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## THE ANTICOSTI ISLAND FAUNAS

by

W. H. Twenhofel

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*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 palæontology 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 assumed 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 ecologic 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 *Rhynchotrema 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

miles separates the two outcrops. 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<sup>1</sup> 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 outcrops 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: *Climacograptus spiniferus*, *C. typicalis magnificus*, *Leptobolus insignis*, *Triarthrus becki macastyensis* and *Orthoceras?* sp. Both lithology and fauna are in harmony with a correlation with the Utica as developed at Ottawa and elsewhere in eastern Canada.

*Ordovician System, Richmond Series.*

*English Head 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

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<sup>1</sup>Schuchert and Twenhofel, Bull. Geol. Soc. Am., Vol. 21, 1910.

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	<i>Lycrophyucus</i>	<i>formosum</i>	46	P.	<i>prolifca</i>
2	L.	<i>robustum</i>	47	<i>Rhytimya</i>	<i>emma</i>
3	L.	<i>vagans</i>	48	<i>Vanuxemia</i>	<i>ungulata</i>
4	<i>Særichnites</i>	<i>abruptus</i>	49	<i>Whitella</i>	<i>plebia</i>
5	<i>Rauffella</i> cf.	<i>filosa</i>	50	W.	<i>sigmoidea</i>
6	<i>Calapoccia</i>	<i>canadense</i>	51	<i>Archinacella</i>	<i>estella</i>
7	<i>Mesograptus</i>	<i>putillus</i>	52	<i>Bellerophon</i> ?	<i>fraternus</i>
8	<i>Paleofavosites</i>	<i>aspera</i>	53	B.	? <i>miser</i>
9	<i>Streptelasma</i>	<i>angulatum</i>	54	B.	? <i>solitarius</i>
10	S.	<i>rusticum</i>	55	B.	? n. sp.
11	<i>Periglyptocrinus</i>	sp.	56	<i>Clathrospira</i>	<i>subconica</i>
12	<i>Cornulites</i>	<i>flexuosus</i>	57	<i>Hormotoma</i>	<i>gracilis</i>
13	<i>Arthroclema</i>	<i>angulare</i>	58	<i>Liospira</i>	<i>americana</i>
14	<i>Dianulites</i>	n. sp.	59	<i>Lophospira</i> ?	<i>circe</i>
15	<i>Dicranopora</i>	<i>fragilis</i>	60	L.	? <i>modesta</i>
16	<i>Phacelopora</i>	<i>pertenuis</i>	61	L.	? <i>varians</i>
17	<i>Ptilodictya</i>	<i>magnifica</i>	62	<i>Metoptoma</i> ?	<i>alceste</i>
18	P.	<i>whiteavesi</i>	63	<i>Oxydiscus</i>	n. sp.
19	<i>Sceptropora</i>	<i>facula</i>	64	<i>Palæacmæa</i>	n. sp.
20	<i>Catazyga</i>	<i>anticostiensis</i>	65	<i>Phragmolites</i>	<i>desiderata</i>
21	<i>Dalmanella</i>	<i>testudinaria</i>	66	P.	<i>pannosa</i>
		<i>meeki</i>	67	<i>Raphistoma</i>	n. sp.
22	<i>Dinobolus</i>	n. sp. l.	68	<i>Salpingostoma</i>	<i>canadensis</i>
23	<i>Dinorthis</i>	n. sp.	69	<i>Sinuites</i> cf.	<i>bilobata</i>
24	<i>Hebertella</i>	<i>maria</i>	70	<i>Trochonema</i>	<i>umbilicata</i>
25	<i>Leptaena</i> ?	<i>ceres</i>	71	<i>Conularia</i>	<i>asperata</i>
26	L.	? <i>nitens</i>	72	<i>Pterotheca</i>	n. sp.
27	<i>Lingula</i>	<i>forbesi</i>	73	<i>Actinoceras</i>	<i>anticostiensis</i>
28	<i>Parastrophia</i>	<i>lenticularis</i>	74	A.	<i>sedgwicki</i>
29	<i>Pholidops</i>	n. sp.	75	<i>Apsidoceras</i>	<i>magnificum</i>
30	<i>Plectambonites</i>	<i>sericeus</i>	76	<i>Ascoceras</i>	n. sp.
31	<i>Protozeuga</i>	<i>anticostiana</i>	77	<i>Billingsites</i>	<i>canadense</i>
32	<i>Pseudolingula</i>	<i>elegantula</i>	78	B.	<i>newberryi</i>
33	<i>Rafinesquina</i>	n. sp.	79	<i>Cycloceras</i>	<i>crocus</i>
34	<i>Rhynchotrema</i>	<i>anticostiensis</i>	80	C.	cf. <i>nicolleti</i>
35	R.	<i>perlamellosa</i>	81	<i>Endoceras</i>	<i>proteiforme</i>
36	<i>Strophomena</i>	<i>fluctuosa</i>	82	<i>Orthoceras</i>	<i>seiboldi</i>
37	S.	<i>hecuba</i>	83	<i>Poterioceras</i>	<i>obesum</i>
38	S.	n. sp.	84	<i>Spyroceras</i>	<i>bilineatum</i>
39	<i>Trematis</i>	<i>ottawaensis</i> n.	85	S.	<i>ferum</i>
		var.	86	<i>Triptoceras</i>	<i>xiphius</i>
40	<i>Zygospira</i>	<i>recurvirostra</i> n.	87	<i>Bollia</i>	<i>semilunata</i>
		var.	88	<i>Bythocypris</i>	<i>lindstroemi</i>
41	<i>Byssonychia</i>	n. sp.	89	B.	<i>obtusa</i>
42	<i>Cyrtodonta</i>	<i>anticostiensis</i>	90	<i>Krausella</i>	<i>anticostiensis</i>
43	C.	<i>harrietti</i>	91	<i>Macrocypris</i>	<i>subcylindrica</i>
44	C.	? <i>insularis</i>	92	<i>Schmidtella</i>	<i>sublenticularis</i>
45	<i>Pterinea</i>	<i>bellilineata</i>	93	<i>Amphilichas</i>	n. sp.

94	Brachyaspis	altilis	100	Encrinurus	multisegmentatus
95	B.	notans			
96	Bumastes	orbicaudatus	101	Eoharpes	ottawaensis
97	Ceraurus	numitor	102	Isotellus	gigas
98	C.	pleurexanthemus	103	I.	cf. maximus
			104	Pterygometypus	n. sp.
99	Ceraurinus	icarus	105	Ischyrina	winchelli

*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:—

1	Lockeia	n. sp.	8	Calapœcia	canadense
2	Lycophycus	vagans	9	Columnaria	alveolata
3	Rusophycus	bilobatum	10	Halysites	catenulatus
4	Hindia	fibrosa	11	Lyellia	affinis
5	Rauffella	cf. filosa	12	Lyopora	goldfussi
6	Beatricia	nodulosa	13	Paleofavosites	aspera
7	B.	undulata	14	P.	aspera n. var.

15	<i>Streptelasma</i>	<i>angulatum</i>	70	L.	? forbesi
16	S.	<i>rusticum</i>	71	Orthis	davidson in. var.
17	Zaphrentis	<i>affinis</i>	72	Parastrophia	lenticularis
18	Carabocrinus?	<i>tuberculatus</i>	73	Pholidops	n. sp.
19	Cupulocrinus	<i>latibranchiatus</i>	74	Plectambonites	<i>sericeus</i>
20	Dendrocrinus?	<i>tener</i>	75	Protozeuga	<i>anticostiana</i>
21	Hudsonaster	<i>rugosus</i>	76	Pseudolingula	<i>elegantula</i>
22	Pleurocystites	<i>anticostiensis</i>	77	Rafinesquina	n. sp.
23	Reticocrinus	<i>fimbriatus</i>	78	Rhipidomella	<i>sola</i>
24	Cornulites	<i>flexuosus</i>	79	Rhynchotrema	<i>anticostiensis</i>
25	C.	<i>richmondensis</i>	80	R.	<i>perlamellosa</i>
26	Arthroclema	<i>angulare</i>	81	Schizocrania	<i>filosa</i>
27	Batostoma	n. sp.	82	Schuchertella	<i>pecten</i>
28	Bythopora	<i>striata</i>	83	Strophomena	<i>antiquata</i>
29	Chasmatopora	<i>granistriata</i>	84	S.	? <i>arethusa</i>
30	Corynotrypa	<i>dissimilis</i>	85	S.	<i>fluctuosa</i>
31	Cyphotrypa	<i>bulbosa</i>	86	S.	<i>hecuba</i>
32	C.	n. sp.	87	S.	n. sp.
33	Dicranopora	<i>emacerata</i>	88	Trematis	<i>ottawaensis</i> n. var.
34	D.	<i>fragilis</i>	89	Zygospira	<i>recurvirostra</i> n. var.
35	Eridotrypa	<i>simulatrix</i>	90	Byssonychia	n. sp.
36	Glauconema	<i>strigosa</i>	91	Ctenodonta	cf. <i>obliqua</i>
37	Goniotrypa	<i>bilateralis</i>	92	Cyrtodonta	<i>anticostiensis</i>
38	Hallopora	n. sp. 1.	93	C.	<i>harrietti</i>
39	H.	n. sp. 2.	94	Pterinea	<i>bellilineata</i>
40	Helopora	<i>imbricata</i>	95	P.	<i>prolifera</i>
41	Homotrypa	n. sp.	96	P.	<i>varistriata</i>
42	Lioclemella	<i>nitida</i>	97	Rhytimya	<i>emma</i>
43	Mitoclema?	n. sp.	98	Whitella	<i>plebia</i>
44	Nematopora	<i>lineata</i>	99	W.	<i>sigmoidea</i>
45	Pachydictya	<i>firma</i>	100	Bellerophon	n. sp.
46	P.	<i>hexagonalis</i>	101	Clathrospira	<i>subconica</i>
47	Prasopora	n. sp.	102	Cyclonema	<i>thalia</i>
48	Protocrisina	<i>exigua</i>	103	C.	n. sp.
49	Ptilodictya	<i>canadensis</i>	104	Hormotoma	<i>gracilis</i>
50	P.	<i>flagellum</i>	105	H.	<i>multivolvis</i>
51	P.	<i>magnifica</i>	106	H.	<i>teretiformis</i>
52	P.	<i>whiteavesi</i>	107	Liospira	<i>americana</i>
53	Rhinodictya	<i>nitidula</i>	108	L.	n. sp.
54	Sceptropora	<i>facula</i>	109	Lophospira	<i>modesta</i>
55	Catazyga	<i>anticostiensis</i>	110	L.	n. sp. 1.
56	Chonetes	<i>primigenius</i>	111	L.	n. sp. 2.
57	Clitambonites	<i>verneuili</i> <i>diversus</i>	112	Phragmolites	<i>pannosa</i>
58	Crania	n. sp.	113	Raphistoma	n. sp.
59	Dalmanella	<i>testudinaria</i> <i>meeki</i>	114	Salpingostoma	<i>canadensis</i>
60	Dinobolus	n. sp. 1	115	Sinuities	cf. <i>bilobata</i>
61	Dinorthis	n. sp.	116	Subulites	<i>richardsoni</i>
62	Eichwaldia?	<i>anticostiensis</i>	117	Conularia	<i>splendida</i>
63	Hebertella	<i>maria</i>	118	C.	n. sp.
64	Hyattidina	<i>charletona</i>	119	Pterotheca	n. sp.
65	Leptæna	? <i>ceres</i>	120	Actinoceras	<i>anticostiensis</i>
66	L.	? <i>nitens</i>	121	A.	? <i>fulgor</i>
67	L.	? <i>reticulata</i>	122	A.	<i>sedgwicki</i>
68	L.	? n. sp.	123	Billingsites	<i>canadense</i>
69	Lingula	? <i>canadensis</i>	124	B.	<i>newberryi</i>
			125	Cycloceras	cf. <i>nicolleti</i>
			126	Cyrtoceras	n. sp.



127	Endoceras	proteiforme	146	Primitia	lativa
128	Litoceras	hercules	147	Primitiella	canadensis
129	Orthoceras	formosum	148	Schmidtella	sublenticularis
130	O.	lyelli	149	Tetradella	lunatifera
131	O.	magnisulcatum	150	T.	simplex
132	O.	seiboldi	151	Ulrichia	nodosa
133	O.	n. sp.	152	Brachyaspis	alacer
134	Poterioceras	apertum	153	B.	altilis
135	P.	obesum	154	Bumastes	orbicaudatus
136	Spyroceras	bilineatum	155	Calymmene	callicephala
137	S.	ferum	156	Ceraurus	pleurexanthemus
138	Aparchites	minutissimus			
139	Beyrichia	parallela	157	Ceraurinus	icarus
140	Bollia	semilunata	158	Chasmops	n. sp.
141	Bythocypris	cylindrica	159	Isotellus	gigas
142	B.	lindstroemi	160	I.	cf. maximus
143	B.	obtusa	161	Proetus	alaricus
144	Ctenobolbina	hammelli	162	Ischyrina	winchelli
145	Krausella	anticostiensis			

*Ordovician System, Gamachian Series.*

*Ellis Bay Formation.* 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-arching 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 the Charleton. 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	Cyclocrinites	halli	23	Zaphrentis	affinis
2	Ischadites	? insularis	24	Z.	n. sp.
3	Hindia	fibrosa	25	Cornulites	richmondensis
4	Rauffella	cf. filosa	26	Allonema	botellus
5	Beatricia	nodulosa	27	Atactoporella	n. sp.
6	B.	undulata	28	Ceramopora	niagarensis n. var.
7	Calapœcia	canadense	29	Chasmatopora	angulata
8	Clathrodictyon	vesiculosum	30	Corynotrypa	dissimilis
9	Columnaria	alveolata	31	Cyphotrypa	bulbosa
10	Dictyonema	n. sp. (doubtful as to its hav- ing been col- lected here)	32	C.	polygona
11	Favosites	forbesi	33	Dianulites	n. sp.
12	Halysites	catenulatus	34	Glauconema	strigosa
13	Lyellia	affinis	35	Hallopora	elegantula n. var.
14	L.	exigua	36	H.	magnipora
15	L.	speciosa	37	Helopora	lineopora
16	Mastigograptus	cf. simplex	38	Lichinalia	n. sp.
17	Paleofavosites	aspera	39	Lioclema	varioporum
18	P.	aspera n. var.	40	Nematopora	lineata
19	Protarea	tenuis	41	Nicholsonella	parvula
20	P.	vetusta	42	Pachydictya	crassa
21	Streptelasma	selectum	43	Phænopora	ensiformis
22	Strombodes	diffluens (doubt- ful as to its having been collected here)	44	P.	excellens
			45	Ptilodictya	gladiola
			46	Stomatopora	siluriana
			47	S.	arachnoidea
			48	Atrypa	marginalis
			49	Atrypina	n. sp.

50	Chonetes	primigenius	97	Vanuxemia	accutumbona
51	Clitambonites	verneuili	98	Bucania	n. sp.
		diversus	99	Clathrospira	subconica
52	Crania	n. sp.	100	Cyclonema	thalia
53	Dalmanella	ruida	101	Cyrtospira	notata
54	D.	testudinaria	102	Diaphorostoma	humilis
		meeki	103	Eccyliomphalus	n. sp.
55	Dinobolus	n. sp. 1. n. var.	104	Hormotoma	gigantea
56	Dinorthis	anticostiensis	105	H.	gracilis
57	Hebertella	maria	106	Liospira	americana
58	Hindella	prinstana	107	L.	helena
59	H.	umbonata	108	L.	n. sp.
60	Leptæna	rhomboidalis	109	Lophospira	? papillosa
61	L.	? ceres	110	L.	sybellina
62	L.	? nitens	111	L.	n. sp. 1
63	L.	? reticulata	112	L.	n. sp. 2
64	L.	? n. sp.	113	Loxonema	rugosa
65	Lingula	forbesi	114	Oxydiscus	n. sp.
66	L.	insularis	115	Palæacmæa	n. sp.
67	Orthis	davidseni	116	Phragmolites	desiderata
68	O.	laurentina	117	Salpingostoma	canadensis
69	O.	lamellosa	118	Schizolopha	n. sp.
70	Parastrophia	lenticularis	119	Sinuites	cf. bilobata
71	P.	reversa	120	Subulites	richardsoni
72	Pholidops	n. sp.	121	S.	n. sp.
73	Platystrophia	dentata	122	Tetranota	cf. obsoleta
74	P.	dentata	123	Actinoceras	sedgwicki
75	P.	fissicostata	124	Apsidoceras	magnificum
76	Plectambonites	sericeus	125	Billingsites	newberryi
77	Pseudolingula	elegantula	126	Cycloceras	crocus
78	Rhipidomella	uberis	127	Oncoceras	fragile
79	R.	uberis	128	Orthoceras	formosum
		rhyncho-	129	O.	seiboldi
		nelliformis	130	Poterioceras	n. sp.
80	Rhynchotrema	anticostiensis	131	Brachyaspis	alacer
81	R.	janea	132	B.	notans
82	R.	n. sp.	133	Bumastes	orbicaudatus
83	Rhynchonella	? nutrix	134	Calymmene	callicephala
84	Schuchertella	pecten	135	Ceraurus	pleurexanthhe-
85	Strophomena	fluctuosa			mus
86	S.	fluctuosa	136	Ceraurinus	icarus
		n. var.	137	Chasmops	truncato-cau-
87	S.	hecuba			datius
88	S.	semiovalis	138	C.	n. sp.
89	Trematis	ottawaensis	139	Cyphaspis	n. sp.
		n. var.	140	Encrinurus	multisegmenta-
90	Byssonychia	n. sp.			tus
91	Clionychia	? superba	141	Isotellus	gigas
92	Ctenodonta	cf. simulatrix	142	I.	cf. maximus
93	Cuneamya	n. sp. 1	143	Sphaerocoryphe	salteri
94	C.	n. sp. 2	144	Technophorus	plicata
95	Pterinea	striata			
96	P.	varistriata			

*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 the Ordovician and the Clinton<sup>1</sup>. In 1857, Billings proposed to place all the Anticosti section above what is now defined 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 Ordo-

<sup>1</sup> Savage, Bull. Geol. Soc. Am., Vol. 24, 1913, p. 351.

vician (Hudson River beds) and the Niagara limestone.<sup>1</sup> 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 (Niagaran). 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	<i>Cyclocrinites halli</i>	15	<i>Ptilodictya gladiola</i>
2	<i>Clathrodiction vesiculosum</i>	16	<i>Atrypa marginalis</i>
3	<i>Cyathophyllum wahlenbergi</i>	17	<i>Brachyprion leda</i>
4	<i>Diphyphyllum caespitosum</i>	18	<i>B. n. sp.</i>
5	<i>Favosites forbesi</i>	19	<i>Camarotoechia neglecta</i>
6	<i>F. gothlandicus</i>	20	<i>Clorinda undata n. var.</i>
7	<i>Halysites catenulatus</i>	21	<i>Coelospira planoconvexa</i>
8	<i>Lyellia affinis</i>	22	<i>Crania n. sp.</i>
9	<i>Paleofavosites aspera</i>	23	<i>Hindella prinstanta</i>
10	<i>Zaphrentis stokesi</i>	24	<i>H. umbonata</i>
11	<i>Helopora concava</i>	25	<i>Orthis davidsoni n. var.</i>
12	<i>H. formosa</i>	26	<i>O. ? flabellites</i>
13	<i>Pachydictya crassa</i>	27	<i>Parastrophia lenticularis</i>
14	<i>Phænopora superba</i>		

<sup>1</sup>Billings, Rept. Progress 1853-1856, Geol. Surv. of Canada, 1857, p. 250.

28	Platystrophia	dentata	34	V.	n. sp.
29	Rhipidomella	uberis	35	Bumastes	orbicaudatus
30	R.	uberis rhyngo-	36	Calymmene	callicephala
		nelliformis	37	C.	niagarensis
31	Schuchertella	pecten	38	Cyphaspis	n. sp.
32	Virgiana	barrandei	39	Illænus	grandis
33	V.	barrandei n.			
		var.			

*Gun River Formation.* Corals play a greater rôle 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	Buthotrephis cf.	gracilis	27	Cornulites	richmondensis
2	Rusophycus	bilobatum	28	C.	serpularius
3	Cyclocrinitis	gregarius	29	Allonema	curtum
4	C.	intermedius	30	Ascodictyon	n. sp.
5	Ischadites	kœnigi	31	Ceramopora	niagarensis n.
6	Aulopora cf.	precisus			var.
7	Clathrodictyon	vesiculosum	32	Corynotrypa	dissimilis
8	Climacograptus	typicalis n.	33	C.	elongata
		var.	34	Diploclama	sparsum
9	Cyathophyllum	euryone	35	Helopora	bellula
10	C.	wahlenbergi	36	H.	concaua
11	Cystiphyllum	niagarensis	37	H.	formosa
12	Diphyphyllum	cæspitosum	38	H.	lineopora
13	Favosites	forbesi	39	Pachydictya	crassa
14	F.	gothlandicus	40	Phænopora	ensiformis
15	Halysites	catenulatus	41	P.	excellens
16	Heleolites	subtubulata	42	P.	superba
17	Lyellia	affinis	43	P.	n. sp.
18	Paleofavosites	aspera	44	Ptilodictya	gladiola
19	P.	aspera n. var.	45	P.	sulcata
20	Petraia	pygmaea	46	Semnocoscinium	n. sp.
21	Streptelasma	latusculum	47	Vinella	radiciformis
22	Strombodes	diffluens	48	Atrypa	reticularis
23	Syringopora	verticillata	49	Bilobites	biloba
24	Zaphrentis	stokesi	50	Brachyprion	leda
25	Z.	n. sp. 1	51	B.	philomena
26	Z.	n. sp. 2	52	B.	n. sp. 1

53	B.	n. sp. 2	88	Triplecia	insularis n. var.
54	B.	n. sp. 3	89	Whitfieldia	? lara
55	Camarotœchia	decemplicata	90	W.	? solitaria
56	C.	fringilla	91	Zygospira	paupera
57	C.	glacialis	92	Z.	n. sp.
58	C.	neglecta	93	Pterinea	emacerata
59	C.	? pyrrha	94	P.	striata
60	Chonetes	primigenius	95	P.	thisbe
61	Clorinda	linguifera	96	P.	n. sp.
62	Cœlospira	hemispherica	97	Cyclonema	bellula
63	C.	planoconvexa (zone 1 only)	98	Diaphorostoma	humilis
64	Dalmanella	n. sp.	99	D.	niagarensis
65	Hebertella	n. sp.	100	Euomphalus	? n. sp.
66	Hindella	umbonata	101	Hormotoma	? aculeata
67	Homeospira	n. sp.	102	H.	? funata
68	Hyattidina	congesta junea	103	Pleurotomaria	? cryptata
69	Leptæna	rhomboidalis	104	Salpingostoma	n. sp.
70	Orthis	davidsoni n. var.	105	Tentaculites	cf. minutis
71	O.	? flabellites	106	T.	ornatus
72	Pentamerus	oblongus	107	Actinoceras	infelix
73	Pholidops	implicata	108	Huronia	persiphonatum
74	Platystrophia	dentata	109	Kionoceras	bellatulum
75	Plectambonites	transversalis	110	Orthoceras	raptor
76	P.	n. sp.	111	Beyrichia	parallela
77	Rhipidomella	uberis	112	Eurychilina	billingsi
78	R.	uberis rhyncho- nelliformis	113	Leperditia	anticostiensis
79	Rhynchonella	? nutrix	114	Bumastes	orbicaudatus
80	Schuchertella	alterniradiata	115	Calymmene	niagarensis
81	S.	pecten	116	C.	cf. vogdesi
82	Stricklandinia	brevis	117	Cheirurus	nuperus
83	S.	davidsoni	118	Dalmanites	caudatus n. var.
84	S.	lirata	119	Encrinurus	punctatus
85	S.	salteri	120	E.	punctatus n. var.
86	Strophomena	antiquata	121	Hlænus	grandis
87	Strophoprion	geniculatum	122	Lichas	canadensis
			123	Phacopidella	orestes

*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-crinoid 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	<i>Buthotrephis</i> cf. <i>gracilis</i>	39	F.	n. sp. 2
2	<i>Hyalostelia</i> ? n. sp.	40	<i>Helopora</i>	<i>bellula</i>
3	<i>Alveolites</i> <i>labechi</i>	41	H.	<i>concava</i>
4	<i>Chonophyllum</i> <i>canadense</i>	42	H.	<i>formosa</i>
5	<i>Clathrodictyon</i> <i>variolare</i>	43	<i>Lioclema</i>	<i>varioporum</i>
6	C. <i>vesiculosum</i>	44	<i>Pachydictya</i>	<i>crassa</i>
7	<i>Climacograptus</i> n. sp.	45	<i>Phænopora</i>	n. sp.
8	<i>Cœnites</i> <i>labrosus</i>	46	<i>Ptilodictya</i>	<i>gladiola</i>
9	C. <i>lunatus</i>	47	P.	<i>sulcata</i>
10	<i>Cyathophyllum</i> <i>anticostiense</i>	48	<i>Thamniscus</i>	n. sp.
11	C. n. sp.	49	<i>Trematopora</i>	<i>irregularis</i>
12	<i>Cystiphyllum</i> <i>niagarensis</i>	50	<i>Vinella</i>	<i>multiradiata</i>
13	<i>Dictyonema</i> n. sp.	51	V.	<i>radiciformis</i>
14	<i>Favosites</i> <i>favosus</i>	52	<i>Atrypa</i>	<i>reticularis</i>
15	F. <i>forbesi</i>	53	<i>Bilobites</i>	<i>biloba</i>
16	F. <i>gothlandicus</i>	54	<i>Brachyprion</i>	<i>leda</i>
17	F. <i>hisingeri</i>	55	B.	<i>philomena</i>
18	<i>Halysites</i> <i>catenulatus</i>	56	B.	n. sp. 1
19	<i>Heleolites</i> <i>interstincta</i>	57	B.	n. sp. 2
20	H. <i>subtubulata</i>	58	<i>Camarotoechia</i> ?	<i>argentea</i>
21	<i>Lyellia</i> <i>affinis</i>	59	C.	<i>decemplicata</i> ?
22	<i>Monograptus</i> <i>clintonensis</i>	60	C.	<i>glacialis</i>
23	<i>Paleofavosites</i> <i>aspera</i>	61	C.	<i>neglecta</i> ?
24	<i>Petraia</i> <i>pygmaea</i>	62	<i>Chonetes</i>	<i>primigenius</i>
25	<i>Plasmopora</i> <i>petalliformis</i>	63	<i>Clorinda</i>	<i>linguifera</i>
26	<i>Streptelasma</i> <i>latuscolum</i>	64	<i>Cœlospira</i>	<i>hemispherica</i>
27	<i>Syringopora</i> <i>verticillata</i>	65	<i>Crania</i>	n. sp.
28	<i>Zaphrentis</i> <i>patens</i>	66	<i>Dalmanella</i>	<i>elegantula media</i>
29	Z. <i>stokesi</i>	67	D.	n. sp.
30	Z. n. sp.	68	<i>Eospirifer</i>	<i>radiatus</i>
31	<i>Crotalocrinus</i> sp.	69	<i>Homeospira</i>	n. sp.
32	<i>Eucalyptocrinus</i> sp.	70	<i>Leptæna</i>	<i>julia</i>
33	<i>Cornulites</i> <i>serpularius</i>	71	L.	<i>rhomboidalis</i>
34	<i>Allonema</i> <i>botellus</i>	72	<i>Lingula</i>	n. sp. 1
35	<i>Ascodictyon</i> n. sp.	73	L.	n. sp. 2
36	<i>Chilotrypa</i> <i>circe</i>	74	<i>Lissatrypa</i>	<i>atheroidea</i>
37	<i>Diploclema</i> <i>sparsum</i>	75	<i>Orthis</i> ?	<i>flabellites</i>
38	<i>Fenestella</i> sp. 1	76	<i>Pentamerus</i>	<i>oblongus</i>



77	Pholidops	implicata	113	H.	? turricula
78	Plectambonites	transversalis	114	Holopea	mediocris
79	P.	n. sp.	115	Pleurotomaria	? cryptata
80	Rhipidomella	uberis	116	Salpingostoma	n. sp.
81	R.	uberis rhyncho- nelliformis	117	Conularia	niagarensis
82	Rhynchonella	? nutrix	118	Tentaculites	cf. minutis
83	Schuchertella	pecten	119	T.	ornatus
84	Stricklandinia	brevis	120	Actinoceras	infelix
85	S.	dauidsoni	121	A.	whitei
86	S.	dauidsoni n. var	122	Glossoceras	? desideratum
87	S.	lirata	123	Huronia	persiphonatum
88	S.	melissa	124	H.	vertebralis
89	S.	salteri	125	Kionoceras	bellatulum
90	S.	n. sp.	126	Oncoceras	futile
91	Strophomena	antiquata	127	Orthoceras	n. sp. 1
92	Strophoprion	geniculatum	128	O.	n. sp. 2
93	Triplecia	insularis n. var.	129	Aparchites	minutissimus
94	Whitfieldia	? julia	130	Beyrichia	venusta
95	W.	? lara	131	Eurychilina	billingsi
96	Zygospira	mica	132	Leperditia	anticostiensis
97	Z.	paupera	133	L.	frontalis
98	Conocardium	elegantulum	134	Macrocypis	subcylindrica
99	Ctenodonta	cf. socialis	135	Calymmene	niagarensis
100	Modiolopsis	miser	136	C.	cf. vogdesi
101	Mytilarca	cf. mytiliformis	137	Cheirurus	nuperus
102	M.	nitida	138	Cyphaspis	christyi
103	Pterinea	curiosa	139	Cybele	elegantulus
104	P.	emacerata	140	Dalmanites	caudatus n. var.
105	P.	striata	141	Encrinurus	punctatus
106	P.	thisbe	142	E.	punctatus n. var.
107	Cyclonema	communis	143	E.	n. sp.
108	C.	percingulata	144	Illænus	grandis
109	Diaphorostoma	humilis	145	Lichas	n. sp.
110	D.	niagarensis	146	Phacopidella	orestes
111	Hormotoma	? aculeata	147	Proetus	? perplexa
112	H.	? funata			

*Chicotte Formation.* The Chicotte facies was one favouring 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 to extinction or to other parts of the sea bottom. The thickness of the formation is 73 feet, the greater part of which consists of 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-two 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 is

two to one and in respect to individuals there is no comparison. The species are:—

1	Chonophyllum canadense	28	Dalmanella	elegantula med-
2	Clathrodictyon variolare			ia
3	C. vesiculosum	29	Eospirifer	radiatus
4	Cœnites labrosus	30	Leptæna	rhomboidalis
5	Cyathophyllum anticostiense	31	Parastrophia	ops
6	C. articulatum	32	Pentamerus	oblongus
7	Favosites favosus	33	Rhipidomella	uberis
8	F. forbesi	34	Conocardium	elegantulum
9	F. gothlandicus	35	Cyclonema	communis
10	F. hisingeri	36	C.	decora
11	Halysites catenulatus	37	C.	varians
12	Heleolites interstincta	38	Platyceras	niagarensis
13	H. megastoma	39	Actinoceras	backi
14	H. subtubulata	40	A.	medon
15	Lyellia affinis	41	Huronia	vertebralis
16	L. americana	42	Oncoceras	amator
17	Paleofavosites aspera	43	Orthoceras	bucklandi
18	Plasmopora petalliformis	44	O.	? pileolum
19	Zaphrentis stokesi	45	O.	n. sp.
20	Z. n. sp.	46	Phragmoceras	n. sp.
21	Crotalocrinus sp.	47	Cheirurus	nuperus
22	Fenestella bella	48	Goldius	insularis
23	Pachydictya crassa	49	Harpes	consuetus
24	Atrypa marginalis	50	Illaenus	grandis
25	A. reticularis	51	Pseudosphærexochus canadensis	
26	Camarotæchia vicina			
27	Cyrtia exporrecta myrtea			

### CORRELATION.

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

1	Rusophycus bilobatum	7	Lycopora	goldfussi
2	Hindia fibrosa	8	Mesograptus	putillus
3	Beatricia nodulosa	9	Streptelasma	rusticum
4	B. undulata	10	Cornulites	richmondensis
5	Calapœcia canadensis	11	Arthroclema	angulare
6	Columnaria alveolata	12	Bythopora	striata

13	<i>Chasmatopora granistriata</i>	33	<i>Platystrophia dentata-acutili-</i> <i>rata</i>
14	<i>Dicranopora emacerata</i>	34	<i>Plectambonites sericeus</i>
15	<i>D. fragilis</i>	35	<i>Rhynchotrema anticostiensis</i>
16	<i>Eridotrypa simulatrix</i>	36	<i>R. perlamellosa</i>
17	<i>Helopora imbricata</i>	37	<i>Schizocrania filosa</i>
18	<i>Lioclemella nitida</i>	38	<i>Strophomena fluctuosa</i>
19	<i>Mitoclema n. sp.</i>	39	<i>Byssonychia cf. radiata</i>
20	<i>Pachydictya firma</i>	40	<i>Ctenodonta cf. obliqua</i>
21	<i>Phacelopora pertenuis</i>	41	<i>Pterinea prolificus-demis-</i> <i>sa</i>
22	<i>Protocrisina exigua</i>	42	<i>Hormotoma gracilis</i>
23	<i>Ptilodictya flagellum</i>	43	<i>Sinuities cf. bilobata</i>
24	<i>P. magnifica</i>	44	<i>Aparchites minutissimus</i>
25	<i>Semocoscinium pretiosa</i>	45	<i>Beyrichia parallela</i>
26	<i>Stomatopora arachnoidea</i>	46	<i>Bythocypris cylindrica</i>
27	<i>Catazyga anticostiensis</i>	47	<i>Tetradella lunatifera</i>
28	<i>Clitambonites verneuili diver-</i> <i>sus</i>	48	<i>T. simplex</i>
29	<i>Dalmanella testudinaria</i>	49	<i>Ulrichia nodosa</i>
	<i>meekei</i>	50	<i>Calymmene callicephala</i>
30	<i>Dinorthis subquadrata n.</i> <i>sp.</i>	51	<i>Ceraurus pleurexanthhe-</i> <i>mus</i>
31	<i>Leptaena rhomboidalis</i> (appears in lower Ellis bay)	52	<i>Ceraurinus icarus</i>
		53	<i>Isotellus gigas</i>
32	<i>L. ? nitens</i>	54	<i>I. cf. maximus</i>

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. Since nearly all the forms considered belong to the benthos in adult life, but plankton in the early stages when distribution is affected by currents, it is suggested that the Anticosti Richmond forms are 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 is 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 these thirty species, no less than twenty-two are considered index fossils to the Richmond. The distribution of the species is also 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 palæontology 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 Kiaer. He erects a number of divisions and the Ellis Bay formation and the upper Charleton correlate fairly well with his etage 5.<sup>1</sup>

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 Becsie River fauna shows its nearest relationships with

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<sup>1</sup> Kiaer, Videnskabs-Selskabets Skrifter, I, Math-Naturv. Klasse, bd. ii.

that of the cataract formation of Schuchert; but if the long ranging 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 Becsie River formation, and, since the general expression of the Cataract formation is younger, it is concluded that there is little 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 Becsie 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 section until the upper zone of this, or the succeeding formation, and, also, since the general appearance of the fauna is younger than that of the Becsie River, it is believed that it will find a closer 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 Irondequoit limestone, this being particularly true for that part lying above zone 2, it is considered probable that the lower zones of the New York Clinton, the Sodus shale, Furnaceville ore bed, and 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 *Triplecia insularis anticostiensis* which then extends until zone 3 of the Jupiter River. In a previous

paper considerable emphasis was placed on the presence of this species<sup>1</sup>, there considered a variety of *T. ortonii*; 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 distribution and may recur again and again with the faunal components practically the same. On stratigraphic grounds it is correlated for the present with the Irondequoit-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<sup>2</sup>, 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 Becsie 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*, *Coelospira 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

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<sup>1</sup>Schuchert and Twenhofel, Bull. Geol. Soc. Am., Vol. 21, 1911, p. 712.

<sup>2</sup>Clarke, Guide Book No. 1, pt. 1, International Geol. Congress, 1913, pp. 110-113.

distribution lead to the assignment of the upper zones to the Lower Llandovery and hence that which lies before has been similarly placed, although it is possible that the Beccie 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 thirty per cent of the Jupiter River fauna. The vertical distribution of many of the species sustains the correlation. *Triplecia insularis* holds to the Upper Llandovery, and its Anticosti variety appears for the 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 this 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 in identical or closely related forms in the Upper Jupiter River and Chicotte formations and these facts make it extremely probable that these Anticosti strata have a time equivalence with the Wenlock.

In the Kristiana region, the Silurian (Lower Llandovery to Wenlock) of the Ringerike section, there is a facies somewhat similar to that of Anticosti, and has thirty-seven species which are represented by identical or closely related forms in the Anticosti Silurian. The Lower Llandovery, Kiaer's etage 6, correlates fairly well with the Gun River and the upper portion of the Beccie River; while etage 7 or the Upper Llandovery, exhibits a close parallelism with the Jupiter River, and etage 8, or the 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<sup>1</sup> 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 LAPWORTH.

Suborder, AXONOPHORA FRECH.

Genus, CLIMACOGRAPTUS HALL.

CLIMACOGRAPTUS TYPICALIS *var.* MAGNIFICUS *n. var.*

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 shales on the banks of the Rideau river at Ottawa, Canada.

The holotype is in Peabody Museum, Yale University.

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Class, ACTINOZOA.

Order, MADREPORARIA MILNE-EDWARDS.

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<sup>1</sup> Savage, Bull. Geol. Soc. Am., Vol. 24, 1913, p. 359.



Sub-order, TABULATA MILNE-EDWARDS AND HAIME.  
 Family, FAVOSITIDAE MILNE-EDWARDS AND HAIME.  
 Genus, PALEOFAVOSITES *new genus*.

From the Ordovician and Silurian rocks of Anticosti, Billings described *Favosites prolificus* and *F. capax*, the latter having the pores at the angles and the former having none. It has since been learned that the two species are identical and also the same as *F. aspera* d'Orbigny and *F. alveolaris* Goldfuss, 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 thus 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.

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Phylum, MOLLUS COIDEA.  
 Class, BRACHIOPODA DUMERIL.  
 Order, PROTREMATA BEECHER.  
 Super-family, ORTHACEA Walcott and Schuchert.  
 Genus, ORTHIS DALMAN (s. str.)  
 ORTHIS? LAMELLOSA *new species*.  
 (Plate I, figures 1-3)

Outline semielliptical, greatest width about halfway from beak to border where it is 8 mm.; 7 mm. wide at the hinge line; thickness 4 mm.; length 6 mm. Sides of the shell straight and 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 mesial sinus, beak slightly incurved. Ventral valve pyramidal, beak highest portion, 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 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, *Strophoprion* holding the same relation to *Strophonella* that *Brachyprion* does to *Stropheodonta*. In one line of development there are *Strophomena*—*Strophoprion*—*Strophonella*; in the other *Rafinesquina*—*Leptaena?* (*ceres*—*nitens* stock, not *rhomboidalis*)—*Brachyprion*—*Stropheodonta*. The type of *Strophoprion* is *Strophoprion geniculatum* (Shaler) (*Brachyprion geniculatum* Shaler, Bull. Mus. Comp. Zool., vol. 1, No. 4, p. 63, 1865).

## Genus, TRIPLECIA HALL.

TRIPLECIA INSULARIS var. ANTICOSTIENSIS *new variety*.

1871. *Orthis insularis* Davidson, Mon. Brit. Foss. Brach., vol. iii, pt. vii, p. 273, pl. xxxvii, figs. 8-15.  
 1910. *Triplecia ortonii* Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. 21, p. 710.

The discovery of this somewhat widely ranging north European species, in the lowest Clinton deposits of the Anticosti section, is a matter of considerable interest, since it has not 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), about a mile west of Jupiter River; Jupiter River (3), Jupiter river. 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 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 so as in *Plectambonites*. In the Ellis Bay formation specimens were found attached by the dorsal valve to the shells of other brachiopods, but whether this has any significance or not is unknown. There are four small spines on each side of the beak. The surface of each valve is covered with numerous fine striæ—about one hundred and fifty to each valve—and in the centre of the ventral valve is a single striation very much stronger than any other, such as occurs in *Leptaena nitens*, whose ventral interior that of this shell also closely resembles. The hinge area is striated as in *Brachyprion leda*. The dorsal interior is not known.

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 *Brachyprion leda* it is extremely probable that both came from the same stock, viz.; a small leptaenoid? with a narrow muscle scar, fine plications, and a single central plication of large size. In the Anticosti measures *Leptaena? nitens* answers to this description.

*C. primigenius* 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. tenuistriatus* 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 umbonal 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 galeatiform, with a sinus on the ventral valve and a fold on the dorsal. In the Betsy 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-*

*da.* With maturity, however, the shell attains large size, becomes decidedly elongate, narrow, and pronouncedly galeatiform and the fold and sinus become reversed, the latter being 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 interior is that of *Clorinda*.

For this type of clorindoid the generic name of *Virgiana* is proposed: the genus to include *V. barrendei*—the genotype—and two varieties of that species.

Order, PROTREMATA BEECHER.

Superfamily, RHYNCHONELLACEA SCHUCHERT.

Genus, CAMAROTOECHIA HALL AND CLARKE.

CAMAROTOECHIA DECEMPPLICATA (SOWERBY).

1866. *Rhynchonella* Eva Billings, Cat. Sil. Foss. Anticosti, p. 44.  
 1871. *Rhynchonella* decemplicata Davidson, Mon. Brit. Foss. Brach., vol. iii, pt. vii, p. 177, pl. xxiii, figs. 20-24.  
 1900. *Anabaia anticostiana* Clarke, Archivos do Museu Nacional do Rio de Janeiro, vol. 10, 1899, Author's Eng. Ed., p. 15, pl. i, figs. 26-28.

This shell was described by Billings in 1866, 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 with 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 Victoria Memorial Museum, 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. More than a dozen specimens of *R. 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 apparently is to be referred to the genus *Camarotoechia*. Through the kindness of Professor Johan Kiaer the writer was able to obtain specimens of *Rhynchonella decemplicata* from etage 6 (Zone, with *Rhynchonella 10-plicata*) 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.

PROTOZEUGA *new genus.*

(Protos, first; zeugos, a yoke).

1882. Waldheima Davidson, Suppl. Sil. Foss. Brach., p. 76.

This new genus is proposed to include a group of small Palæozoic brachiopods which constitute the oldest known terebratulids and which are characterized by the possession of a long loop similar to the matured structure seen in *Waldheimia* 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 at the anterior margin; dorsal valve only slightly convex at the posterior 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 process 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 inward and ventralward almost to the point of meeting. The principal lamellæ extend forward to within a short distance of the front and are then reflected posteriorly to form the loop which is not angular, but uniformly curved; it rises above the primary lamellæ until its apex is on a level with the crural apophyses, having been reflected a distance equal to about half the length of the primary lamellæ. Shell structure plentifully, but not thickly punctate (this was demonstrated by treating the shell with hydrochloric acid and specimens so treated are studded with small needle-like elevations) Genotype *Waldheimia mawii* Davidson.

The matured loop of this genus is very like that of the final metamorphosed form as developed in *Waldheimia* or *Magellania*, but the resemblance is one of parallelism. In *Protozeuga* 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 *Protozeuga* to be a primitive type of terebratulid whose systematic position is near the Centronellidae; but in a family distinct therefrom, the Protozeugidae. To this genus are referred *Waldheimia mawii*; *W.?* *glassii* Davidson, a somewhat larger form whose brachial apparatus has not yet been demonstrated, both from the upper Wenlock of Shropshire; *W. bicarinata* Angelin from Gotland, considered by Davidson as identical with *W. mawii*; *Protozeuga sulcomarginata* Savage from the Girardeau Limestone of Illinois and Missouri (Bull. Geol. Soc. Mo., vol. 24, p. 359, 1913); and the new species from Anticosti described as *Protozeuga anticostiana*.

PROTOZEUGA ANTICOSTIANA *new species*.  
(Plate I, figures 8-10).

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 *Protozeuga 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 above 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 WAAGEN.

Family, ATRYPIDAE GILL.

Subfamily, LISSATRYPINAE *new subfamily*.

Smooth atrypoids with the external aspect of *Nucleospira*.

*Genus*, LISSATRYPA *new genus*.

(Lissos, smooth; atrypa).

In 1866 Billings described from Gull cape (Wreck beach),



Anticosti, a smooth brachiopod to which he gave the name of *Athyris lara*. He called attention to the fact that some specimens have a faint indication of a mesial sinus in the ventral valve, 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." These shells were collected by Doctor G. J. Hinde near Jupiter river and it is now known that they were not correctly identified.

Specimens of *Athyris lara* which were collected at the type locality and compared with the prototypes show that it is a true meristellid and probably to be referred to the genus *Whitfieldia*. 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 shells and there is no question but that their spirals are of the atrypoid type. Externally they have the expression of *Nucleospira*, but lack the hirsute exterior. For atrypoids having these characters the generic name of *Lissatrypa* is proposed.

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

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

Dorsal valve with a faint sinus at the umbo; hinge plate composed of two diverging processes meeting at the apex at about 60 degrees; each has two longitudinal grooves dividing

it into three small ridges of unequal size of which the outer overhangs the dental sockets and ends abruptly and free; the inner ridges small. The middle ridges are slightly the longest and bear the crura which converge toward the dorsal valve for about one-sixth the length of the shell, where two knob-like crural apophyses are developed and almost come in contact. At the origin of these apophyses the primary lamellæ are abruptly recurved and develop the vertical spirals of which each has eight turns or less and has the apex directed toward the central area of the dorsal valve.

The genotype is *Lissatrypa atheroidea*, the specific name being selected to call attention to the fact that the shell resembles an *Athyris* (*Athyris*; oidos, like). According to Professor Schuchert (personal communication) *Atrypa phoca* (Salter) is also to be referred to this genus.

*LISSATRYPA ATHEROIDEA new species.*

(*Athyris*, oidos, like).

(Plate I, figures 11-15.)

1882. *Athyris lara* Davidson (not Billings), Suppl. Sil. Brach., p. 121.

1910. *Nucleospira* n. sp., Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. 21, p. 714.

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? 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 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 a mile west of Jupiter river; Jupiter River (3-5), mouth of Jupiter river.

The cotypes are in Peabody Museum.

## Family, MERISTELLIDAE HALL AND CLARKE.

HYATTIDINA CHARLETONA *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 *Phragmolites pannosa*, *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 juncea*, 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. Jour. 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. charleton* 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.

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Phylum, ARTHROPODA.

Class, CRUSTACEA.

Subclass, TRILOBITA WALCH.

Order, OPISTHOPARIA BEECHER.

Family, OLENIDAE BURMEISTER.

Genus, TRIARTHURS GREEN.

TRIARTHURS BECKI *var. MACASTYENSIS* *new variety.*

1910. *Triarthrus spinosus* Schuchert and Twenhofel, Bull. Geol. Soc. Am., vol. 21, p. 694.

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. jemilandicus* 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 I.

Figs. 1-3. *Orthis lamellosa* new species.

- " 1. View of the dorsal valve of holotype, x 3, Ellis bay, zone 9 of Ellis Bay formation, holotype in Peabody Museum, Yale University.
- " 2. Ventral valve of holotype, x 3.
- " 3. Outline view of holotype, x 3.

Figs. 4-5. *Chonetes primigenius* 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 Charleton point, x 2, zone 3 of Charleton formation, specimen in Peabody Museum.

Figs. 6-7. *Hyattidina charletona* new species.

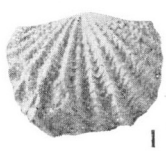
- " 6. View of dorsal valve of holotype, x 4, Charleton point, zone 3, of Charleton formation, specimen in Peabody Museum.
- " 7. Ventral view of same specimen, x 4.

Figs. 8-10. *Protozeuga anticostiana* new species.

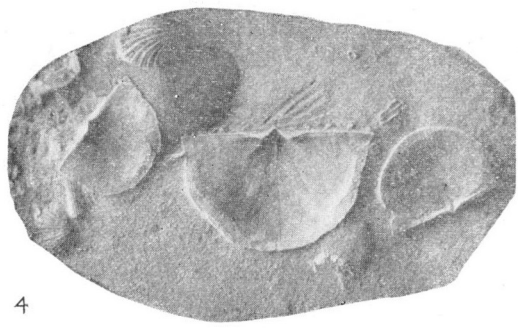
- " 8. Outline view of holotype, x 4, Macasty bay, zone 4 of English Head formation, specimen in Peabody Museum.
- " 9. Dorsal valve of holotype, x 4.
- " 10. Ventral valve of holotype, x 4.

Figs. 11-15. *Lissatrypa atheroidea* new species.

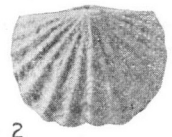
- " 11. Outline of holotype, x 2, Jupiter River cliff, zone 3 of Jupiter River formation, specimen in Peabody Museum.
- " 12. Hinge plate of ventral valve, x 2, same locality and horizon, specimen in Peabody Museum.
- " 13. Dorsal valve of holotype, x 2.
- " 14. Dorsal aspect of the spirals, x 2, same locality and horizon as preceding, specimen in Peabody Museum.
- " 15. Ventral view of holotype, x 2.



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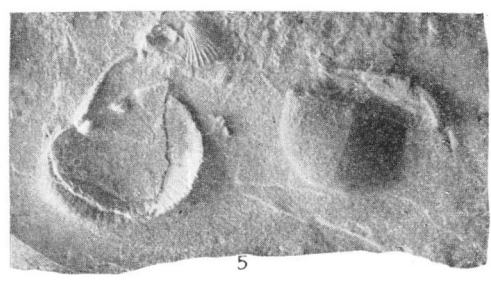
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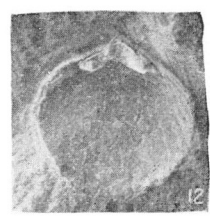
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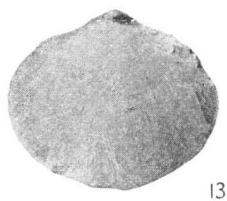
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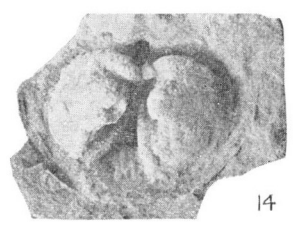
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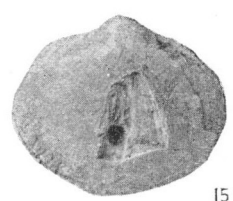
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The first number of the Museum Bulletin was entitled, *Victoria Memorial Museum Bulletin Number 1*.

The following articles of the Geological Series of Museum Bulletins have been issued.

*Geological Series.*

1. The Trenton crinoid, *Ottawacrinus*, W. R. Billings; by F. A. Bather.
2. Note on *Merocrinus*, Walcott; by F. A. Bather.
3. The occurrence of Helodont teeth at Roche Miette and vicinity, Alberta; by L. M. Lambe.
4. Notes on Cyclocystoides; by P. E. Raymond.
5. Notes on some new and old Trilobites in the Victoria Memorial Museum; by P. E. Raymond.
6. Description of some new Asaphidæ; by P. E. Raymond.
7. Two new species of *Tetradium*; by P. E. Raymond.
8. Revision of the species which have been referred to the genus *Bathyurus* (preliminary paper); by P. E. Raymond.
9. A new Brachiopod from the base of the Utica; by A. E. Wilson.
10. A new genus of dicotyledonous plant from the Tertiary of Kettle river, British Columbia; by W. J. Wilson.
11. A new species of *Lepidostrobus*; by W. J. Wilson.
12. Prehnite from Adams sound, Admiralty inlet, Baffin island, Franklin; by R. A. A. Johnston.
13. The origin of granite (micropegmatite) in the Purcell sills; by S. J. Schofield.
14. Columnar structure in limestone; by E. M. Kindle.
15. Supposed evidences of subsidence of the coast of New Brunswick within modern time; by J. W. Goldthwait.
16. The Pre-Cambrian (Beltian) of southeastern British Columbia and their correlation; by S. J. Schofield.
17. Early Cambrian stratigraphy in the North American Cordillera, with discussion of the Albertella and related faunas; by Lancaster D. Burling.
18. A preliminary study of the variations of the plications of *Parastrophia hemplicata*, Hall; by Alice E. Wilson.