dorsal fold and does not have a layered structure to the shell. These differences, however, can not be relied on, since there are many specimens which so far as external characters are concerned may be put in either species.

Horizon and Locality. Silurian; Gun River (5), about one mile west of Jupiter River; Jupiter River (3.5), month of Jupiter river.

The cotytypes are in Peabody Museum.
Family. *Meristellidae* Hall and Clarke.

*Hyattidina charleitonana* new species.

(Plate I, figures 6-7.)

The single specimen upon which this species is based was discovered on a slab from Charleton point, the same slab containing *Phragmocystites pumosa*, *Zygospira recurvirostra* n. var., and other Richmond fossils. Had it occurred in higher strata no hesitancy would have been felt in referring it to *H. congesta jacea*, although it is somewhat smaller, 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, the posterior outline being trigonal, the anterior two-thirds 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 apex, beneath which is a small foramen. A medium ridge, grooved toward the front, extends from the umbo to the anterior margin. From the depression bounding this ridge the surface slopes to the lateral margins. The dorsal valve is marked by three convex lobes of which the middle widens towards the margin and becomes divided by a longitudinal groove. No area has been seen on either valve. The shell is 4 mm. long, 3.5 mm. wide about mid length, and 1.25 mm. thick just in front of the umbo.

No hesitation is felt in referring this little shell to the genus *Hyattidina* though the interior has not been seen. This genus has hitherto in America not been found below the Clinton, but in England *Rhynchonella portlockiana* Davidson [demonstrated by Reed to belong to the genus *Hyattidina* (Reed, Quar. Geol. Soc., 1897, p. 75)] ranges from the upper Llandeilo to the Bala; hence its appearance in American strata as early as the Richmond should occasion no surprise. It is further probable that *H. charleiton* is a migrant from the British seas and is in the direct line of ancestry to *H. congesta*, since it chiefly differs from *H. portlockiana* 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."
Horizon and Locality. Ordovician; Charleton (3) Charleton point.

The holotype and only known specimen is in Peabody Museum.

Phylum. Arthropoda.
Class, Crustacea.
Subclass, Trilobita Walch.
Order, Opisthoparia Bilcher.
Family, Olenidae Burmeister.
Genus, Triarthrus Green.
Triarthrus becki var. macastyensis new variety.


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 specimen is 3.5 mm. wide; 4.5 mm. long; the entire cephalon 5 mm. long. That it grew to a larger size is proven by a specimen which has the cephalon at least 8 mm. long. The same type of facial suture is seen in the T. becki from the Collingwood black shale of Ottawa, Canada, and Doctor Ruedeman has called the writer's attention to the fact that T. jemtlandicus Lindstrom has a similar facial suture, though otherwise different.

Horizon and Locality. Ordovician; evidently present in considerable abundance in the Macasty black shales.

The holotype and a single paratype are in Peabody Museum.
EXPLANATION OF PLATE 1.

Figs. 1-3. *Orthis lamellans* new species.
1. View of the dorsal valve of holotype, x 3, Ellis Bay, zone 9 of Ellis Bay formation, specimen in Peabody Museum, Yale University.
2. Ventral valve of holotype, x 3.
3. Outline view of holotype, x 3.

Figs. 4-5. *Chondra primigenia* new species.
4. View of a small slab containing the holotype, middle shell, and two paratypes, x 2, Wreck beach, zone 3 of the Gun River formation, specimen in Peabody Museum.
5. View of a specimen from Charlton point, x 2, zone 3 of Charlton formation, specimen in Peabody Museum.

Figs. 6-7. *Hydtilina charltonia* new species.
6. View of dorsal valve of holotype, x 4, Charlton point, zone 3, of Charlton formation, specimen in Peabody Museum.
7. Ventral view of same specimen, x 4.

Figs. 8-10. *Proezenga antiscostana* new species.
8. Outline view of holotype, x 4, Morses Bay, zone 4 of English Head formation, specimen in Peabody Museum.

Figs. 11-15. *Lissolyta* allisoni new species.
11. Outline of holotype, x 2, Jupiter River cliff, zone 3 of Jupiter River formation, specimen in Peabody Museum.
12. Hinge plate of ventral valve, x 2, same locality and horizon, specimen in Peabody Museum.
14. Dorsal aspect of the spines, x 2, same locality and horizon as preceding, specimen in Peabody Museum.
15. Ventral view of holotype, x 2.
The first number of the Museum Bulletin will contain 13 papers. The following articles of the Geological Survey of Museum Bulletins have been issued:

1. The Frontrange Beld, by W K Ballinge, by F A Barlow.
2. Notes on the glacier, by F A Barlow.
3. The occurrence of the glacier, by R A Barlow.
5. Notes on the glacier, by F A Barlow.
6. Description of some new species of Pterostichus, by F A Barlow.
7. Two new species of Pterostichus, by F A Barlow.
8. Revision of the species which were collected in the genus, by R A Barlow.
10. A new species of Pterostichus, by F A Barlow.